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AEGIS

Advanced Big Data Value Chains for Public Safety and Personal Security

WP5 – AEGIS Data Value Chain
Early Community Demonstrators

D5.5 – Demonstrators Evaluation and Feedback – v3

Version 1.1

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AEGIS KEY FACTS

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AEGIS PARTNERS

Fraunhofer	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
GFT	GFT Italia SRL
KTH	Kungliga Tekniska högskolan
UBITECH	UBITECH Limited
VIF	Kompetenzzentrum - Das virtuelle Fahrzeug , Forschungsgesellschaft-GmbH
NTUA	National Technical University of Athens – NTUA
EPFL	École polytechnique fédérale de Lausanne
SUITE5	SUITE5 Limited
KONKAT	ANONYMOS ETAIREIA KATASKEVON-TECHNIKON ERGON, EMPORIKON, VIOMICHANIKONKAI NAUTILIAKON EPICHEIRISEON KON'KAT
HDIA	HDI Assicurazioni S.P.A

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EXECUTIVE SUMMARY

D5.5 documents the efforts undertaken within the context of Tasks 5.2, 5.3, 5.4, 5.5 and 5.6 of WP5 which span until M30. The current deliverable builds on top of the work and outcomes of deliverable D5.4, and reports the progress of the AEGIS demonstrators. It documents the qualitative and quantitative evaluation of the AEGIS platform (the final stable version of the AEGIS platform that was made available) and of the three discrete AEGIS demonstrators, analysing the test cases that were supported during the last evaluation phase. For each evaluation, the document provides the challenges faced and the recommendations proposed for successfully facing and overcoming these challenges.

D5.5 provides a detailed description of the evaluators that were defined in the AEGIS evaluation framework, providing details with regards to their technical background and expertise, their role in the project and their involvement in the evaluation. Following this, the results of the holistic evaluation of the final version of the AEGIS platform which was made available for the third and last phase of the pilot trials (and the corresponding evaluation phase) are presented. The quantitative evaluation was performed based on the list of KPIs that were defined in the previous deliverables of the series, while the qualitative evaluation was performed with the help of small focus groups consisting of data scientists and developers that were involved in the implementation process of the third version of each demonstrator.

D5.5 also describes in detail the work that was performed during the implementation of the third and final version of the three demonstrators that validated the added value of the AEGIS platform. The results of the scenarios that were executed for each demonstrator are presented with details for each step performed on each scenario. Following the scenarios execution, the results of the two-fold approach of the AEGIS evaluation framework for the evaluation of each demonstrator are presented, providing the results of the quantitative evaluation based on the list of demonstrator-specific KPIs and the qualitative evaluation based on the small focus groups that were conducted by each demonstrator.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AAL	Active and Assisted Living
API	Application Programming Interface
CO	Confidential, only for members of the Consortium (including the Commission Services)
CPU	Central Processing Unit
CSP	Care Service Provider
CSV	Comma Separated Values
D	Deliverable
DoW	Description of Work
H2020	Horizon 2020 Programme
GUI	Graphical User Interface
HVAC	Heating Ventilation and Air Conditioning
IT	Information Technology
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
PSPS	Public Safety and Personal Security
R	Report
RTD	Research and Development
SHAL	Smart Home and Assisted Living
UI	User Interface
VOC	Volatile Organic Compounds
XML	Extensible Markup Language
WP	Work Package
Y2	Year 2

1. INTRODUCTION

1.1. Objective of the deliverable

The scope of D5.5 is to conclude the specific series of deliverables derived from WP5 associated with the evaluation of the AEGIS platform and the demonstrators supported, and thus documents the efforts undertaken within the context of Tasks 5.2, 5.3, 5.4, 5.5 and 5.6 of WP5 for the period M25 - M30. The current deliverable builds on top of the work and outcomes of deliverable D5.4, and reports the progress of the AEGIS demonstrators. It documents the qualitative and quantitative evaluation of the AEGIS platform (the final stable version of the AEGIS platform that was made available) and of the three discrete AEGIS demonstrators, analysing the test cases that were supported during the last evaluation phase. The quantitative evaluation of both the AEGIS platform and of each of the demonstrators supported was performed based on the list of KPIs that were defined in the previous deliverables of the series, while the qualitative evaluation was performed with the help of small focus groups consisting of data scientists and developers that were involved in the implementation process of the third version of each demonstrator. For each evaluation, the document provides the challenges faced and the recommendations proposed for successfully facing and overcoming these challenges.

1.2. Insights from other tasks and deliverables

The deliverable builds on top of the work already reported in the context of WP5 through the previous deliverables of the series. In particular, the previous outcomes of the work performed in WP5 provided the AEGIS evaluation framework, as well as the methodology on how to implement the framework during the implementation phase of the three demonstrators of the AEGIS project. These findings have been reported in D5.1, D5.2, D5.3. D5.5 builds on top of these, and more importantly on D5.4 having been delivered on M24 and documenting the outcomes of the evaluations of the second version of the integrated AEGIS platform and of the second version of the AEGIS demonstrators.

The outcomes of deliverable D5.2 served as guidance on how the evaluation of both the AEGIS platform and the AEGIS demonstrators should be performed.

The outcomes of deliverable D5.3, where the first (early) versions of the demonstrators were evaluated, guided the implementation of the second (medium) version of the demonstrators. The challenges faced and the recommendations were taken into consideration from the development team of each demonstrator.

The outcomes of deliverable D5.4, where the second (medium) versions of the demonstrators were evaluated, guided the implementation of the third and final version of the demonstrators. The challenges faced and the recommendations were taken into consideration from the development team of each demonstrator.

1.3. Structure

Deliverable D5.5 is organised in seven main sections as indicated in the table of contents:

- The first section introduces the deliverable. It documents the scope of the deliverable and briefly describes how the document is structured. It also documents the relation of

the current deliverable with the other deliverables, and how the outcomes of other deliverables are received as input to the current deliverable.

- Following the introductory section, the second section describes the evaluators involved in the AEGIS evaluation framework, providing information of their technical background and knowledge, how are they related to the project and their involvement in the evaluation.
- The third section documents the results of the evaluation of the third and final stable version of the AEGIS platform. In this section both the results of the quantitative and the qualitative evaluation are documented. Additionally, in this section the challenges faced related to the AEGIS platform during the third (final) version of the demonstrators are documented and a series of recommendations for the enhancement of the platform are presented.
- Following the third section, the upcoming sections, namely sections 4 -6 present the progress made throughout M25 – M30 and the evaluation of each one of the three AEGIS demonstrators.
    - Section four undertakes the documentation of the progress and of the thorough evaluation of the Automotive demonstrator.
    - Section four undertakes the documentation of the progress and of the thorough evaluation of the Smart Home & Assisted Living demonstrator.
    - Section four undertakes the documentation of the progress and of the thorough evaluation of the Insurance demonstrator.

  For each demonstrator, the results of the scenario(s) execution within the context of the third (final) version of the demonstrator are documented. Following the scenarios execution, the demonstrator evaluation is presented, providing the results of both the quantitative and qualitative evaluation for each demonstrator. Last but not least, each section includes a sub-section dedicated to the challenges faced during the implementation of each demonstrator accompanied by a list of recommendations for successfully facing and overcoming the challenges faced.

- Section 7 concludes the deliverable. It outlines the main findings of the deliverable, which will guide the future research and technological efforts of the consortium.

2. AEGIS EVALUATORS

It should be noted that this section is provided for coherency reasons and there are no changes from the information included in deliverable D5.3.

The AEGIS evaluation framework, as documented in D5.1 and D5.2, is aiming at evaluating the AEGIS platform in terms of how it addresses the requirements and expectations of the AEGIS PSPS stakeholders of the three demonstrators and beyond. The AEGIS evaluation framework is also aiming at performing a holistic evaluation of the platform. As such, the evaluators included in the framework are the main direct beneficiaries of the AEGIS platform, which are the PSPS data scientists from the three different sectors that will develop the data-driven AEGIS PSPS services and the PSPS end users for the corresponding sectors that will consume the developed services. Additionally, the AEGIS platform developers are also involved in the evaluation framework in order to assist in the evaluation focusing mainly on the technical evaluation of the platform.

In the forthcoming subsections, the AEGIS evaluators are described focusing on their profile, role in the project and their involvement in the evaluation.

2.1. PSPS Data Scientists

In general, a data scientist is a professional that collects, analyses and extracts information from large amount of data using a variety of big data analytic tools, in order to extract useful information and insights that will help a business improve operations and gain competitive advantage over rivals or provide the necessary results and advancements in a research program. Data scientists have the experience and proper skills to use advanced analytics technologies that include machine learning and predictive modelling techniques, in order to unveil useful insights beyond statistical analysis. Nowadays, with the data explosion from the voluminous amounts of data produced and collected from various heterogeneous sources the role of the data scientists has become very crucial for the enterprises and organisations towards the aim of maximising the results of the data processing.

In terms of evaluation, the data scientist is one of the most important stakeholders for a Big Data analytics ecosystem. The mix of experience and analytics skills makes the data scientist the most appropriate person to perform the evaluation and identify the deficiencies of the processes and tools of the platform. Through their extended experience and usage skills with a variety of tools and technologies related to big data analysis, data scientists are able to evaluate and propose the best practises in the data collection, data management, data processing and data analysis processes.

In the context of the AEGIS project PSPS data scientists from three different sectors will be involved in the development of the AEGIS PSPS services:

- PSPS data scientists from the automotive sector. In the context of the AEGIS Automotive demonstrator, the PSPS data scientists from VIF will implement the data-driven automotive services that will create data-driven workflows on the AEGIS platform by exploring the relevant collected vehicle data and other automotive-related sources.

- PSPS data scientists from the smart home and assisted living sector. In the context of the AEGIS Smart Home and Assisted Living demonstrator, data scientists from Konkat, UBITECH and Suite5 will implement a series of data-driven services that will create data-driven workflows on the AEGIS platform by exploring the collected data from smart home devices, wearables and other assisted living devices.
- PSPS data scientists from the insurance sector. In the context of the AEGIS insurance demonstrator, PSPS data scientists from HDI will implement the data-driven Insurance services that will create data-driven workflows on the AEGIS platform by analysing the events detected by the AEGIS tools after exploring data for weather, news and crime open data.

In accordance with the AEGIS Evaluation Framework that is documented in deliverable D5.1, the PSPS data scientists from the three different sectors mentioned above will be involved in the evaluation of the AEGIS platform. More specifically, the AEGIS platform will be evaluated in terms of functionalities offered by the platform and required by the PSPS data scientists in order to implement the PSPS data-driven services through the AEGIS demonstrator-specific evaluation cases. Additionally, the PSPS data scientists will participate in guided interviews that will also evaluate the perceived usefulness and usability of the service design process.

2.2. PSPS End Users

The PSPS end users are experienced professionals from different sectors with different technical and theoretical background. As such, the PSPS end users have different requirements and expectations from the AEGIS platform from the rest of the stakeholders. The PSPS end users are the main consumers of the AEGIS PSPS services that will be developed from the PSPS data scientists. Their expectations vary depending on the requirements of their corresponding sectors but in general, the main goal of the PSPS end user is to exploit the platform and the developed services with the aim of enhancing a process, a product or a service and in some cases introducing new ones.

In terms of evaluation, the end user is an important stakeholder for a Big Data analytics ecosystem. The end user is the most appropriate person to perform the evaluation and identify the deficiencies of the usefulness of the platform in order to fulfil their tasks and gain valuable insights, as well as of the usability, ease of use and quality of the platform. As the consumers of the PSPS data-driven services, the end users are able to evaluate the features of the platform, as well as the added value offered by the services developed by the PSPS data scientists.

In the context of the AEGIS project PSPS end users from three different sectors will consume the AEGIS PSPS services developed by the involved PSPS data scientists:

- PSPS end users from the automotive sector. In the context of the AEGIS Automotive demonstrator, the PSPS end users from VIF will consume the AEGIS PSPS services created by the corresponding PSPS data scientists within the AEGIS Automotive demonstrator. The end users will evaluate the services in terms of gaining valuable insights for safer driving and safer roads by the analysis of the driving styles and driving behaviour.
- PSPS end user from the smart home and assisted living sector. In the context of the AEGIS Smart Home and Assisted Living demonstrator, PSPS end users from Konkat,

UBITECH and Suite5 will consume the AEGIS PSPS services created by the corresponding PSPS data scientists within the AEGIS Smart Home and Assisted Living demonstrator. The end users will evaluate the services in terms of efficiency and effectiveness in monitoring at-risk individuals and patients, in case the of care providers or doctors, and in terms of usefulness, usability and non-intrusive behaviour in assisting their everyday lives in the case of at-risk individuals and patients.

- PSPS end users from the insurance sector. In the context of the AEGIS insurance demonstrator PSPS end users from HDI will consume the AEGIS PSPS services created by the corresponding PSPS data scientists within the AEGIS insurance demonstrator. The end users will evaluate the services in terms of benefits achieved by the developed services, the legibility of the produced reports and the customer's feedback depending on their role in the company.

In accordance with the AEGIS Evaluation Framework that is documented in deliverable D5.1, the PSPS end users from the three different sectors mentioned above will be also involved in the evaluation of the AEGIS platform. More specifically, the experiences and satisfaction of the PSPS end users in regards to usefulness, usability and business relevance of the developed PSPS data-driven demonstrator services will be leveraged and will be included in the holistic evaluation of the AEGIS platform with the use of guided interviews.

2.3. AEGIS Platform Developer

The AEGIS platform developer is the experienced professional involved in the development process and production of the platform. The platform developer has extended technological know-how and experience in the Big Data technologies and tools, as well as in the software design and implementation. The platform developer is involved in all the relative phases of the platform development, from the requirements elicitation and the extraction of functional requirements, the design and specification of the platform components and architecture to the implementation and integration of the AEGIS platform. The AEGIS platform developer is aiming at developing and offering novel services and applications that will allow data scientists from the PSPS-related industries to develop advanced and intuitive PSPS data-driven services that will be exploited by the PSPS end users.

In terms of evaluation, the AEGIS platform developer is the most appropriate person in order to assist in the AEGIS platform evaluation in terms of software quality characteristics. The software quality characteristics are measured with the list of technical Key Performance Indicators (KPIs) of the AEGIS platform, as defined in section 2.1 of D5.2, and is related to the quantitative evaluation of the AEGIS platform that will be executed by the AEGIS platform developers.

3. AEGIS PLATFORM EVALUATION

Following the same approach as with the deliverables D5.3 and D5.4, and in accordance with the AEGIS evaluation framework that documented in deliverable D5.1 and was extended in deliverable D5.2, a holistic evaluation is performed with a two-fold purpose: a) to capture the satisfaction of the AEGIS PSPS stakeholders with the platform, and b) to provide valuable feedback to the AEGIS platform developers that will drive the enhancements and refinements of the AEGIS platform towards the success of the AEGIS project.

The AEGIS evaluation framework dictates the AEGIS platform evaluation to be executed in three iterations in order to be aligned with the three phases of the demonstrators' implementation. Two first two iterations were conducted at M18 and M24 of the project and the results were documented in deliverables D5.3 and D5.4 respectively. The current deliverable documents the results of the final iteration that was performed at M30 of the project. As with previous iterations, the scope of the evaluation is to provide the useful insights on the requirements and expectations of the AEGIS PSPS stakeholders to the AEGIS platform development team.

As described also in the AEGIS evaluation framework, the AEGIS platform evaluation is performed following also a two-fold approach. On the one hand, the AEGIS platform is evaluated following the quantitative method that is based on a list of Key Performance Indicators (KPIs), that were defined in deliverable D5.2, and on the other hand, the AEGIS platform is also evaluated following the quantitative method via small focus groups with key stakeholders.

In the following subsections of the current section, the results of both the quantitative and the qualitative evaluation of AEGIS platform that was conducted during the third and final (advanced) version of the AEGIS demonstrators' implementation, are presented in detail. Following the presentations of the evaluation results, a description of the challenges faced during the implementation of the third and final (advanced) version of the AEGIS demonstrators with regard to the AEGIS platform and its offerings. Furthermore, the current section concludes with a set of recommendations from the demonstrator partners for the next steps of the platform after the project's completion.

3.1. Quantitative Evaluation of the AEGIS platform

It should be noted that the current section contains content from the previous deliverables for coherency reasons.

For every technological project in scale, the quality measurement of the developed solution has become increasingly important, especially when different people are involved in the various parts of the developed solution. For this reason, the continuous monitoring and improvement of quality characteristics of the developed solution is very important towards the aim of safeguarding the desired level of quality for the developed solution.

As defined in the AEGIS evaluation framework, the quantitative evaluation of the AEGIS platform aims at the evaluation of the software quality characteristics of the platform in order to perform the technical evaluation. For this purpose, as it was described also in deliverable D5.2, the software quality characteristics and the software product evaluation process model as

defined by the ISO/IEC 25010:2011 were used as a guidance in order to generate the list of technical KPIs of the AEGIS platform.

The list of technical KPIs derived from the following software quality characteristics as proposed by ISO/IEC 25010:2011:

- Functional suitability
  - Functional completeness
  - Functional correctness
  - Functional appropriateness
- Performance efficiency
  - Time behaviour
  - Resource utilisation
  - Capacity
- Compatibility
  - Co-existence
  - Interoperability
- Usability
  - Appropriateness recognisability
  - Technical Learnability
  - Ease of Use
  - User error protection
  - User interface aesthetics
  - Technical Accessibility
- Reliability
  - Maturity
  - Availability
  - Fault tolerance
  - Recoverability
- Security
  - Confidentiality
  - Integrity
  - Non-repudiation
  - Accountability
  - Authenticity
- Maintainability
  - Modularity
  - Reusability
  - Analysability
  - Modifiability
  - Testability
- Portability
  - Adaptability
  - Replaceability

Through the list of technical KPIs, the quantitative evaluation of the AEGIS platform is performed towards the aim of providing quality assurance and control in all three versions of the demonstrators. The quantitative evaluation of the platform is performed by the AEGIS

platform developers, as well as the developers involved in the implementation of the three demonstrators towards the aim of providing a holistic technical evaluation of the AEGIS platform.

The following table presents the results of the evaluation of the AEGIS platform that was utilised in the implementation of the third and final (advanced) version of the demonstrators.

Sub-characteristics	KPIs	Calculation Type	Mandatory / Optional	Value	Comments
Functional suitability					
Functional completeness	Portion of completed User Stories	[Completed User Stories] / [Iteration Cycle of User Stories] * 100%	M	100%	All use cases planned for the third (advanced) version were executed.
Functional correctness	Portion of User Stories without reported bugs	[Completed User Stories without bugs] / [Iteration Cycle of User Stories] * 100%	M	95%	During the implementation phase, a small list of bugs was identified, however they were all successfully addressed.
Functional appropriateness	Straightforward task accomplishment	Are tasks completed without the use of unnecessary steps? [Yes/No]	O	No	Due to the nature of the accomplished tasks, assistance from the respective persons was required in some cases.
Performance efficiency					
Time behaviour	Average latency	[Total response time] / [Number of requests]	M	~1.0 sec	Average latency was measured with tools such as Chrome Dev Tools.

	Throughput	[Total Number of Kilobytes] / [Total Time of Operation]	M	~ 300 KB/sec.	Value documented while previewing files and downloading files.
Resource utilisation	Mean CPU Utilisation	[Σ[%CPU utilisation probes]] / [Number of probes]	M	<38%	Based on the resource monitoring tool of the platform
	Mean memory usage	[Σ[RAM Megabytes used in each probe]] / [Number of probes]	M	<20%	Based on the resource monitoring tool of the platform
	Maximum memory usage	Maximum % RAM Memory utilisation recorded	M	42%	Based on the resource monitoring tool of the platform
	Maximum processing power used	Maximum % CPU utilisation recorded	M	90%	As the resource management is performed by YARN (see deliverable D3.5), the appropriate resource allocation is always performed according to the provided configuration.
Capacity	Maximum file size upload	Total number of Kilobytes of files	M	5.1 GB	Note: This is size of the current biggest individual file available.

