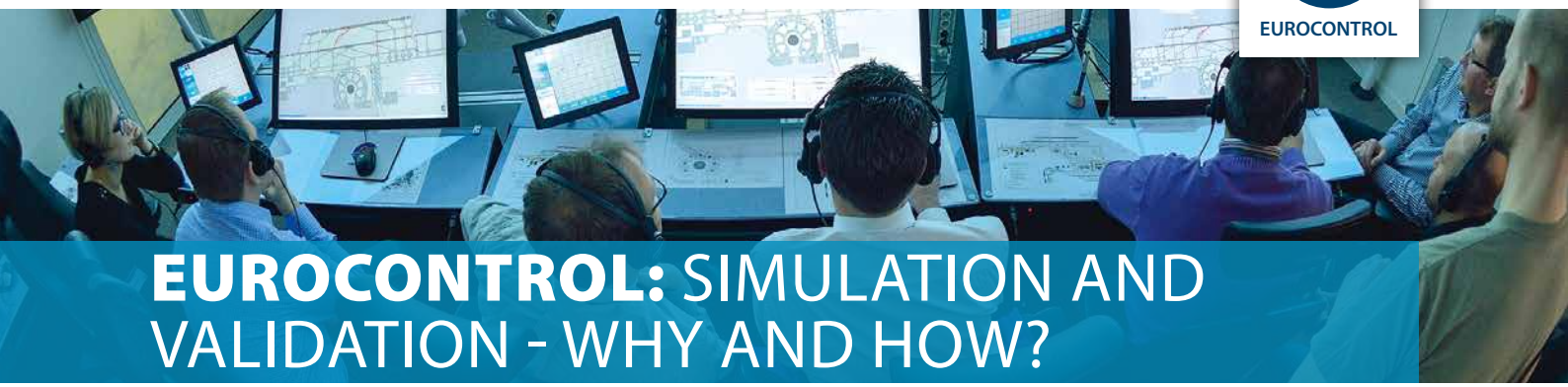


EUROCONTROL: SIMULATION AND VALIDATION - WHY AND HOW?

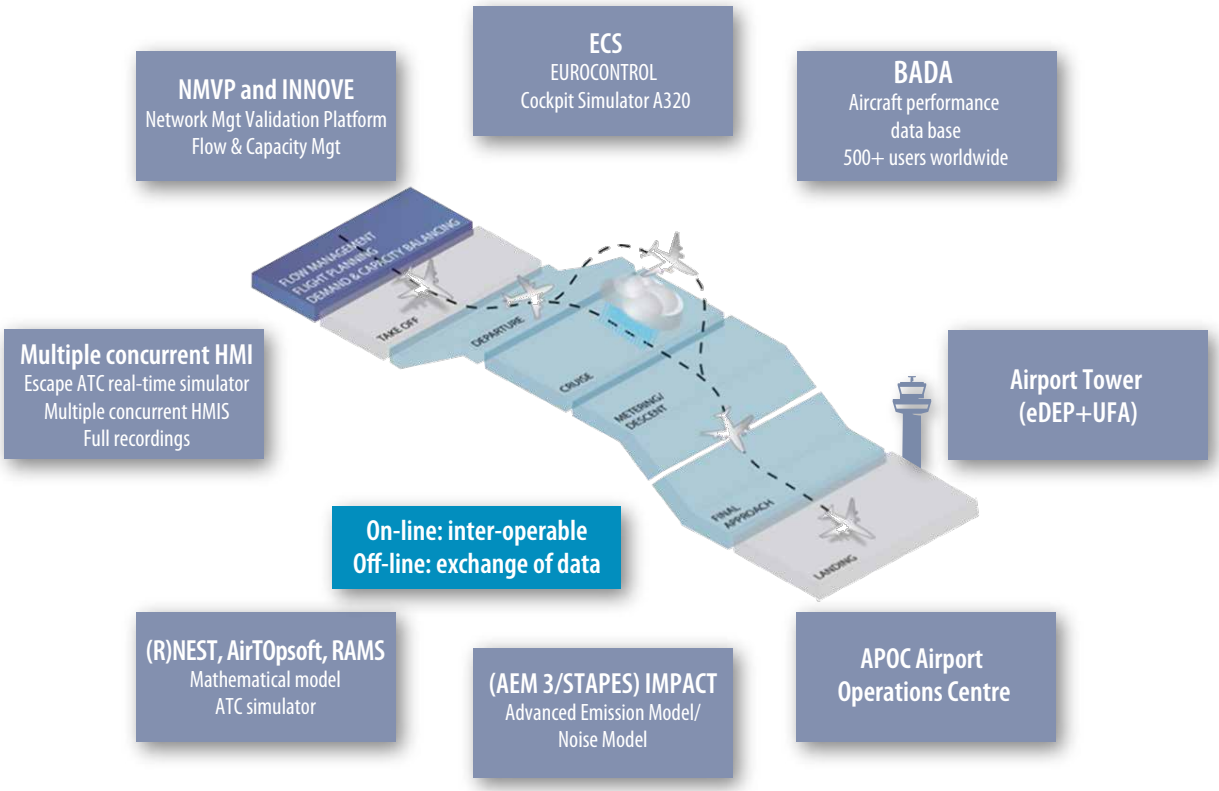
Changing complex systems in any business is risky and expensive. Knowing if the changes will actually do what they are intended to do helps reduce the risk element. Having a realistic idea of just what will be involved in the change – benefits as well as obstacles – reassures investors.

