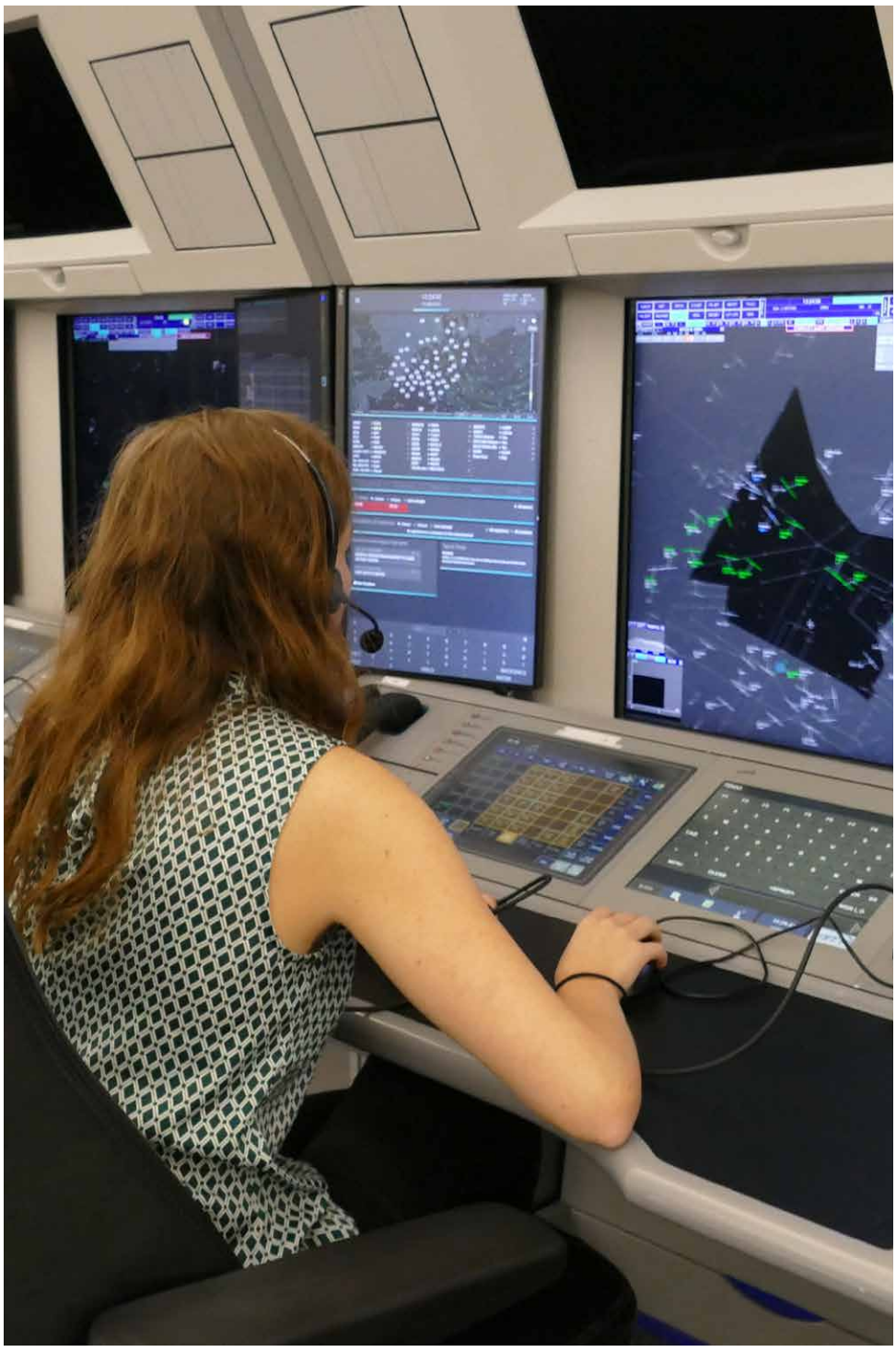
FOCUS ON…MUAC TECHNICAL SYSTEMS

Operating in one of the busiest airspaces in Europe, EUROCONTROL MUAC is handling demanding and complex technical developments. Members of the **MUAC Technical Systems Uni**t and **MUAC Ops Units** outline some of their work concerning digitalisation in ATM.



