AIRMES

NEWSLETTER # 2 \ February 2018

Welcome to the second 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

During the last six months, the AIRMES activities have accelerated and intensified. The consortium partners have generated first results that will be further matured in the upcoming months in order to achieve what AIRMES stands for: contribution to reduce technically-induced operational disruptions, thus reducing the average delay time of flights and improving aircraft utilisation.

After having developed the first prototypes, the partners will focus in 2018 on the integration activities which will turn the current set of standalone solutions into a coherent services suite. Their proof of concept will demonstrate the ability to help airlines and MROs in dealing with the uncertainties of the daily operations in a smoother and more resilient way. Some of the demonstration activities will take place already in 2018. We will pave the way to a successful 2019 when the solutions will be fully demonstrated and its benefits assessed.

In this second issue you will get to know how the activities progressed within the project work packages. The "Get Together" section will inform you about the upcoming major events related to the AIRMES research fields. The interview will let you discover the day-to-day life of people involved in achieving the project goals. I invite you to visit the AIRMES website (www.airmes-project.eu) regularly updated with news and events from the project. Feel free to inform us of any activity 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 Air Portugal

NEWS & EVENTS

The partner ISQ will represent AIRMES at the TRA 2018 conference which will be held from 16 to 19 April 2018 in Vienna.

➔ Read more

AIRMES will be present at ILA Berlin 2018 at the joint stand of Clean Sky 2 and European Commission. The partner ISQ will exhibit the Virtual Reality prototype.

➔ Read more

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E2E SERVICE & OPERATIONS DESIGN

The second half of 2017 was important for E2E service and operations design. We managed the completion of a necessary deliverable: the MRO Business Analysis. This analysis helps us to estimate and understand the European MRO market and serves as a basic input for other AIRMES activities as well as the ADVANCE project.

This deliverable defines the link between the project objectives and the prototype results. It further enables the opportunity to measure the impact of each technology for the European market and the stakeholder landscape. After an agreement to finalize this deliverable on the ADVANCE level, the work package dedicated to E2E service and operations design is officially closed from the AIRMES perspective.

Later in 2017 M2P, Airbus and DLR aligned an important approach to connect the outcomes of all three projects within the ADVANCE focus (AIRMES, DEMETER, PACMAN). At the annual meeting in Hamburg, M2P and DLR presented the E2E approach to all participants.

Within 2017, M2P and DLR run AIRTOBS by including project-relevant information from the MRO Business Analysis. AIRTOBS is a software tool developed by DLR which helps us to measure the impact of each use case on the European MRO environment.

In 2018, M2P and DLR will focus on the E2E evaluation and will start a first run of AIRTOBS by integrating prototype results from Technology University of Delft and the Maintenance Planning Optimization (MPO)-Tool.

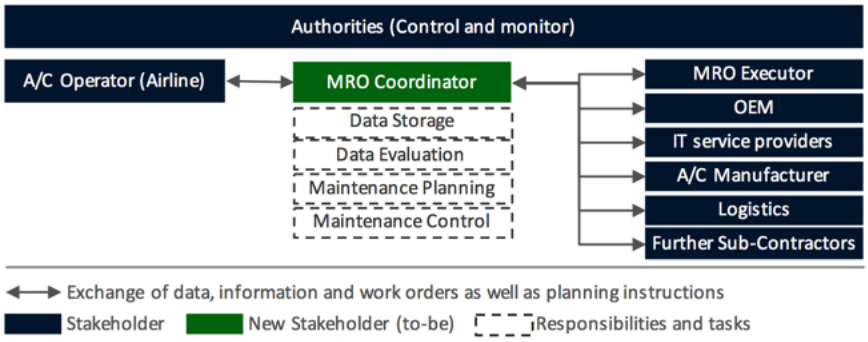

Figure 1: Change of stakeholders between as-is and to-be global value chain.

Cost cluster	Cost component	As-Is Costs (EUR)	To-Be Costs (EUR)	Delta	
MRO Execution	A/C Data Collection and Transmission	7.724M	7.297M	445M EUR[1]	6%
	Engineering Analysis				
	Planning and Preparation				
	Execution				
	Recording				
Disruption	Unscheduled Maintenance Execution Time	858M	809M	49M EUR	6%
	Unscheduled Maintenance	4.000M	3.468M	532M EUR	13%
Non-productive A/C time	Non-productive A/C time (maintenance time)	300M	100M	200M EUR	67%
Total		12.882M	11.674M	1.226M	10%

Remarks:
[1]Share of improvements according to estimated market impact – AIRMES Proposal Part BI (Technical Section)
Data Source: ICF International: MRO Market Forecast & Key Battlegrounds, 13.10.2015; Oliver Wyman: Turbulence Ahead – Disengage the Autopilot; 13.10.2015, internal analysis

Figure 2: As-is and to-be MRO cost structure (best case).

