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### GLOSSARY

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<tr>
<td>AIM</td>
<td>Air Information Management</td>
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<tr>
<td>ANSP</td>
<td>Air Navigation Service Provider</td>
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<td>ATC</td>
<td>Air Traffic Control</td>
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<td>ATCO</td>
<td>Air Traffic Controller</td>
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<td>ATM</td>
<td>Air Traffic Management</td>
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<tr>
<td>BPMN</td>
<td>Business Process Model &amp; Notation</td>
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<tr>
<td>CNS</td>
<td>Communication Navigation Surveillance</td>
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<tr>
<td>CORA</td>
<td>Conflict Resolution Advice</td>
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<tr>
<td>CRYSTAL</td>
<td>Flow Management Tool</td>
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<td>DEVOPS</td>
<td>Development &amp; IT Operations</td>
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<td>FABEC</td>
<td>Functional Airspace Block for Europe Central</td>
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<td>FDM</td>
<td>Flight Data Management</td>
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<td>FDP</td>
<td>Flight Data Processing</td>
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<td>FOCA</td>
<td>Federal Office of Civil Aviation</td>
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<td>HMI</td>
<td>Human Machine Interface</td>
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<td>HRO</td>
<td>High Reliability Organisation</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>ITIL</td>
<td>IT Infrastructure Library</td>
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<td>MBSE</td>
<td>Model-Based System Engineering</td>
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<td>NRH</td>
<td>New Route Handling</td>
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<td>PJ</td>
<td>Project</td>
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<tr>
<td>RP</td>
<td>Reference Plan</td>
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<tr>
<td>SES</td>
<td>Single European Sky</td>
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<td>SESAR</td>
<td>Single European Sky ATM Research</td>
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<td>SESAR JU</td>
<td>Single European Sky ATM Research Joint Undertaking</td>
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<tr>
<td>SOA</td>
<td>Service-Oriented Architecture</td>
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<td>SOI</td>
<td>Service-Oriented Infrastructure</td>
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<tr>
<td>SWF</td>
<td>Software Factory</td>
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<td>TOM</td>
<td>Target Operating Model</td>
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<td>UML</td>
<td>Unified Modelling Language</td>
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<tr>
<td>VC</td>
<td>Virtual Centre</td>
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<td>VCT 1/2/3</td>
<td>Virtual Centre Tranche 1, 2 or 3</td>
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Dear reader,

Welcome to this new 2020 Blueprint edition, skyguide’s technology outlook.

We report back from our transformation journey at skyguide. An endeavour where technology drives the change in Air Traffic management and where skyguide is at the forefront as innovation leader in Europe.

Florian Guillermet from Single European Sky Aviation Research (SESAR) will first talk about the visionary European Airspace Architecture Study from last year and highlight the link between location independent services based on Virtual Centres and dynamic airspace configuration. This short document has become a cornerstone of a future ATM system in Europe because the solution finally goes beyond national borders and the classic limited and inefficient local set up of a traditional ANSP. Skyguide fully supports this watershed proposal and courageous modern airspace architecture.

Nicole Leyre, CFO of skyguide, will then address our financial context and explain the structural issues that put pressure on our cost and income – or how to manage change in the corset of a European tariff system which tries to simulate a market in the fog of national political interest.

Urs Lauener, COO, will describe the strategy to move from an operational concept which controls sectors to an operational concept which manages the flow through an airspace.

As head of Operation he will also describe the challenge of running a mature safety critical operation while changing its foundations at the same time.

Skyguide is a High Reliability Organisation (HRO) and the HRO principles are systematically integrated and embedded in this transformation. How this can be tied into the agile delivery methodology on the software engineering side was a very positive learning and shows how concepts from different practices can be successfully married.

Skyguide is a company that delivers safe air traffic services. The task of the technical department is to integrate, deploy and run robust systems in support of air traffic operation. The chapter on the redesign of our Software Factory in Skysoft is based on a clear role and interaction between Engineering in ATM and software development. And finally, digitalisation is on its way and will prove its real benefit, if we succeed to reduce the complexity of traditional technical systems in Air Traffic Management by moving towards a layered lean systems operation.

Thank you for joining us on our path towards the future. I appreciate your continuous support in this endeavour.