"MUAC has always had a pioneering spirit, and we are currently undergoing more change that at any time in history"

I lead the Technical System Unit (TSU) composed of more than 150 engineers responsible for the development, maintenance and operations of MUAC's IT infrastructure and applications. We serve internal and external operational users, ensuring the continuous evolution and round-the-clock safe and efficient operations of our advanced technical systems. We work in close collaboration with change management and operational staff to support current operations, ATM development, and technical system development.

There is growing demand and complexity, both in traffic and in terms of technology. From a technical perspective, there are two key areas of focus: automation and interconnectivity. In terms of automation, in the Ops area there are plans to make flow management more autonomous, for example. This will involve ensuring optimal sector opening times and ATCO rostering. There will also be more automation in the ATC area with regard to delegation from human to machine in certain low complexity scenarios and more automation support in high complexity scenarios. Behind the scenes, test automation and automation of software integration and deployment is being introduced. This is to help cope with the scale and complexity of engineering work. Every year, we have four to five major system updates and up to 100 system baselines. System

resilience is critical to ensure we can anticipate, monitor, respond and learn.

In terms of interconnectivity, a big change is that systems are now more interlinked. We have moved from traditional separate systems toward more interconnectivity, especially in terms of Air Traffic Flow and Capacity Management (ATFCM), where there is more interconnection with the Network Manager, as well as with airlines and airports. Security and resilience must be embedded in system design, including the system architecture.

My focus is on the evolution of technology, including the strategy and vision. One key ambition of MUAC is to become a certified ATM data service provider serving several Ops rooms at different locations. This is the 'ATM Data as a Service' (AdaaS) concept, which was already demonstrated in partnership with Slovenia Control. The concept is centred on a common ATM system replicated in two geo-redundant data centres to cope with maintenance requirements and the risk of catastrophic failures. The service will initially apply to the Belgian ANSP skyes and the Belgian Air Force, as well as Slovenia Control. We also foresee an agreement with DFS for their Karlsruhe Centre, to cooperate further on common system developments and virtualisation.

MUAC has always had a pioneering spirit, and we are currently undergoing more change that at any time in history. This is not only a technological change, but also a cultural shift and change in the whole organisation. I am fortunate and proud to be leading a great team of engineers, working with our partners to deliver a world-class system.

Răzvan Mărgăuan
Head of Technical Systems

"Digitalisation has led us to change the way we think"

My role is day-to-day management of the MUAC Ops room for systems, airspace and procedures. I help to make sure that the conversation between the Technical Systems Unit and Ops is fluent. I help to ensure that the severity of issues reflects the reality, that workarounds are developed and known to 24/7 staff, and that correct priority is given for implementing solutions.

We manage our high complexity interdependent systems by creating points in our processes to meet weekly for coordination and monthly for trend analysis. The conversations focus first on safety then balancing sometimes conflicting interests. In some cases, Ops accepts delays in non-critical implementation if the technical sequence of baseline implementation is complex. In other cases, the Technical Systems Unit works on issues we identify as critical and with highest priority by delaying other non-critical work. Often, we have to coordinate with many external military, civil, technical and operational partners.

Digitalisation has led us to change the way we think of not only systems but also accompanying procedures, competencies and the management of critical events. For example, we understood that we have to develop technical ability to monitor any system's health and monitor the data quality within the system. At the same time, there are intense conversations on how we deal with increased automation, detection of credible corruption and data streams. We are constantly learning as we go, and perhaps one of the most important things we have internalised is never to be complacent.