	Maximum file system size[1]	Total number of Kilobytes of files	M	163.5 GB	Note: This is the current size of HopsFS that can scale according to the needs of the project.
Compatibility					
Co-existence	Ability to Co-Exist (host in a single environment)	Can the AEGIS platform operate in shared environment? [Yes/No]	O	Yes	
Interoperability	% of APIs coverage	[Number of integrated systems exposing or consuming data through API] / [Total number of integrated systems] * 100%	M	100%	All integrated components / services are integrated through APIs
	Ability to handle different datasets	Can the AEGIS platform consume datasets from different formats (e.g. CSV, JSON, XML files)? [Yes/No]	M	Yes	No limitations on the file formats HopsFS can store. Files can be processed using the appropriate libraries by the data scientist.
		Can the AEGIS platform provide datasets in various formats (e.g. CSV, JSON, XML files)?	M	Yes	No limitations on the file formats HopsFS can store and provide.

[1] AEGIS platform utilises the distributed file system HopsFS. Thus, the database size metric was modified.

		[Yes/No]			
Usability					
Appropriateness recognisability	% Positive feedback on appropriateness based on the available documentation	[Number of positive response] / [Total number of responses] * 100%	O	90%	The final version of the documentation of the platform (that is delivered as part of D4.4) received positive feedback during the final evaluation phase.
Technical Learnability	% Coverage of features with learning documents	[Unique number of help documents mentioning a feature] / [Total number of features available] * 100%	M	100%	In the final version of the documentation all the features of the platform are properly documented.
Ease of Use	Dashboard availability	Is there an available dashboard or wizard with easy navigation? [Yes/No/Partially]	O	Yes	The UI of the platform was completely redesigned from the previous versions (see deliverable D4.4).
User error protection	% Coverage of input fields with error protection methods	[Number of error protected fields] / [Total number of critical input fields] * 100%	M	100%	All input fields in the UI are protected.
User interface aesthetics	% Positive feedback on user interface aesthetics poll	[Number of supported screens] / [Total number of	O	90%	The latest version of the user interface includes several

		different screens] * 100%			improvements and refinements towards the aim of better aesthetics and improved user experience.
	Responsiveness	[Number of supported screens]/[Total number of different screens] * 100%	M	100%	No inaccessible or malformed screens were identified.
Technical Accessibility	WCAG 2.0 Conformance Level[2]	[None/ A/ AA/ AAA]	M	A	
Reliability					
Maturity	Maximum Concurrent users	Maximum number of concurrent users recorded	M	40	
	Simultaneous requests	Maximum number of simultaneous requests	M	In terms of containers allocated the maximum value recorded was 22, in terms of applications was 11 concurrent application and in terms of requests to filesystem 20 concurrent requests.	Based on the resource monitoring tool of the platform

[2] WCAG 2.0: https://www.w3.org/WAI/WCAG20/quickref/

Availability	% Monthly availability	[1-[Downtime in minutes] / [Total month minutes]] * 100%	M	~98%	The downtime recorded was due to infrastructure upgrade
	Success rate	[Number of correctly completed requests] / [Total number of requests]	M	~96%	The problematic requests were successfully addressed with bug fixing.
Fault tolerance	% of identified Software problems affecting the platform	[Critical Software Issues] / [Total number of Software faults detected] * 100%	M	~19%	All problems have been identified and fixed.
	% of identified Hardware problems affecting the platform	[Critical Hardware Issues] / [Total number of Hardware faults detected] * 100%	M	100%	Critical hardware issues were identified and fixed in short time.
Recoverability	Mean recovery time from Software problems	[Total recovering time from Software issues] / [Total number of Software issues in need of recovery]	M	~ 1 hour	
	Mean recovery time from Hardware problems	[Total recovering time from Hardware issues] / [Total number of Hardware issues in need of recovery]	M	~ 1 hour	
Security					
Confidentiality	Incidents of ownership changes and accessing	Number of recorded incidents	M	None	

	prohibited data				
Integrity	Incidents of authentication mechanisms breaches	Number of recorded incidents	M	None	
Non-repudiation	% Activities reporting	[Number of log categories] / [Total number of system operations]	M	97%	The platform provides advanced logging mechanism
Accountability	User actions traceability	Are usernames included in each activity log entry uniquely? [Yes/No]	M	Yes	Logging mechanisms provide all the appropriate reporting information
Authenticity	Level of User authenticity	Can you identify that a subject is the one it claims to be? [Yes/ No/ Partially]	M	Yes	
Maintainability					
Modularity	% of modularity	[Number of components that can operated individually] / [Total number of components] * 100%	M	100%	
Reusability	% of reusable assets	[Number of assets that can or are reused] / [Total number of assets] * 100%	M	100%	
Analysability	Level of analysability	Can the changes in the performance of the AEGIS platform be efficiently evaluated after	O	Yes	The system offers monitoring tools with performance indications.

		each upgrade? [Yes/No]			
Modifiability	% of update effectiveness	[Number of updates performed without operational issues] / [Total number of updates] * 100%	M	97%	Several updates were performed successfully with minor issues
Testability	Level of testing	Are tests able to probe the behaviour of the AEGIS platform? [Yes/No]	M	Yes	
Portability					
Adaptability	Mean number of errors per hardware change/ upgrade	[Total number of errors recorded] / [Total number of hardware changes]	M	None	
	Mean number of errors per software change/ update	[Total number of errors recorded] / [Total number of software changes]	M	<2%	Minor errors were identified and fixed.
Replaceability	% of software products replaceability within AEGIS platform	[Number of replaceable software components] / [Total number of used software components] * 100%	M	100%	

Table 3-1: AEGIS Platform quantitative evaluation

3.2. Qualitative Evaluation of the AEGIS platform

In addition to the quantitative evaluation of the AEGIS platform and in accordance with the AEGIS evaluation framework, a qualitative evaluation of the AEGIS platform was also carried out. The evaluation approach is the same as in the deliverables D5.4 and D5.5, which allows a

comparison of the results. This qualitative evaluation aims to shed additional light on aspects such as the usefulness of the platform and the perception of the technical process of implementing the third version of the AEGIS demonstrators.

The qualitative evaluation provides valuable feedback that a quantitative evaluation alone could never generate and returns this knowledge to the platform developers to further improve the AEGIS platform. However, as the project is closing at M30, most of these comments cannot be addressed within the project runtime (but in the latter exploitation phase). In order to conduct the qualitative evaluation, focus groups were conducted at the demonstrator sites. The following section contains the results of these focus groups.

3.2.1. Automotive Demonstrator

In order to document the perception of the demonstrator developers, *a two-member mini-focus group consisting of the data scientists* responsible for the implementation of the vehicle demonstrator V3 was again carried out. As far as demonstrator V2 is concerned, an experienced data scientist responsible for implementation and a young data scientist performing many implementation activities contributed to the focus group. The aim of the focus group was again to determine the perceived usefulness of the AEGIS platform (especially if/as it has been increased since the last version) and the perception of the technical process of implementing the vehicle demonstrator (especially if/as it has been improved since the implementation of version V2).

A remarkable result of the focus group was that the perception of the platform has increased positively. The new user interface and the new and modern look and feel of the platform prototype V3 contributed intensively to the increased perception. In addition, the collaboration between the demonstrator developer and those responsible for implementing the platform has further improved. The trust between the data scientists and the platform developers has further increased over time and reached a maximum level at the end of the project. Technical problems with the implementation of demonstrators, such as restarting the core or increasing the computing power or RAM required for the data processing workflows, were quickly solved by those responsible for hosting the platform. This contributed to a greater joy of using the AEGIS platform for data science. As a result, another mini use case, a neural network for classifying drivers, was implemented by a data scientist using the capabilities of the platform.

One issue that remained a challenge was the alignment of demonstrator deadlines with platform development and update deadlines. Thanks to the weekly technical telephone conferences, the implementation of the demonstrator V3 went much smoother than the implementation of V2, but after upgrading the platform to the version V3, some manual record creation and data import still had to be done. Having a smoother backup and import process of projects is a requirement of platform improvements in the project exploitation phase.

During the implementation of the automotive demonstrator, the responsible data scientists had to find out how to optimally use the AEGIS concept of data sets, folders and notebooks to convert raw data into intelligent data so that their three business applications, the broken road indicator, the safe driving indicator and the regional driving risk estimator, could be implemented on the platform. That was learning by doing during most of the demonstrator's third implementation phase, but the documentation that was made available at a later stage of the project, as well as the usage documentation that is documented in deliverable D5.6, will

certainly make the work of the data scientists that are interested in the platform much easier and more convenient for them.

After the complete implementation and evaluation of the automotive demonstrator V3, a redesign of the data processing pipeline has been performed to fully utilize the AEGIS concept, affecting all three demonstrators. This required some additional expenditures but greatly improved the quality of the results regarding the demonstrators. Datasets and scripts now span four different phases of the automotive data processing pipeline, (1) data extraction & preparation, (2) event calculation & aggregation, (3) analytic & result generation, and (4) output preparation (for the visualiser). A separate folder structure has been developed for each data set (which is filled after code has been executed on the platform) to allow better exploration and use of the data generated by drivers beyond prototyping.

In general, the data scientists liked the new GUI and colour settings, which is appealing and facilitates the use of the platform. In the beginning of the AEGIS platform use with the new design, however, data scientists did not find some platform functions, such as the start and properties of Jupyter (to be found in the AEGIS tools menu) that was quickly resolved by the platform developers. In addition, searching data sets posed some minor challenges in the beginning, as the position for the left click and the duration of the double click seemed to be crucial for the execution of the correct function. By getting used to this functionality, however, the data scientists liked the procedure of quickly accessing and modifying uploaded data. Right-clicking on a record opens a context menu, which is rather unusual for web applications and takes some time getting used to. If this behaviour is internalized by the data scientists, working with the AEGIS platform becomes even more comfortable, like using the context menu within a desktop application to quickly execute commands. Dataset icons are nicely designed; however they are quite large and contain little information about the data they contain. It would be optimal to use less space for them, especially within large projects, and utilise this space for displaying the dataset name which is truncated in the case of long dataset name and poses a minor challenge in the case where many datasets are stored in a project. It would be very useful to use the dataset icon to display additional information about the dataset such as its file size and the number of files it contains. In addition, the number of folders contained in a dataset would be a very useful information. The project settings information contains such information, but it would be great to also have it in the dataset view.

Finally, the cooperation between the data scientists and the developers in charge of the visualiser went smoothly. Many requirements that came up during the implementation of the demonstrator concerning the heatmap and marker visualisation were implemented quickly, so that the usefulness of the visualiser for the automotive demonstrator was further increased.

In summary, it can be said that both the (perceived) usefulness and the (perceived) user-friendliness of the platform have greatly increased from V1 to V3. In addition, the process of implementing a demonstrator has been perceived also as much simpler than before.

3.2.2. Smart Home and Assisted Living Demonstrator

For the qualitative evaluation of the AEGIS platform during the third and final implementation phase of the Smart Home and Assisted Living demonstrator evaluation process, the same approach as it was performed during the development of the second (medium) version of the demonstrator, was followed. In details, a focus group consisting of six participants in total, one

data scientist and one developer from each of the three partners involved in this demonstrator, was conducted.

The scope of this focus group was two-fold: a) to extract the perception of the Smart Home and Assisted Living demonstrator with regards to the perceived usefulness of the AEGIS platform, and b) to document the perceived ease-of-use of the AEGIS platform for the implementation of the specific demonstrator. The members of the focus group were involved in the development process of the demonstrator from the first implementation phase, hence they are considered as the most suitable persons in order to evaluate the evolution of the AEGIS platform during the whole project period.

The participants agreed that the final version of the AEGIS platform that was utilised during the implementation of the third and final version of the demonstrator has increased significantly their perception for the platform in terms of usefulness, usability and ease-of-use in a positive way. More specifically, they pointed out that the functionalities offered by the platform, as well as the level of maturity of these functionalities, are in this final version in a state that the implementation of the third version of the demonstrator was smooth and the required tasks for this final implementation were completed without particular issues. Furthermore, the redesign of the user interface of the platform was well received by the participants and it was acknowledged that is far more appealing for the developers and data scientists, while also offering a significantly improved experience compared to the previous one. The new user interface is also facilitating the usage of the platform even for non-experienced users of platforms focused on the data science sector. Additionally, the participants agreed that the documentation has been significantly improved and the relative guidelines provided by the platform developers are now very useful for any user that would like to perform any development activities on the platform.

Apart from the user experience, the participants acknowledged that the services of the platform are now more customisable and can be tailored to the developer or data scientists needs, which is another benefit of the platform. While this required a higher level of tuning and custom parametrization of the services and software components offered in the AEGIS platform, in association with the platform developing team, the few issues identified were resolved, leading to a refinement of the parametrization capabilities exposed to the data scientists by the different AEGIS modules. Another addition in the final version of the platform is the availability of the predefined tools, such as the as the Query Builder, the Visualiser and the Algorithm Execution Container, by default on each project which was an issue in the previous releases that is now resolved and saves development effort.

The participants pointed out that during the implementation phase of the third version of the demonstrator the collaboration between the demonstrator developers and the platform developers was further improved. However, as the AEGIS platform received several refinements and updates during this period, minor issues were faced, especially in the user interface environment that was completely redesigned, and the demonstrator developer had to wait for the stable intermediate release of the platform before they could continue their development activities. This is understandable due to the time-plan of the Description of Action of the AEGIS project and the participants noted that the help of the platform developers was very helpful at these cases in order to have an uninterrupted development process of the demonstrator to the highest possible degree. The platform offers several powerful features that

are not highlighted and only the experienced users will identify them, such as the ability to schedule a notebook to be executed at a specific time point as a preconfigured or scheduled job.

Furthermore, as mentioned before in some cases the high level of customisation of some of the AEGIS services required the help of the platform developers in order to be able to exploit their capabilities. For this reason, they suggested that the platform documentation should be further extended in the project exploitation phase to incorporate the documentation of these capabilities mainly required by expert users in the data science sector. Finally, the upgrade process has been improved and most of the manual processes that were identified in the previous version were resolved. However, in some cases some manual processes were still needed by the administrator so this remain also one item for exploitation in the upcoming project exploitation phase.

As a final note, the participants highlighted that the perceived usefulness, as well as the ease-of-use, of the AEGIS project has been increased in a great level in the course of the project as the platform releases were delivered according to the time-plan from the first version to the last version of the platform. They all agreed that the platform facilitates the work of data scientists significantly and the development process for any interested party is now smooth and effective.

3.2.3. Insurance Demonstrator

The third scenario of the insurance demonstrator has been developed and tested by a group of heterogeneous in skills and background participants. Two software developers were in charge of the HDI Web App developments, while two data scientists had the role of identifying the data required for the scenario execution, pre-processing them (when needed) and customizing the three notebooks used for the scenario implementation (namely the Query Builder, the Visualizer and the Algorithm Execution Container). We would like to consider as a developer also the person who supervised the whole scenario execution, orchestrating the interaction between the two groups and providing them continuous feedback about the workflow and results. During the developments, the project partners that provided the three aforementioned Jupyter notebooks have always been available for suggestions and cooperation.

While for the first two scenarios the qualitative evaluation has been conducted at the end of the development and testing phases, for the third scenario the approach was different: the semi structured qualitative evaluation (described in D5.2) followed for the first scenario evaluation has been applied but the feedback have been collected during the whole timing. Furthermore, the questions of the first scenario evaluation have been slightly changed, taking into consideration both the evolution of the platform and the fact that the third scenario is the last one.

As reported in D5.2 and D5.3 the objective was to provide a feedback about the perceived usefulness of the AEGIS platform, as well as the perception of the technical process of implementing the demonstrator itself.

There are three major aspects, which have been the focus of the qualitative evaluation: (1) the perceived overall usefulness of the AEGIS platform, (2) the perception of the technical process of implementing the demonstrator, and (3) the final considerations about the actual usability of the AEGIS platform in real business decisions.

1. *From what you have so far learned in the application of the AEGIS platform, how useful do you perceive the AEGIS platform in general?*

A huge potential is clear from all the functionalities that have been included in the platform, as most of the technologies that are exploited by AEGIS platform are the ones that have already been used by the data scientists, making the AEGIS platform usage a valid alternative to the actual commercial tools.

Huge steps forward have been made from the first and the second prototypes of the platform, and several improvements were introduced. One of the most important improvements that was introduced in the final version, which was also mentioned in the previous evaluations from the demonstrators, is the availability by default of the three Jupyter notebooks (namely the Query Builder, the Visualizer and the Algorithm Execution Container).

2. *How did you perceive the technical process of developing and implementing your AEGIS demonstrator with/on the AEGIS platform?*

As stated in the previous answer, the customization of the notebooks was eased by the Jupyter knowledge of the data scientists, and Python offers a huge variety of libraries that can support the needs of a multitude of scenarios. For the advanced demonstrator of HDI this easy adaptation of the technologies used is fundamental since the workflow is not as 'standard' as for the first two insurance scenarios (as will be highlighted also in section 6 of the current deliverable). The improved workflows, for instance right clicking to open the notebooks, made less manual and time-wasting the general platform usage.

On the other hand, since the development of the platform and the demonstrator's scenarios were executed in parallel, some delays have been encountered, and in some cases the platform updates caused errors in notebooks that were previously working. However, the platform development team quickly acknowledged the issues and resolved them.

3. *How would you see the adoption of the AEGIS platform in your daily activities?*

The use of the AEGIS platform was bounded to the project purposes, however for a real usage of the platform a further integration is needed:

- Between the HDI Web App and the HDI System. At the moment, the Web App that implements the workflows of the scenarios is not integrated with the HDI System;
- Between the HDI System and some functionalities of the platform, for instance the real time notifications from the Event Detection Tool/Harvester.

3.3. Challenges and recommendations

Several recommendations can be derived from the focus groups of all three demonstrators, which represent valuable feedback for platform developers. However, due to the completion of the project at M30, most of them can be considered in the later exploitation phase.

The main recommendations of the automotive demonstrator are:

- Improve the update process of the platform regarding existing data science projects to further reduce the workload for data science projects

- Provide a quick guideline on how to best use the platform for data science projects from lessons learned in the project.
- Improve minor content and layout issues of the user interface on the testbed.

The main recommendations of the smart home and assisted living demonstrator are:

- Further highlight some existing capabilities of the platform such as the predefined or scheduled job execution.
- Expand the documentation of the platform to include a short guideline for the customisation capabilities of the AEGIS services for the expert users of the platform.
- Further fine-tune the upgrade process in order to eliminate any manual intervention needed.

The main recommendations of the insurance demonstrator are:

- The creation of the AEGIS user account should be eased, as the actual verification of the account by an administrator could mean days to wait.
- The Jupyter quotas should be managed directly by the user, without any intervention by the administrator, or the administrator should receive a notification if the user is out of quotas.
- The default projects number for each user should be increased.
- The documentation provided for the notebooks could be updated, eventually providing some concrete examples for data analysts (without coding skills).
- The getting started should be redesigned to be clear and professional while being more attractive to be used by externals. Some functionalities of the platform at the moment are not properly highlighted even if they could be very useful in actual applications.

4. AEGIS AUTOMOTIVE DEMONSTRATOR

4.1. Pilot overview

The automotive demonstrator is developed according to three different scenarios, (1) broken road indicator, (2) safe driving indicator, and (3) regional driving safety risk estimator. All three scenarios have been successfully implemented and evaluated. In particular, the *regional driving safety risk estimator* is reported in this deliverable.

The following figure shows a high-level view of the data processing pipeline implemented on the AEGIG platform for the automotive demonstrator. Thereby the steps (1) data extraction, (2) data preparation, (3) event calculation & aggregation, (4) analytics & result generation and (5) output preparation for the visualizer are executed.