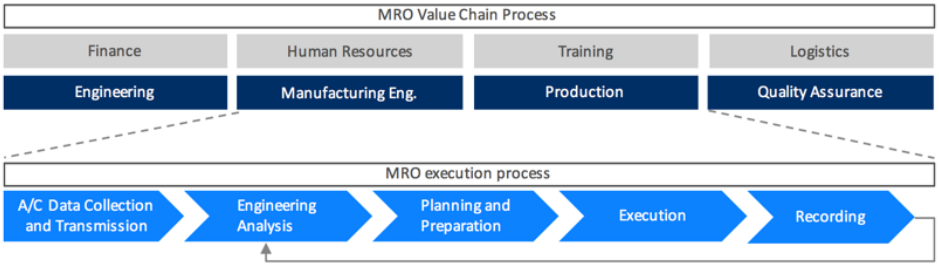

Figure 3: Global and detailed MRO Value chain, based on ADVANCED Scope and Perimeter.

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E2E MAINTENANCE PLATFORM AND IHMM DEVELOPMENT AND DEMONSTRATION

A maintenance architecture modeling language customized for AIRMES needs was developed during the last months. It relies on a computable but very generic language having the advantage of being processible. However, used directly, this language can make the direct description of the architecture very difficult. Hence, some extensions introducing AIRMES concepts and relations were developed so that the final architecture modeling may directly talk about, for instance an Aircraft Maintenance Technician (AMT). Practically, several extension layers are progressively refining the language concepts until the required level of details is reached (see Figure 4 for an intermediate layer already introducing the notions such as HumanRole, System and Function for example).

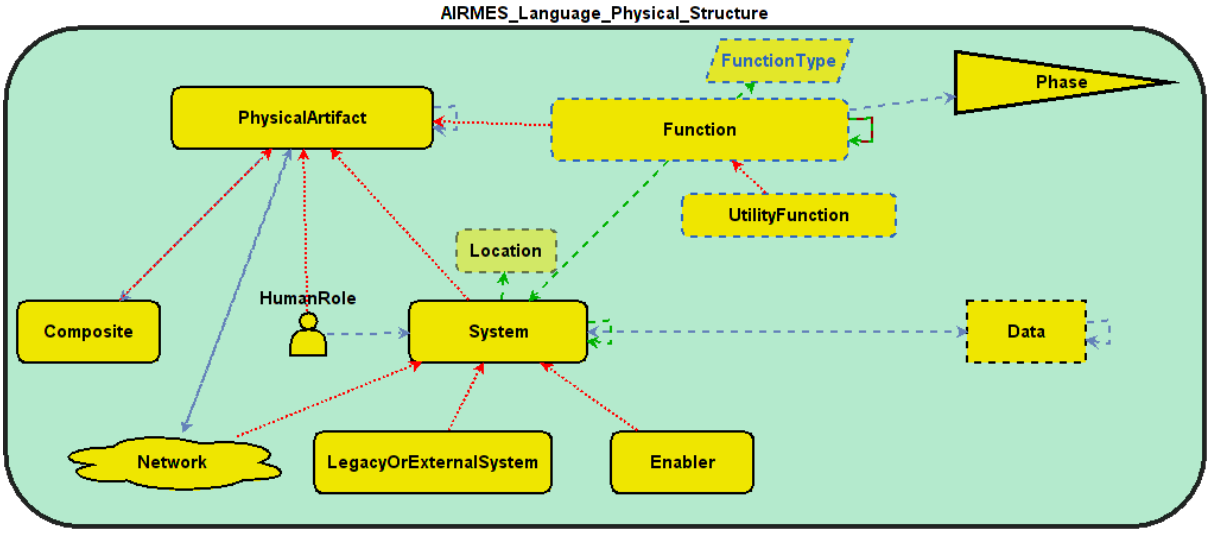

Figure 4: One intermediate language.

Some simple examples of performance indicator computation have been developed to illustrate the processing capability (e.g. computation of the ratio of human versus automated actions during a scenario depending on the architecture description).