Sincerely,
Klaus Meier
An Airspace Architecture Study, ordered in 2017 by the European Commission, itself acting after a decision of the European Parliament, was carried out by SESAR Joint Undertaking (JU) and published at the end of 2018. According to Florian Guillermet, SESAR JU’s executive director, the study concludes that in order to deliver better performances in Air Traffic Management (ATM), virtualisation and new technologies have to supplement the existing physical infrastructure.

“THE SOVEREIGNTY OVER DATA, NOT OVER AIRSPACE OR BORDERS, WILL BECOME MORE AND MORE CRUCIAL”
evolution of the service delivery model. Our study sets out a three five-year-phases roadmap with necessary building blocks to achieve this by 2035.

Where do the various ANSPs in Europe currently stand?
FG There are examples of ANSPs moving in this direction on a bilateral basis or within the framework of the same ANSP. Skyguide is a good example of an ANSP, which is advancing the concept of virtualisation. In the future, with virtualisation, controller training and licensing could be progressively based on traffic complexity, rather than sector specificities. This would enable ANSPs to deploy ATCOs more flexibly depending on the volume or the flows of traffic. Such initiatives already exist today and need to be progressively scaled up at network level.

Which system and airspace architecture should we choose?
FG More than systems, we have to think about data, gathering information about the density of traffic, making sure that aircraft are operating along the right trajectories, and ensuring communication with aircraft. The study proposes an evolution of the airspace architecture that leverages modern technologies to decouple the service provision from the local infrastructure in a single European airspace system. At the same time, the level of collaboration and automation through a data rich and cyber-secured connected ecosystem should increase progressively. In short: we have to be more agile and more dynamic and we need a high degree of virtualisation.

Have any decisions concerning these proposals already been taken?
FG The European Commission has asked us to draw up a proposal for a transition plan. As announced at the high-level event on “digital sky” in September, the Commission has begun to work on the elements necessary for implementation, such as the financial modules, the liability issue, or certification. However, nothing should prevent ANSPs from developing in this direction and taking the first steps from a technological standpoint.

What should these first steps be?
FG The first step is the implementation of virtualisation techniques and the conversion of the system to a service architecture. Joint data services or airspace management with your neighbours would be helpful. If ANSPs do not move in this direction, there is no way to establish closer relations and manage airspace more flexibly. With the progressive increase of automation support, the ATCO training would as well gradually shift from knowing all the routes by heart to the management of systems and data.

What are the main challenges of such an endeavour?
FG The development of aircraft has accelerated rapidly and taken on a new dimension as a result of the intensified environmental debate. Fleets are being modernised more rapidly. ATM has not developed at the same speed. The emergence of drone-related services is also prompting a surge of innovation in air traffic management as well. These disruptive technologies force a change in mindset in our industry in order to remain relevant.

“WE HAVE TO BE MORE AGILE AND MORE DYNAMIC AND WE NEED A HIGH DEGREE OF VIRTUALISATION”
FINANCES
TO ENSURE OUR FUTURE, COST EFFICIENCY IS MANDATORY

NICOLE LEYRE  CHIEF FINANCIAL OFFICER

Liberalisation may still be some years away for the Air Traffic Management (ATM) industry, but air navigation services today mirror the telecommunications industry in 1995. At that time, the value chain was completely disrupted and transformed, thus allowing the entry of new stakeholders. Since this last decade, pressure on costs is constantly increasing with challenging European Targets (RP3) and loss of state’s subsidies. In order to take on these challenges, skyguide has to completely change its business model and invest in innovative technologies. By tackling upstream the financial constraints, Nicole Leyre, chief financial officer (CFO) at skyguide, is convinced that skyguide is moving in the right direction.

“THE ATM WORLD IS NOT ACCUSTOMED TO HAVING ITS SERVICE FEES CHALLENGED, BUT HAS TO FACE THE NEW REALITY OF THE MARKET”

SKYGUIDE  What are skyguide’s major financial challenges and how are those addressed?