Changes to air traffic management systems are no exception to this general rule. Fortunately for air transport professionals who would like to update their systems, we at EUROCONTROL can help them determine just what their envisaged changes and improvements will entail.

At our Experimental Centre, we can run a variety of simulations, ranging from simple, quick ones to extremely realistic, detailed ones. We prepare, manage, run and report on them for air navigation service providers (ANSPs) - either singly or grouped into Functional Airspace Blocks - and airlines.

We can demonstrate to our clients that the changes they want to introduce will (or will not) bring about the desired benefits and we can give them a reliable assessment of what will be involved.

EUROCONTROL VALIDATION INFRASTRUCTURE



Model-based simulations are helpful – and we use them a lot for research, developments and prototyping – but the most powerful simulations involve real people – genuine air traffic controllers (ATCOs) and pilots - testing concepts in an environment that is as realistic as possible.

So, our real-time simulations are highly valued by the air transport community. How do we go about them?

Say, for instance, an ANSP would like to see if they should introduce Free Route Airspace Operations. They want to know if they will actually bring tangible benefit and what the drawbacks could be. They will need to have an accurate idea of the impact that this change will entail – and they will need to justify the expense, showing that it will deliver. They will also need to convince their staff that the change is for the better: ATCOs are famously conservative – rightly so, given their weighty responsibility for safety.

That ANSP can come and consult us at our Experimental Centre in Brétigny. We use a "case-based" approach in helping them.

How do you usually go about choosing professional help? You would probably go to someone with a good reputation. But you would also need to feel that they have the appropriate knowledge, sound experience and reliable methods.

At the Experimental Centre, we have 52 years of experience and an excellent reputation in the field of simulations. We also have a tested, credible method, which we developed with colleagues from Headquarters and the European Commission. Known as E-OCVM, the European Operational Concept Validation Methodology, it is a high-level document that gives solid guidelines on how to build a case, demanding evidence at every step.

Let's go back to our ANSP who wants to introduce Free Route Airspace Operations. Not only are they worried about the time and effort involved, they need to be sure that the benefits will outweigh the downsides. They also have to be sure that they will not be favouring one quality area, capacity, say, over another, more important one: safety!

So, they come to us. We, the Simulation Team, will tease out the issue in its entirety and put everything in context for them.

In our search for evidence, a simulation is only one part of the process. We begin by looking at the **context** and thinking about all the angles, human and machine, as well as the procedures that will be involved.

We examine the ANSP's operational environment minutely, so acquiring a high-level understanding of the issues they face.

We then make a thorough **assessment** of their **expectations** and carry out a **stakeholder analysis**. We follow this by examining the potential **solutions**. We break them down into smaller change elements and define the benefit mechanisms, working out how each change could deliver the advantages we seek.

It is at this stage that we ask: what is the best simulation approach that we should adopt in order to collect all the relevant supporting evidence? Do we need a mathematical, fast-time solution? Should we try a gaming exercise? A real-time simulation? A live trial? Or, perhaps, a combination of these?