On the end to end (E2E) Evaluation and Demonstration side, the plan document was created. It describes the different experiments that will take place during the project for every partner bringing a technology improvement. The E2E Evaluation System, the tool that will concretely compute high level E2E performance indicators from the integration of each technology improvement observed during demonstrations, have been aligned with the projects DEMETER and ADVANCE.

Next steps are to use the AIRMES architecture modeling language to describe the final candidate architecture retained for the project as soon as validated and to produce modeling and performance indicators on it. Safety will also be assessed on relevant scenarios given the constraints coming from the architecture models. IHMM specification will continue its refining process to reach a higher TRL (TRL5). Eventually, a first draft of the Evaluation System will be developed.

PROGNOSTIC SOLUTION DEVELOPMENT, INTEGRATION AND OPERATIONAL PERFORMANCE DEMONSTRATIONS

The aim of this work package is to create a prognostics tool that would allow reducing unscheduled maintenance by anticipating part replacements. The key difference with other prognostic tool is that ours is based on fault messages (i.e. “Function XXX has failed”) rather than on sensor data (i.e. “Pressure XXX is 250 PSI”).

Since summer 2017, the involved partners have been working on defining the best prognostic algorithms. The algorithms must be tailored to the input data and the expected outcomes. Several methods have been tested (mostly variants of the subspace methods and of the neural network methods), each of them with several sets of parameters. Each partner has used its preferred methods based on its own background. We focus on reducing the number of false predictions to a minimum.

The algorithms are based on the records of four years of maintenance from the TAP Air Portugal medium- and long-range Airbus fleet. These aircraft being very reliable, there is a comparatively very limited number of unscheduled maintenance events during this timeframe, despite the very important number of flights operated. This creates a very large asymmetry in the input data (very few maintenance events but a lot of flights without defects). This asymmetry is one major difficulty in defining the prognostics.

The next step, starting in the spring 2018, is to integrate our prognostics algorithms in a demonstrator tool. This will be done by summer 2018. This demonstrator will allow assessing the economical and technical benefits of our prognostics solutions.

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COLLABORATIVE AND DATA ANALYTICS ENVIRONMENT DEMONSTRATION

Collaborative Environment is a Cloud Platform dedicated to the AIRMES project and provided by Atos. This is a Paas (Platform as a Service) providing services to facilitate application deployment, data analysis, data consolidation and Knowledge Warehouse.

The platform itself received has new features in the last months: security components, integration of NextCloud for File Sharing, integration of a mySQL database used by the Server application developed by TEKEVER and deployed on the platform.

The technical solution of the Knowledge Warehouse feature is based on the Web Semantics Technology. The platform provides services according to the "Link Data Platform (LDP)" recommendation of the W3C. This technical choice is a strategic one as it will ensure data storage, data access and data consolidation features.

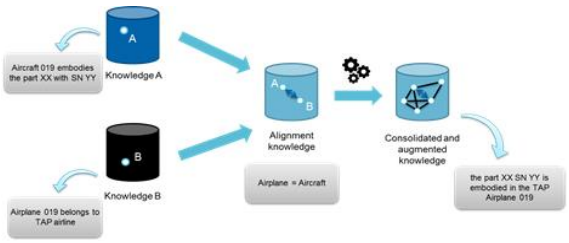

Figure 5: Ontology alignement for data consolidation.

Alignment strategies between ontologies have been studied and prototypes in the objective of data consolidation. These techniques are a way to consider different disjoint and heterogeneous databases as a whole.

Simultaneously to this specialist work, a global initiative has been decided during the last consortium committee in November 2017. It consists in the constitution of a “task force” focused on the ontologies for AIRMES. The objective is to rapidly define a prototype of a core ontology for the maintenance domain and to demonstrate all significant usages. This initiative is firstly a collaborative work involving experts from different domains and technical experts on semantics technology. First production consists of an ontology presenting a harmonized view of the domain, which is at least a valuable output.

Data Analytics algorithms are developed. The solution takes place in an integration in the Collaborative Environment of the Jupyter Notebook for python code. Cranfield University is developing its algorithms applied on maintenance data provided by TAP Air Portugal. A fault prediction algorithm for ACMS data has been investigated using deep learning approach (recurrent neural network). A pattern analysis of fight delay is performed by using dispatch reliability data.