NICOLE LEYRE  The financial gap between costs and revenues is growing at an alarming pace. At skyguide, we refer to this as the crocodile’s mouth. Our net result in 2018 was negative and we expect the same for 2019. Coming years do not look brighter as airlines are under financial pressure and challenge the fees they pay for air traffic management services. Consequently, through an arduous financial roadmap (Reference Plan), the European regulation requires a lowering of the unit price and sharing productivity with our users: starting next year, we will have to give back almost 2% of productivity per year to our customers. This will lead to a steep decrease in our revenues. The ATM world is not accustomed to having its service fees challenged, but has to face the new reality of the market. In order to make the situation sustainable for skyguide and limit the decrease of revenues, we tackle the challenges on several fronts: since last year, in close cooperation with the Swiss regulator (FOCA) we work to shape and influence the targets of the 3rd European Reference Plan (RP3). In parallel with investing in innovative technologies, we do our homework to ameliorate our cost efficiency. Our overarching guide is the Target Operating Model (TOM) programme. Its aim is to review and align processes, reallocate resources in a leaner way and reduce the complexity of the organisation.
Switzerland is a very expensive country and skyguide cannot provide budget-priced services. As a state-owned monopoly, shouldn’t skyguide be able to charge what it considers suitable?

Indeed we have the highest service unit cost in Europe. In 2018, we charged €235 for an A320 flying 200 km at upper level from Geneva to Zürich, while other FABEC countries only charged €170 for the same type of service. We know that customers are ready to pay for Swiss quality – good service with little delay – but they are not ready to pay 40% more. Monopolistic thinking is no longer possible either, as subsidies from the state tend to decrease and the loss of revenues cannot be compensated. Our pricing depends on European regulations as well as increasing pressure from the aviation industry on European institutions. Presently airlines using Swiss airspace and Swiss airports are bound to use skyguide services. In the near future, however, we can expect competition looming in ANS activities. For instance, when the European space architecture will be in place, thanks to a dynamic airspace, the different ANSP will compete on a “market tender” basis to manage the different blocks of controlled airspace. On the regional aerodromes side, a request for alternative management has already been launched. As it may take some time to complete the rules for liberalisation, we should absolutely seize the opportunity to transform ourselves and be ready to cope with the coming drastic changes.

What forces can skyguide leverage in its financial transformation? What weaknesses have to be overcome?

Today, we follow a very fragmented approach to supplier management: every project chooses its own providers without having a global picture. To address this, we are currently developing a strategy to find a global approach and identify strategic suppliers or partners. We also want to better leverage value adding suppliers and be able to reduce our costs by buying scalable solutions. In addition, discussions about capital and other operating expenses distract us from looking at the total cost of projects and managing them properly. Budgets are too fragmented which prevents us from setting the right priorities and standardizing. Globalizing costs and budgets will create more transparency, less work and a higher ownership. We also aim to improve the ability to identify and harvest benefits in order to set up the right priorities for the development backlog.

“WE HAVE TO BE MORE EFFICIENT AND FLEXIBLE IN THE WAY WE MANAGE AIRSPACE AND INSTALL MORE STANDARD AND COST EFFICIENT TECHNOLOGIES”

What is the outlook considering the current financial situation?

We invest in different initiatives, our main ones being the Virtual Centre programme and the Target Operating Model programme. Their aim is to drastically change our business model and the way we operate. We have to be more efficient and flexible in the way we manage airspace and install more standard and cost efficient technologies. We have to set and influence a Europe-wide framework, create the workforce of the future and develop new businesses. With the TOM and VC programme, we will certainly achieve all of that: one data centre and the same procedures in GVA and ZRH will mean less maintenance and more standardization and scalability. Of course VC represents a huge investment, but we can finance it, as well as other strategic initiatives, if we become leaner, collaborate in ways that are more efficient and prioritize our expenses.
SKYGUIDE Why has skyguide launched this transformation process?

URS LAUENER The way of providing ATM services has not much changed over decades. The answer to the lack of capacity and inefficient handling of traffic-flows cannot be the usual manner of just adding more ATCOs into the system and re-shaping sectors. ATCO resources are scarce and expensive; their training takes a long time and is very static. We must reach a much higher flexibility in the way we train and use ATCOs in order to better align to customer’s needs.

How will this transformation process impact operations?

UL Today’s shortcomings can only be overcome by adding more technology. ATCO jobs will have to be shifted from being human centred to system centred, from Air Traffic Control to Air Traffic Management. Today, ATCOs are trained for a defined number of sectors. In the future, location independence will allow us to react quickly to unforeseen changes in capacity needs. This requires a system enabling us to refrain from the geographical ratings and shift to system ratings, thus enabling almost any ATCO to work any piece of airspace from any work position. As a result, ATCO training will become more standardized and shorter, and it will allow us to provide more flexible services at lower cost.

“ATCO JOBS WILL HAVE TO BE SHIFTED FROM BEING HUMAN CENTRED TO SYSTEM CENTRED, FROM AIR TRAFFIC CONTROL TO AIR TRAFFIC MANAGEMENT”
What will be the most difficult part of the transformation?