Milena Bowman
Executive Manager Airspace, Systems and Procedures, MUAC OPS

"The challenge is always to keep the right balance between correct functioning, operational acceptance, and pace of delivery without jeopardising safety"

The MOSYS team consists of a variety people with different operational and technical backgrounds. They work closely together with other actors across the organisation and external partners to develop an understanding of the different requirements, and continuously look for improvements and develop new innovative concepts. It is critical to deliver products to meet the customer's needs, while keeping the overall system design and integrity as a central consideration.

As we have most of our own technical systems development in-house, and work 'close' to the customer, we can develop at a rapid pace. This requires a challenging change management process to allow sufficient validation from end-user perspective. We all know that with innovative products not everything is right from the start. The challenge is always to keep the right balance between correct functioning, operational acceptance, and pace of delivery, while maintaining safety.

Kristof Schippers
Team Lead, MOSYS (MUAC Operational Systems)

"The new Shared ATM System will run from the MUAC data centre and will provide ATM-Data-As-A-Service"

MUAC, the Belgian ANSP skeyes, and the Belgian Air Force are jointly designing a Shared ATM System (provisionally called 'SAS3'). SAS3 will run from the MUAC data centre and will provide ATM-Data-As-A-Service (AdaaS) to the OPS room at skeyes, Tower systems at Belgian airports and to the different airbases of the Belgian military. An equivalent service will be used by our own MUAC Ops room. All AdaaS instantiations are set up as a managed service provided by MUAC in collaboration with its partners. Dedicated system clusters for each Ops Room ensure that failure modes in one cluster do not propagate to a neighbour. This allows horizontal scalability (serving more Ops Rooms in the future), while still supporting rich interoperability and re-use of software (we always maintain the same software version for all OPS Rooms with configurations specific to each).

A particular challenge is interfacing with auxiliary systems not managed by MUAC, like arrival managers, tower systems, electronic strip systems, or safety nets specific to lower airspace. This will be achieved by the 'OpenATM' interface, a standard system-wide information management (SWIM) interface based on modern technologies that will serve as a common integration layer.

Herbert Naessens
Team Lead Architecture & Systems Engineering (TS/ASE) and Project Manager Traffic Prediction Improvements (TPI)

"We have recently started to explore the potential benefits of artificial intelligence"

Our team is mainly working on increased automation of various areas of the ATM business. Current topics include manpower planning tools, where advanced mathematical optimisation techniques allow for a high degree of automation of ATCO work planning, down to the allocation of physical positions in the Ops room. These tools are highly adaptive and maximise staff comfort while minimising traffic delays. While these tools are already fully operational at MUAC and NM, the next generation is currently being developed with both functional enhancements and technological transformations. Another important topic is the development of novel assistance tools for the ATCO such as conflict detection and resolution tools, paving the way toward automated ATC monitoring and control. Years ago, we deployed the first operational implementation of machine learning in ATM worldwide (the Traffic Prediction Improvements project led by my colleague, Herbert Naessens). To take the concept further, we just started to explore the potential benefits of artificial intelligence in a potential fully automated flow management process based on machine learning (deep neural networks).

Micha Janssen
Team Lead Airspace, Capacity and Environment (TS/ACE)

"We support the virtualisation platforms on which almost all components of the ATM system are running"

My team is working on a variety of components of the MUAC ATM system. As a service to the other teams, we support the virtualisation platforms on which almost all components of the ATM system are running. Additionally, we provide tools for the Ops room and maintain the simulator used for ATCO training and system testing.

Concerning digitalisation, I would like to emphasise two great recent achievements: the new Operational Support Data Retrieval (OSDR) and the deployment of the remote test and training infrastructure. In 2017, my team started with the development of the new OSDR. We deployed the first version in October 2018 and made it possible for ATCOs and other Ops room staff to access all operational documentation electronically from their position. The information is displayed in a web browser on a dedicated screen next to the radar screen.