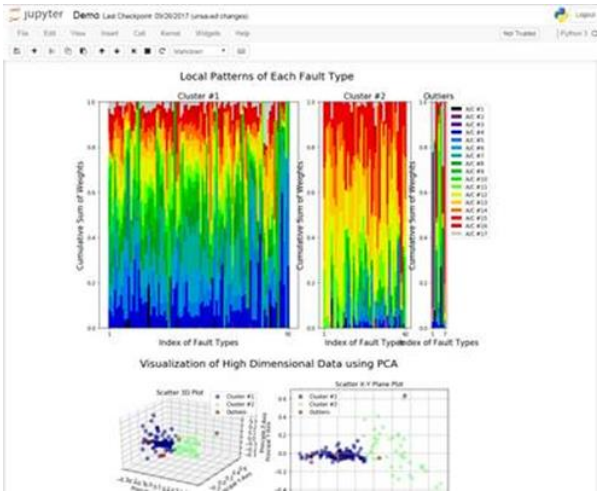

Figure 6: Running of initial prototype of data analytics algorithm on collaborative environment.

MAINTENANCE PLANNING AND OPTIMIZATION AND CONFIGURATION MANAGEMENT SOLUTIONS

The first prototype solutions were presented, demonstrated, and delivered during the last months.
The maintenance planning and optimization (MPO) first prototype covers the C-check and A-check scheduling optimization. It consists of two parts: a user interface and an optimization algorithm. The interface interacts with users. It loads input data, exports output, and displays the optimization results. After the input is loaded, the MPO tool processes the data and triggers the optimization algorithm. The algorithm optimizes the aircraft C-check and A-check schedule for several years and returns the optimized schedules to the interface for visualization.
The next steps of the MPO tool development will involve the planning of the operational maintenance activities, with a particular focus on the incorporation of unscheduled events, Engineering Orders, and SB orders, and on the definition of maintenance tasks per C-check/A-check.

Regarding the Configuration Management function, the solution has been developed and fully integrated with the Configuration Capturing function. The prototype presented was a standalone version. It has achieved a significant level of maturity in terms of available functions. The Configuration Management module covers the initialization, consultation, comparison and storage of an “as-allowed” and “as-flying” product structures. In Configuration Capturing (CC), loaders have been built to import an as-allowed view, either an Aircraft Inspection Report or a subset of the Illustrated Parts Catalogue. The scope of the as-allowed are currently being analyzed.
The next step is to work on the integration phase with an interface mainly with the Work Space from TEKEVER, in order to update the as-flying configuration based on the change introduce by work-orders (part replacement due to, e.g., SB, AD).

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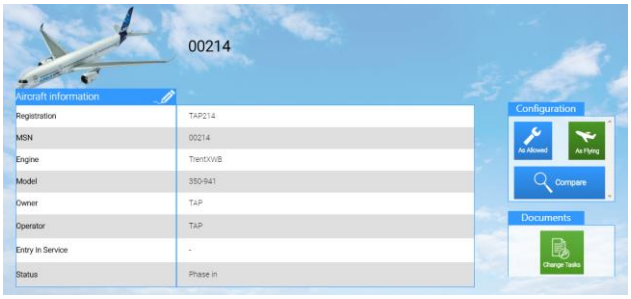

Figure 7: CM&CC prototype – Aircraft Information Page.

INTEGRATED MOBILE SOLUTIONS FOR MAINTENANCE EXECUTION ENHANCEMENT

2017 was a very active and exciting year in the work package dedicated to integrated mobile solutions. The first prototypes were built and workshops were organised to test them among end-users (Aircraft Maintenance Technicians and Back-office workers). The results obtained were very encouraging: overall, the prototypes were very well received by the end-users, which is a strong indicator that AIRMES is contributing to make aircraft maintenance works easier to accomplish, more efficient, streamlining the processes and contributing to increase workplace.

Figure 8: CAM prototype being tested in TAP line maintenance environment.

In 2017, especially in the second half, the grounds for the 2018 integration works were set and concrete actions were undertaken. On the top of the interfaces matrix (refer to previous newsletter), templates for the technical details of the interface (e.g. information to be exchanged, UC definition, data format,…) were created and partners successfully populated and delivered those documents to TEKEVER and ATOS, who will naturally be the integration leaders. The first physical integration workshop took place and it was a cornerstone in the integration definition, since it enabled an extremely rich and fruitful exchange between all partners.