Once the **approach** has been agreed on, and the decision made to conduct a real-time simulation, we start on the initial planning. We work out a **budget** and go over it with the client. As we will be using their ATCOs, we have to do this planning very far in advance. Their ATCOs will need to come to us for the simulation – and ATCOs typically plan their schedules nine months in advance.

Once the ANSP agrees on the **schedule** and the budget, we draw up a Special Agreement, to be signed by both them and EUROCONTROL.

Then, we begin with a series of focused meetings for the Simulation Team and the ANSP.

Firstly, we have **operational meetings** in which we define the traffic and airspace. In order to test the new idea – Free Route Airspace Operations, in this case – we need to make sure that we imitate not only current reality as perfectly as possible but also the projected, future scenario, featuring all the changes: new concepts, higher traffic levels, modified airspace structures and procedures, for instance. We will build the same traffic flows and complexity that the ANSP has in reality into the simulation.

At the follow-up **technical meetings**, we prepare the specifications for the controller working positions. We have already simulated 15 different types of ATC systems. We examine all the procedures and tools that will be needed for the simulation. In this Free Route Airspace Operations example, controllers will need training on the new decision-making support and safety tools before they can test the concept.

Then, we hold **validation meetings**. Together, we look at how the experiment will be conducted; we define precise objectives for each step and spell out the claims to be tested. The Simulation Team then works out how many exercises will be needed and which data preparation and analysis tools to use.

It takes an average of ten months to prepare a simulation.

Airspace improvement projects begin with a mathematical simulation on our **fast-time simulator**. This just involves computers, no people as yet – their behaviour is modelled in the simulator. But it helps pinpoint trouble areas – and gives lots of useful data to be fed into the real-time, large-scale simulation.

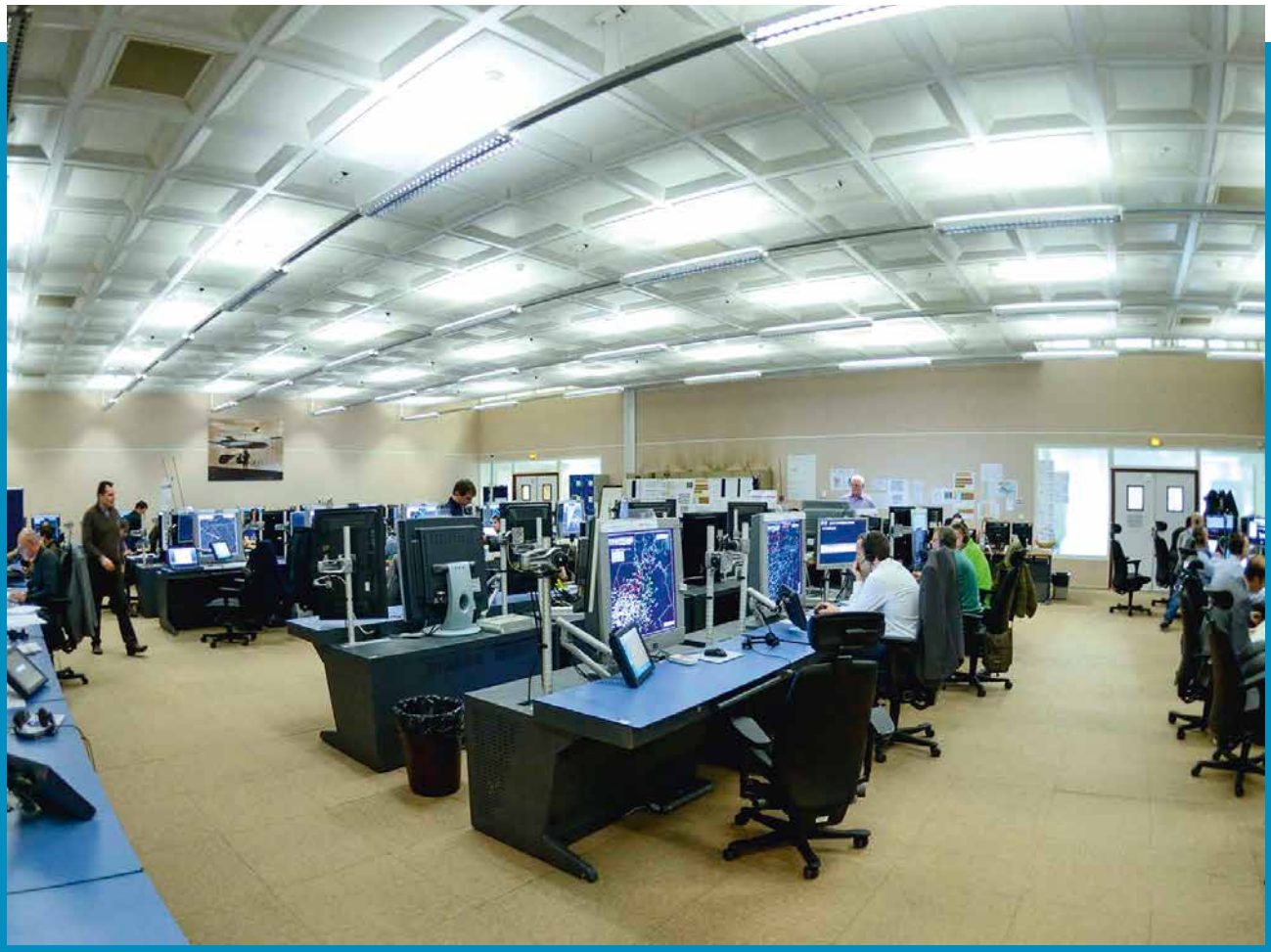
Then, using the **ESCAPE** platform, we build a simulated environment that is as close to the ANSP's own centre as possible – right down to the seating, the screen layout and colours, even the mouse position!

