AIRMES

NEWSLETTER # 1 \ July 2017

Welcome to the first AIRMES newsletter!

The AIRMES project focuses on optimising end-to-end maintenance activities within an operator's environment. It will develop and validate an innovative, state-of-the-art, integrated maintenance service architecture that will be a key step in achieving the goal of no technically-induced aircraft operational disruptions in European air traffic. These activities will be performed within the scope of the Large Passenger Aircraft (LPA) Integrated Aircraft Demonstrator Platform (IADP) of the Clean Sky 2 Joint Undertaking (JU).

Introduction

It is with great pride and enthusiasm that I present to you the AIRMES project and its first newsletter. We believe that AIRMES will contribute to reduce technically-induced operational disruptions, thus reducing the average delay time of flights and improving aircraft utilisation.

AIRMES brings together 12 partners across Europe, each one contributing with high-level expertise and experience such as airline / MRO, systems health monitoring, semantics, knowledge based engineering, architecture, diagnostics, prognostics, maintenance planning and optimisation, and mobile tools for remote support of maintenance activities.

I invite you to visit the AIRMES website (www.airmes-project.eu) which is regularly updated with news and events from the project. Feel free to inform us of any publication, project or event which should be brought to the attention of the AIRMES community. We look forward to meeting with you during our future dissemination activities.

Enjoy the newsletter!

Joel Felgar Ferreira
AIRMES Project Coordinator
Innovation Manager
TAP Portugal

NEWS & EVENTS

The European Congress and Exhibition on Advanced Materials and Processes EUROMAT 2017 will take place on 17-22 September in Thessaloniki, Greece. One of the AIRMES partners, ISQ, will represent the project during the event.

>> Read more

The AIRMES leaflet and poster are now downloadable from our website.

>> Download the pdf

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Word from the Topic Manager

Maintenance and Integration as a single topic for research? The answer is clearly 'YES, of course!'

After many years of research on individual aviation maintenance topics such as Structure Health Monitoring, System Prognostics, Planning optimization techniques and, new and innovative approaches for maintenance execution; it was the right time to bring together the main aviation industry actors to address the challenge of integration of individual solutions in a digitalized world and to demonstrate its potential when deployed in a strongly diversified airline business and operational environment.

The CleanSky 2 community quickly understood the challenges and benefits of the topic and has opened its door to work on a demonstrator for the seamless and value driven End-to-End integration of the various maintenance technologies in a collaborative manner. The project ADVANCE (Advanced Value and Service driven Architectures for Maintenance) was born to demonstrate its support of the EU Horizon 2020 objectives on seamless mobility and industry competiveness. As work package 3.6 in Platform 3 of the Large Passenger Aircraft IADP - ADVANCE - follows the objectives of reducing Operational Disruptions of air travel caused by unscheduled maintenance through application of Health Monitoring and Management Solutions, reduction of aircraft out of service time and increased asset utilization through condition based maintenance solutions and improvement of the maintenance industry value chain through services and exploration of its impact on the operational environment.

AIRMES, as a call for proposal partner consortium, joined the ADVANCE family of 19 partners (OEMs, suppliers, airlines, MRO, Universities and Research Organizations) in 2015. AIRMES is not only a key contributor in terms of skills, capabilities and experience but also by enriching ADVANCE through the AIRMES partners positive and collaborative mind set, engagement and openness.

Many challenges have been already successfully tackled together and more are ahead. But thanks to the engagement of AIRMES and the other partners, this project has solid foundation and we, the ADVANCE team, are looking forward to continuing to share with you our European journey and achievements of the projects.

Alexander Plagemann
Cleansky2 LPA ADVANCE Project Coordinator
Aircraft Operability Foundation – EIO4
Airbus

Word from the Coordinator

AIRMES is a successful story of collaboration.

Eighteen months have gone by, and along with it, a lot of overcome challenges. Some still lie ahead of us, but if anything, we learned that we are completely up to it and everything is easier with teamwork.

Being AIRMES such an ambitious and complex project, in the beginning we faced some difficulties to build a common understanding of the project among the partners.

Our main goal is to demonstrate that the integration of a number of different technologies into a consistent sevices suite, that will answer to different aspects of the aircraft maintenance value chain, is possible.