We are now in a position to say that the grounds for the 2018 integration works are well set and that the team is in a position to deliver an integrated prototype that will meet the end-users' requirements.

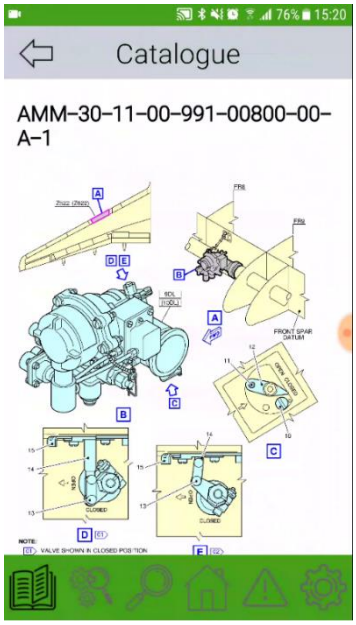

Figure 9a: Contextualised Documentation.

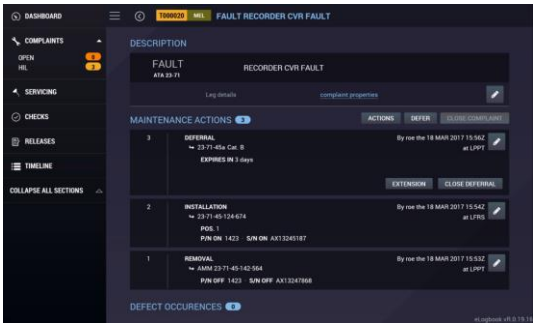

Figure 9b: Defects Reporting and Knowledge Database.

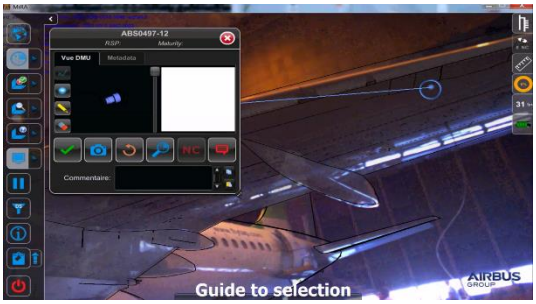

Figure 9c: AR component location.

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Figure 9d: AR structural damage location.

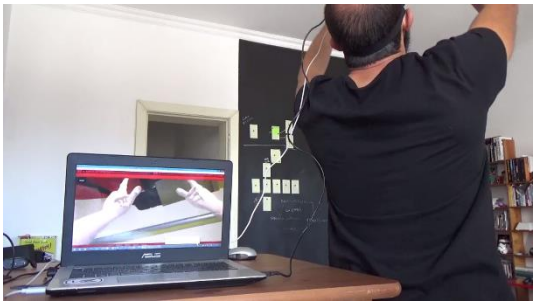

Figure 9e: Virtual Reality.

GET-TOGETHER

TRA 2018 16-19 APRIL 2018, VIENNA, AUSTRIA

The Transport Research Arena 2018 is an arena for researchers, companies and public authorities active in the field of transport. It welcomes policy makers and stakeholders framing research and transport policy to share and discuss new ideas, research results, technological solutions and new business models. The key focus areas will be:

- How digitalisation is transforming transport & mobility systems
- Decarbonisation & future growth – how to change our mobility system & remain competitive
- Shaping the new mobility landscape – a vision for transport & mobility for Europe

Source: http://www.traconference.eu/

We are happy to inform that the AIRMES partner ISQ will present a poster entitled "Implementation of advanced technologies into Aeronautic integrated maintenance concept - Use of virtual reality in ground-floor training maintenance execution" during TRA 2018 Marketplace.

ILA BERLIN 25-29 APRIL 2018, BERLIN, GERMANY

The ILA Berlin Airshow focuses on aerospace innovations in five categories: Aviation, Space, Defense & Security, Supplier and Special Features. Over 1 000 exhibitors will showcase their expertise from civil and military fields as well as from major corporations to highly specialized suppliers. Source: https://www.ila-berlin.de/en

The partner ISQ will exhibit the AIRMES Virtual Reality prototype at the joint stand of Clean Sky 2 and European Commission.