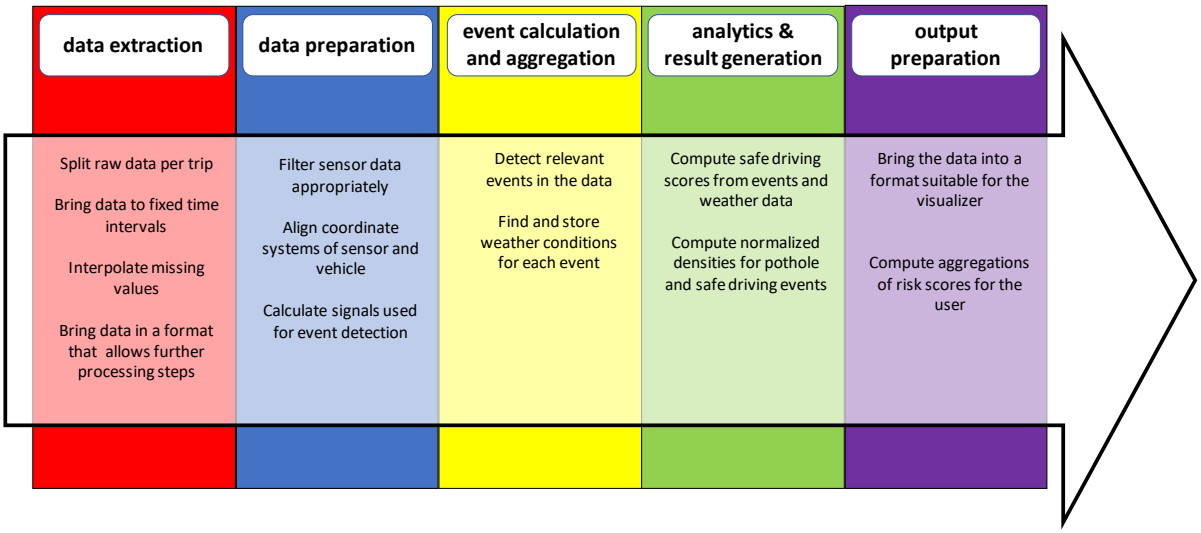


Figure 4-1: High level view of automotive data processing pipeline

Raw data is captured by a logger developed at VIF connected to the vehicle's on-board diagnostics interface. The data logger turns on automatically at the vehicle's start and starts recording vehicle movement data. Likewise, it shuts down and turns off automatically if the vehicle's engine is turned off. Vehicle data from multiple drivers covering multiple trips is manually uploaded to the platform to the Automotive Demonstrator project[3].

A data-analysis pipeline is executed as shown in the figure below to enable the regional safety risk estimator (automotive demonstrator V3), which is in its core a heatmap visualisation of the aggregated driving risk on a geographic map. A number of data preparation and processing steps must be performed before the result is finally passed to the AEGIS Visualizer.

[3] Automotive Demonstrator Project: https://bbc6.sics.se:8181/aegis/#!/project/1056

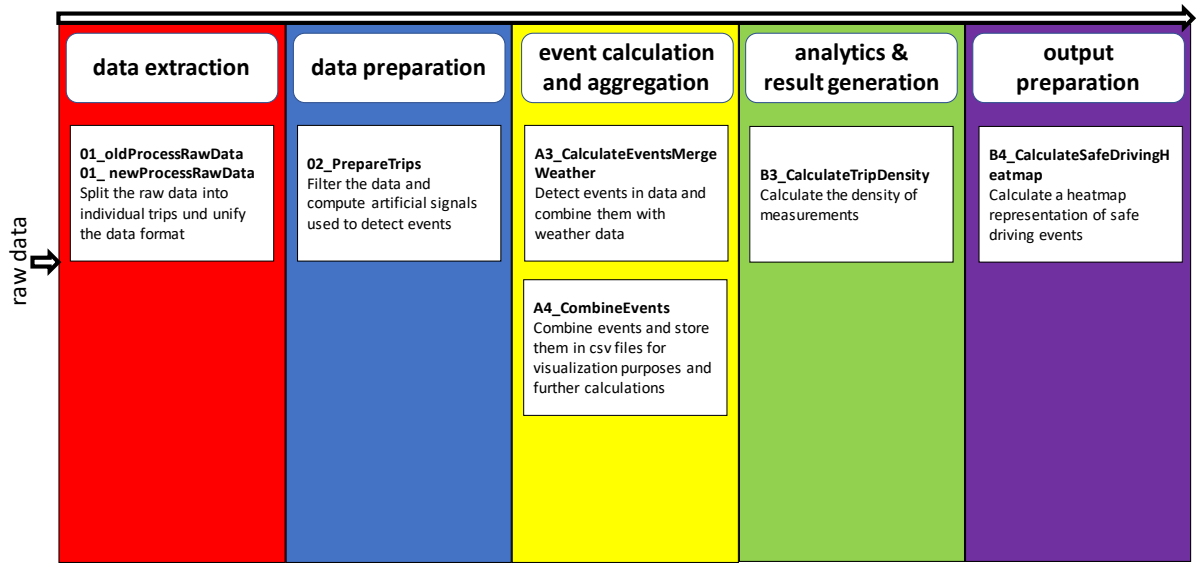


Figure 4-2: Data workflow for automotive demonstrator v3

The Demonstrator V3 uses most of the scripts from V1 and V2 for data extraction & preparation as well as for event calculation & aggregation, too. The safe driving indicator (Automotive Demonstrator V2) has quantified individual driving risks per trip and driver (in terms of harsh acceleration, braking and curving events). To increase the value of this information for various stakeholders, the Automotive Demonstrator V3 aggregates the individual driving risks detected in the trips of all drivers into regional driving risks as decision relevant information for e.g. traffic planners. Regional driving risks are visualised as a heatmap overlay on a geographic map of the respective region and provides further interaction and export capabilities. The figure below shows the output of the regional driving risk estimator for the three districts *Jakomini*, *St. Peter* and *Liebenau* in Graz based on trips collected in the Greater area of Graz and made available on the AEGIS platform. It becomes clear from this visualisation that intersections in particular are dangerous hotspots, where harsh(er) driving behaviour has been practised.

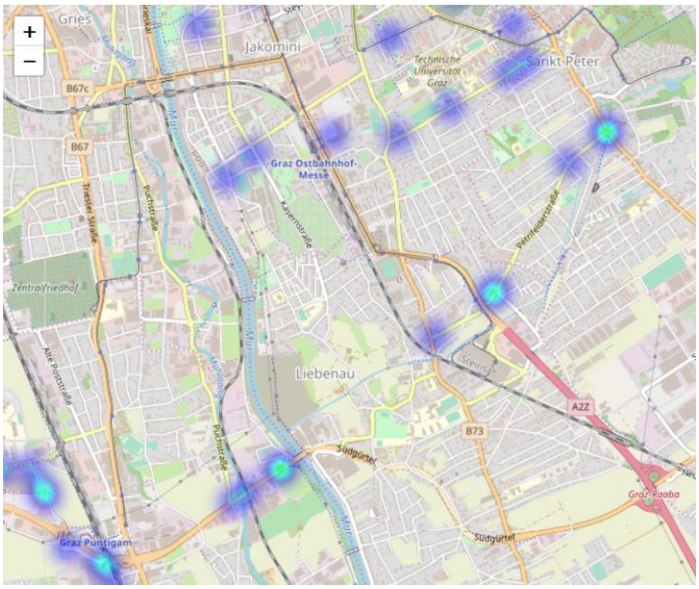


Figure 4-3: Regional Driving Safety Risk Estimator Heatmap

The figure below shows the project page of the automotive demonstrator as well as all datasets created on the AEGIS platform, which are necessary to run the three demonstrators. In total 2.163 trips were processed and analysed on the AEGIS platform resulting in ~47 GB Vehicle Raw Data, ~17 GB TripData_raw, ~18 GB TripData_prepared, and ~22 GB TripDensity in the corresponding folders as shown in the figure below. However, due to improvements of the data workflow till M30, dataset names and script names will be further adjusted for a smoother presentation of the demonstrator to externals. The final structure will be presented in D5.6.

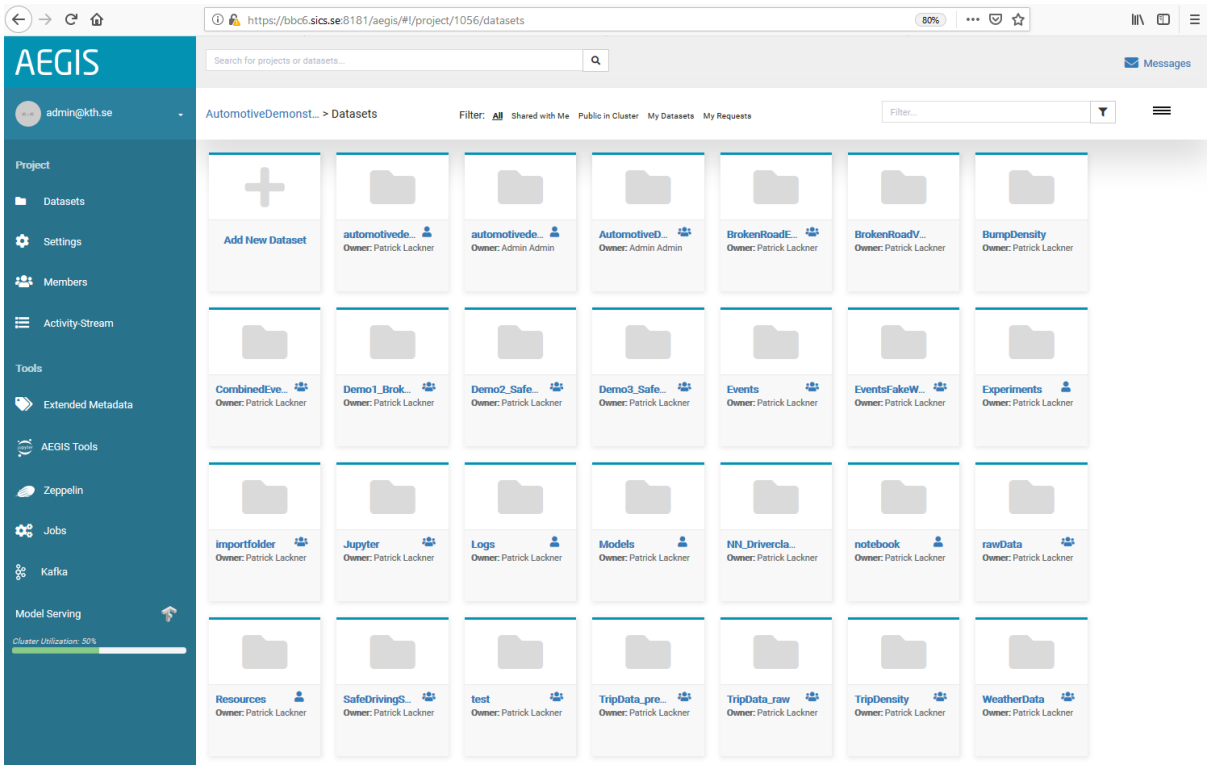


Figure 4-4: Automotive demonstrator dataset overview

4.2. Scenario execution

The **third scenario** "regional driving risk estimator" includes executing one additional test case to scenario 1, broken road indicator, and scenario 2, safe driving indicator, (1) assess regional driving safety risk with a geographic risk estimator and visualise it in a heatmap. The results of the other test cases are provided in D5.3. and D5.4.

4.2.1.1. Test Case 1 for "Assess regional driving safety risk with a geographic risk estimator and visualise it in a heatmap"

Actors:	PSPS data scientist
Pre-conditions:	1. Broken road dataset is available 2. Save driving dataset is available

Post-conditions:	1. A heatmap indicating high-risk regions is visualised (high risk regions are such regions where multiple single safety-critical events have occurred in the past)
Normal Flow	1. The data scientist queries save the driving dataset for the safety critical events, the corresponding weather conditions, and the broken road dataset by using R code or the query builder. 2. The data scientist executes R-code on the platform using the result of the query as input to calculate a two-dimensional density estimate of driving risk and to visualise it with a heatmap as overlay to a geographic map. Event-types (e.g. braking, road damage, ...) can be selected and de-selected to adjust the visualisation in the heatmap.
Pass Metrics	1. A proper heatmap is visualised to the user.
Fail Metrics	1. No heatmap is visualised and an error message is provided to the user.
Notes and Issues:	-
Execution Results	Safety critical events including harsh braking, harsh acceleration and harsh curving have been detected and are stored on the AEGIS platform (in the course of the development of the automotive demonstrator v2). All safety-related events are stored along with the respective weather conditions of all trips. Thereby the scripts *01_oldProcessRawData*, and *01_ newProcessRawData* are executed to split the raw data into individual trips and unify the data format within the data extraction step. Then the script *02_PrepareTrips* is executed to filter the data and compute artificial signals used to detect events in the data preparation step. In a next step, the two scripts: 1) *A3_CalculateEventsMergeWeather* to detect events in data and combine them with weather data and 2) *A4_CombineEvents* to combine events and store them in csv files for visualization purposes and further calculations in the step event calculation and aggregation, are executed. The script *B3_CalculateTripDensity* is executed to calculate the density of measurements in the analytics & result generation step. To prepare the output for the visualizer, finally the script B4_CalculateSafeDrivingHeatmap is executed to calculate a heatmap representation of safe driving events.
	To enable interaction with the computed risk data, the *visualizer* script is executed and the prepared heatmap visualisation file is selected as shown in the figures below:

Hide

Current Directory: **/Projects/AutomotiveDemonstrator/Demo3_SafeDrivingHeatmap**

Folder/File: safedrivingheatmap_current_dri

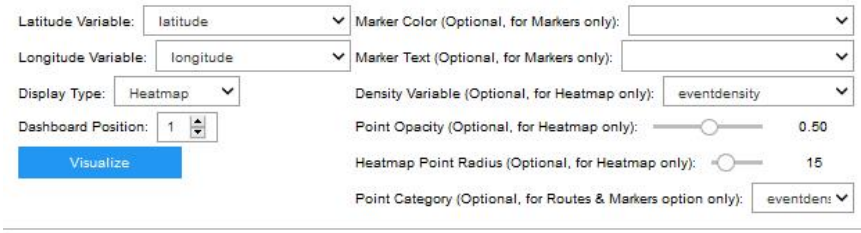
CSV Delimiter: ,

Open | Back to Root

Hide

	latitude	longitude	eventdensity	tripdensity	normalsafedrivingscore
0	47.033357	15.424554	12952.260062	0.000049	0.416903
1	47.029762	15.426688	12952.260062	0.000058	0.349430
2	47.056006	15.460161	12952.260062	0.000040	0.511482
3	47.116405	15.361209	12952.260062	0.000022	0.930948
4	47.075870	15.454293	25904.520124	0.000115	0.350422
5	47.071286	15.406684	12952.260062	0.000051	0.397039
6	47.033267	15.424554	12952.260062	0.000050	0.404884
7	47.060141	15.454960	12952.260062	0.000041	0.494236
8	47.034256	15.424021	12952.260062	0.000037	0.547872
9	47.029043	15.429488	12952.260062	0.000061	0.331552
10	47.033177	15.442558	25904.520124	0.000103	0.391805
11	47.056905	15.412419	12952.260062	0.000060	0.335532
12	47.055916	15.460161	12952.260062	0.000039	0.518941
13	46.996327	15.407084	12952.260062	0.000057	0.354180
14	47.062747	15.460694	25904.520124	0.000040	1.000000

In a final step the visualisation for the heatmap is configured accordingly.



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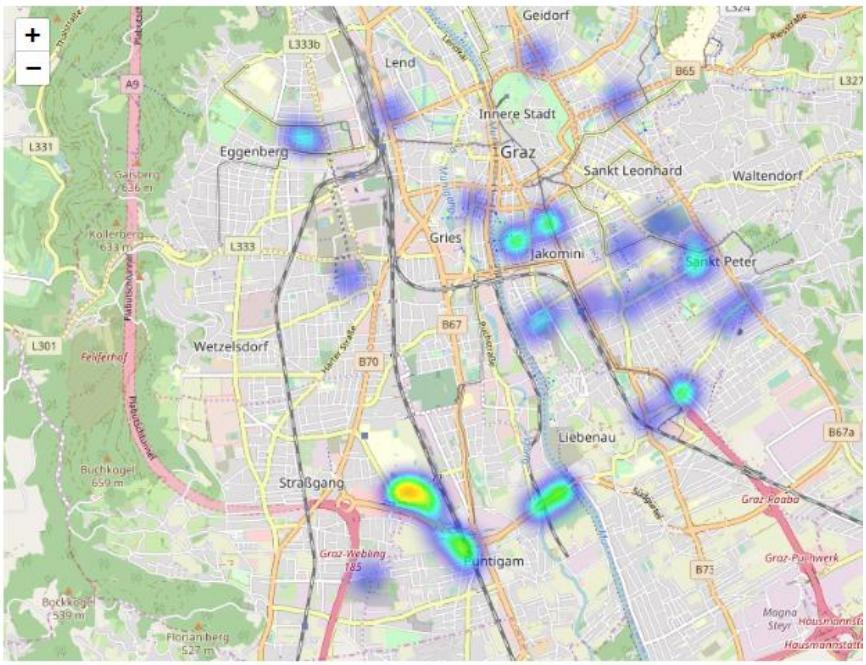


The heatmap shows places where a sufficient density of unsafe driving events have been performed by the volunteer drivers who provide their vehicle movement data to the project. Therefore, the event detection

	thresholds were set rather low to detect a sufficient number of events within the data for heatmapping.

4.3. Demonstrator Evaluation

4.3.1. Quantitative Evaluation

The demonstrator-specific quantitative evaluation action focuses on the completeness on the test cases as well as on some demonstrator-related KPIs. Only the KPIs related to V3 of the demonstrator are shown in the table below.

Sub-characteristics	KPIs	Calculation Type	Mandatory / Optional	Means to Verify	Value
Regional driving risk estimator function completeness	Number of successfully completed Test Cases	[Successfully Completed test cases] / [No of cases] * 100%	M	Calculation (0-100%)	100%
Include multiple trips in driving data	Number of different Trips	Sum	O	Counting numbers	2.163
Include multiple drivers in driving data	Number of different drivers	Sum	O	Counting numbers	15

Table 4-1: Automotive demonstrator quantitative evaluation

4.3.2. Qualitative Evaluation

In the scope of the automotive demonstrator V3, different drivers have provided vehicle movement data for further analysis. Focus groups are a valuable instrument to gather more in-depth information on perceptions, insights, attitudes, experiences, or beliefs of people.

Hence, a *three-person mini focus group with persons knowledgeable in traffic planning activities* have been conducted in May 2019. The goal of this focus group was to demonstrate and discuss the regional driving risk estimator service (i.e. the corresponding dashboard on the AEGIS platform which can even be downloaded as html-file and shared with them for own exploration) and to generate additional feedback on how the experts experienced the service. Experts were furthermore asked for recommendations on how to improve usability, usefulness, and user experience in general and the regional driving risk estimator dashboard specifically. The discussion with the experts triggered many useful ideas and feedback, going even beyond the scope of the demonstrator.

To kick-off the focus group, a short presentation of the regional driving risk estimator was conducted. Thereby the data-scientist in charge explained the concept and demonstrated the service for making aggregated driving risks visible on a geographic map as an interactive heatmap overlay. After this short introduction, experts were asked if they understood the concept of the regional driving risk estimator as presented. In a next step, which was the main purpose of the focus group, individual feedback on the service was requested from each expert. This request immediately led to a fruitful discussion on service provision, further requirements and ideas on how to further improve and extend the service.