To make sure that the technologies fully address the issues they are supposed to cover, we had to grant some freedom to the different teams inside our consortium so that they could empathise with the different aspects of each issue on a stand-alone basis, thus focusing on the specifics of each subject matter. At the same time, we had to find a balance between the independence we gave to the teams and their sense of awareness to the bigger picture, not to lose track of the fully integrated solution we intend to achieve in the end.

This is an exciting project which is moving faster and faster and where our biggest strength is our team.

We are looking forward to sharing with you the first results as the prototypes become ready.

Joel Felgar Ferreira
AIRMES Project Coordinator
Innovation Manager
TAP Portugal

AIRMES at COTEC National Innovation Meeting 2017

The 14th COTEC National Innovation Meeting took place on 16th May 2017 in Portugal. The team of one of the consortium partners, ISQ, attended the meeting and presented their ongoing projects. Among other guests, the President of the Portuguese Republic was introduced to the objectives of the AIRMES project.

Figure 1: ISQ team with the President of the Portuguese Republic. Courtesy of Miguel Figueiredo Lopes (Presidency of the Portuguese Republic).

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E2E SERVICE & OPERATIONS DESIGN

This work package is responsible for the overall project framework including definition of methods, languages and collaboration as well as the baseline to evaluate the business and operational impact of AIRMES. Since the beginning the validation and verification plan to track the progress of the innovation was created. Further, a business analysis of the European market including the end-to-end value chain of the MRO market was developed. Lastly, operational scenarios were designed to gain a baseline for future evaluation of the innovations developed by the other partners. As the focus of this work package was in 2016, all deliverables will be completed by Summer 2017. However, the partners will accompany, monitor and support the overall AIRMES-progress until the end of the project.

E2E MAINTENANCE PLATFORM AND IHMM DEVELOPMENT AND DEMONSTRATION

One of the ongoing activities is the specification and development of the Integrated Health-Monitoring and Management (IHMM) application. IHMM has now reached Technology Readiness Level 4 and the demonstration is on the rails.

Figure 2: IHMM prototype on a mobile device.

Evaluation and demonstration of the whole end-to-end maintenance improvements is also built. It incrementaly takes into account the benefit brought by each technology enablers that partners are contributing to and integrates this benefit in the whole maintenance process and its predictable evolution over the coming years.

In addition, a standard end-to-end architecture graphical description is in progress in a way that will facilitate the assessment of performance indicators and safety impacts directly from the architecture models.

PROGNOSTIC SOLUTION DEVELOPMENT, INTEGRATION AND OPERATIONAL PERFORMANCE DEMONSTRATIONS

This work package aims at reducing the unscheduled maintenance of aircraft. This means fewer delays for all of us who fly for leisure or business. Our method to reach that goal is to predict a component failure before it actually occurs.

We use state-of-the-art prognostics methods, consisting in dedicated algorithms. These prognostic algorithms are fed with operational data (recorded on a fleet of medium and long haul airliners during the past few years), allowing them to learn and detect significant trends and patterns. Then, based on the messages provided by the aircraft integrated maintenance system to the pilots and maintenance staff, they can predict a component failure a few flights before it would actually occur. This allows the airlines to replace that component at an appropriate time and location. This results in fewer flight planning disruptions and reduced maintenance costs.

Our input data is not sensor data. It is failure messages and cockpit alerts. This is the key differentiator from other methods.

We are currently in the process of selecting, cleansing and sorting the most relevant data from the operational database. This is a key step that will determine the scope and performance of the prognostic algorithms. The next step will consist in refining and tuning these algorithms, and then in integrating them in a user-friendly tool that can be used by the airlines engineering and maintenance departments.

COLLABORATIVE AND DATA ANALYTICS ENVIRONMENT DEMONSTRATION

This work package deals with the development of a knowledge warehouse infrastructure in a collaborative environment platform (including data mining solutions and data analytics features).

The collaborative environment is a PaaS (Platform as a Service) providing the necessary services to help users to integrate and query data using semantic web technologies.

This Platform, provided by Atos, is fully extensible by users that can provide new high level services and making them available to others by deploying their own application.

Web semantic technologies are participating in the collaborative aspects of the solution by providing a standard way of defining, handling and computing knowledge and data.