AIAA AVIATION FORUM 25-29 JUNE 2018, ATLANTA, USA

The AIAA Aviation and Aeronautics Forum and Exposition will combine the best aspects of technical conferences with insights from respected aviation leaders. Source: https://aviation.aiaa.org/

EASN-CEAS INTERNATIONAL WORKSHOP 2018 4-7 SEPTEMBER 2018, GLASGOW, UK

The 8th EASN-CEAS International Workshop on Manufacturing for Growth & Innovation builds on the successful series of EASN conferences and is the first joint EASN-CEAS International Workshop aiming to offer a forum for the presentation, discussion and exchange of information about state-of-the-art research and development activities relative to its topic. The workshop is co-organized by the University of Glasgow, the European Aeronautics Science Network Association (EASN)and the Council of European Aerospace Societies (CEAS). Source: https://easnconference.eu/

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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 # 2, we propose you several tags which will lead the interview: **objectives and stakes - Collaborative Environment – components - data consolidation – results – industry.**

STEPHANE DUPRAT
PROJECT DIRECTOR
ATOS ORIGIN INTEGRATION SAS

Q1: You are the leader of work package 4 (WP4) "Collaborative and Data Analytics Environment Demonstration" within AIRMES. Can you please remind us the **objectives and stakes** of this work package?

A1: I would say that the ambition of the "Collaborative and Data Analytics Environment Demonstration" Work Package is to help collaboration between application and between people in the most effective way. . The aeronautical maintenance domain is very large andinvolves different business and technical areas like prognostic, planning optimisation, or configuration management for example. Each of them, introduce their specific improvement, but they are also closely linked functionally. It appears in an obvious way that we need to facilitate their integration and their communication to optimize the End 2 End process. Therefore it has been proposed at the definition of the AIRMES project to provide a Cloud Platform with expected characteristics of scalability, security, and application deployment first. Secondly, the technical solution relies on the Semantic Web techniques in order to build a common comprehension of the domain and to give technical keys for data storage and data exploitation, that is the Knowledge Management feature. Atos as a digital and cloud company provides to their partners and users a Collaborative Environment as a Cloud platform with advanced features. What is at stake is to provide the good features that should be adopted by several users and partners. For that, providing technical specification is not sufficient. It is also important to accompany partners through use cases.

Q2: What are the challenges of developing the **Collaborative Environment** in AIRMES?

A2: A Collaborative Environment cannot be built from scratch, this is mainly an integration work with a part of development for specific components. The infrastructure has several technical levels and requires a wide range of skills. The different layers are starting with the infrastructure layer, then the OS of the VM, then the network and the firewall, software components for user management, authentication and security, and then applicative components, font-ends as graphic interfaces. The story doesn't end there because the platform is made to be extended by partner's applications and used.

Q3: What are the **components** and features that you and the partners are currently working on?

A3: Once a first version is built, the Collaborative Environment is continuously improved. The platform has to integrate a graphical component allowing users to manage by themselves the deployment of their applications. A better integration of the data analytics component (Jupyter Hub technology) with the other elements will facilitate data flow.

Q4: What technical solutions are under study to support the process of **data consolidation**?

A4: The main objective of Data consolidation is to be able to consistently process a large amount of data originating from different sources with common related elements but not always in the same format. The chosen solution for the AIRMES project is based on Semantic Web techniques that have been integrated in the platform and provided as services. Semantic web techniques are coming from the internet and have been created to work on different and independent data. The idea is not to impose a common and mandatory format for everyone, but to let each usage with their format and to be able to retrieve a consolidated view of all data when it is needed. Computational features of Semantic Web techniques (with advanced graph oriented queries, usage of reasoners, spin rules) offer very added values features facilitating creation of high value application.

Q5: How will the **results** of WP4 be beneficial to the AIRMES consortium?

A5: Collaborative Environment offers a wide variety of features that widely spreads its usage. A first usage can be just the host of an application developed by a partner and deployed through a containerized technique (Docker). The Collaborative Environment is not restrictive and is designed in an open way; the Data that are stored in a graph-oriented database can be accessed from either inside or outside the Platform itself.

Q6: In broader terms, how does the work align with contemporary trends in **industry**? How do you ensure that your results match the needs of end users?

A6: Another good question! There are several key points that we identified in this project, with a system integrator perspective. Broadly, the idea is the ability of a Cloud platform with enhanced features of analytics and reasoning that can address a large industrial domain. If it is tested positively on the wide domain of aeronautics, this can open other different fields. We are in the field of the Industry 4.0. More specifically we have many ambitions for the Semantic Web Technology. The integration of these techniques in this platform is opening an industrial usage of these techniques that can be valuable in various domains.

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