[EN-I-034] The role of research organizations in SESAR 2020

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[+]Dr. Helmut H. Toebben*, Prof. Dr. Dirk Kuegler*, Trond Bakken**

*Deutsches Zentrum fuer Luft- und Raumfahrt e.V., (German Aerospace Center) DLR
Institute of Flight Guidance
Lilienthalplatz 7, 38108 Braunschweig, Germany
helmut.toebben@dlr.de, dirk.kuegler@dlr.de

**Stiftelsen for industriell og teknisk forskning, SINTEF
Strindveien 4, 7465, Trondheim, Norway
trond.bakken@sintef.no

Abstract: This paper reports on the role of research organizations within the Single European Sky ATM Research (SESAR 2020) Research and Innovation (R&I) Programme. The SESAR 2020 Programme (2016 to 2021) is intended to demonstrate the viability of the technological and operational solutions already developed within the preceding SESAR R&I Programme (from 2008 to 2016) in larger and more operationally-integrated environments. SESAR 2020 is divided into two sections. One part is the so called Industrial Research (IR) and Very Large Demonstrations (VLD) part with a funding of 398 Mio. € conducted by a Public-Private-Partnership (PPP) consisting of 19 members. The second part is the so called Exploratory Research (ER) part with a funding of 81 Mio. € contracted via open Horizon 2020 calls. While the Exploratory Research covers the lower Technology Readiness Levels (TRL) 1 and 2 the Industrial Research is covering TRL 3 to 6. The above mentioned Very Largescale Demonstrations are organized in two ways. They are partly covered by the members of the PPP and partly contracted via open Horizon 2020 calls with a funding of 37 Mio. €. These calls are especially addressing the involvement of the airspace users, e.g. airlines.
The only research organizations which are full members of the PPP are: 1) Stiftelsen SINTEF from Norway as part of the North European ATM Industry Group - NATMIG Consortium 2) Deutsches Zentrum fur Luft-und Raumfahrt e. V. (German Aerospace Centre, DLR) and 3) Stichting Nationaal Luchten Ruimtevaartlaboratorium (Netherlands Aerospace Centre, NLR) together forming the AT-One Consortium. All three organizations are involved in every part of the SESAR 2020 research programme. In addition they are coordinating several projects in the Exploratory Research section plus one project in Industrial Research section and one Very Largescale Demonstration.

From the experience gained within these three research organizations, this paper will give an overview about the different research topics as well as about the role of research organizations within the SESAR 2020 programme.

Keywords: SESAR 2020, Industrial Research (IR), Exploratory Research (ER), Very Largescale Demonstration (VLD), AT-One Consortium, NATMIG Consortium, Sintef, DLR, NLR

1. INTRODUCTION

The Single European Sky (SES) Programme is an initiative of the European Commission (EC) that started in the late 90's to cope with the increasing air traffic growth, delays and concerns about efficiency of the Air Traffic Management (ATM) system. The plan was to unify, harmonize and better synchronize the European Air Traffic Management, (ATM). The major High-Level Goals of SES as stated in 2005 are [1]:

- enable a threefold increase in capacity while reducing delays both on the ground and in the air;
- improve safety by a factor of 10;
- enable a 10% reduction of the effects flights have on the environment;
- a reduction of air traffic management (ATM) service costs to airspace users of at least 50%.

This resulted in the creation of the Single European Sky ATM Research (SESAR) Programme which is the technological pillar of the SES. SESAR was aimed at developing the operational concepts and technology required to achieve objectives of SES. The SESAR Programme is generally divided into three phases (see Figure 1):

- The definition phase (2004–2008) aimed at defining the way forward and resulted in the "European Air Traffic Management Master Plan" (ATM Master plan) [2]
- The development phase (2008–2021) is going to develop, validate and demonstrate the required solutions. The programme is managed by the SESAR Joint Undertaking (SJU) and is divided in

SESAR (2009-2016) and SESAR 2020 while SESAR 2020 is again split into two waves (2016-2019 for Wave 1 and 2019-2021 for Wave 2).