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To ensure high-availability and scalability, the collaborative platform has been designed to be deployed inside a cloud infrastructure and offers the following support services:

- Security Service;
- Processing Pipeline;
- Workflow Management;
- Data Management;
- Data Storage;
- Services Management;
- Resources Management.

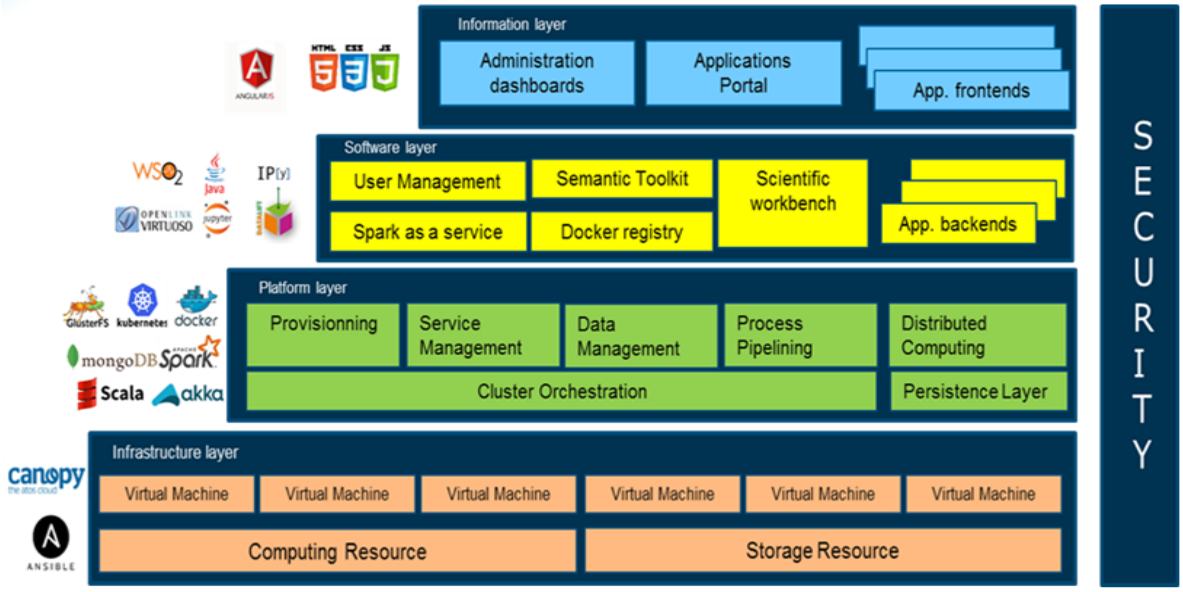

Figure 3: The collaborative environment stack.

The cloud platform which is the technical answer for the collaborative environment is now stabilized.

The Notebook service allowing the edition and the execution of a code (python language) embedded in a web page is also available.

The Data Analytics specialists in Cranfield University have integrated their specific developments within a Notebook with success.

Furthermore, Cranfield issued a paper named “A New Application of Data Analysis using Aircraft Fault Record Data”. It deals with two types of data analysis techniques for extracting useful information contained in aircraft fault record data: pattern analysis and correlation analysis.

Illustrations of results are given below:

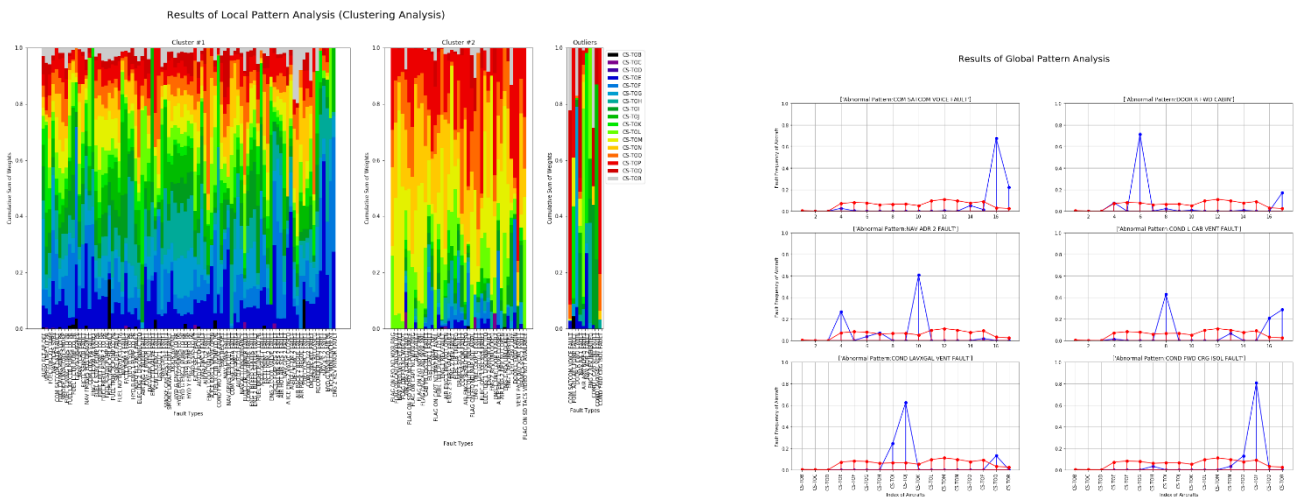

Figure 4a: Examples of pattern analysis results.

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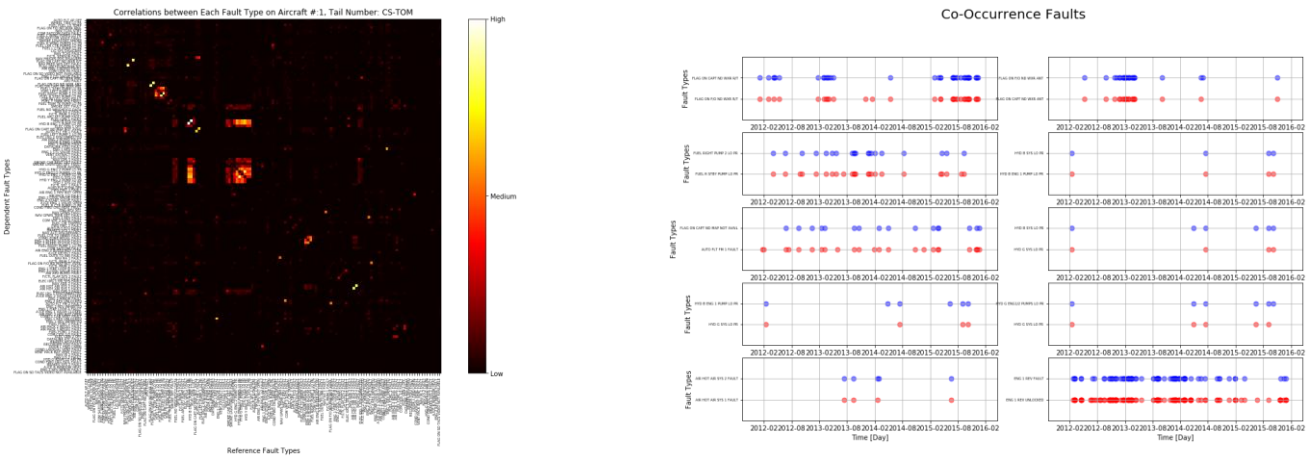

Figure 4b: Examples of correlation analysis results.

Several workshops have been organized with partners, including PTC and Tekever, with two objectives:

- Discuss the way the developments of partners can be integrated in the collaborative environment;
- Identify and define the concepts that can be part of a knowledge base of an end-to-end maintenance from operator's point of view. This knowledge base is designed by an ontology with semantics technologies.

The future steps will be the continuation of these activities with a progressive concretization of the implementation.