Now, three years later, many functions have been added, such as graphically displaying weather predictions (wind, CB nowcast, turbulence, and temperature), METARs, NOTAMs, aircraft performance, current and upcoming sectorisations with current and predicted load, planned activations of danger/restricted areas, etc. Many other features are in the pipeline.

In order to uphold essential controller training and software test and development activities during the lockdown period, we made the MUAC's Test and Training available outside the MUAC premises. Together with other teams, we rolled out this development in record time after the start of the lockdown in March 2020.

From early April 2020 onwards, MUAC employees have been able to use within a web browser on their private PC at home, controller working positions in the Test and Training Room.

This solution allowed MUAC to uphold its development, test and training capacity, whilst keeping staff numbers at the premises to the minimum. Meanwhile ATCOs use this set-up also for self-training and in meetings to demonstrate the functionalities of our ATM system by sharing the controller working positions via MS Teams. This has allowed us to keep the competency of our ATCO staff up to date and is a key enabler to the swift and flameless traffic recovery with zero impact for the airlines and the passengers. The benefits of this remote test and training solution will extend beyond the pandemic and will be enlarged and automated further.

Dominique Mathijs
Team Lead, Simulation – Replay – Support (TS/SRS)

"We maintain one of the most complex and one of largest sub-systems of the Maastricht Data Processing and Display System"

In the Flight Data Processing (FDP) team, we maintain one of the largest and most complex systems of the Maastricht Data Processing and Display environment (MADAP). The FDP is truly the 'brain' of our technical system, responsible for generating and maintaining the flight trajectories and the distribution of flight relevant information to the controller working positions and to many other sub-systems.

For a safety-critical system with a large code base (over 1 million lines of code), such as FDPS, the risk of 'regression' grows statistically with new developments. A regression is when a code change in the software impacts the existing functionality, perhaps where a feature stops working (a type of software bug).

Until recently, 'non-regression assurance', which aims to verify whether new or modified functionality operates correctly, has been achieved through long sessions of manual testing by the FDP team. This year, we modernised our testing capabilities by automating our regression tests. For that purpose, we are using a test engine that allows us to write test scenarios that can be executed automatically and on-request. We have currently completed the foundation of the test framework and started developing automatic tests, replacing our manual tests. The next step will be to put in place a test-driven development methodology where each new software change will bring additional tests, which will continuously improve system robustness and stability. The new test framework will be introduced in January 2022.

With the latest SAS3 cooperation agreement signed by MUAC and the civil and military Belgian ANSPs, the technical roadmap will include major changes. Automatic tests are the only test strategy that can efficiently mitigate that risk. Thanks to the automatic tests, non-regression assurance can be done earlier on, and we will save on testing effort. This will allow our team to focus on functional features, dedicate more time to innovation, and better support the OPS room.

For MUAC, this is a major milestone on the path of building a fast and efficient continuous integration and deployment pipeline to ensure a resilient and futureproof MADAP system.

Khaled Badri
Team Lead, Flight Data Processing (TS/FDP)

Learn more

About our Maastricht Upper Area Control Centre https://www.eurocontrol.int/info/about-our-maastricht-upper-area-control-centre

Traffic prediction improvements https://www.eurocontrol.int/project/traffic-prediction-improvements

Civil and military air traffic control in Belgium now managed using a single air traffic management system https://www.eurocontrol.int/press-release/civil-military-atc-belgium-managed-using-single-atm-system

ATM Data as a Service (AdaaS) - Towards the concept of data centres https://www.eurocontrol.int/publication/atm-data-service-adaas-towards-concept-data-centres

EUROCONTROL and Slovenia Control sign cooperation agreement to deploy the ATM Data as a Service concept https://www.eurocontrol.int/news/eurocontrol-muac-slovenia-control-sign-agreement-deploy-adaas

All civil and military air traffic controllers to use the same system to manage Belgian airspace https://www.eurocontrol.int/press-release/civil-military-atc-use-same-system-manage-belgian-airspace