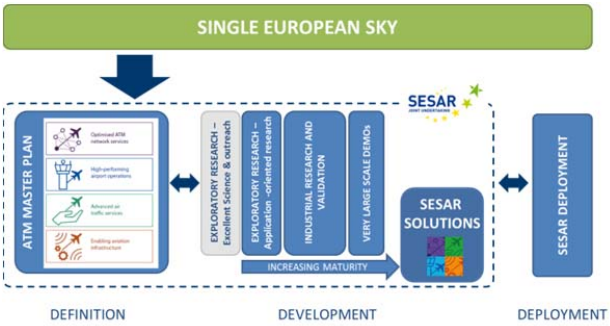

Figure 1: The big picture [3]

- The deployment phase (2014–2020) is conducted by the SESAR Deployment Manager (SDM) who coordinates the implementation of the EU's Pilot Common Project (PCP) to ensure that the solutions derived from the ATM Master Plan are deployed in a timely, coordinated and synchronised manner in Europe.

2. SESAR 2020

The currently running SESAR 2020 programme is structured into three main research phases (Figure 2) with different associated funding schemes.

Figure 2: Research Areas of SESAR 2020 and funding [5]

Phase 1 – Exploratory Research (ER)

Exploratory Research is funded via open Horizon 2020 calls and is further broken down into two areas. One is covering the fundamental science and outreach. The other investigates the initial applications of this science for ATM.

Phase 2 – Industrial Research & Validation (IR)

The Industrial Research & Validation represents the major part and includes Applied Research as well as Pre-Industrial Development and Validation. This part is covered by the SJU public-private partnership (PPP).

Phase 3 – Very large Scale Demonstrations (VLD)

The third phase consists of the Very Large Scale Demonstrations (VLD) of concepts and technologies. This part is funded twofold: it is partly covered by the PPP and its members and partly by open Horizon 2020 calls securing the involvement of Airspace Users (AU) in the Programme.

The three research phases cover a technology maturity level ranging from 1 to 7 in the scale of the Technology Readiness Levels (TRL) [6] as shown in Figure 3.

Figure 3: SESAR 2020 Technology Readiness Levels (TRL) [5]

At the entry level, the Exploratory Research is covering fundamental research ranging from fundamental scientific research at TRL 1 to application-oriented research at TRL 2. During this phase, research is focussed on the understanding of basic principles and the translation of scientific results into applied research. It is also taking inventions from other domains like computer science or automotive industry in to account. ER is trying to introduce these into the ATM area. This fundamental research shall discover new seeds which can then be feed into Industrial Research. The Exploratory Research Call also covers the area of drones. It contains one general call on drone topics and one specific call about geo-fencing.

Before any new concept is developed further towards higher TRL in SESAR 2020, it has to successfully pass several gate reviews. This gate reviews are set up following the European Operational Concept Validation Methodology (E-OCVM) [7]. In Exploratory Research, a concept has to pass the TRL2 gate which means the necessity and the potential benefits of the new concept are well identified. If a concept passes this review gate it will then be taken into the main area of SESAR 2020 which is the Industrial Research part.

Within the IR there are three more gate reviews to pass (V1 to V3):

- **V1 Scope** – Definition of the operational concept and technical solution. Identification of potential costs and benefits.

- **V2 Feasibility** – Concept development and exploration of its feasibility mainly via simulation.
- **V3 Pre-industrial development & integration** – Transition from research to an operational environment; validation of required benefits. Done via implementation of industrial prototypes in realistic environments.

When a concept has passed the gate review V3 it is used in a VLD which means it is demonstrated in real world scenarios. After having passed the final demonstration gate, the concept is ready for deployment within ATM.

The industrial research is further divided in four key areas capturing the operational improvements and technical enablers:

- High Performing Airport Operations
- Optimised ATM Network Services
- Advanced Air Traffic Services
- Enabling Aviation Infrastructure

Each of these key areas is further decomposed in several projects which are then divided into several solutions. Figure 4 is giving an overview of the current projects within SESAR 2020. PJ19, PJ20 and PJ22 are the so called transversal projects which are meant to interconnect the single projects to a programme. The left hand column contains 15 fundamental scientific research TRL 1 projects. The second column contains 7 projects on drones and also provides some place for further projects on drones. The next column then contains 9 application-oriented research projects with TRL 2. It is followed by the largest block consisting of 17 IR projects. On the most right it is finished by the 5 VLDs.