The link of the collaborative environment with the main R&D topics is given hereafter:

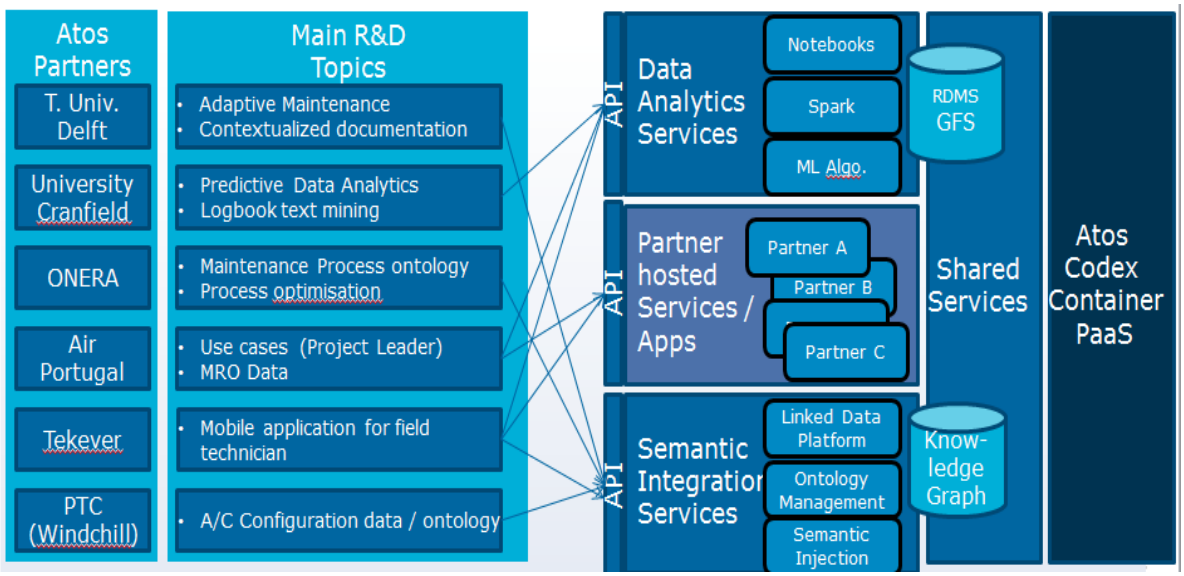

Figure 5: Collaborative Environment for Maintenance Improvement.

MAINTENANCE PLANNING AND OPTIMIZATION AND CONFIGURATION MANAGEMENT SOLUTIONS

The main goal of this work package is to develop an efficient maintenance planning framework that can provide optimised maintenance schedule solutions. This framework will enable holistic short and long term planning optimisation and will contribute to maximise both airline's and MRO's assets. The solutions are computed based on updated aircraft health information (provided by Prognostics) and accurate knowledge of the aircraft configuration. The aircraft configuration knowledge will be mastered by innovative real-time configuration management technologies, developed and demonstrated in this work package.

The focus during this first year of AIRMES was on defining the requirements and specifications for both functions, Maintenance Planning Optimisation and Configuration Management, and on developing initial prototypes. An optimisation algorithm that computes the long-term (5-years) C-check inspections for a fleet of heterogeneous aircraft was tested and validated. No health information or aircraft configuration knowledge

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has yet been used. Nonetheless, preliminary results suggest that an optimal plan can result in 5 to 8 less C-check inspections over a period of 5-years for a fleet of more than 40 aircraft.

Regarding the Configuration Management function, the data structure and navigation principle have been defined. The implementation of the first prototype is under development and the demonstration strategy is being discussed.

Next steps will involve the planning of A-check inspections and the conclusion and demonstration of the first Configuration Management prototype.

INTEGRATED MOBILE SOLUTIONS FOR MAINTENANCE EXECUTION ENHANCEMENT

In this work package, the objective is to create an integrated mobile tool that will provide enhanced remote support. In order to pursue the development of the mobile tool, an iterative approach is being followed, obeying the philosophy described in Figure 6.