Once this is done, we verify the simulation environment with the ATCOs. They help us tweak it so it feels just like home. The simulation is run in a known environment first, so as to establish a baseline: the reference scenario. We will subsequently be able to measure the effects of the new variables and make comparisons.

Then we run our new or future scenarios - four times, as a rule so that we have enough statistically valid data. A typical exercise lasts for about an hour but it can take twice as long if the airspace to be simulated is large and complex.

We collect subjective and quantitative data. Every event is recorded and measured: the time it takes for ATCOs to respond; how long they talk on the radio or telephone; the traffic density in the sector or over hotspots.

To collect subjective data, after each session, the ATCOs are given a questionnaire which helps us clarify human factor elements: situational awareness and stress levels.



We measure their workload perception every two minutes. Each ATCO is constantly invited to choose from a series of buttons to indicate how they feel about the workload at that particular time. We always use the same ATCOs to test both the present and future scenarios: after all, A's heavy workload might be perfectly manageable for B!

A debriefing is held at the end of each day. As everything is recorded, we can go back and examine different aspects of the simulation; controllers can see for themselves how they handled the new system and tools. To enrich the discussion, we draw their attention to specific events that took place in the simulation.

For complex scenarios, we might have to split the simulations into different steps or various sessions; we can repeat exercises many times, testing a different aspect in each one.