UL We have to take the ATCOs along. Today they are used to intervening on almost every flight, but in the future they will have to change their work methodology: this requires a change of mindset. The transition from Air Traffic Control to Air Traffic Management will be demanding. The ATCO job per se will change and ATCOs will have to be prepared for step changes in terms of tools to be used and procedures applicable. The workforce of the future demands a different type of personality. The selection of this new type of ATCO needs to start very soon. The challenge is to ensure a safe and efficient service delivery every day while implementing the transition into this new world. We aim for a smooth transition, not a big bang. We must carefully define the human role in the system and avoid repeating the mistakes made by airlines and aircraft manufacturers when changing the human-machine interface.

Have you started elaborating and implementing changes in the ATM work methodology already?

UL Yes, it has started. We are permanently trying to improve the system, especially at the Zurich airport, where it is very complex. Becoming “stripless” in the Radar Centres, we have ceased to deliver information on paper, resulting in a remarkable capacity increase. In parallel, we have introduced additional safety nets, as we shall not only increase capacity, but also safety. New systems will be implemented, intended to support the ATCO in doing their job, one of which is CORA (Conflict Resolution Advice) as part of the VC programme. However, in whatever we do, it remains vital that the ATCOs have full trust in the new system.

Can Switzerland do this on its own?

UL For the first time ever, we have an operational strategy which we will now start to implement. Question is, are we now dependent on our neighbours? Yes and no. There are some major adaptations we can and shall do on our own in order to improve the provision of services, even if we are the only ones doing it. For example, I am talking of one sky by one system, location independence etc. However, the full benefits of the future setup will only be available once the neighbouring ANSPs implement similar changes and play along the same lines.

“IN THE FUTURE, LOCATION INDEPENDENCE WILL ALLOW US TO REACT QUICKLY TO UNFORESEEN CHANGES IN CAPACITY NEEDS”

But for skyguide’s success, European initiatives like SESAR surely are primordial?

UL SESAR can only be successful if it fosters the network thinking. The system is still weak when it comes to setting the right incentives. ANSPs are being incentivised for actions they take in isolation. This does not contribute to create a European network and must change. SESAR has to address the limits of the airspace capacity and the fragmentation of airspace, and to promote location independence to replace the current state where each centre is acting on its own. We have to emphasize that the success of the transformation can only be achieved if we can collaborate in a new European airspace setup. There was an attempt with FABEC, but due to sovereignty issues, the outcome was poor. The success of a new attempt lies in a European airspace architecture and Service-Oriented Infrastructure (SOI). One important case study is PJ10: SESAR members NATS, skyguide, COOPANS (LFV) and INDRA have jointly tested an initial validation exercise of a solution to change the existing operating method. The solution aims at much greater flexibility, allowing air traffic controllers to perform in a particular type of sector in any control centre across Europe. That’s the right model for the future.
ENSURING SAFE TRANSFORMATION WITH HRO
CROSS-FUNCTIONAL COOPERATION AND TRUST-BUILDING

KERSTIN KNOPF  HRO PROGRAMME LEADER
FRANK BARNER  CORPORATE AGILE TRANSFORMATION TEAM AND AGILE COACH

How to ensure a safe transformation of skyguide? It is all about integrating the ideas of a High Reliability Organisation (HRO) and Agility into our daily practice, since both are based on principles and values that translate into concrete good practice behaviour, mindset and actions. Both HRO and Agile focus on people, the way we collaborate, interact and communicate, with the aim to reduce risks and increase continuous learning and improvement. Kerstin Knopf, HRO programme leader, and Frank Barner, part of the Corporate Agile Transformation Team, explain the approach they developed for fostering these elements through joint reflections, called “Team Flow Progression”. The objective is the company’s transformation in an HRO way, and ultimately to be more reliable and agile.

SKYGUIDE How is HRO defined, in particular by skyguide?
KERSTIN KNOPF The HRO concept is a set of actions, good practices, behaviour and mindset to reduce risks and prevent incidents, and to react appropriately whenever something happens. This includes reporting of errors honestly, responding quickly, learning from mistakes, having a systemic approach and improving the process for the next challenge. HROs principles are based on collaborative teamwork, iterative learning approaches and the ability to communicate. HRO is guided by five principles. Three deal with prevention: preoccupation with failure, reluctance to oversimplify and sensitivity to operations. The last two with damage containment: resilience and deference to expertise. Especially when going through a transformation, it is important to integrate the five HRO principles equally in daily activities.