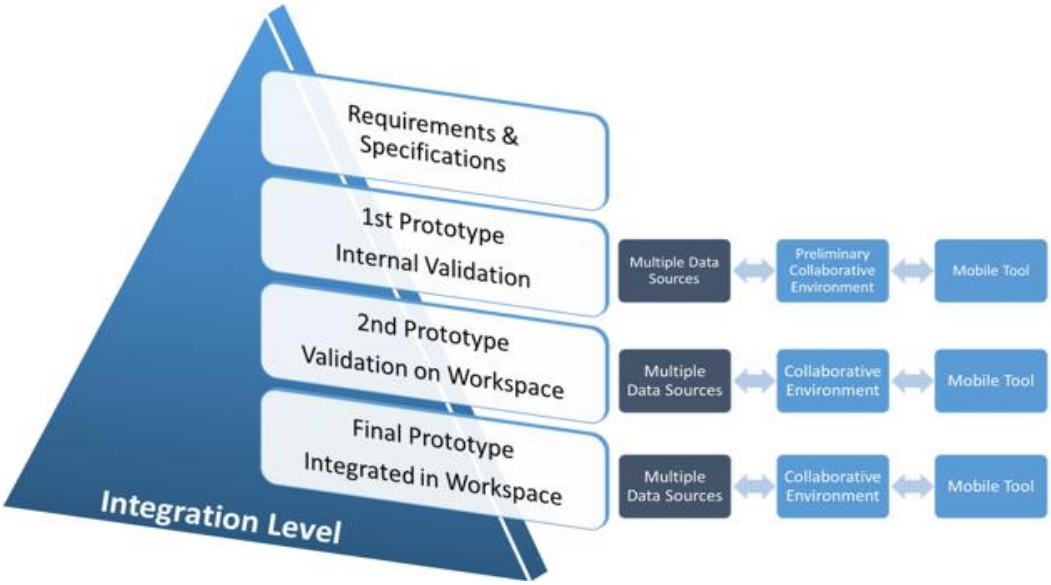


Figure 6: Development philosophy.

During the first months of the project, the objectives were to:

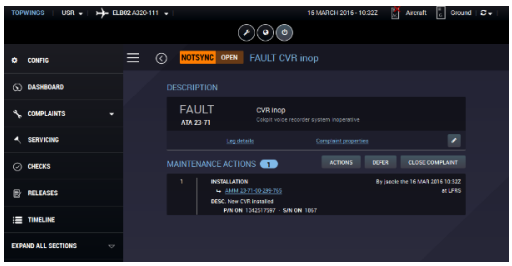
- Build a common understanding of the work package as a whole and of each individual task;
- Define the boundaries in each activity, thus avoiding gaps and overlaps;
- Collection of end-user requirements;
- Definition of UCs and relevant scenarios;
- Establishment of the requirements and respective specifications.

All this work was materialised in Deliverable D6.1, delivered to the CSJU in September 2016.

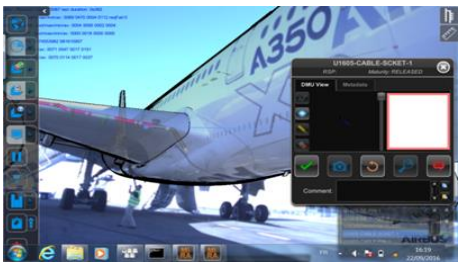
After this, the development of the first individual prototypes began, with the partners achieving the first elementary working prototypes, some of which can be seen in Figure 7.

So far, the results have been very encouraging and the partners are aiming at delivering the first prototypes in July of the current year.

Despite the encouraging results, one of the main risks that this work package is facing is the complexity of the integration works, which may reveal more time consuming than initially planned. To address this issue, some partners are already performing some elementary integration to anticipate some of the difficulties that can be found more ahead. Also, the partners have already established the functional interfaces matrix and have already started working in the physical architecture matrix. This anticipation of the integration works enables the partners to start addressing some of the risks that, otherwise, would remain hidden in a radar shadow until the Q3 of 2017, when the development of the integrated prototypes is scheduled to start.



Defects Reporting.



Augmented Reality component location.

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Augmented Reality structural damage location.

Virtual Reality.

Figure 7: First prototypes.

GET-TOGETHER

AIRPORT IT 12-13 SEPTEMBER 2017, VIENNA, AUSTRIA

International Airport Review's Airport IT conference will again bring together CIOs, IT Directors and Head of Operations for two days of invaluable insights and open debate. To share and discuss their visions for the future on how social media, mobile and cloud can be used to connect with customers and streamline airport operations. Delegates will also have the opportunity to discuss visions and plans for their Airport IT operations and debate best practice in aligning technology with airport strategy. Source: http://www.intairportexpo.com/airport-it/.