Results of the focus groups have shown that in general the information provided to the experts in the dashboard is perceived to be useful to better understand driving risks within urban areas and further improve interventions to mitigate them. However, the experts had a series of suggestions and ideas for improvement that go even beyond the addressed scope of the demonstrator.

In a first step, the experts asked some questions about how the heatmap was created and what exactly they can see in this heatmap. They also asked questions about what objects are at the locations where the heatmap is displayed, such as whether a school is there, a speed limit, a bus stop, a speed zone, or a traffic light. The experts were told that the system marks positions where the drivers have braked strongly, accelerated hard or taken a fast turn independently from the context. The only source of information besides the heatmap is the geographic map which may include some interesting objects like schools or universities. Finally, the experts were informed that this dataset only covers a limited number of drivers and was created for a proof of concept, leading to many limitations what can be done with this dataset in practice.

One idea of the experts was to enable heat maps for different drivers or driver groups (depending on their driving style). They were informed that the calculation of the heat map density was standardised so that safe-driving events detected in certain areas covered by fewer trips were considered less. Experts showed great interest in the amount of road use which is currently not shown in the visualisation (although it is computed on the platform to enable the heatmap as driving density). One expert had the idea of marking or greying out roads on the map where no one has driven in a certain time span. Unfortunately, the visualization doesn't show how often someone has driven within a certain area, making it harder to judge the heatmap for driving risks.

Furthermore, experts would like to open a context menu when clicking on the heatmap (e.g. on a dense area as the one in the ‘Brucknerstrasse, Graz’) and then receive a statistical evaluation about the total number of drivers driving daily within this area (and how many of them drive on a regular base). They would also like to know more about places where drivers started their trip and where drivers ended their trip, when investigating certain areas on the heatmap to learn more about traffic flows in cities. Finally, they would like to have more information about how far people travelled and how long they drove.

In general, experts would be interested in getting more contextual information about areas covered by the heatmap and the underlying trip data used to calculate the heatmap. Maybe it could even be made possible to deduce from the vehicle data collected, how many people were sitting in cars. Receiving more context information would be a strong motivation for a further exploration of the regional driving risk estimator. Furthermore, the experts had interest in adding a speeding event, too, as speeding is a major cause of accidents.

Experts were interested to know why certain relevant areas on the city map (e.g. a shared space area installed near Graz University) do not appear as risky areas in the heatmap. For the experts, the question arises as to whether people generally drive very cautiously in such areas? It would be ideal to mark a place that is not covered by the heatmap and then to display additional context information on how people have driven and how many people have driven in this place within a particular time frame to see whether a particular traffic planning concept is successful (here: a shared space was installed in the sense of risk reduction). Were traffic interventions installed for reducing the traffic risk successful in terms of leading to less risky driving behaviour?

Ideally, a combination of the intensity of road use, e.g. by using lines while their thickness indicates the number of trips, and the representation of the traffic risk by the heat map in a second view or in a combined view would be ideal for them. For instance, map view 1 could shows how many people are driving within a street or area (using a heatmap or route view) while map view 2 shows how many safety-critical events occurred within a street or area (using a heatmap with a different colour set).

There was a general interest of the experts to learn more about traffic flows in the city and combine traffic flow analysis with risk analysis: They would for instance like to know how the traffic flows distributes in the traffic network. If vehicles must drive through a traffic 'needle eye', how does the traffic spread after passing this needle eye, which streets are used by which drivers at which time of the day. If the risk estimator additionally indicates safety-relevant issues at this 'needle eye' (showing how drivers cope with it), this would be an indication to set a traffic intervention.

Another interesting idea mentioned by the experts are dynamic heatmaps: Such heatmaps could not just display the density of all events, but also include the severity of detected events in the computation of the heatmap. For instance, individual strengths of braking are not considered in the calculation. There is a threshold set, which controls the consideration of events for the heatmap calculation. The experts indicated that it would be interesting to change and adjust the threshold and create a new heatmap dynamically (e.g. by using a slider). Finally, variations of the heatmap according to included events (e.g. select or de-select certain events) as well as day and time of the week would be relevant. It would be further interesting to see how driving manoeuvres change with respect to changing traffic density. It would also be interesting to see how the heat map changes depending on a particular weather condition. Which safety-relevant events occur at which position at what weather status?

Sometimes certain events (e.g. a trade fair) are organised within a city, which affect the traffic situation and may lead to risky driving. Experts would be interested to explore the traffic situation before, during, and after the event in the area where this event is located.

A combination of different traffic concepts would also be interesting, for example, motorists and cyclists. The knowledge on risky areas with respect to car traffic could be used to plan safer traffic routes for cyclists. Furthermore, also risky cycling behaviour could be displayed.

In general traffic planners want to receive decision support for long-term traffic planning. They want to get an overview of the traffic situation and see what they can do better.

One relevant aspect to know are standstill (times) of vehicles (e.g. before regulated and unregulated intersections). With such an information, planners could further optimize traffic

flows in cities. In this way, it is possible to even identify intersections, where people spend unusually long periods of time at red traffic lights. In this respect, it would be even more interesting to play simulation games on how, for example, an intervention such as a road closure due to a construction site affects traffic flow and traffic risk.

Traffic density and risk simulations would also be interesting. For example, given the collected data, what happens if a road were closed at 08:00 in the morning? How do drivers distribute to other roads? A simulation tool allowing to block road sections and a simulation how traffic is then spreading to other roads to avoid the blocked road could be interesting for traffic planning improvement.

Finally, it would even be exciting if a city's traffic management system could communicate directly with navigation systems installed in vehicles and redirect and distribute ad-hoc traffic as needed in an intelligent way to avoid traffic jams.

4.4. Challenges and recommendations

A series of challenges have been identified and recommendations have been made by the experts which are in particular interesting for the exploitation phase of the project as they go beyond the scope of the automotive demonstrator V3. The experts mentioned useful functionality, which they were highly interested into:

- A larger driving dataset would be great, which covers a wider area of the city and a wider scale of dates and times where people were driving in the city.
- Displaying road use as (additional) heatmap or route-based visualisation would be a great addon to the service.
- A context menu leading to further information while marking certain areas of the heatmap would be interesting to better judge the severity of the indicated risks. In general, experts raised the interest on having more context information provided to them.
- Experts indicated interest in knowing places where trips started and ended in terms of traffic flow prediction. In general traffic flow prediction and visualisation were topics of great interest for them.
- The visualiser could show different information layers: While a first map could indicate, how many people drove on a particular road (e.g. showing the trip density as route thickness), another map could display the number of safety-critical events happening on this particular road (event density as heatmap). While the first is computed on the platform (but currently not shown in the visualiser), the second is shown in the regional driving risk estimator.
- The GPS data is in general inaccurate leading to inaccurate positions of events and to heatmaps spanning areas which are not roads. This should be corrected within the movement data, if feasible.
- Adding a speeding event would be interesting as speeding leads to many risky situations and accidents.
- Thresholds seem to be far too sensitive on the platform, sometimes causing too many events shown. (But this is intended in order to better test the platform functionalities.)
- Dynamic heatmaps would be an interesting add on for the services, allowing the experts to select/de-select events, set threshold values for events, and date:time for heatmap visualisations.

5. AEGIS SMART HOME AND ASSISTED LIVING DEMONSTRATOR

5.1. Pilot overview

The Smart Home and Assisted Living (SHAL) Demonstrator aims to illustrate the added value of the AEGIS big data platform in the area of personal security and safety, through tailored smart home and assisted living services. The encompassing case study is repeated here for completeness: a social / health care service provider, who desires to exploit big data-driven insights, in order to provide added value services to vulnerable individuals, aspires the creation of services pertaining proactive and reactive safety and assisted living features through smart notifications and personalised recommendations, as well as indoor comfort and quality preservation. These 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 three main services developed within the demonstrator are the following:

- Monitoring and analysis of an individual's well-being conditions and physical activity retrieved and aggregated mainly from wearables worn by the at-risk individuals, towards the provision of monitoring services to the at-risk individuals' carers (namely the social / health care service providers).
- Monitoring and analysis of an individual's well-being conditions, physical activity, approximate positioning (at city and/or area-level), information from wearables as well as outdoors environmental data (e.g. meteorological conditions and air-quality, social media), towards the provision of anonymised group-based or even personalised notification and recommendation services to the at-risk individuals, as well as to the at-risk individuals' informal carers.
- Monitoring and analysis of indoor air quality and ambient conditions, energy and operational device data towards the provision of an increased indoor comfort and welfare service to the at-risk individuals, empowered by smart home automation functionalities.

Six detailed scenarios and associated test cases were a-priori defined in Deliverable 5.2, two for each of the early, medium and advanced development and evaluation stages of the demonstrator. The early and medium demonstrator implementation and evaluation are reported in Deliverables 5.3 and 5.4 respectively. In this document, we report on the final, advanced, version of the demonstrator. The two corresponding scenarios are shown in Table 5-1.

ID	Scenario	Functionalities	Demonstrator Version
5	Personalised notifications and recommendations for (at-risk) individuals and their carers	Definition of personalized medical rules, personalised alerts and recommendations to (at-risk) individuals and notifications to informal carers	Advanced

6	Smart home automation services	Optimization and automated control of HVAC and lighting devices	Advanced

Table 5-1: Smart Home and Assisted Living demonstrator scenarios

The development during the last months proceeded according to the time plan provided in Deliverable 5.2, without major deviations. The progress and status of the demonstrator are portrayed in the following subsections, where the details on the execution of the different test scenarios and cases are provided. In summary, the late stage developments concentrated on two main aspects. One the one hand, it concentrated on the optimization of the at-risk individual classification model, which periodically (re-)classifies the (at-risk) individuals into personas taking into consideration additional dimensions, and on the development and fine-tuning of an enhanced event detection mechanism supported by a rule engine that identifies at risk individuals that diverge significantly from their assigned persona acceptable parameter values, as well as the risk of conditions exacerbations mainly attributed to / caused by environmental and ambient conditions, such as extreme meteorological conditions and/or air quality. The recognition of these events and the advanced rules constant evaluation, leads to the inclusion of the personalized notification functionality, in which the CSP, through the dashboard, can easily identify cases that require immediate attention while personalized push notifications are automatically delivered through the mobile app to the (at-risk) individuals. On the other hand, the focus was the recommendation and automation services for the smart home automation scenario. Extending the work from Scenario 4, notifications on adverse indoor conditions are now enriched with recommendations suggesting the best course of action (in terms of device control signals). Additionally, the individual, through the mobile app can accept the suggested controls, which are then automatically applied by the automation service. With the successful completion of scenarios 5 and 6, the demonstrator has reached its final stage.

5.2. Scenario execution

5.2.1. Scenario 5 - Personalised notifications and recommendations for (at-risk) individuals and their carers

Scenario 5 comes to verify the final version of the demonstrator, where personalization comes into place, as well as automation, in notification triggering, based on the profiles and data of the individuals registered in the SHAL demonstrator, and the rules placed by the CSPs that are monitoring those individuals (either directly or under the "anonymous" umbrella groups of personas).

More specifically, during this scenario the test had to do with the **revealing of identity to CSPs selected by the individual**, which can be performed through the web-app and allows CSPs to have a direct view on the (at-risk) individual's data, that allows to either build customised rules for notification triggering, or allow them to evaluate certain dimensions (based also on historical data) and issue manual notifications and recommendations.

For this to work, the **at-risk individual classification model** constructed in the previous stage of the demonstrator is **enhanced with new dimensions**, and a constant weekly re-execution of the model is executed on the AEGIS platform, as the entire **SHAL database is ported, in an anonymised format**, to the AEGIS platform, automatically using the AEGIS harvester. This

allows the CSP to perform on a weekly basis a re-classification of individuals to personas, resulting to the application of potential new rules to individuals that shift into new personas, as in principle generic rules are bound to personas.

Those rules, are part of **a backend event detections and rules engine**, that takes as input changes to the values of individuals (or of personas) in real-time (simulated on an hourly basis for our demo) and decides whether certain notifications, prescribed by CSPs should be sent to these specific groups of individuals (or to an individual specifically in the case he is monitored outside the persona, provided he has granted the CSP access to his data). On top of the re-classification of the at-risk individuals into new personas and the identification of shifting between personas through the deviation from the assigned persona acceptable parameter values, the developed event detection mechanism also facilitated the identification of the risk of conditions exacerbations mainly attributed to / caused by environmental and ambient conditions, such as extreme meteorological conditions and/or air quality

5.2.1.1. Test Case 5.1 - Enhanced (at-risk) individuals profile and provision of access to CSPs for personalised notifications

Actors:	(At-risk) individual
Pre-conditions:	Mobile app available
Post-conditions:	1. Enhanced private (at-risk) individual profiles with notification and recommendations enabled.
Normal Flow	1. The individual fills in the additional personal information as needed (for example: health information). 2. The individual provides his/her consent in the system to reveal information to selected CSPs (chosen by the user), to receive the personalised notifications and recommendations. 3. CSPs acknowledge this invitation and get access to data 4. CSPs are able to push personalised notifications
Pass Metrics	1. Enhanced (at-risk) individual profiles 2. CSPs get access to individuals' dashboards 3. Personalised notifications and recommendations are enabled
Fail Metrics	1. (At-risk) Individual is not able to store in additional personal information 2. (At-risk) Individual is not able share his data with CSPs 3. CSPs are not able to view data from individuals.
Notes and Issues:	This scenario has been slightly altered from the initial one planned in D5.2, as now the individual is specifically choosing with which CSPs to share his

	non-anonymised data. Furthermore, extra features have been introduced, to revoke access to such data by individuals.
Execution Results	This test has been completed successfully. Moreover, the revocation of access to individuals' non-anonymised data has been also successfully tested.

5.2.1.2. Test Case 5.2 - Registration of medical rules

Actors:	CSP
Pre-conditions:	1. (At-risk) Individual profiles with personalised notifications and recommendations option enabled exist on the system
Post-conditions:	1. A set of medical rules is linked to the (at-risk) individuals' profile or to a persona
Normal Flow	1. The CSP selects the profile of an (at-risk) individual or a persona 2. The CSP is defining medical rules for this specific profile/persona based on the available data coming from the individual/persona/third party APIs, which are linked to the profile from this point. 3. The CSP defines standardised notification messages for each set of complex rules
Pass Metrics	1. Set of medical rules are linked to the (at-risk) individuals' profile 2. Rules are triggered based on changing data values
Fail Metrics	1. No rules are triggered when value changes are over the set thresholds
Notes and Issues:	This test case has been extended to cover not only rules that are bound to individuals, but also cover persona wide rules
Execution Results	This test has been completed successfully.

5.2.1.3. Test Case 5.3 – Re-Classification of Individuals

Actors:	CSP
Pre-conditions:	1. The trained individual classification model facilitating the clustering of individuals exists in the AEGIS platform and has been tested with the AEC.

	2. A new dataset containing the weekly updates of the measurements of the wearables of the individuals can be uploaded on the AEGIS platform. 3. A job is in place that regularly checks whether a new dataset has been uploaded so as to trigger the re-classification model to run.
Post-conditions:	1. The re-classification model is successfully executed and the at-risk individuals whose data have been uploaded are re-classified into the pre-defined personas.
Normal Flow	1. The CSP selects to upload a new dataset on a private repository on the AEGIS platform because she is suspecting that some of the individuals are having repeated measurements exceeding their "normal" thresholds 2. The dataset is forwarded to the AEGIS Cleaner, which undertakes the handling of outliers in accordance to the medical rules that have already been registered. 3. The AEGIS Cleaner forwards the cleaned dataset to the private repository on the AEGIS platform where it is stored. 4. The re-classification job is executed (on a periodic basis) and identifies that a new dataset containing updated measurements of at-risk individuals has been uploaded on the AEGIS platform. 5. The re-classification job triggers the execution of the re-classification model in order to perform the clustering of the individuals into the pre-defined personas. 6. The re-classification job produces a new dataset holding the associations of the individuals' IDs and the new personas to which they now belong. 7. The new dataset holding the associations is made available to the SHAL web-app in order to be visualised for the CSPs.
Pass Metrics	1. The execution of the model classifies (clusters) the various at-risk individuals into personas.
Fail Metrics	1. The re-classification job fails to be executed. 2. The re-classification job fails to be executed 3. Despite consecutive registered measurements exceeding the thresholds of the persona in which an individual had been originally classified, the re-classification process produces the same results (namely no persona shifting identified by the system)

Notes and Issues	Though the initial test case talked about outlier detection, this essentially means in the SHAL case for persona members to shift to other personas, thus the test case was revised accordingly.
Execution Results	This test has been completed successfully.

5.2.1.4. Test Case 5.4 –Dynamic Dashboard following Algorithm Execution

Actors:	CSP
Pre-conditions:	1. Trained optimised model executed on AEGIS 2. (At-risk) Individual data exist
Post-conditions:	1. Dynamic dashboard containing interactive visualisations
Normal Flow	1. The CSP uploads to the SHAL platform the updated personas 2. The web app automatically queries the members of the new personas to index the new results 3. The results are visualised on the web app in a dashboard containing using the data of the individuals belonging to the personas
Pass Metrics	1. Dynamic dashboard visualising the results
Fail Metrics	1. No stream/close to real-time batches uploaded in the web app 2. No visual graphs showing major persona values
Notes and Issues	This test case has been altered from the original test case in D5.2, as it was obsolete, due to the fact that persona clustering and re-clustering is now happening on the main AEGIS platform and not on the SHAL side
Execution Results	This test has been completed successfully.

5.2.1.5. Test Case 5.5 – Persona and Personalised notifications

Actors:	(At-risk) Individual, Carer
Pre-conditions:	1. Successful realisation of test cases 5.1, 5.2, 5.3, 5.4 and 6.1, 6.2.
Post-conditions:	1. Notifications/recommendations received by (at-risk) individuals and carers

Normal Flow	Automatic flow 1. The change in data values as recorded by the users, are triggering rules which are bound to standardised notifications 2. The (at-risk) individual receives the notification 3. The (in)formal carer also receives the enhanced notification Manual flow 1. The indications identified and visualised on the dashboard point the CSP to author a notification (or recommendation and send it to the persona/individual 2. The (at-risk) individual receives the notification or recommendation 3. The (in)formal carer also receives the notification/recommendation
Pass Metrics	Automatic flow 1. Personalised notification is received by the (at-risk) individual automatically upon data value changes 2. Similar notification is received by the carer Manual Flow 1. Personalised notification is received by the (at-risk) individual automatically upon CSPs command 2. Similar notification is received by the carer
Fail Metrics	1. (At-risk) Individuals and/or carers do not receive personalised notifications
Notes and Issues	This test case has been extended, to include both automatic notifications, as well as manual notifications and recommendations
Execution Results	This test has been completed successfully, also in conjunction with Scenario 6 test cases.

5.2.2. Scenario 6 - Smart home automation services

Scenario 6 describes the last step towards the fulfilment of the smart home service offering, and is the respective part of the advanced-level demonstrator. The CSP envisions the complete smart home app as an HVAC and lighting automation service, in addition to the monitoring and notification functionalities, being part of the holistic treatment offering. The functionalities implemented, as seen by the respective end users are the following:

- CSP: A recommendation system, developed by the CSP's data scientist is integrated with the profiling and notification service, running on the backbone server. Upon

generation of an alert, recommendations, if the form of suitable control actions (optimal set point, heating/cooling mode, fan speed, lighting dimming level) are estimated, so as to guarantee restoration of indoor conditions within acceptable limits.

- At-risk individual/Carer: The suggested control signals values are communicated to the at-risk Individual and/or informal carer, extending the alert message. The user can then accept or deny the suggested change. If accepted, a control signal is sent to the home gateway to schedule the changes in the devices' operation.