What do HRO and Agile have in common?
FRANK BARNER Agile and HRO share values and principles like openness, trust, transparency and the handling of errors. Those Agile values and principles, as well as Agile practices, are much more about behaviour than about processes. HRO and Agile develop cross-functional cooperation and trust. They strengthen continuous learning, reduce risks through early detection of signals of weakness and errors, strengthen the individual responsibility and empower the organisation to take decisions according to the existing knowledge.

“AGILE AND HRO SHARE VALUES AND PRINCIPLES LIKE OPENNESS, TRUST, TRANSPARENCY AND THE HANDLING OF ERRORS”
FB Agile is not new, but common sense rebranded. The concept of one man thinking and hundred individuals working is no longer sustainable in modern working environments where complexity rises at a high pace.

What was the initial driving force for Agile and HRO?

KK HRO and Agile teams began to collaborate when the core strategical programme of skyguide, the Virtual Centre (VC), started taking off. At the beginning we heard some people say that the HRO principles can’t be applied to transformation and that Agile is not HRO-compatible. Therefore, we started to reflect and we identified many similar or complementary aspects. The ultimate objective being to enable skyguide to be more reliable and flexible, thus fostering its transformation.

You introduced joint reflections based on HRO and Agile values called “Team Flow Progression”. Can you elaborate on their objectives?

FB The team-reflection is an interactive session held in a retrospective format. The objective is to reflect on the team’s way of communicating, interacting and collaborating according to HRO and Agile values and to generate commitment for improvement. Based on this, the team establishes working agreements. The Virtual Centre being the main driver for transformation, we chose to test this approach on three teams coming from this programme, specifically in the Tranche 2 (VCT2).

Is this approach only applicable for Agile and project teams?

FB No, the concept is not bound to Agile or VC. It can support any team, and we are looking to extend this approach to our whole organisation. The team-reflections are integrated into existing team sessions and regularly repeated to measure evolution and improvement. We want to encourage teams to organise themselves and to take over responsibility.

KK By a systemic and multi-stream approach, the HRO principles will be integrated into transformation and into most daily activities, in order to make them become part of our company’s and employees’ DNA.

“By a systemic and multi-stream approach, the HRO principles will be integrated into transformation and into most daily activities, in order to make them become part of our company’s and employees’ DNA”
Air Navigation Services (ANS) did rely for a long time on the treatment of analog signals, which were then interpreted by our air traffic controllers. The “digital-native” drone industry is now shaking up our legacy model. To counteract the fragmentation and lack of agility in the current ATM environment, the benefits of digitalisation, and its benefits, need to be urgently implemented to improve the performance and quality of services, states Philippe Chauffoureaux, chief information architect at skyguide.

How is the Virtual Centre Programme supporting this transformation?

PC The Service-Oriented Architecture infrastructure (SOI) was implemented by this Programme as the core of our new operational assets. The first SOI-migrated tool was CRYSTAL, the air traffic forecasting application, deployed in 2018. Then were implemented operationally the first steps of New Route Handling (NRH).

Which further development do you anticipate?

PC Beyond our current efforts, technologies booming in other areas such as artificial intelligence or block chain technology are opening up new opportunities. However, capturing their benefits will only be possible if built on top of a properly layered architecture.
The Model-Based System Engineering (MBSE) focuses on creating and exploiting drawings as the primary means for exchanging information between engineers, rather than being based on documents, explains Patricia Bomme, head of Safety and Compliance within the technical department of skyguide. This method strives to look at the source authority model instead of looking at a package of disassociated and disconnected sets of documentation.

**What is the Model-Based System Engineering all about?**
**PATRICIA BOMME** Drawings are among the most powerful communicative and conceptual tools. Psychological experiments show that drawing to encode information surpasses other strategies, such as writing, mentally visualizing, or viewing photos. In MBSE, models are simplified representations of the reality from which unnecessary parts have been removed. They use modelling languages like Archimate (in architecture), BPMN (Business Process Model and Notation), a graphical representation of business processes) or UML (Unified Modelling Language, used in software engineering to provide a standard way of visualising the design of a system). Commonly, MBSE is using central repository-based modelling tools.