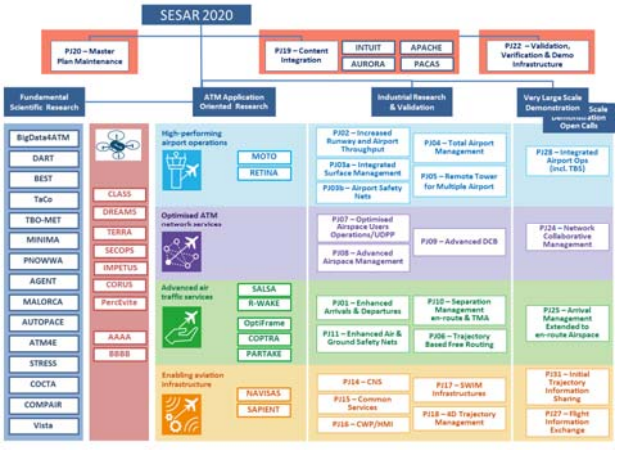

Figure 4: SESAR 2020 projects [4]

3. Involvement of Research Organizations

Three large research organizations are involved in the SESAR 2020 Programme. Two of them are forming the AT-One Consortium. Those are Deutsches Zentrum fur Luft-und Raumfahrt e. V. (German Aerospace Centre, DLR) and Stichting Nationaal Luchten Ruimtevaart-laboratorium (Netherlands Aerospace Centre, NLR). This consortium is involved in all three parts (ER, IR, VLD) of the SESAR 2020 Programme and is coordinating several projects within the Exploratory Research, one project in Industrial Research and one Very Largescale Demonstration.

The third research organization is Stiftelsen SINTEF (the Foundation SINTEF) as part of the North European ATM Industry Group - NATMIG Consortium. SINTEF was already part of the first SESAR Programme and is also involved in all three phases of SESAR 2020.

AT-One

The AT-One consortium had already applied to become a full member in the preceding SESAR Programme but unfortunately was not selected. Nevertheless AT-One, or NLR and DLR respectively, were participating in SESAR in several projects in many different roles. After not being selected as a full member to SESAR, AT-One applied as so called Associated Partner to SESAR and was selected in several calls for proposals. In addition, NLR and DLR became subcontractors of different full members like DFS Deutsche Flugsicherung GmbH and Air Traffic Control the Netherlands (LVNL).

Although it has been stated that *"Research did not deliver"* prior to SESAR it is evident that the opposite is the truth. Without the large Research Institutions, there would be much less innovation in ATM research. One very good example is the idea for Remote Tower [8]. Figure 5 shows the timeline of the Remote Tower development. The idea was born in 2002 within a DLR internal contest for new ideas. As one of the winners of this contest, the idea of a virtual or remote tower surveillance started with a small DLR internal funded concept study named ViTo (Virtual Tower). It was then followed by two large DLR internal funded projects with a funding of about 6 Mio. € named Remote Airport Tower Operation with Augmented Vision Videopanorama Human System Interface (RapTOr) and Remote Airport Traffic Control Center (RAiCe).

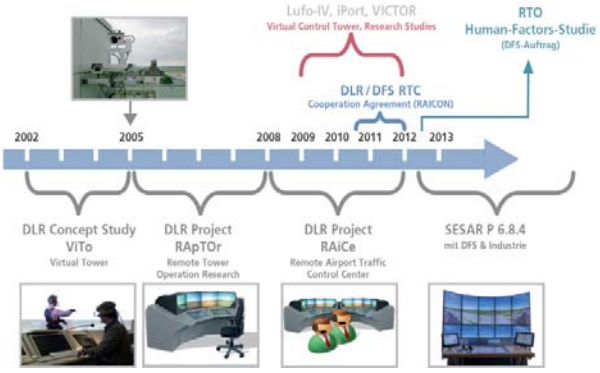

Figure 5: Timeline of Remote Tower projects

After being patented and funded internally at DLR for 6 years, the first cooperation with DFS started in 2008. This

cooperation was initialized with the cooperation agreement between DLR and DFS called Remote Airport Cooperation (RAiCon) and the national funded project Virtual Control Tower Research Studies (VICTOR). By 2012 the project was then taken on-board of SESAR in project 6.8.4 and is now further investigated within PJ05 Remote Tower for Multiple Airports of SESAR 2020.