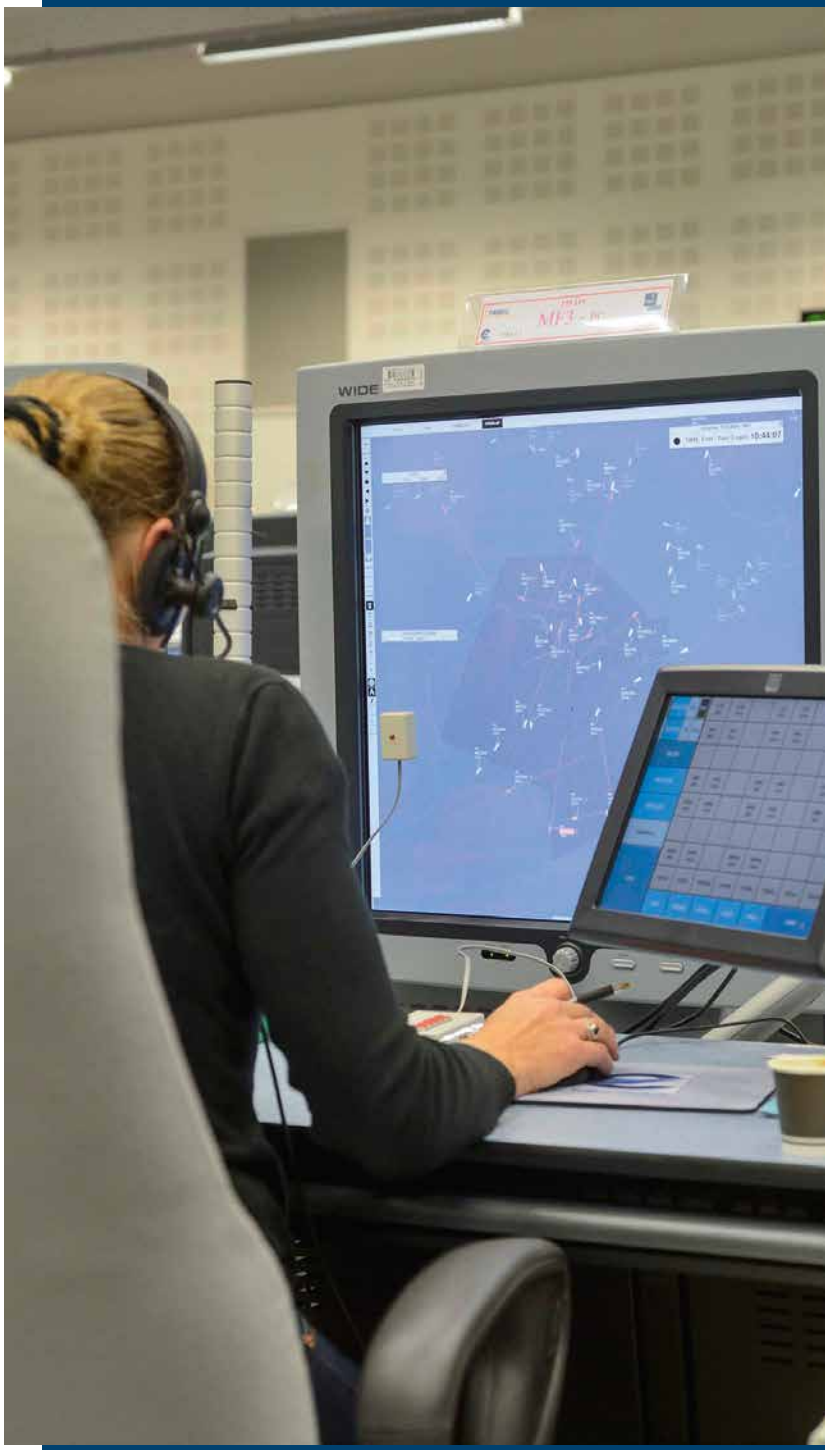
Once the exercises have all been run – and this typically takes two weeks – another key phase in our work begins: analysing the mountains of data that the simulations have generated.