36TH DASC 17-21 SEPTEMBER 2017, FLORIDA, USA

The conference theme for the 36th Digital Avionics Systems Conference is the design of technologies, procedures, and regulations to safely and efficiently accommodate a diverse spectrum of platform types into space and into modern civil airspace systems. Participants will be challenged to show how their work helps to develop, promote, or enable multiple classes of users (Commercial, Civil, General Aviation, Military, Recreational) access to space and global civil airspaces. Source: http://2017.dasconline.org/.

EUROMAT 2017 17-22 SEPTEMBER 2017, THESSALONIKI, GREECE

The European Congress and Exhibition on Advanced Materials and Processes 2017 conference series is organised by the Federation of European Materials Societies (FEMS). It is one of the largest events of this kind in Europe, covering the full spectrum of materials science and technology. One of the symposia will address advanced materials for transport applications and focus on the following topics:

- additive manufacturing for transport applications;
- hybrid engineering materials & structures for multi-material designs;
- intelligent materials, structures and systems in transportation;
- simulation, modeling, optimization and bigdata applications for process discovery.

One of the AIRMES partners, ISQ, will present some of the project results. The presentation, co-authored by TAP Portugal, is entitled "Implementation of advanced technologies into aeronautic integrated maintenance concept - use of virtual reality in ground-floor training maintenance execution". Source: http://euromat2017.fems.eu/.

EASN CONFERENCE 26-29 SEPTEMBER 2017, WARSAW, POLAND

The 7th EASN International Conference on "Innovation in European Aeronautics Research will include talks and presentations by key-figures from the academia, industry, research community and policy makers. It will also include thematic sessions on a series of domains and disciplines of A&AT along with technical workshops where evolving ideas, technologies, products, services and processes will be discussed. Research projects can exploit the opportunity and disseminate their results and achievements in dedicated sessions. Source: https://easnconference.eu/.

CEAS 2017 16-20 OCTOBER 2017, BUCHAREST, ROMANIA

The Aerospace Europe CEAS 2017 Conference brings together academic, research, industry and operator representatives for a fruitful date exchange of the latest ideas and developments in European aeronautics and aerospace. Source: http://ceas2017.org/.

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INTERVIEW

AIRMES newsletters offer you the possibility of getting to know some of the project partners a little better… Thus, the interviews section will let you discover the day-to-day life of the people involved in achieving the AIRMES goals.

In this edition of the AIRMES Newsletter # 1, we propose you several tags which will lead the interview: **operational scenarios – KPI – interfaces**.

SOEREN BILET
MANAGER / LEADER OF WP1 "E2E SERVICE & OPERATIONS DESIGN"
M2P CONSULTING GMBH, 60323 FRANKFURT/MAIN, GERMANY

Q1: What are the stakes of the definition of **operational scenarios**?

A1: The Operational Scenarios serve as an environment to show the impact of the technologies developed within AIRMES. It can be compared to a stage where the technologies are able to perform their play. Hence, all partners are involved in the development to ensure that every technology (such as Prognostics, IHMM, Defects Reporting, Virtual Reality, Maintenance Planning Optimization) can demonstrate its performance in the correct environment. At a later stage the operational scenarios serve as baseline to extrapolate the global effect.

Q2: Key Performance Indicator (**KPI)** definition is the next step: what is the difficulty lying behind these definition?

A2: The KPI definition is crucial to get a starting point and finish line. First of all, the correct indicator including its unit needs to be determined. The indicator must be measurable and reflect the impact of the technology. Since AIRMES focus is on state of the art technologies sometimes (e.g. for Prognostics of part failures there is currently no as-is value / benchmark), there is no simple starting point or As-Is value. Most of the technologies will change the complete way of doing things, such that the figure needs to be determined indirectly. Further, the to-be value requires an estimation for something totally new. To close this gap the KPI will be measured for each prototype (1st, 2nd, final).

Q3: Can you describe the **interfaces** with other work packages but also other projects in ADVANCE like PACMAN and DEMETER on these points?

A3: As an interdisciplinary Work Package, we have interactions with all other work packages. However, the interfaces focus on alignment of the created frameworks and documents. On the other hand, we also highly interact with the other consortia such as PACMAN and DEMETER. PMT (Process, Methods, Tools), IVV (Integration, Verification and Validation plan) and the evaluation environment (Ops Scenarios and Value Chain) act globally for ADVANCE and need to be aligned between all stakeholders. The interaction between AIRMES and the other consortia is shown in the figure 8 below. AIRMES provides the results of the prototypes and feeds them into the DEMETER Evaluation Tool (AIRTOBS) for further processing. Later, the final results are fed back to evaluate the impact of the technologies from a global, value chain driven perspective.