Another excellent example with respect to innovation through active partnership between research organizations and industry is the continuous development of the concept of "Sectorless Air Traffic Control"; in SESAR 2020 now known as "Flight and Flow- Centric Operations". As in military radar vectoring, this concept supposes that the given airspace is not subdivided into geographically separated sectors where two active Air Traffic COntrollers (ATCO) are controlling each sector. It rather assumes an airspace concept with no sectors in a given airspace at all. Instead, one ATCO actively controls an aircraft during its complete trajectory from the entry point to the exit point of an airspace. Extensive simulation trials at DLR have shown that one ATCO hour can control up to four aircraft hours within this concept whereas in the current sectored regime the efficiency is rather in the area of two controlled aircraft hours per ATCO hour [9].

This principle concept has been studied by paper research before DLR started the extensive research in 2008 together with DFS Deutsche Flugsicherung GmbH (German Air Navigation Services). DLR together with DFS has sufficiently matured the concept by developing the first comprehensive simulation platform and transported it onto the European agenda where "Flight and Flow- Centric Operations" now is the key innovation theme inside SESAR 2020. Furthermore, many European ANSPs are starting projects to implement the concept within their airspace.

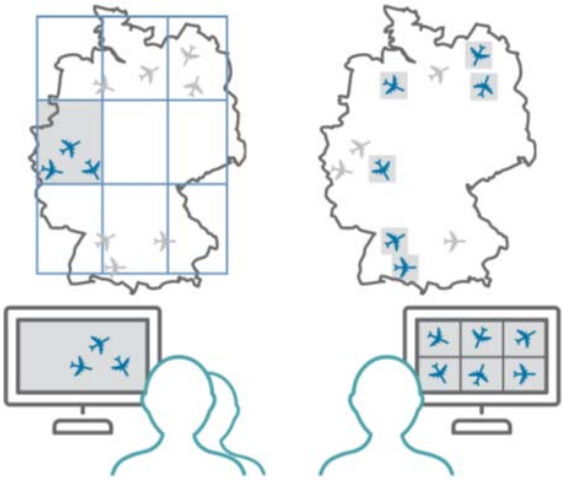

Figure 6: Sectorless ATC principle

SINTEF

Towards the end of the SESAR definition phase, SINTEF realized that it would be important to become a member of SESAR to take part in future European ATM research. SINTEF, as the only research organization, partnered with a few industrial companies and established NATMIG with the ambition to become a full member of the first SESAR Programme. SINTEF carries out contract research in a wide range of scientific and technical areas. The business model spans from basic research with main focus on applied research to commercialization of results into new business ideas.

SINTEF Digital is specialized in leading edge information and communications technology which forms the technology basis for the ATM activities. The technological areas considered to be most relevant to SESAR 1 were:

- Information Modelling - Creating the Aviation internet
- Ground, air and satellite Communications – enabling the Aviation internet
- Traffic Synchronisation and optimization – predicable arrivals
- Reduced environmental impact (Noise)
- Aircraft turbulence – reduced separation
- ATM Safety and Security
- Human Performance
- Risk Modelling
- 3D Modelling for remote tower operations
- Optimization algorithms for ATM safety Nets

In SESAR, SINTEF participated in more than 30 industrial research and development projects and participated and managed several exploratory research projects in the so called Work Package E.

For example, SINTEF led the project ZefMap that was aiming at introducing process improvement methods and tools coming from other domains in the context of tower control rooms. The project showed that optimization tools for planning can do calculations and trade-offs (probably) outside of human capability when handling Hamburg airport in simulated scenarios. The decrease in average taxi time was between 33% and 36% while punctuality improved from 57% to 67%.

For SESAR 2020, SINTEF focuses on these topics:

- Operational analysis/optimization
- Digital communication and networks
- Satellite navigation
- Frameworks for model based architectures
- Safety and risk models, including Resilience
- Verification and validation

One of the most important arguments for SINTEF to join private public partnerships is that the research is done together with the industry and future customers developing

requirements and bringing it towards implementation together. Additionally, the European Commission with their member states put everything into force by implementing new regulation and legislation. One drawback can be that in PPPs like SJU, the funding is the same for all members. This implies that a research organization is funded at the same rate as the industry, which can be challenging since the business model of a research organization is very different compared to the manufacturing industry or the air navigation service providers.

4. SESAR 2020 Exploratory Research

This chapter gives a short overview of the projects with the participation of AT-One and SINTEF in current SESAR 2020 ER. This list is not complete as there are still some calls open for decision.