5.2.2.1. Test Case 6.1 – Smart home automation recommendation system

The smart home control recommender system was developed for the SHAL demonstrator and deployed as a service in the SHAL server. The service monitors and listens for alerts generated by the smart home gateway. When the comfort boundaries are violated, the system performs a simulation of the indoor conditions, in order to identify the optimal control signals that can alleviate the issue. An example of this optimization process can be seen in Figure 5-1. When the temperature drops below the lower acceptable limit, a warning is generated in the gateway and sent to the backbone server, which is subsequently advanced to the mobile app of the user. At the same time, the recommender system solves the thermal modelling problem to forecast the temperature path based on current conditions, HVAC status and external environmental conditions. In case it recognizes the need for action, it computes the required control signals (for example as seen in the figure). These are bundled along with the alert message and passed on to the individual at risk or their carer.

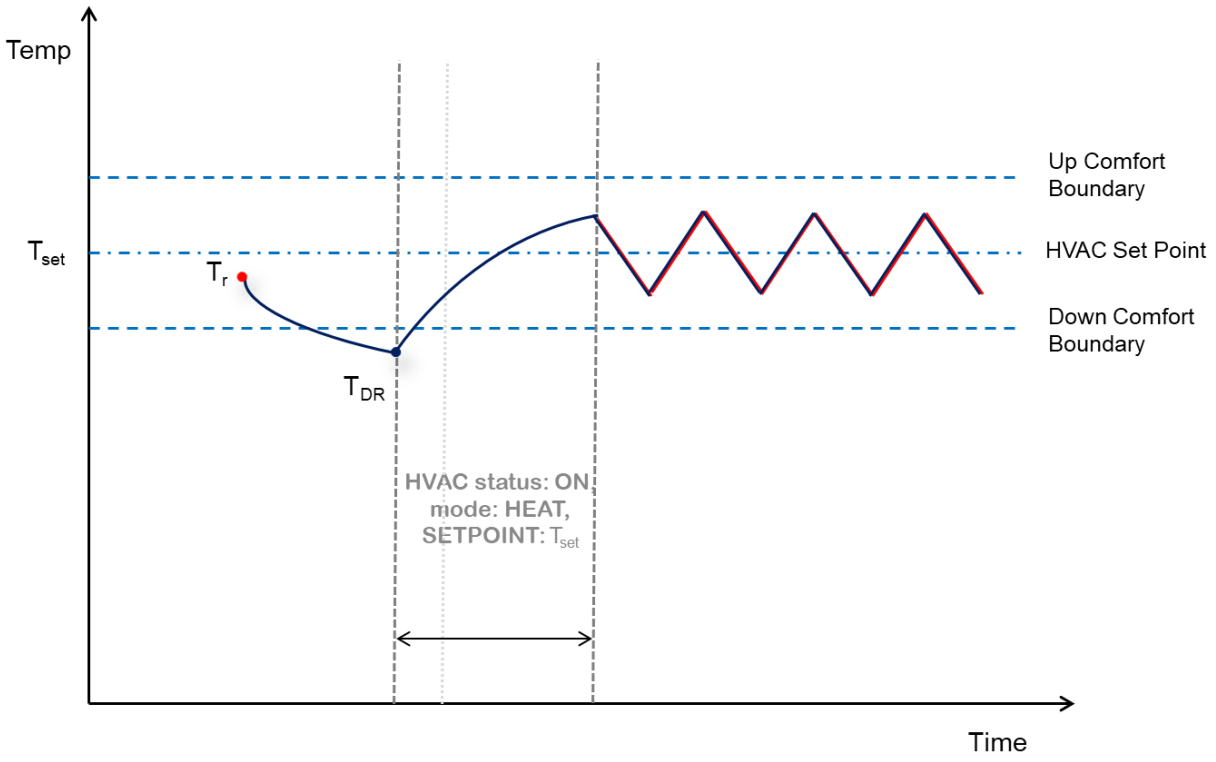


Figure 5-1. Example computation of recommended HVAC control actions in case of adverse indoor temperature conditions.

The warning message structure is extended as follows:

```
{
	"sender": "smart_home",
	"key": "home_identifier",
	"title": "Smart Home Notification",
	"message": "…",
	"recommended_action" : {
		"HVAC_status": "ON",
		"HVAC_mode": "HEAT",
		"HVAC_fanspeed": "AUTO",
		"HVAC_setpoint": 25
	}
}
```

Actors:	CSP
Pre-conditions:	1. Successful realization of test cases 2.1 and 2.2. 2. Successful realization of test case 4.1.
Post-conditions:	1. Smart home notification message bodies are extended to include recommended actions, as solutions to the identified issues.
Normal Flow	1. The data scientist develops the recommendation system, to complement the profiling and notification service. 2. The new system is added to the web service of SHAL. 3. When alerts are identified, the recommendation system compares current conditions to the closest comfortable ones, and computes the required status (On/Off), mode(Heating/Cooling/Ventilation), Fan speed (1/2/3), set point (in degrees Celsius) and dimming level (percentage) to alleviate the issue. 4. The aforementioned variables are integrated to the notification message sent to the mobile app.
Pass Metrics	1. Control recommendations achieve the desired change in indoor conditions, if they timely adopted.
Fail Metrics	1. Control recommendations are not appropriately estimated. 2. Communication issues between the server and the gateway.
Notes and Issues:	-

Execution Results	The recommender system was developed by the project partners. Based on this, a daemon recommendation service was activated, which monitors the alerts generated by the smart home gateway (see test case 4.2), and generates the required control signals. The test case was successfully completed.

5.2.2.2. Test Case 6.2 - Smart home automation implementation

The mobile user interface was enhanced with functionality allowing the user to inform the automation service that he accepts the control actions suggested in a warning message generated as described in Test Case 6.1.

As an additional example of the automation service, data acquired from a validation test at Konkat premises are shown in Figure 5-2. Temperature limits were set between 21 and 23 degrees Celsius. The power line indicates when the HVAC is ON and delivering heating energy to the room. Within 14:00 and 15:00 we can notice that, first, the temperature is going above the accepted threshold. The automation service sends a status OFF signal to the HVAC system. When, on the other hand, the temperature goes below 21, the HVAC is automatically turned ON and maintains the temperature at acceptable for the remaining of the working day.

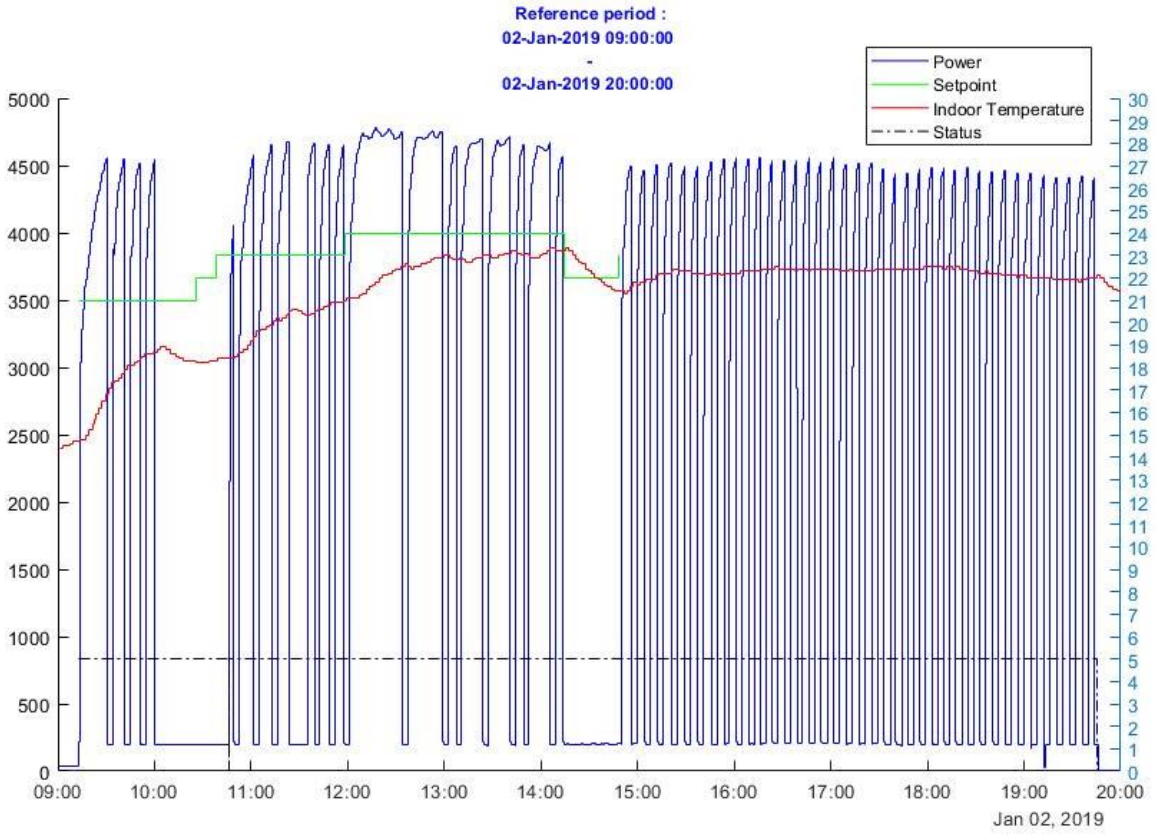


Figure 5-2. Temperature, HVAC power and setpoint Data from test automation event at Konkat premises.

Actors:	(At-risk) individual, Carer
Pre-conditions:	1. Successful realization of test cases 2.1 and 4.1. 2. Successful realization of test case 6.1.
Post-conditions:	1. The individual, directly or through the informal carer, is informed about the optimal course of action, and if further able to automate, through the application's UI, the implementation of the control signals.
Normal Flow	1. Upon arrival of a notification, the suggested actions are shown as part of the message. 2. Additionally, an accept changes button is included in the message shown to the individual. 3. If pressed, the control signal is sent to the actuator to automatically modify the its operational status.
Pass Metrics	1. End-users frequently opt to accept the recommended control actions.
Fail Metrics	1. Control recommendations, if adopted, do not have the desired effect. 2. End-users forgo with the adoption of the automation recommendations. 3. Communication issues between the server and the gateway.
Notes and Issues:	-
Execution Results	The alert messaging service from test case 4.2 was extended, so that the user is not only informed about the identification of adverse indoor conditions, but also about the controls required to correct the situation. Additionally, the user, through the mobile UI is given the option to notify the automation service that he accepts the control actions. The automation service propagates the modification signal to the smart home gateway, which automatically performs the required control actions. The test case was successfully completed.

5.3. Demonstrator Evaluation

5.3.1. Quantitative Evaluation

The following table summarizes the quantitative evaluation for the third (advanced) version of the SHAL demonstrator.

Sub-characteristics	KPIs	Calculation Type	Mandatory / Optional	Means to Verify	Value
Advanced demonstrator functional completeness	Portion of successfully completed advanced stage Test Cases	[Successfully Completed test cases] / [No of tested cases] * 100%	M	Access realization of respective test cases through the defined pass metrics and calculate KPI e according to the calculation type	100%
Comfort satisfaction	Average comfort satisfaction rate	[Sum of Comfort probability as learnt by the profiling model] / No of learnt profiles	O	Quantified comfort of users based on control actions.	3
Number of Medical Rules/ Smart Home Condition Boundaries	Medical rules in the web app	No. of medical Rules	M	Count of medical rules in the web app	52
Number of Notifications automatically linked to medical conditions	Number of Notifications / Recommendations attached to outlier	No. of notifications defined	O	Count of notifications defined	52 (one for each defined medical rule)

No of active users (volunteers)[4]	Active Users	No of users with data changes	O	No of users whose data are updated frequently	12

Table 5-2: SHAL demonstrator quantitative evaluation

5.3.2. Qualitative Evaluation

For the qualitative evaluation of the third and final version of the demonstrator an online focus group (in the sense of a webinar followed by a Q&A session) was conducted in May 2019[5]. The focus group consisted of the 37 volunteer participants in the demonstrators, as well as other interested stakeholders, with some of them being experts from the healthcare sector. The scope of the focus group was to present the final version of the demonstrator to the participants and collect their feedback and evaluation. The pillars of this external evaluation was that the participants are experienced users of similar wellbeing/healthcare services, while also having extended knowledge of the available healthcare services, and since they were not involved in the development of the demonstrator they will be able to provide valuable and unbiased feedback to the demonstrator team.

The session begun with a demonstration of the developed demonstrator and all of its core features to the participants. At first, an overview of the scope of the AEGIS project was presented, moving on with focusing on the goals of this demonstrator, the approach followed and the artefacts developed in order to achieve the demonstrator's goals. Following the overview presentation, both the web application and the developed mobile applications (for iOS and Android) has been demonstrated. For each application, a walkthrough of the functionalities was presented, as well as details on the background process that are executed. Additionally, the development team of the application presented how the AEGIS platform is exploited in order to produce and utilise the at-risk individual classification model which is one of the core parts of the SHAL demonstrator.

The participants were very interested on the approach followed in particular to classification model that was designed and its interactions with the underlaying rule engine. They acknowledge that the approach of personas, the classification of the (at-risk) individuals on these personas and the ability of a CSP to define a set of medical rules on each persona or (at-risk) individual based on their experience and expertise is very useful. Additionally, they acknowledged the added value from the utilisation of the wearable devices, as well as the smart home devices, in the near real-time monitoring and analysis of an individual's well-being and home conditions. They also noted that the integration of these devices can be quite challenging due to the lack of common specifications and uniformity, however the benefits from the achievement of this demonstrator to collect and aggregate input from these different devices is clearly noticed. The discussion that was performed with the participants led to some useful

[4] It is noted that no real-users have been foreseen for the implementation of the SHAL in the DoA, however 12 volunteers have been selected to test certain aspects of the system and its usability.

[5] A recorded session of the presentation part of the focus group/webinar is stored in the public AEGIS website ad YouTube channel.

insights and ideas on how to enhance the demonstrator with additional features and functionalities, such as the extensibility and configurability of the at-risk individual classification model based on the needs of the CSP, the extensibility of the data integration mechanism of the demonstrator to support additional wearable or IoT devices upon needs. Last but not least, the participants noted their interest in the existence of a platform as AEGIS, as in their own institutions there is no dedicated infrastructure that could help to perform such analyses, nor are they willing to trust third-party cloud based big data services (like amazon) to upload data of patients

As it was mentioned before, the purpose of this focus group was to collect valuable feedback on the developed demonstrator and ask for recommendations for the further improvement of the demonstrator with regards to usefulness, ease-of-use and the user experience. For this purpose, the participants were asked after the demonstration to provide their input for these topics and their experienced opinion and thoughts is presented in the following table.

Perceived Usefulness Do you believe that the developed demonstrator, utilizing the AEGIS platform offer specific advantages?	• The participants acknowledged the added value of the developed demonstrator. They all agreed that the collection and aggregation of the (at-risk) individual's near real time information from various sources is the cornerstone for any monitoring and recommender system. • The easily tuneable recommender system is considered a strong advantage of the demonstrator. • The offered level of customisation for the medical rules on the personas or the individual is considered very useful and it was well received by the participants. • The personalized notifications with added functionalities of automation increase the level of end user engagement, whilst not reported as intrusive. • The privacy level offered in the analysis of fata (due to the ability to host AEGIS in-premise and retain data in-premise) is very important.
Perceived Ease-of-Use What aspects of the presented demonstrator did you find easy to use /difficult to use and why?	• Both the web application and the mobile applications offer a very user friendly and easy to use user interface. All the presented stakeholders of the demonstrator (at-risk individuals, informal carers and CSPs) are offered with a set of functionalities that are straightforward and easy to learn. • Most of the functionalities offered by the demonstrator are easily customised according to the needs of the stakeholder.

	• The notification mechanism can be easily configured and tailored to the needs of the CSP. • The users can be easily navigated to the various services of the application and find the request information without any unnecessary steps.
Perceived User Experience Evaluate the demonstrator's applications. Do you foresee/expect any potential issues for end-users when using the apps and services?	• The user interfaces are providing a smooth and unified experience to the users. All screens provide the appropriate information to the users and navigation between the different service is easy. • The required configuration for the non-expert users is minimal and easy to perform. • The personalised notifications are providing an enhanced user experience to the users. • All functionalities of the demonstrator despite the level of complexity at the background is running seamlessly and with great performance. • Need for advanced automated updating of information (not possible at current mobile OS) would be helpful.

Table 5-3: Qualitative evaluation of the SHAL advanced stage demonstrator.

5.4. Challenges and recommendations

The participants of the performed focus group provided a series of challenges and recommendations for the SHAL demonstrator. However, as this is the final version of the demonstrator and at the same time the project is completed, most of them will be considered in the later exploitation phase. The following list include the identified challenges and proposed recommendation from the participants of the conducted focus group:

- The continuous data retrieval, processing and analysis pipeline from data sources such as the wearables and smart home devices is challenging as it depends on various parameters outside of the demonstrator's application such as the permission of the OS to keep such calls in the background and revive them constantly, the availability of network or active connection of these devices in order to push their data to the demonstrator's application.
- The extensibility of the data retrieval, processing and analysis pipeline with new additional devices can be rather challenging due to the lack of standards and formats utilised by the companies offering these devices.
- The import of the anonymised SHAL database in the AEGIS platform can be challenging if the size of the database grows and non-efficient methods are exploited. However, as most organisations are interested for an in-premise solution, this can be easily overcome.
- The data protection and anonymisation of the collected information must be always at the finest level due to the nature of the collected information.

- The inclusion of a “right to be forgotten” feature in the demonstrator application shall be properly handled within the application.

6. AEGIS INSURANCE DEMONSTRATOR

6.1. Pilot overview

The third version of the pilot scenario is focused on the business needs that could arise during the seasonal planning of the company and the AEGIS platform's analytic tools are the means for:

- Setting ad-hoc marketing campaigns and specific offers to selected customers;
- Improving the presence of the HDI commercial agents in the territory;
- Evaluating the company trends, for instance the type of the policies sold in relation to the events that mainly hit the area.

Figure 6-1: Main features of the version 3 of the Insurance Demonstrator

To test and evaluate the "Business plan and marketing strategy" scenario, the historical in-house datasets (from 2015 to 2019) have been considered, as well as open data mainly gained from the following Italian institutions:

- ISTAT (*Istituto nazionale di statistica – National Statistic Institute*),
- ISPRA (*Istituto Superiore per la Protezione e la Ricerca Ambientale - Italian Institute for Environmental Protection and Research*),
- INGV (*Istituto Nazionale di Geofisica e Vulcanologia – National Institute of Geophysics and Volcanology*).

It is important to remark that:

- The in-house data used for the scenario evaluation are synthetic data that faithfully replicate the data stored in the HDI databases. The reason for this decision will be better explained in Section 6.3.1.
  Even if the data used for the analysis are synthetic, in order to simulate the reality as much as possible, the synthetic data have been anonymized for what it concerns the personal data, making them not linkable with a person (in a real scenario). The anonymization has been performed with the Anonymizer, the offline tool provided by a project partner and installed in a local HDI environment.

- The selected are for the scenario 3 is, as for the first two scenarios also, the Lazio region, for which the synthetic data were produced.

The table below shows the actors involved in the third scenario execution.

Actor	Activities and responsibilities
Management Department Team (also named as Experts)	The team is involved in: • AEGIS requirements identification and description; • Significant AEGIS data sources detection; • Evaluation of the benefits achieved using the AEGIS outputs/ evaluation of the legibility of the AEGIS reports.
Developers (both internal and external)	They are involved in the: • Definition of the service workflow on the AEGIS platform for the insurance demonstrator; • 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 analysis is expected to be more accurate and complete in this final scenario. 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's response time acceptable? Does the platform really provide a set of innovative tools to ease the data analysis?
Agents	They are the people in direct contact with the customers, hence they have followed the guidelines provided by the Experts and actuate them contacting the HDI customers.

Table 6-1: AEGIS Insurance Demonstrator Advanced Demonstrator actors and related activities and responsibilities

Finally the HDI Web App has been enhanced in order to support the workflow related to the third version of the scenario.

The analysis of historical weather data and eventually their 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 for tuning the models.