**What do you intend to achieve with the introduction of MBSE?**
**PB** You have to put MBSE in the context of our Virtual Centre (VC) which is introducing new technologies for applications such as Service-Oriented Architecture, DevOps, Scaled Agile Framework, a layered infrastructure and an intensified role for suppliers. Thus, VC is increasing the complexity of our technical solution delivery and operations. To handle this complexity, new technical competencies and new collaborative working models are required.

**This demands a new company culture, doesn’t it?**
**PB** Yes, shifting to a new collaborative model is tightly linked with the company culture. The collaborative working model is more challenging and requires a new mindset. In the past, engineers were able to deal with hardware and software issues occurring on their own equipment for which they possessed the necessary knowledge and information. The information was then neatly documented and sustained by the users for their usage and for compliance purposes. However, this will no longer be the case in the future.

**What are the key factors to achieve a successful implementation?**
**PB** We need to prove early on that MBSE effectively works by improving stakeholder communication and identifying problems, facilitating buy-in, simplifying information and standardizing the support of knowledge management, visualising the whole system dealing with complexity and reusing architecture to maximize cost savings. One of the success factors is the ability to share information and to communicate unequivocally with interested parties. Information must have a single source of truth and be validated by all concerned; it has to be available and accessible.
The term DevOps is a concatenation of the two words Development and (IT) Operations. The goal of DevOps is to enable a more agile and efficient cooperation between development and IT operations through shared incentives, processes and software tools. DevOps is supported by an automated delivery chain which aims to ship working software faster, reduce overall efforts in repetitive tasks, and increase the overall quality, says Karim Limam, head of Integration Services at skyguide.

**SKYGUIDE** How would you define DevOps?

**KARIM LIMAM** DevOps is a set of practices and tools that enable us to be as fast as possible in shipping software to the business as well as to enhance collaboration between development and IT operations. DevOps is hardly possible without the adoption of Agile principles in the way we think and make software. Then, to obtain the most efficiency from the Agile approach, the delivery chain from development to IT operations has to enable aspects like fast feedback, information sharing, automatic pipeline, and collaboration. The goal of DevOps is to change and improve the relationship between development and IT operation by advocating better communication and collaboration.

**SKYGUIDE** So, what is actually changing?

**KARIM LIMAM** We are starting an important change journey. We try deeply modifying the way we collaborate. So far, only a reduced set of employees, mainly technical operators, have access to information from production. They are responsible for the run and they communicate with development only if they cannot solve an occurring problem or incident themselves. While enabling DevOps we are currently promoting a different approach, which consists of allowing the development teams to directly access production information, and engaging IT Operation to contribute to the design of our IT solutions. In DevOps, IT Operation and Development are co-responsible for ensuring a stable run.

In this journey we are also modifying the way we ship software to production. Today, some applications are still installed and tested completely manually. By adopting DevOps we are also introducing a standard way of automating deployment and testing. We are convinced that this will reduce the overall effort we spend on repetitive tasks and open up the opportunity to concentrate on value-adding activities.

**SKYGUIDE** Who is the DevOps team?

**KARIM LIMAM** The DevOps team is any team, which delivers a working software that meets the expectations and requirements of the company, while autonomously applying the concepts of Continuous Integration, Continuous Delivery, Continuous Testing, Continuous Monitoring and Continuous Improvement (the five C’s), as well as integrating IT Operation. At skyguide, the group Integration Services is putting in place the technical and organisational prerequisites for DevOps but is certainly not the DevOps team; they should rather be considered as “the DevOps enablers”.

**SKYGUIDE** Could you describe the DevOps roadmap?

**KARIM LIMAM** In the simulation environment we are today able to ship working software automatically in all environments. I consider
this a success story. The second phase started at the end of last year by applying the same approach to the actual ANS, the applications used by our ATCO’s. We have started to work on the applications and services in the scope of the Virtual Centre programme and are moving now to the next business critical applications. The main investment phase will be considered as achieved once “dev” and “ops” break the silos, share the same platform, get continuous value with a minimum transversal support, and implement the five C’s mentioned above. We, as IT, will then enter a continuous improvement phase, which aims to get more out of the automation and collaboration. The adoption of DevOps will become true when it is lived by all the IT stakeholders.