MINIMA (DLR) - MItigating Negative Impacts of Monitoring high levels of Automation

Introducing systems that execute tasks formerly executed by human operators and leaving the operator with a monitoring role often leads to unintended results. MINIMA is working on a solution for this. Brain activity will be measured to infer the operator's vigilance and the task will be adapted to the needs of the operator in real-time.

MALORCA (DLR, NLR) - Machine Learning of Speech Recognition Models for Controller Assistance

One of the main causes hampering the introduction of higher levels of automation in the Air Traffic Management (ATM) world is the intensive use of spoken language as the natural way of communication. One promising solution is the introduction of automatic speech recognition as an integral part of automation. This project proposes a general, cheap and effective solution to automate the adaptation and customization of automatic speech recognition to new environments, taking advantage of the large amount of speech data available in the ATM world.

CORUS (DLR) - Concept of Operations for the EuRopean UTM System

The project CORUS will develop an operational concept enabling safe interaction between all airspace users in Very Low Level (VLL) considering contingencies and societal issues. The project will provide a clear and well defined concept of operations which will support ongoing Unmanned Traffic Management (UTM) research and is expected to influence UTM systems to be put in operation from 2020 onwards.

AIRPASS (DLR, NLR) - Advanced Integrated RPAS Avionics Safety Suite

The variety of drones, the variety of operations they perform, the variety of locations, in any class of airspace, make an infinite number of combinations which need to be safely integrated in the airspace and be interoperable with other drones as well as with conventionally piloted aviation (including the ATM system). Within the AIRPASS project the on-board technologies for drones that are required in order to implement the UTM concept for drone operations in VLL conditions and within the visual flight rules (VFR) environment will be addressed.

BEST (SINTEF) - Achieving the benefits of SWIM by making smart use of semantic technologies.

BEST will determine how semantic technologies can be used effectively to maximize the benefits of adopting system-wide information management.

PACAS (SINTEF) - Participatory Architectural Change Management in ATM Systems.

PACAS will model and analyse changes at different layers of the ATM system to support change management, while capturing how architectural and design choices influence the overall system

SALSA - Satellite-based ADS-B for Lower Separation Minima Application (DLR)

The introduction of an integrated Air Traffic Surveillance system, using satellite based, terrestrial and maritime ADS-B receiver stations, allows for a global and seamless surveillance of air traffic also in the non-radar airspaces (NRA), e.g. the transatlantic routes. The project SALSA will conduct studies, which will help to introduce reduced separation minima in NRA, once space based ADS-B surveillance is operational.

5. SESAR 2020 Industrial Research

The following examples show some of the major contributions from the research organizations in the IR. The full coverage of their contribution is much wider but mentioning all projects would go beyond the scope of this paper.

PJ01 Enhanced Arrivals and Departures

The project addresses the development of concepts, tools and procedures to increase the capacity of Extended TMAs (E-TMAs) to meet forecast traffic growth in a safe, cost-effective and environmentally sustainable manner. DLR is solution lead for PJ.01-06 (Enhanced Rotorcraft and GA operation in the TMA) and responsible for the design of advanced PinS procedures including GNSS contingency loss procedures, integration of a helmet mounted display system, and the conduction of validation flight.

PJ 02 EARTH Enhanced RWY Throughput

PJ02 addresses situations of over-demand on capacity constrained airports related to separation minima, considering constraints such as weather, environment, noise, runway configuration, mixed mode operations, surveillance and traffic mix, with a view to optimising traffic throughput with existing infrastructure, improving safety and environment. DLR is contributing to PJ.02-01 (Wake Turbulence Separation Optimisation) with the topics weather dependent separations both for arrivals and

departures as well as onboard wake vortex prediction. Further, it leads the concept “wake decay enhancing devices” conducting a live trial for the assessment of enhanced wake vortex decay rates at Vienna airport. SINTEF is part of solution PJ.02-08. The solution aims at providing ATC with integrated dynamic assistance tool to improve single and multiple runway airport operations by increasing predictability of runway capacity, optimizing runway configuration and optimizing arrival and/or departure spacing.

PJ 03a SUMO Integrated Surface Management
The project PJ03a will contribute to the key feature High Performing Airport Operations. One of the main objectives is to improve the predictability of ground operations in all weather conditions. The implementation of collaborative decision making processes involving all relevant stakeholders will ensure an optimization of airport resources allocation.

SINTEF is part of Solution 1 in PJ.03a. The main focus here will be in developing optimization algorithms for route planning and scheduling of taxing airplanes and vehicles at the aerodrome.