For the Management Department team, the planning of the marketing campaign and the business plan are high effort activities. A tool that helps in such fundamental and critical activities would ease and improve the company results. Hence, through the AEGIS analytics tools 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. In that view, the analysis of historical weather data and their correlation with the seasonal forecasts and the HDI customer data, both actual and historical, represents a step forward in the business model creation. With such technologies, AEGIS platform helps to adapt the HDI marketing strategy and policy pricing with decision support models.

For completeness reasons, the following table shows the main functionalities that are required for the development of the three versions of the demonstrator.

ID	Scenario	Functionalities	Demonstrator Version
1	Personalised early warning services for asset protection	• Event Detection tool configuration and training • Event Detection notification • Create Project • Uploading in-house dataset • Identification of the possibly involved customers • Priority list (report) sharing and Personalised offer	Early
2	Financial impact, customer support and services	Additional functionalities required are: • Mobile App Geolocation • Event Detection tool configuration and training (version 2) • Identification of the possibly involved customers (version 2) • Evaluation of the financial impact • Personalised offers • Report sharing and customer support (push notifications on the Mobile App)	Medium

3	Marketing strategy and pricing support services	Additional functionalities required are: • Business analysis request (HDI Web App workflow) • Algorithm Execution Container • Report visualisation and sharing (HDI Web App workflow)	Advanced

Table 6-2: Insurance demonstrator scenarios

6.2. Scenario execution

The present section reviews the achievements of the third scenario, starting from the description of the test cases: a first definition of the test cases has been provided in D5.2 (paragraph 5.2.1, 5.2.2 and 5.2.3).

The third scenario of the Insurance Demonstrator is highly business oriented and includes all the analysis performed with the AEGIS platform for strategic reasons. The AEGIS services would constitute a key for the development of an accurate and successful business plan, ad-hoc marketing campaigns and specific offers to selected customers through the analysis of the risks of selected areas, the pricing analysis and the analysis of the trend of the Company.

The analysis performed will involve the type of the policies sold in relation with the territory and previous marketing campaigns. Open Institutional location-based stats will be exploited and correlated with both actual and historical in-house datasets. The main features of the third scenario are shown in Figure 6-2.

Figure 6-2: Insurance Demonstrator, Scenario 3 Overview

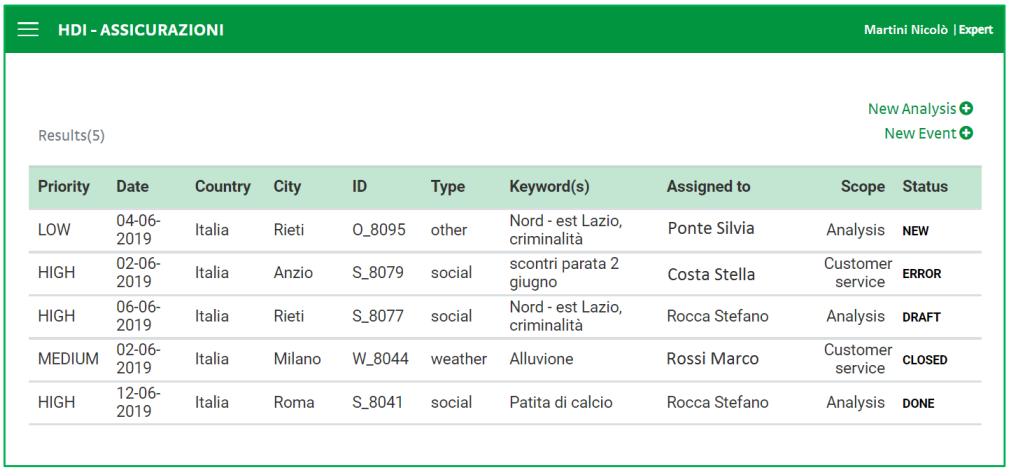
Hereinafter, there will be the description of the functionalities required named as test cases. From what was stated in D5.2 some changes have been done in the test cases description in order to adhere to the work performed for the scenario 3 execution.

It is important to point out that from Test Case 5 to Test Case 7 we have tried to describe different kind of "Business Analysis Requests", grouping the action performed on the Notebook involved: Test Case 5 describes the actions implemented with the Query Builder, Test Case 6 those implemented with the Algorithm Execution Container and Test Case 7 those implemented with the Visualiser.

6.2.1. Test Case 1 for "Business Analysis request"

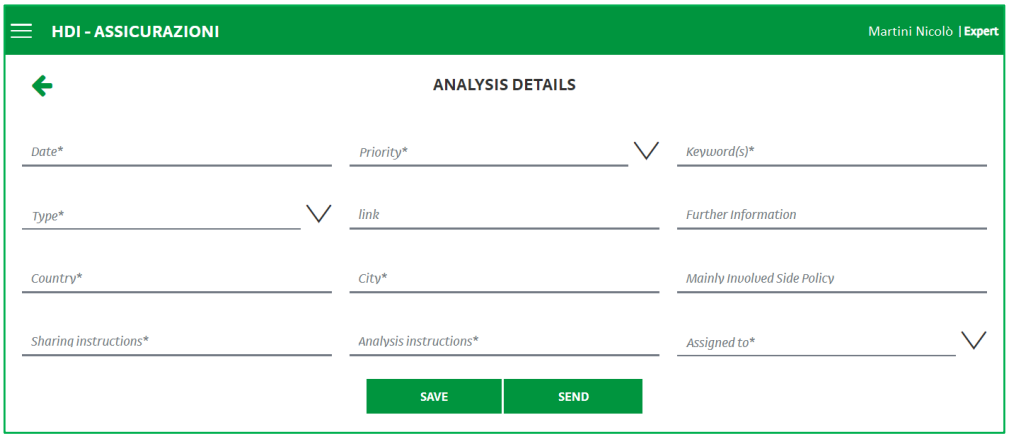
Actors:	HDI Developers, HDI Experts, HDI Data Scientists
Pre-conditions:	1. The Developer sets on the Web App a workflow to enable the request of a Business request analysis.
Post-conditions:	1. The Data Scientist has all the information needed to perform the Business Analysis.
Normal Flow	1. The Expert identifies geological, social or weather events of interest for business purposes, and sends a request of analysis to the Data Scientist. 2. The request is made by the Expert filling a pre-defined form where the parameters that have to be taken into account during the analysis are specified. 3. The Data Scientist receives an email with the details of the request and a notification on the HDI Web App.
Pass Metrics	1. The Data Scientist has all the information needed to perform the Business Analysis.
Fail Metrics	1. The Data Scientist does not receive the request. 2. The parameters of the analysis are not correctly defined.
Notes and Issues:	-
Execution Results	No issues have been found for the execution of the test case. The workflow created on the Web App for the "New (business) analysis" is almost the same that has been created for the previous scenarios. For the execution of the third scenario the "New Analysis" button (on the top-right of the screen below) starts the request. To provide an overview of the requests in advance and of their scope, a new 'Scope' column has been added in the landing page

overview table.

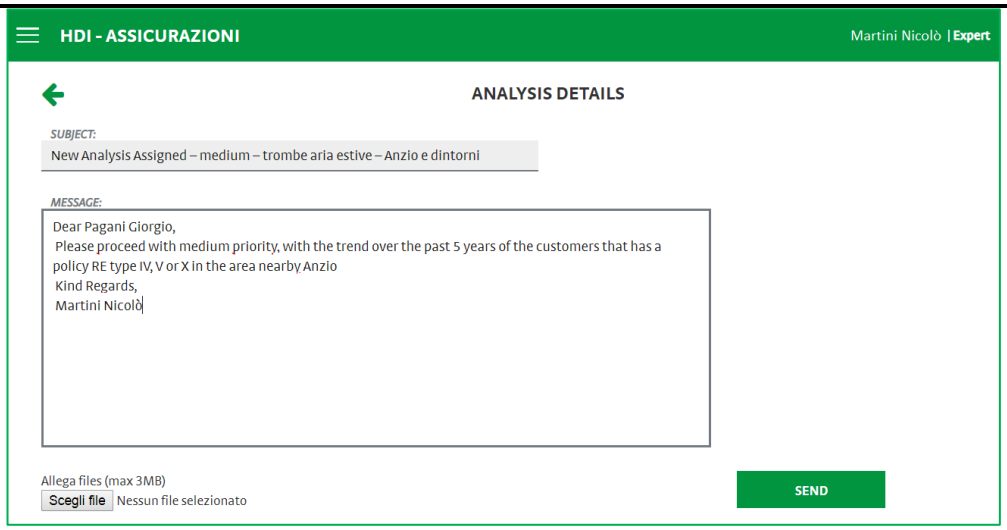


Priority	Date	Country	City	ID	Type	Keyword(s)	Assigned to	Scope	Status
LOW	04-06-2019	Italia	Rieti	O_8095	other	Nord - est Lazio, criminalità	Ponte Silvia	Analysis	NEW
HIGH	02-06-2019	Italia	Anzio	S_8079	social	scontri parata 2 giugno	Costa Stella	Customer service	ERROR
HIGH	06-06-2019	Italia	Rieti	S_8077	social	Nord - est Lazio, criminalità	Rocca Stefano	Analysis	DRAFT
MEDIUM	02-06-2019	Italia	Milano	W_8044	weather	Alluvione	Rossi Marco	Customer service	CLOSED
HIGH	12-06-2019	Italia	Roma	S_8041	social	Patita di calcio	Rocca Stefano	Analysis	DONE

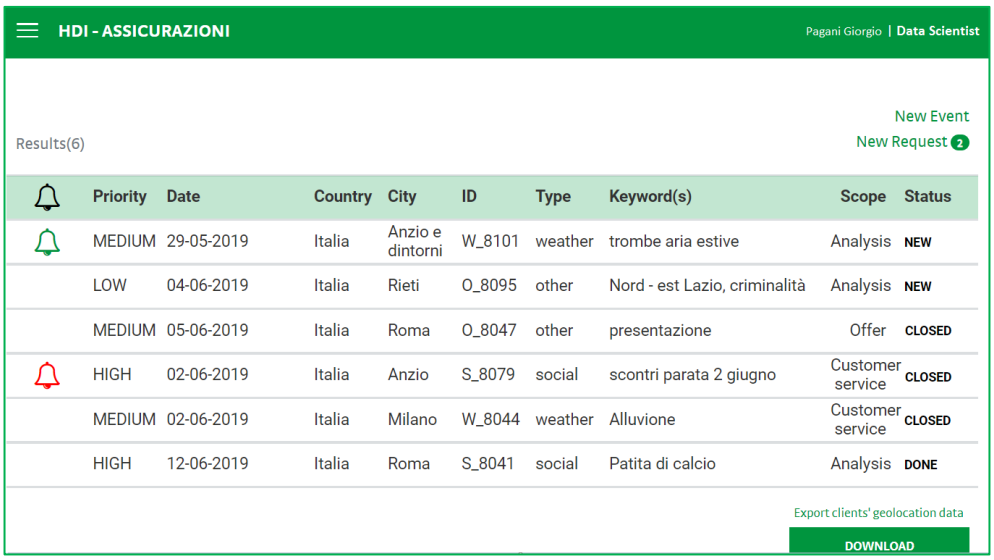
The figure below shows the form that has to be filled by the HDI Expert to open a new request analysis. The fields have been defined in cooperation with the HDI Experts that tested the solution.



When the HDI Expert sends the request, the page shown in the figure below opens: a pre-defined (but editable) email can be written to inform the Data Scientist, and a file, for instance a previous market analysis or some data available only by the Expert, can be attached.



The following figure shows the landing page of the Data Scientist: a new analysis request is highlighted by the green bell icon.



6.2.2. Test Case 2 for "Create Project" and Test Case 3 for "Uploading anonymised datasets"

These test cases are the same as reported in previous deliverables, and their achievement is the basis of each analysis on the AEGIS platform, since any kind of analysis is dependent on the creation of a project (new or already existing). Every time a new project is created, it is necessary to upload the needed datasets. Please note that, these two steps could be skipped if a project with the datasets of interest has already been placed in AEGIS.

Briefly:

1. The Data Scientist when logged in with his/her AEGIS account creates a "*BusinessAnalysis*" project.

2. The Data Scientist through the offline Anonymiser provided by the AEGIS platform and installed on his/her computer, anonymise any sensitive in-house data. This step is required only if the customers data are sensitive: some analysis may start from aggregated data, in this case the anonymization might not be needed.
   Figure 6-3 reports the configuration page of the Anonymiser: since the in-house datasets have always the same structure, the same configuration, as defined before, has been used for all the data/scenarios.

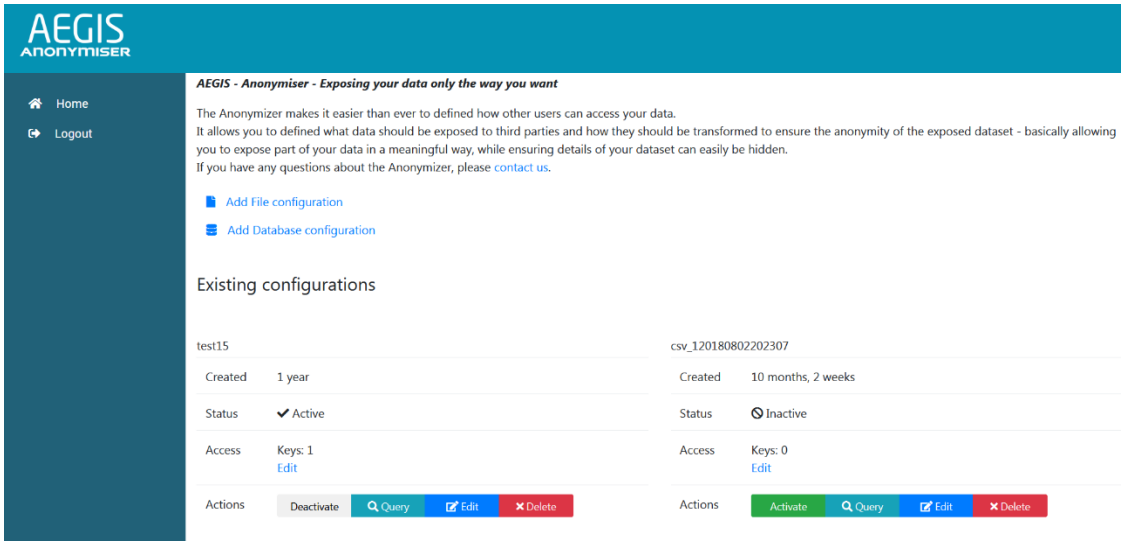


Figure 6-3: Anonymiser configuration screen

3. The in-house datasets of interest (.csv files) are uploaded and associated with the "*BusinessAnalysis*" project.

It is important to mention that following the precise rules disposed by the Consortium's Ethical Advisory Boards, while treating in-house datasets the principle of minimization has been followed, although the data were synthetic (and anonymized), and were bounded by the Data Scientist account credentials on the AEGIS platform.

6.2.3. Test Case 4 for "Business Analysis – open datasets search"

Actors:	HDI Data Scientists
Pre-conditions:	1. The Data Scientist has all the information needed to perform the Business Analysis and, following the instructions of the Expert, creates a new project called "BusinessAnalysis". 2. The in-house datasets of interest (both of the actual portfolio data and the historical portfolio data from 2015) are uploaded and associated with the "BusinessAnalysis" project.
Post-conditions:	1. The Data Scientist has all the required data (both internal and external) to perform his/her analysis.

Normal Flow	1. The Data Scientist through the Search of the AEGIS platform accesses open data that were previously uploaded on the platform. Depending on the request he/she may find and add to the current project flood and landslide risk-related data, crime related data, seismicity data, all referred to the Italian territory. 2. The Data Scientist sends a 'Join request' to ask the data owner to access the dataset.
Pass Metrics	1. The Search identifies the data needed. 2. The Data Scientist accesses the open datasets available on the platform and associates them with the "BusinessAnalysis" project.
Fail Metrics	1. The Data Scientist cannot access the required datasets, the needed files are not available (searchable) on the platform, or the Search does not detect them.
Notes and Issues:	-
Execution Results	No issue has been encountered while executing the test case. The open datasets have been uploaded on the platform as searchable. The Search detected them and the 'Join request' succedeed. The following figures illustrate an example of search and of request to join a project.