**You are talking about the “five C’s”. Could you elaborate on that?**

**KL** The five C’s are the technical aspects of DevOps. The concept is to inscribe a set of defined actions into Continuity. At skyguide, we’re currently focusing on four Cs: Continuous Integration means that the work is sliced in small pieces and packaged as soon as it has been successfully tested. Continuous Delivery means that software is deployed (or delivered) in a test environment automatically upon successful testing and verification. Automatic delivery comes with less manual intervention and more reliable deployment or rollback of software. Continuous Testing means that, as soon as software is deployed somewhere, complete test campaigns are run automatically. The development team is automatically informed as soon as results are available to shorten the feedback loop. Continuous Monitoring means that the monitoring capability is defined already during the development phase and used along the chain and not only once the applications run in operation. Due to current compliance and regulation framework we decided not to put in place a fifth “C” called Continuous Deployment. Instead, we keep the final step, corresponding with the deployment into the production environment, strictly manual.

**What are the main challenges?**

**KL** We need to break down mental barriers and deal with “it doesn’t work” or “we’ve been doing it differently for years”. Like in any transformation process, some people can feel insecure with all the changes DevOps infuses. We’ll need to tackle this as an IT organisation and give a clear vision to those who think they need to work differently.

We are building the airplane while flying. Although our DevOps chain is not yet complete, we have to convince people that DevOps belongs to a leading transformation agent towards a performant IT environment.

*“WE ARE BUILDING THE AIRPLANE WHILE FLYING. ALTHOUGH OUR DEVOPS CHAIN IS NOT YET COMPLETE, WE HAVE TO CONVINCE PEOPLE THAT DEVOPS BELONGS TO A LEADING TRANSFORMATION AGENT TOWARDS A PERFORMANT IT ENVIRONMENT”*
Previously, separated IT environments co-existed at skyguide: mainly corporate IT and technical IT. Now the different IT environments have to converge by making use of standardized shared infrastructure services. The transition from the current mode of operation to the future lean IT is a move away from an equipment-based vertical structure to horizontal responsibilities, says Philipp Schlatter, head of IT Infrastructure Services at skyguide.

**What does “Lean IT” mean?**

**Philipp Schlatter** We have now organisationally merged several units responsible for operations of the different environments and technology layers. Each has its own operational processes that have to be aligned. “Lean IT” means trying to focus on value streams and defining where the bottlenecks and blockages are and how they can be removed. Skyguide documentation for example is still paper-based, not content-based, which hardly renders a consolidated view. Standardizing the way we document our services, processes and more while making use of a well-established documentation tool is the way forward here.

Is the move to horizontal structures a revolution or an evolution?

**PS** Evolution is the preferred approach as long as we get the necessary time for the implementation. We have to ensure safe operations and therefore cannot take any risks. The tuning of applications and shared infrastructure services is time consuming. In situations where we are constrained to react by a given deadline because of obsolescence, we are rushed to implement the changes needed to avoid creating technical deficits, which in return will affect our delivery capacity further down the line.

How does virtualisation contribute?

**PS** Virtual Centre (VC) is driving technical changes most importantly with the Service-Oriented Infrastructure (SOI) that VC Tranche 2 (VCT2) brought in. Thanks to VC we now have some shared infrastructure
services which can be leveraged to the legacy environment, speeding up standardization and consolidation. Server virtualisation is a core technology in terms of hardware optimization, availability and location independency. In addition, further layers such as storage, network, and application are integrated parts of a modern infrastructure, and virtualisation is evolving here as well. Virtualisation in many cases requires some refactoring of applications and does not come for free. Depending on the demand, we might virtualise the network but not the server or vice versa. On the other hand, a virtual desktop infrastructure (VDI) is very powerful technology for training and simulation.

Does “One data centre, one test centre” make sense?

PS Yes, this is the most efficient way to assure a proper layout and stable service. This will take some time but thanks to virtualisation we will get there. I am convinced that we cannot duplicate the current layout. We have to simplify in one centre.

What do you provide with the new IT infrastructure services?

PS If the services are well designed, comply with best industry practice, fulfill skyguide’s demands and go along with a service description based on the Information Technology Infrastructure Library (ITIL), they contribute decisively to simplifying the IT environments. We can provide Active Directory, Antivirus, Public Key infrastructure and many others. Most of the products are implemented and ready to be used widely. However, the integration of these standard products must be driven by the application owners.

How can cloud services help?

PS Cloud services are well established and a valid technology that skyguide can use. Very good experiences with some skyguide internal services, like Skype for Business for instance, have been had. In constant exchange with the legal and security department, we examine further possible business cases. Reducing maintenance and downscaling skyguide’s own infrastructure are the main drivers.