PJ04 Total Airport Management (TAM)
The project consists of two solutions, addressing ‘Enhanced Collaborative Airport Performance Monitoring and Planning’ in Solution 1 and in Solution 2 the corresponding ‘Enhanced Collaborative Airport Performance Management’. In Solution 1 DLR is providing conceptual support. While Solution 2 and the conceptual work around Total Airport Demand Capacity Balancing is led by DLR. Together with Eurocontrol DLR is developing an enhanced concept concerning Airport and Network integration in performance deteriorated situations. Its feasibility will be explored in a validation exercise around Airport Operations Centre (APOC) to APOC coordination with the Network Manager. SINTEF is planning exercises and developing simulator prototypes with Oslo airport, Gardermoen (SEAC), AT-One, COOPANS and Leonardo.

PJ05 Remote Tower for Multiple Airports
The project consists of two operational and one technological solution, addressing ‘Remotely Provided Air Traffic Service for Multiple Aerodromes for up to three airports’ in Solution PJ.05-02, ‘Highly Flexible Allocation of Aerodromes to Remote Tower Modules’ in solution PJ.05-03 and ‘Advanced Automated MET System’ in the technological solution PJ05.-05. The project is coordinated by DLR and, in addition, with valuable technical contribution to the solutions themselves. In PJ05-02 in the DLR Braunschweig Tower Laboratory a multiple remote tower solution whereas one controller controls three airports simultaneously is set up and, together with HungaroControl, Frequentis and Selex AS, tested for its feasibility. In PJ.05-03 DLR (AT-One) will provide its validation know-how to perform an exercise at a DFS simulator platform, which hosts a Frequentis remote tower prototype, to proof its feasibility to operate multiple remote control in a highly flexible allocation of aerodrome within and in between of Remote tower modules in a remote tower centre environment. SINTEF will contribute to both Solution 02 and 03. For 02 SINTEF will contribute to improving remote tower services for more than one airport, by integrating their 3D technologies into a remote tower solution. Work to be addressed includes validating improvements to ATCO situational awareness through coupling 3D model with video as well as automation of runway incursion alarms based on improved detection. It will also include technical aspects, such as network quality of service and other resilience/redundancy related issues. For Solution 03, SINTEF will provide methodological and conceptual tools for the validation and implementation of a resilient, flexible allocation of aerodromes to Remote Tower Modules (RTM).

PJ 08 AAM Advanced Airspace Management
The major objective of the PJ08 Advanced Airspace Management project is to make the Dynamic Airspace Configuration (DAC) Concept from SESAR 1 further grow in maturity by enhancing the operational processes and automated tools that will support Sector Design and Sector Configurations. SINTEF is 1) leading an exercise for the design of new CWP HMI able to receive dynamic sector configuration updates 2) do the human performance assessment in two exercises 3) give advice on the DAC algorithm and how to integrate in the collaborative DCB process.

PJ 09 DCB Advance Demand and Capacity Balancing
Project PJ09 Advanced DCB is addressing the performance driven balancing of traffic demand and ATM capacity in a collaborative process with all ATM stakeholders and Airspace Users involved. The major objective of the PJ09 Advanced DCB concept is to evolve the existing DCB process to a powerful distributed network management function which takes full advantage from the SESAR Layered Collaborative Planning, Trajectory Management principles and SWIM Technology to improve the effectiveness of ATM resource planning and the network performance of the ATM system in Europe. SINTEF is leading an exercise for the design of new CWP HMI able to receive dynamic sector configuration updates, develop technical specification for Constraint Reconciliation algorithm and prototype development.

PJ10 Separation Management en-route & TMA
The SESAR 2020 project PROSA (Controller Tools and Team Organisation for the Provision of Separation in Air Traffic Management) focusses on separation management. The project also addresses new ways of working together. Air traffic controllers traditionally work in pairs within specific airspace. Could we change this traditional setup to multi-planner setup, sectorless airspace and seamless

cross-border operations? One part of the PROSA project is the solution "Flight Centric ATC", coordinated by DLR. Flight Centric ATC is based on the concept of sectorless ATM, which envisions en-route air traffic control without conventional sectors. Since 2008, DLR has been researching the sectorless ATM concept together with their partner DFS Deutsche Flugsicherung GmbH. In the PROSA solution DLR, together with the Hungarian air traffic control service HungaroControl, will carry out trials on the practical implementation of Sectorless ATM in Hungarian airspace.