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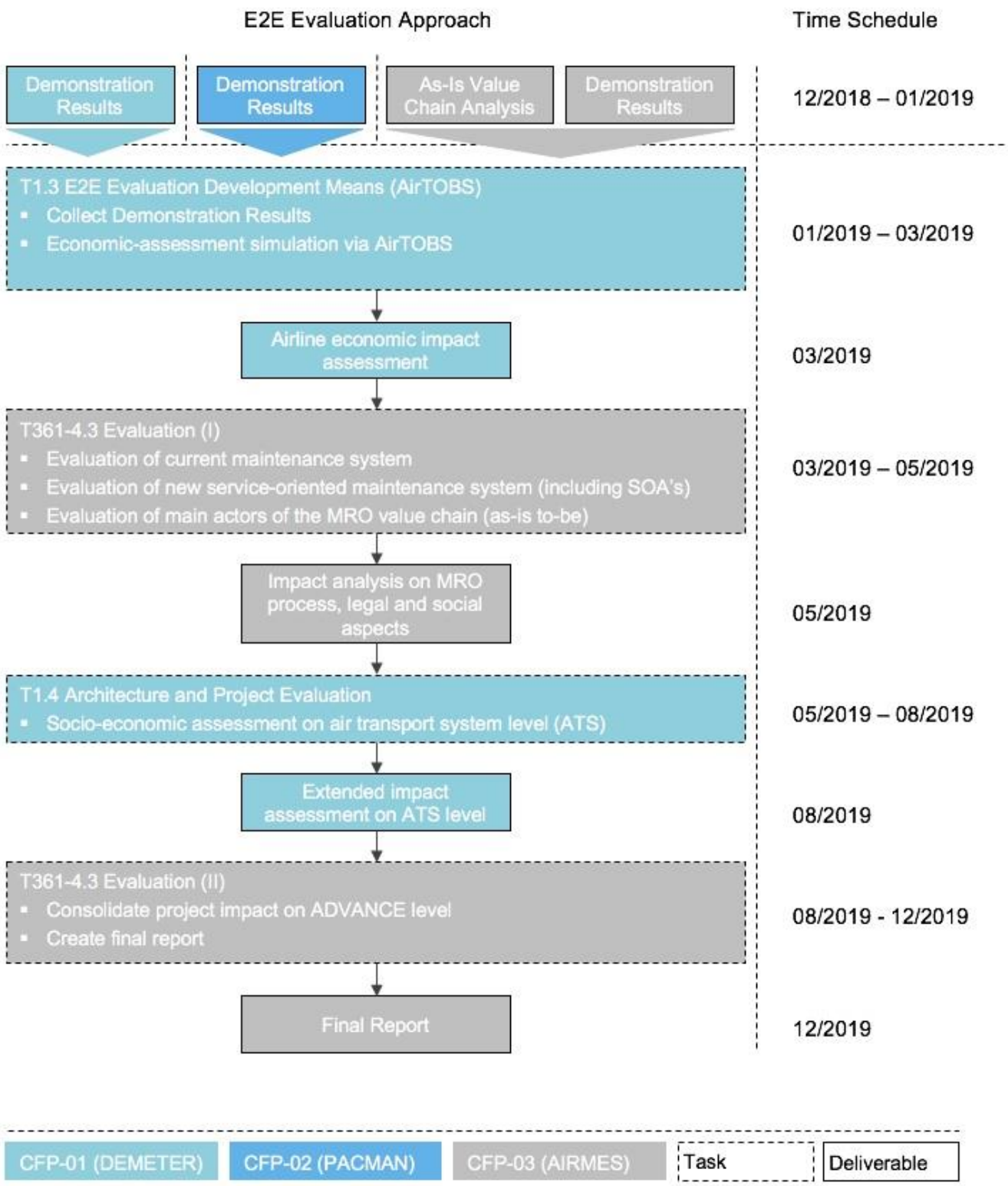

Figure 8: E2E Evaluation Approach and AIRMES interaction with other consortia.

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