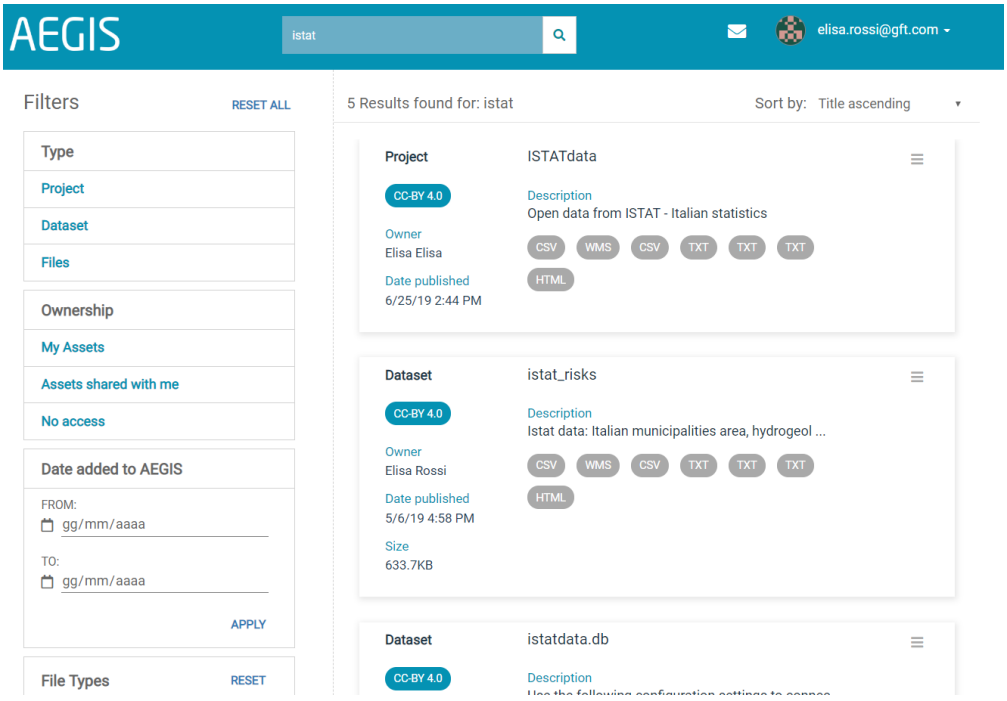


Figure 6-4: AEGIS platform - search page

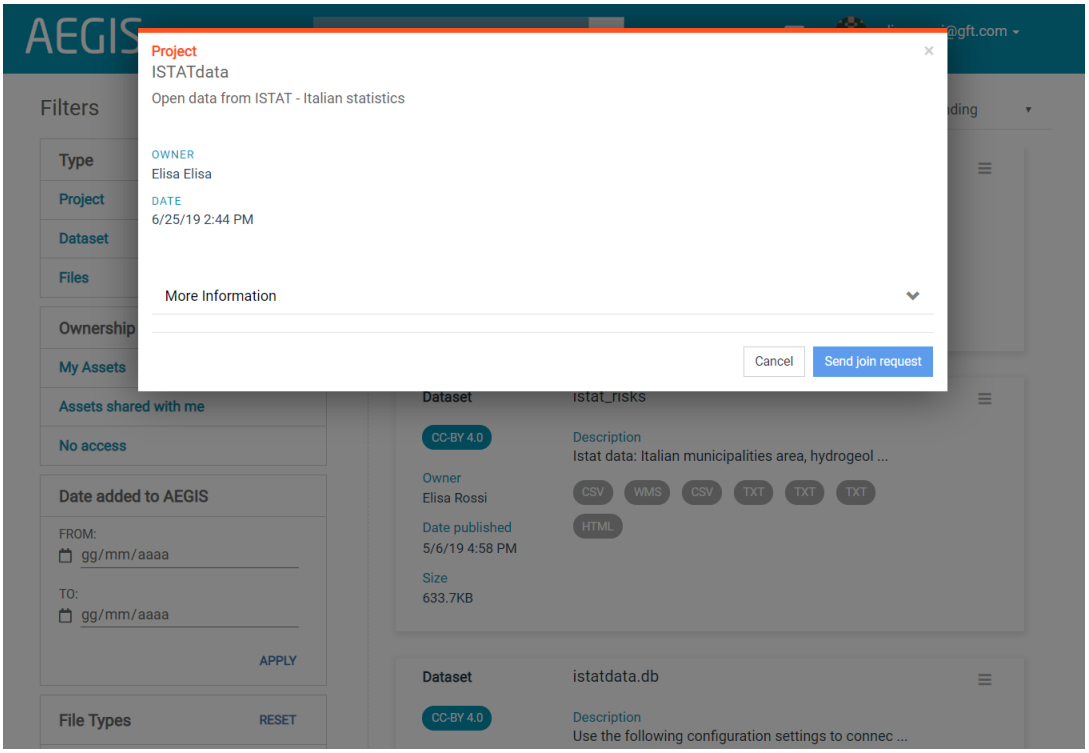
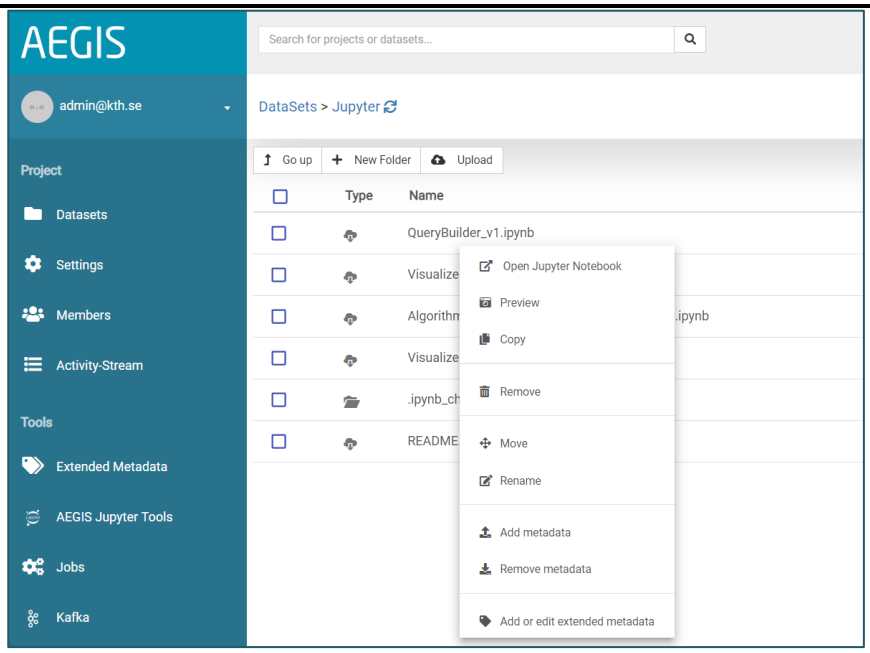


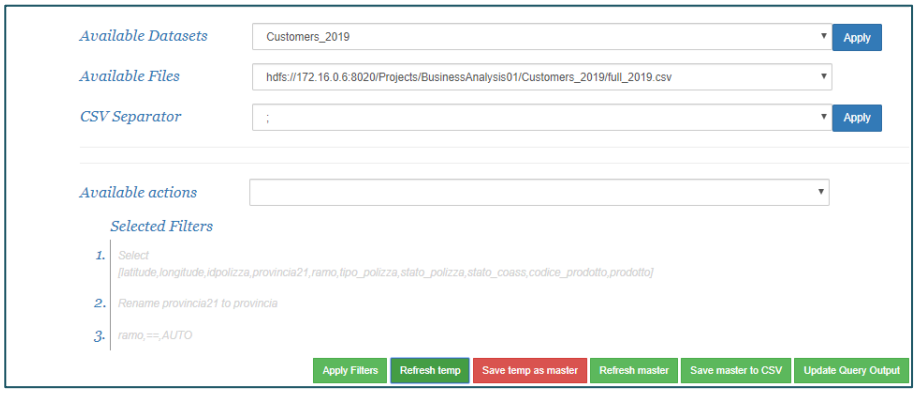
Figure 6-5: AEGIS platform - request to join a project

6.2.4. Test Case 5 for "Data preparation with Query Builder"

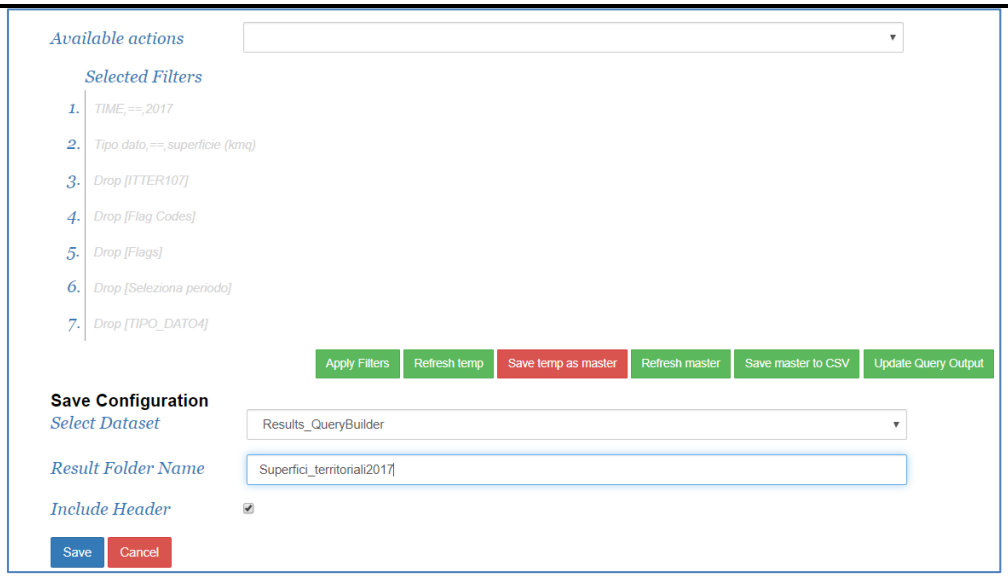
Actors:	HDI Data Scientists
Pre-conditions:	1. The Data Scientist has all the datasets (both internal and open) needed to perform the requested analysis uploaded on "BusinessAnalysis". 2. The three Jupyter notebooks are available on the platform and added by default when the new project was created.
Post-conditions:	1. The datasets are ready for further processing with the Algorithm Execution Container. 2. The datasets are ready for further processing with the Visualiser. 3. The datasets are saved in the *Query_Builder_results* folder within the "BusinessAnalysis" project.
Normal Flow	1. Within the Jupyter default dataset, the Data Scientist right-clicking the *QueryBuilder_v1.ipynb* notebook opens a menu that allows him/her to "Open the Jupyter notebook" directly as show in the figure below:



2. To prepare the data for marketing strategies and to analyse the trend of the company over the years, the Data Scientist through the Query Builder correlates the in-house datasets of each of the considered years (2015 to 2019) in order to have one file with all the information needed for further processing. Moreover, the Query Builder is used also for filtering the datasets gaining for instance, the customers of a specific city or the customers that have subscribed a specific policy. An example of Query Builder usage for the third scenario is shown below.



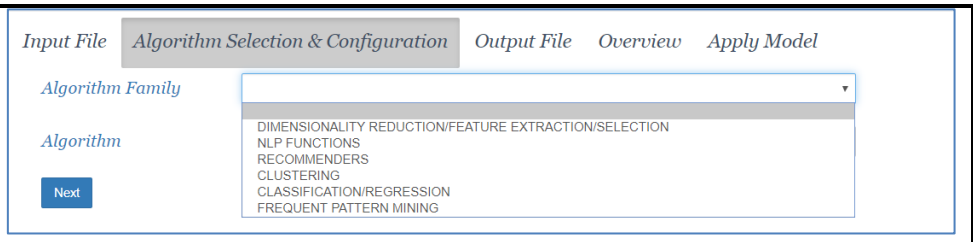
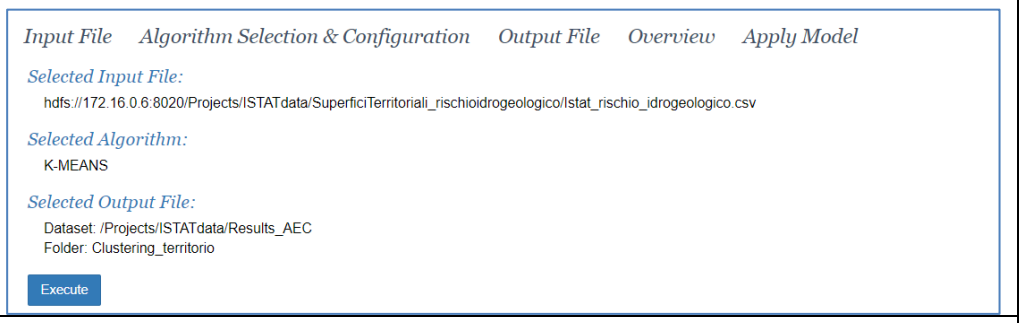
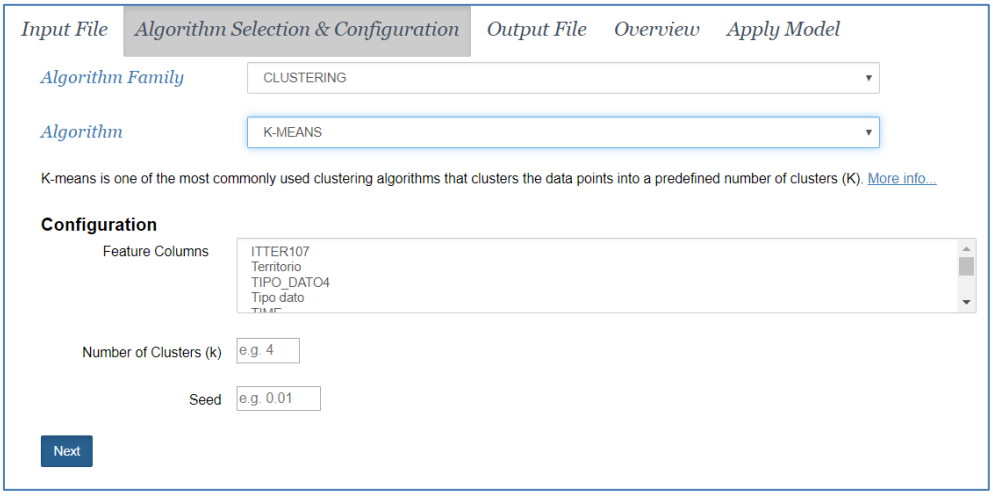
3. Depending on the request received, the file could be enriched with the information of external sources (i.e., AIA**, BDS**, CERVED**, CCI**) as described also for the first scenario.
4. To allow the creation of risk-related maps, some actions are needed in order to make the open ISTAT data compliant with the Visualiser. The data have to be normalised and with the Query Builder some mathematical operations are applied. An example is provided below.

	
Pass Metrics	1. The resultant files contain the required information in a format compliant with the Visualiser/ Algorithm Execution Container requirements. 2. The resultant files are correctly saved in the *Query_Builder_results* folder.
Fail Metrics	1. The steps to be performed are not executed in the correct order leading to a loss of data, making further analysis impossible. The pre-processing needs to be re-executed. 2. The resultant file is not saved in the correct folder.
Notes and Issues:	** Repositories that the Italian insurance companies have to feed and may consult. They contain data related to: BDS – antifraud and car insurance repository AIA – integrated antifraud repository CERVED – (for legal entities) payment habits database CCI - database of accident prevention
Execution Results	The right-click menu for the notebooks has eased the general workflow of a Data Scientist within the AEGIS platform. The default notebook supported all the actions needed for the data preparation, nevertheless, to speed some steps that are common for many business requests, the default Query Builder notebook has been customised in order to merge with one click the files with the customers' details. In particular, the *collect_data_hdi()* and the *merge_customers_over_years()* functions have been defined in order to get the full information from the different in-house files, and to have an overview of the policy held by the customers over the years.

	A valuable point is that, during the execution of the test case, the Data Scientist could monitor systematically the success of the actions applied with the Query Builder "*Temp dataset preview*", decreasing the risk of errors while preparing the data for further processing. An example is illustrated in the figure below. **Temp Dataset Preview (first 40 rows)** Hide Prompts ☐ Hide Code ☑ Hide Outputs ☐ +----------+----------+----------+---------+----+-----------+--------------+----------+ |latitude |longitude |idpolizza |provincia|ramo|tipo_polizza|codice_prodotto|prodotto +----------+----------+----------+---------+----+-----------+--------------+----------+ |41.7407071|12.3582111|386454731 |RI |AUTO|INDIVIDUALE |99287 |99287-INCENDIO MUTUI TRASCODIFICA |41.4736818|12.6099297|31243502598|LT |AUTO|INDIVIDUALE |99222 |99222-GLOBALE DANNI TRASCODIFICA |41.5688978|12.5252473|46377224668|LT |AUTO|INDIVIDUALE |536 |536-LEASING BENI STRUMENTALI |41.5696937|12.5244982|1521259616 |RM |AUTO|INDIVIDUALE |536 |536-LEASING BENI STRUMENTALI |41.5879888|12.4996716|25807035727|RM |AUTO|INDIVIDUALE |329 |329-C.A.R. MERLONI |41.6088529|12.4754596|31071700664|RM |AUTO|INDIVIDUALE |532 |532-INFORTUNI FAMIGLIA NEW |41.654454 |12.7734086|67446322107|RM |AUTO|INDIVIDUALE |99299 |99299-LION BROKER TRASCODIFICA |41.6564323|12.4930767|71052694632|RI |AUTO|INDIVIDUALE |541 |541-#AUTO |41.6650469|12.5002347|96831901115|LT |AUTO|INDIVIDUALE |532 |532-INFORTUNI FAMIGLIA NEW |41.6696156|12.4351578|90880627233|RM |AUTO|INDIVIDUALE |99299 |99299-LION BROKER TRASCODIFICA |41.6855999|12.470814 |88337034604|RI |AUTO|INDIVIDUALE |99222 |99222-GLOBALE DANNI TRASCODIFICA

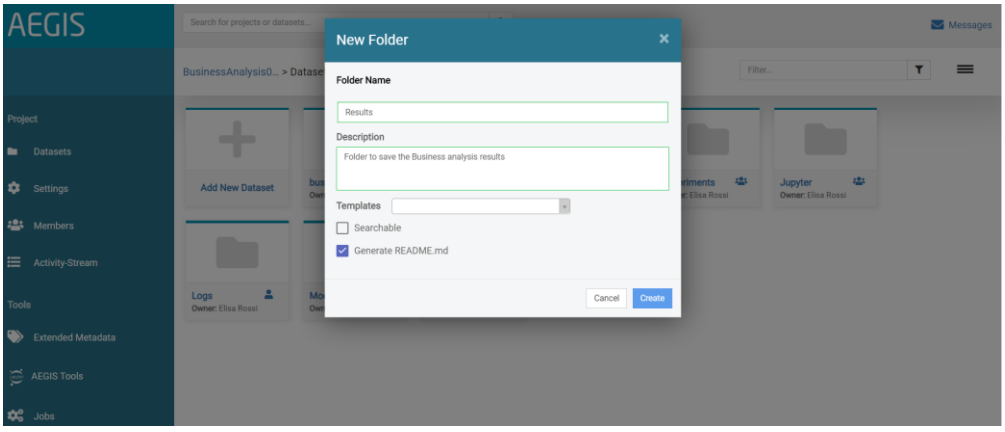
6.2.5. Test Case 6 for "Data analysis with Algorithm Execution Container"

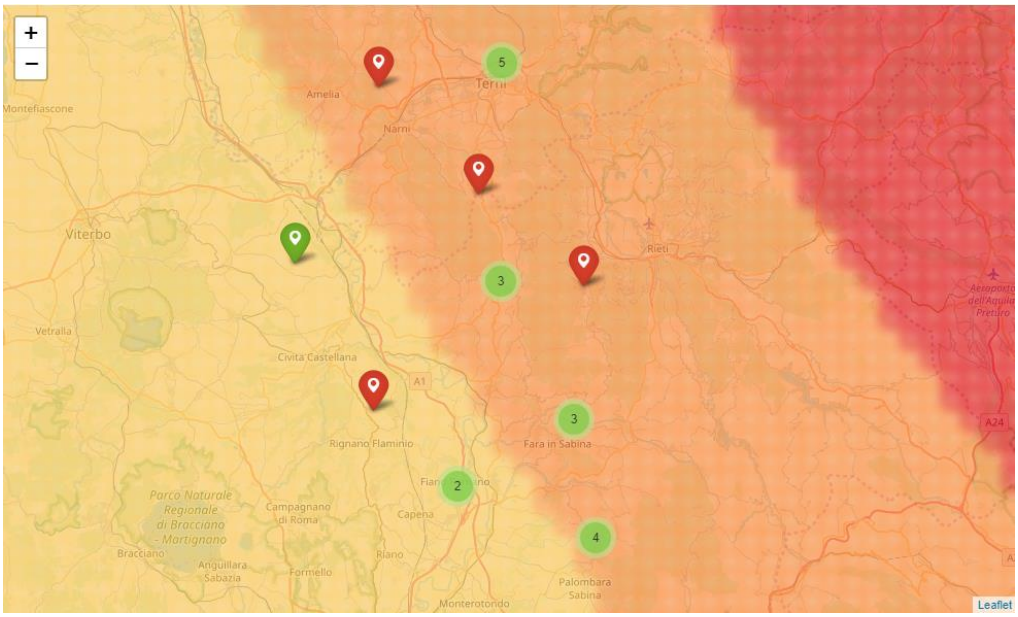
Actors:	HDI Data Scientists
Pre-conditions:	1. The Data Scientist has pre-processed (when needed) the data of interest with the Query Builder.
Post-conditions:	1. The results of the analysis performed are saved into the *Results_AEC* folder. 2. The results of the analysis are ready to be further processed with the Visualiser or to be downloaded by the Data Scientist.
Normal Flow	1. Within the Jupyter default dataset, the Data Scientist right-clicking on the *Algorithm Execution Container.ipynb* notebook opens a menu that allows him/her to "Open the Jupyter notebook" directly. 2. From the Jupyter console, the Data Scientist selects the input data for the analysis, the type of the algorithm that has to be applied, configures the parameters that have to be taken into account, and defines the folder to save the results:

	 Before starting the analysis an overview of the settings is displayed: 
Pass Metrics	1. The algorithms required for the analysis is available in the default notebook. 2. The output file is correctly saved on the defined folder.
Fail Metrics	1. The needed algorithms are not available on the platform. 2. The saving procedure does not work properly.
Notes and Issues:	The brief description and the link to the documentation provided as reference for the available algorithms makes the AEC a tool that can be adapted also from trainees/students. 
Execution Results	Within the demonstrator, the AEC has been used in order to classify the pricing of the policies depending on the risk (for instance earthquake or crime risks) associated to the area and on the customer features (the BDS, CCI, AIA scores).

	The customers datasets (from 2015 to 2019) have been treated with classification algorithms to reveal similarities between clients and their decisions. Regression has been used to link customer profiles to specific policies/offers.