PJ 14 EECNS Essential and Efficient Communication Navigation and Surveillance Integrated System

PJ14 EECNS, as one of the enabling projects, aims at providing advanced, integrated and rationalised aviation infrastructure for Communication, Navigation and Surveillance (CNS), supporting High Performing Airport Operations, Optimised ATM Network Services and Advanced Air Traffic Services and providing the underlying technical capabilities to meet the operational improvements. SINTEF contributes to the development of satellite navigation through the activities on MC/MF GBAS CAT II/III ground system prototype development and validation including evaluation of the requirements set for a MFMC GBAS, verification of the MCMF ground sub-system functions and operational evaluation through modelling/live data analysis.

PJ16 Controller Working Position Human Machine Interface (CWP HMI)

PJ16 project aims to reduce development and operating costs of ANSP in two solutions. DLR is leading the second solution PJ16.04 that deals with new methods of controller interaction like Multi Touch Inputs or Automatic Speech Recognition with the Human Machine Interface (HMI), applying mature technologies from other domains to ATM. This will increase controller productivity, reduce workload, stress level, and enable the use of SESAR advanced tools, safely facilitating performance based operations. Amongst other actions DLR develops Assistant Based Speech Recognition Components for different CWPs and an Attention Guidance prototype. SINTEF will contribute with state-of-the art knowledge in user interface modelling, user interface design and rapid prototyping.

PJ14 Essential and Efficient CNS

The project addresses the development of a suite of integrated Communication, Navigation, and Surveillance (CNS) solutions meeting the operational requirements of the ATM system in the short, medium and long term with technologies that are consistent with the European ATM Master Plan and the ICAO Global Air Navigation Plan. DLR leads the specification of the LDACS data link in PJ.14-02-01 and is solution lead for PJ.14-03-04 (Alternative Position, Navigation and Timing).

PJ18: 4D Trajectory Management

The project develops and provides enablers for a future spatio-temporal management of flight trajectories in the framework of Single European Sky. DLR participates in Solutions PJ.18-04b “MET information Services” and PJ.18-04c “AIM and MET information use in the cockpit”. It leads three tasks in 18-04b: “CC2.3 Cockpit-Ready MET”, “CC3.3 MET Information Generation for Climate-Optimized Routing” and “IS.5 MET Information Service for Aircraft Information and Control Domains”. DLR further collaborates in other tasks in 18-04b and c. DLR develops products and services for weather hazards as well as climate change functions along planned flight tracks.

PJ 19 CI Content Integration

PJ 19 is executing the programme steering as provided and endorsed by SJU management and SESAR governance, and integration of developed content (e.g. SESAR CONOPS, Functional Architecture, Information and Services) in the SESAR programme. SINTEF's main contribution is related to service- and information architecture development including support for application on the architecture development method within the solution projects.

6. SESAR 2020 Very Large Scale Demonstrations

DLR is leading a VLD which is very closely related to the project PJ04 Total Airport Management.

PJ28 Integrated Airport Ops

The SESAR Integrated Airport Operations (IAO) Project is a Very Large Scale Demonstration (VLD) and consists of five demonstrations out of which two are on-board exercises while the other three take place at the airports of Nice, Budapest and Hamburg. In those demonstrations IAO will cover ATM solutions in the areas of Manual and automated taxi routing, Pre-Departure Sequencing, On-board Traffic alerts and Airport safety nets. DLR (AT-One) is coordinator of the project, is responsible for the dissemination activities (including video preparation) and leads the demonstrations at Hamburg Airport. Using the Airport Research and Innovation Facility Hamburg (ARIF) DLR and its partner SINTEF will demonstrate optimized surface management functions for controllers in a live airport environment.

7. CONCLUSIONS

Firstly, this paper gave an overview of the complex structure of the most important European research programme on ATM research SESAR 2020.

Secondly, with the example of Remote Tower, the paper showed how important and inevitable the involvement of research organizations in large research programmes is. New ideas that were brought into the SESAR 2020 programme by the research organizations like e.g., “Flight and Flow- Centric Operations” (or “Sectorless Air Traffic

Control") and new means of human machine interaction, underline this in the current research programme. With that, the paper supports the thesis that "*ATM Research does deliver!*".

8. ACKNOWLEDGMENTS

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