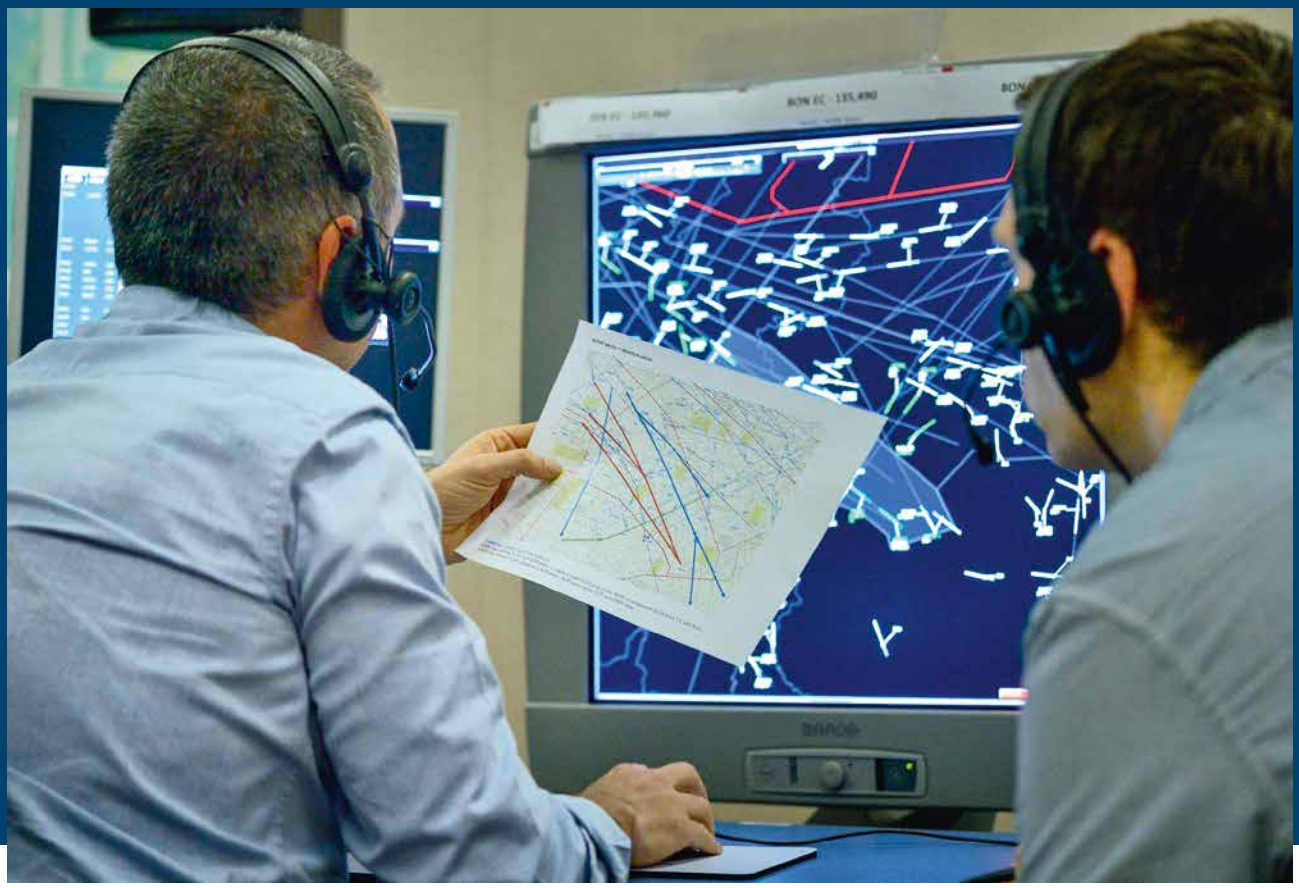
As is the case for any professional - researchers, doctors or lawyers -, our clients expect us to give them useful information, good recommendations and reliable knowledge, not volumes of data.

Analysing the data collected and writing up the report usually takes us three months. We do our best to give practical, workable recommendations and sound, operational solutions.

What of the cost of a simulation? Depending on the size, complexity and duration, it can range between €300,000 and €900,000. To have the full picture, you have to add in the costs of the ATCOs who are taking part: their travel, accommodation and the time they spend in the simulation.

At Brétigny, we have different types of simulator platforms and various tools for validation.





The major one used for air traffic control simulations is ESCAPE, the EUROCONTROL Simulation Capability and Platform for Experimentation. It is built around major components such as:

- EUROCONTROL's air traffic generator (eATG);
- the flight data processor (ground);
- the human machine interface (with a vast library of existing interfaces);
- the data preparation module;
- BADA, the Base of Aircraft Data, which is a database of aircraft performance models.

We have several ATC simulation rooms: two large ones with up to 40 controller positions and a smaller one, accommodating up to 16. We have a total of 46 piloting positions for pilots to feed information to the controllers.

We also have other simulators to complement these ATC simulators, allowing our experts at the Experimental Centre to address all phases of flight:

- for network issues and planning, we have the EUROCONTROL Network Management Validation Platform (NMVP) and Isa Software's INNOVE (for V2 maturity simulations);
- for airports: the ASTRIUM airport operations centre (APOC) gaming platform and the combined EUROCONTROL eDEP and UFA (3D visualisation) tower simulator;
- for the cockpit: the ECA FAROS-based Airbus A320 cockpit simulator;
- for environmental studies: our IMPACT suite of simulators for emissions and noise assessment studies;
- we also have a variety of other mathematical simulators such as AirTOpSoft, RAMS (ATC fast-time simulators), SAAM and (R)NEST for airspace and network studies.

With our broad expertise and this powerful set of simulators, EUROCONTROL is able to help the European ATM community overcome the complex validation challenges it is currently facing with the Single European Sky's research (SESAR) and deployment activities.

TO FIND OUT MORE

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