6.2.6. Test Case 7 for "Report visualisation"

Actors:	HDI Data Scientists
Pre-conditions:	1. The Data Scientist obtains the analysis as requested by the Expert.
Post-conditions:	1. The Data Scientist downloads the report from the AEGIS platform.
Normal Flow	1. Once gained the analysis it is further elaborated by the Visualiser of the AEGIS platform: the Data Scientist following the previous instructions of the Expert displays the analysis in the desired format (for instance a map or a scatter plot) setting the customizable features as requested. 2. The Data Scientist saves the output from the Visualiser Jupyter notebook to the 'Results' dataset previously created on the "BusinessAnalysis" project.  3. The Data Scientist from the dataset page of the AEGIS platform downloads the results obtained with his/her analysis.
Pass Metrics	1. The report is saved into the proper folder of the project within the AEGIS platform. 2. The information of the report are complete and in the required format.
Fail Metrics	1. The saving from the notebook to the 'Results' folder does not work.

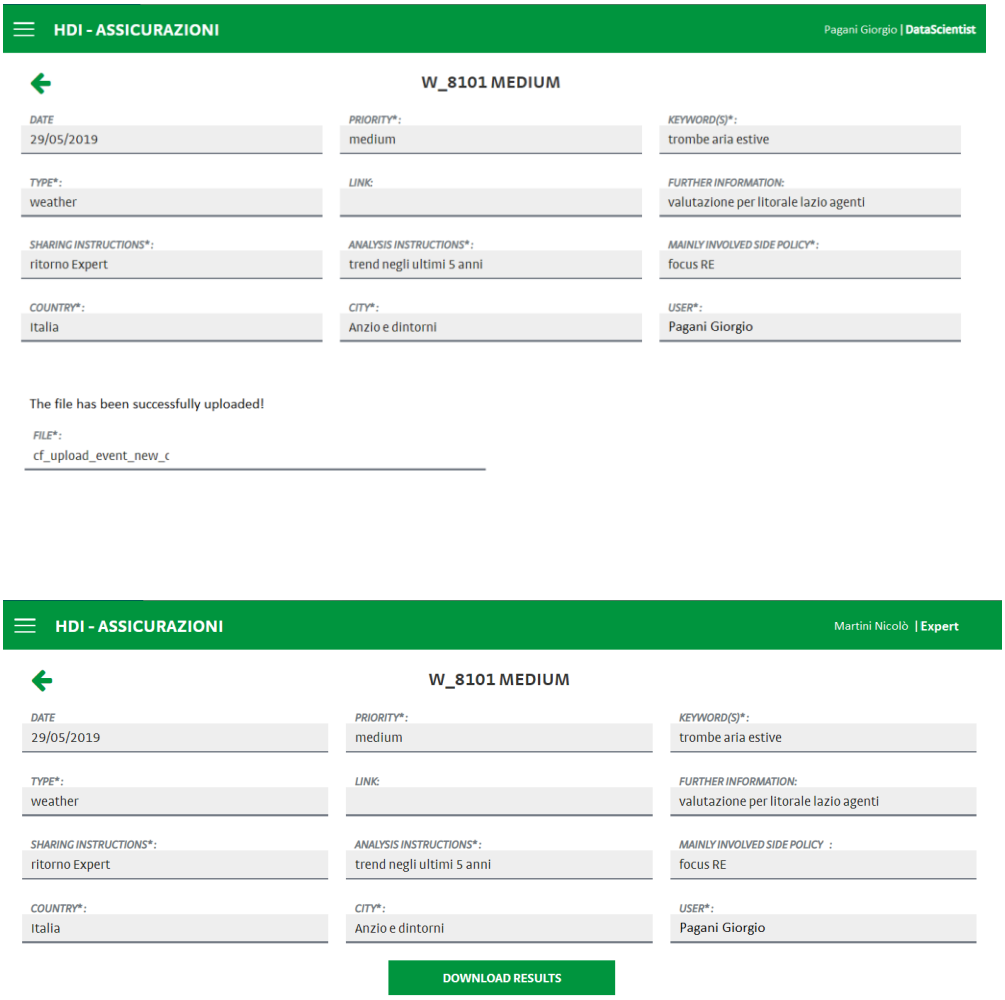
Notes and Issues:	-
Execution Results	The earthquake (as displayed in the figure below), landslide and flood-related risk maps have been created through the Visualiser, using the ISTAT (concerning landslide and flood risks) and the INGV (for seismicity) open data. To have an overview of the HDI customers in the areas of interest the default notebook has been customised: depending on the type of the policy the customers are marked with different colours.  Furthermore, since the encoding of the ISTAT files is neither the standard UTF-8 nor the ascii, the 1252 has been included as option as shown below:  The same has been applied also to visualise on the map the customers over the years. Moreover, to have a clear visualisation of the earthquake risk map, it was necessary to extend the heatmap on-top of maps to support multiple layers.

6.2.7. Test Case 8 for "Report sharing"

Actors:	HDI Data Scientists, HDI Experts
Pre-conditions:	1. The Data Scientist downloads locally the report obtained from AEGIS.

Post-conditions:	1. The report is available at the HDI Expert that made the request.
Normal Flow	1. Once he/she gains the report from the AEGIS platform, the Data Scientist uploads the file on the HDI Web App on the page related to the request and sends it to the Expert. 2. The Expert receives an email and a notification, opening the request from his/her workspace of the HDI Web App, he/she may download the report.
Pass Metrics	1. The report is sent to the Expert that made the request. 2. The Expert receives an email and a notification on the Web App. 3. The information of the report is easily understandable for the Expert and satisfy the request.
Fail Metrics	1. The sharing through the HDI Web App fails. 2. The Expert does not receive any information about the updated status of his/her request. 3. The information of the report is not adequate with the needs.
Notes and Issues:	-
Execution Results	The workflow implemented for the HDI Web App for the third scenario execution worked both from the Data Scientist and the Expert perspectives. The following HDI Web App screens show the successful upload of the report

by the Data Scientist and the availability of a report to download in the page dedicated to the request on the Expert Web App workspace.



6.3. Demonstrator Evaluation

6.3.1. Quantitative Evaluation

Most of the KPIs defined in D5.2 are not at all applicable to the advanced demonstrator since the developed Web App has not been integrated with the HDI Systems. For this reason, additional KPIs were added to the previous list in order to provide a quantitative evaluation of the third scenario.

Furthermore, the KPIs reported in D5.2 cannot be evaluated since the in-house datasets used for the analysis are synthetic datasets that mimic the actual datasets (both from the datasets structure and from the range of values perspective) but have been built with random functions. In agreement with the Ethical Advisory Boards of the project, we followed this direction since in order to have a valuable amount of customers data (from 2015 to 2019) to perform consistent analysis, required the signing of a specific consent by a considerable number of both actual and

past customers, slowing down the demonstrator developments, execution and testing phases. In the synthetic datasets, the number of customers included are around 6000 for each considered year.

The following table summarizes the quantitative evaluation for the third (advanced) version of the Insurance demonstrator with corresponding KPIs for this version and reports an update for two KPIs of the second version of the demonstrator.

Sub-characteristics	**KPIs**	**Calculation Type**	**Mandatory / Optional**	**Means to verify**	**Value**
Second (medium) demonstrator functional completeness	Event Detection Tool trained events	Sum	M	4 (flood, whirlwind, hailstorm, socio-political)	4
Second (medium) demonstrator integration completeness	Integration of the AEGIS Kafka service with the HDI Web App	y/n	M	Notifications from the Kafka service about the detection of new events	y
Third (advanced) demonstrator, portion of successfully completed Test Cases	Evaluation of the pass metrics fulfilment for each Test Case	[Successfully Completed Test Cases] / [No of Tested Cases] * 100%	M	Portion of successfully completed Test Cases of the Advanced demonstrator	100%
AEGIS Platform notebooks adaptability to different requests of the Advanced Demonstrator	Query Builder, Algorithm Execution Container and Visualiser (default) notebooks completeness	([Number of functionalities required for the scenario execution] - [Number of default functionalities for the scenario execution] / [Number of default functionalities for the scenario	M	Customisation of the default notebooks needed to execute the Advanced demonstrated test cases	90%

		execution]) * 100			
All demonstrators	Number of datasets uploaded	Sum	M		150

Table 6-3: Insurance demonstrator quantitative evaluation

6.3.2. Qualitative Evaluation

In this section, the qualitative evaluation, that is based on a workshop held in HDI, is presented. The workshop participants were three Experts and three Data Scientists from different areas of business functions within the company.

The workshop was organized in three main sessions with the following characteristics:

- General overview of the AEGIS project: motivation, stakeholders identified, approach, objectives, technical components of the platform, target users and demonstrators.
- Focus on the insurance demonstrator: motivation and background, scenarios description and development.
- Demo session: HDI Web App and AEGIS platform combined workflow.

At the end of the workshop, in order to encourage feedback and the usage by the participants of the two main environments showcased (AEGIS platform and HDI Web App), a quick questionnaire, as presented in Table 6-4, was given to the participants.

HDI Web App	1. Is the workflow to create an event/analysis request simple and intuitive? 2. Are the information that have to be filled in the pre-defined forms complete and effective? Would it be useful to add/remove some fields? 3. Could be worthy to change the workflows for the three scenarios execution? What could be the changes? 4. If your company adopted the Web App, would you use it? Will it be useful to enhance/ease some processes? 5. General satisfaction about the usability of the Web App (from 1 definitely not satisfied to 5 very satisfied). 6. General satisfaction about the completeness of the functionalities of the

	Web App (from 1 definitely not satisfied to 5 very satisfied). 7. Free field for feedback about the HDI Web App.
AEGIS platform	1. Would you see an actual usage of the AEGIS platform in your company? Why? 2. Which are the platform functionalities that can be considered more important from your business perspective? Which could be further functionalities to be added? 3. What could be modified to improve the AEGIS platform usability?
General	1. Between the roles identified in the three scenarios (Expert, Data Scientist, Operator, Agent), which is the one that fits more with your actual job? 2. Would you like to have more information about certain features between those discussed? 3. General feedback about the AEGIS platform and the project.

Table 6-4: Insurance demonstrator - Guided feedback questionnaire for the Qualitative Evaluation

From the analysis of the questionnaire and the feedback received during the workshop sessions, the participants acknowledged that they would like to use more the AEGIS platform on their own. In fact, all of them recognized in the proposed scenarios a business value that could generate an additional value (and scenarios) with a deeper (individual) usage/training. The workflows for the three scenarios execution with the Web App, have been evaluated as satisfying both from the logical perspective of opening a new event/analysis request and from the intuitiveness of the various steps. One participant pointed out that, at the moment, many steps are based on personal relationships that will be cut off with the automation of the processes. The average general satisfaction out of 5 (very satisfied) is 4.

The information provided when opening a new event/request was considered complete, even though it could be improved in some other use cases. Three participants out of six highlighted the possibility of adding a further field with a list of relevant guarantees related to the event/request.

Furthermore, 5 out of 6 participants are satisfied by the workflows/implementation, one suggested a different approach for the assignment of an event/analysis request to the data

scientist: the new event/request could be automatically assigned to a data scientists depending on predefined rules (based, for instance, on the expertise) or depending on a learning process (based, for instance, on a work-branch built from the events/requests that have already been processed).

In general the use of the AEGIS platform combined with the internal management that is based on the HDI Web App has been positively evaluated. The participants provided some further suggestions. Their recommendations can be briefly described as follows:

- The fraud detection, customer care and retention potential are high, and from a business perspective could be worthy. Moreover, the personalised offers for the asset protection means also a minimization of the risk exposure of the company. The client-based support for events is crucial to improve customer care and retention, while reducing the risk exposure of the company, it enhances the marketing activities, leading to a targeted up-selling and cross-selling.
- The opportunity to merge and process in parallel big data could lead to a better knowledge of the market and its processes, leading to the creation of further business cases.
- The data analysts will have a central role, since their role is essential and further investments should be made in this direction.
- The business cases are transversal for the different sections of the company (claims, commercial, portfolio, etc..) leading to a cooperation between different areas and competencies for a common goal.

The AEGIS platform at the moment is a good opportunity to study and test the big data techniques for information extraction, while the enrichment of the in-house datasets with external datasets available on the platform is promising.

6.4. Challenges and recommendations

The major challenge that has been pointed out from the beginning is the privacy and security regulation. For the project purposes, as remarked also in section 6.3.1, the way to overcome this issue, in agreement with the EABs, was the use of synthetic data. The adoption in the business processes of the solution built for the project will need further effort from HDI (mainly from the legal department and the HDI agents), even if the first foundations were laid with the consent form needed to download the HDI Mobile App.

The key point for the success of the third scenario of the Insurance demonstrator was the availability on the platform of different types of visualisation, algorithms for data analysis as well as filters and data processing methods. For its nature the so called ‘Business request’ in fact, should require a wide range of analysis, leading to different visualisation techniques to display the results at best. In the same time, since the input data vary case by case, data processing methods are fundamental as well. The default notebooks provided by the consortium partners allowed almost all the functionalities needed, only minor changes have been made to the Visualiser to show customers on risk-related maps and to better visualise the Italian seismicity map. The effort needed for these changes was minimum, since the Python language is well known by data scientists, and offers many libraries and support material to help the developers. In future applications HDI will continue to take advantage of the AEGIS platform exploring also the functionalities not exploited during the project life time.

As recommendations, during the workshop the involved participants expressed their interest on exploiting more telematics and geolocation in order to better support the agents and from a wider perspective, the commercial activities. Towards this end, the Jobs and the Kafka services that have been used by the Insurance demonstrator within the project only to get the alerts from the Event Detection tool should be further exploited.

7. CONCLUSION

The scope of D5.5 is to conclude the specific series of deliverables derived from WP5 associated with the evaluation of the AEGIS platform and the demonstrators supported. The current deliverable builds on top of the work and outcomes of deliverable D5.4, and reports the progress of the AEGIS demonstrators. It documents the qualitative and quantitative evaluation of the AEGIS platform (the final stable version of the AEGIS platform that was made available) and of the three discrete AEGIS demonstrators, analysing the test cases that were supported during the last evaluation phase. The quantitative evaluation of both the AEGIS platform and of each of the demonstrators supported was performed based on the list of KPIs that were defined in the previous deliverables of the series, while the qualitative evaluation was performed with the help of small focus groups consisting of data scientists and developers that were involved in the implementation process of the third version of each demonstrator. For each evaluation, the document provides the challenges faced and the recommendations proposed for successfully facing and overcoming these challenges.

The efforts undertaken within the context of Tasks 5.2 – 5.6 throughout the reporting period of M25 – M30, in terms of demonstrator execution and evaluation (quantitative and qualitative) of both the AEGIS platform and the AEGIS demonstrators, identified a series of very important outcomes for the evolution of these exploitable assets produced by the project, and which have been documented in the current deliverable. A synopsis of these findings in the form of recommendations are provided herein:

The main recommendations of the automotive demonstrator associated with the use of the AEGIS platform include:

- To improve the update process of the platform regarding existing data science projects to further reduce the workload for data science projects
- To provide a quick guideline on how to best use the platform for data science projects from lessons learned in the project.
- To improve minor content and layout issues of the user interface on the testbed.

On top of these, a series of challenges have been identified and recommendations have been made by the experts which are in particular interesting for the exploitation phase of the project as they go beyond the scope of the automotive demonstrator V3. The experts mentioned useful functionality, which they were highly interested into:

- A larger driving dataset would be great, which covers a wider area of the city and a wider scale of dates and times where people were driving in the city.
- Displaying road use as (additional) heatmap or route-based visualisation would be a great addon to the service.
- A context menu leading to further information while marking certain areas of the heatmap would be interesting to better judge the severity of the indicated risks. In general, experts raised the interest on having more context information provided to them.
- Experts indicated interest in knowing places where trips started and ended in terms of traffic flow prediction. In general traffic flow prediction and visualisation were topics of great interest for them.

- The visualiser could show different information layers: While a first map could indicate, how many people drove on a particular road (e.g. showing the trip density as route thickness), another map could display the number of safety-critical events happening on this particular road (event density as heatmap). While the first is computed on the platform (but currently not shown in the visualiser), the second is shown in the regional driving risk estimator.
- The GPS data is in general inaccurate leading to inaccurate positions of events and to heatmaps spanning areas which are not roads. This should be corrected within the movement data, if feasible.
- Adding a speeding event would be interesting as speeding leads to many risky situations and accidents.
- Thresholds seem to be far too sensitive on the platform, sometimes causing too many events shown. (But this is intended in order to better test the platform functionalities.)
- Dynamic heatmaps would be an interesting add on for the services, allowing the experts to select/de-select events, set threshold values for events, and date:time for heatmap visualisations.

The main recommendations of the smart home and assisted living demonstrator associated with the use of the AEGIS platform include:

- Further highlight some existing capabilities of the platform such as the predefined or scheduled job execution.
- Expand the documentation of the platform to include a short guideline for the customisation capabilities of the AEGIS services for the expert users of the platform.
- Further fine-tune the upgrade process in order to eliminate any manual intervention needed.

On top of these however, the participants of the performed focus group provided a series of challenges and recommendations for the SHAL demonstrator. However, as this is the final version of the demonstrator and at the same time the project is completed, most of them will be considered in the later exploitation phase. The following list include the identified challenges and proposed recommendation from the participants of the conducted focus group:

- The continuous data retrieval, processing and analysis pipeline from data sources such as the wearables and smart home devices is challenging as it depends on various parameters outside of the demonstrator's application such as the permission of the OS to keep such calls in the background and revive them constantly, the availability of network or active connection of these devices in order to push their data to the demonstrator's application.
- The extensibility of the data retrieval, processing and analysis pipeline with new additional devices can be rather challenging due to the lack of standards and formats utilised by the companies offering these devices.
- The import of the anonymised SHAL database in the AEGIS platform can be challenging if the size of the database grows and non-efficient methods are exploited. However, as most organisations are interested for an in-premise solution, this can be easily overcome.
- The data protection and anonymization of the collected information must be always at the finest level due to the nature of the collected information.

- The inclusion of a “right to be forgotten” feature in the demonstrator application shall be properly handled within the application.

The main recommendations of the insurance demonstrator associated with the use of the AEGIS platform include:

- The creation of the AEGIS user account should be eased, as the actual verification of the account by an administrator could mean days to wait.
- The Jupyter quotas should be managed directly by the user, without any intervention by the administrator, or the administrator should receive a notification if the user is out of quotas.
- The default projects number for each user should be increased.
- The documentation provided for the notebooks could be updated, eventually providing some concrete examples for data analysts (without coding skills).
- The getting started should be redesigned to be clear and professional while being more attractive to be used by externals. Some functionalities of the platform at the moment are not properly highlighted even if they could be very useful in actual applications.

On top of these however, the major challenge that has been pointed out from the beginning is the privacy and security regulation. For the project purposes, as remarked also in section 6.3.1, the way to overcome this issue, in agreement with the EABs, was the use of synthetic data. The adoption in the business processes of the solution built for the project will need further effort from HDI (mainly from the legal department and the HDI agents), even if the first foundations were laid with the consent form needed to download the HDI Mobile App.

The key point for the success of the third scenario of the Insurance demonstrator was the availability on the platform of different types of visualisation, algorithms for data analysis as well as filters and data processing methods. For its nature the so called ‘Business request’ in fact, should require a wide range of analysis, leading to different visualisation techniques to display the results at best. In the same time, since the input data vary case by case, data processing methods are fundamental as well. The default notebooks provided by the consortium partners allowed almost all the functionalities needed, only minor changes have been made to the Visualiser to show customers on risk-related maps and to better visualise the Italian seismicity map. The effort needed for these changes was minimum, since the Python language is well known by data scientists, and offers many libraries and support material to help the developers. In future applications HDI will continue to take advantage of the AEGIS platform exploring also the functionalities not exploited during the project life time.

As recommendations, during the workshop the involved participants expressed their interest on exploiting more telematics and geolocation in order to better support the agents and from a wider perspective, the commercial activities. Towards this end, the Jobs and the Kafka services that have been used by the Insurance demonstrator within the project only to get the alerts from the Event Detection tool should be further exploited.