“LEAN IT MEANS TRYING TO FOCUS ON VALUE STREAMS AND DEFINING WHERE THE BOTTLENECKS AND BLOCKAGES ARE AND HOW THEY CAN BE REMOVED”
Consolidating all custom software development activities in a single Software Factory (SWF) has become an essential part of the transformation process within skyguide. To improve its efficiency as a provider of high quality, safe and deployable solutions for custom ATM software, skyguide has identified agility, automation and better resource management as crucial for its future, explain Klaus Meier, chief information officer (CIO) at skyguide, and Pierre Henri Guisan, managing director of SkySoft-ATM. The Software Factory plays an important role in fostering the DevOps culture, providing automated end-to-end services, and streamlining all software development activity. This should result in savings, improved time to operation, higher resilience and better interoperability.

**SKYGUIDE** Consolidating all custom software development activities in a single Software Factory under the roof of SkySoft has become a central topic within skyguide. What is a Software Factory?  
**KLAUS MEIER** We develop software in one single development centre with standing teams around clearly defined “products”. We could also call it a software or digital factory. In the past this was not the case because we developed software within skyguide but we also had, for some components Skysoft, our internal software company. This was inefficient because the roles were confusing: who develops, who integrates and who maintains the software? The reason why we are still developing software in-house is the fact that we still cannot buy critical components for the Virtual Centre on the market. But skyguide is not a software company. Its core is the safe management of air traffic.

**PIERRE HENRI GUISAN** SkySoft is a software company with its proper mindset and DNA, but also with a deep understanding of the safety critical environment of Air Traffic Management (ATM). We need to distinguish between an organisation which develops software and one which integrates, deploys and runs it. Therefore, SkySoft is the ideal software development partner for skyguide.

“For software developers, it will be professionally more rewarding to work in a company whose core business is software”
How is the software production at skyguide currently organised?

**PHG** Currently all core ATM software with the exception of radar processing, but including flight data processing chains, are managed by SkySoft. Much of the radar software was developed by skyguide.

How do the Virtual Centre Programme (VCP) and the new SWF relate to each other?

**KM** Virtual Centre is the change agent and we are building new solutions and introducing new thinking around it. With the learnings from this strategic transformative programme, we will have to adapt the processes and methodologies within skyguide and SkySoft. Virtual Centre has greatly contributed to developing a new mindset in software development in an Agile and standardized setup.

**PHG** We intend to build on many things that have been introduced under VCT2, especially on the Agile framework for projects and DevOps “from Development to Operation”. Incidentally, this term must be clearly defined, since “operations” in DevOps means running software, while “operations” at skyguide means Air Traffic Management.

What is your vision and what are your targets? Which changes do you expect?

**KM** Today we have a portfolio of projects. We define requirements and fight for resources. The future Software Factory will be a much more global proposition with the ambition to centralise all software development activities in a single standardized and automated factory according to clear priorities.

**PHG** A lot can be done to better connect end-to-end activities and extend the scope of development teams through integration and operational phases. This is a long-term endeavour and requires a complete change of paradigm from the multiple *modus operandi* and silos existing through the product portfolios and teams. Furthermore, it necessitates a higher degree of collaboration and communication within the various teams. Once all that scope and budget work has been done and approved, the next step will be to work on the roadmap for the next two to three years. The activities will range from deciding which teams to integrate, how to phase the various transfers, how to address teams and products with complex scopes only partially covered by the Software Factory and of course start building the organisation and the platforms. For software developers, it will be professionally more rewarding to work in a company whose core business is software.

**“SKYGUIDE IS NOT A SOFTWARE COMPANY. ITS CORE IS THE SAFE MANAGEMENT OF AIR TRAFFIC”**

What are the expected benefits?

**KM** Once the Software Factory is fully operational, it will offer efficiency gains as all teams share common approaches and platforms, deploy an expanded area with fewer resources, and shift the most repetitive, low-value tasks through a sourcing model at better cost. There will be much less duplication of activities and confusion of roles and responsibilities. Time to market will be improved and the reaction to changing demands will be accelerated by streamlining processes and automating software delivery. Operational resilience is being enhanced as development teams will act within a DevOps-oriented deployment practice. And for all parties, ease of use and simplicity will improve.

**“THE FUTURE SOFTWARE FACTORY WILL BE A MUCH MORE GLOBAL PROPOSITION WITH THE AMBITION TO CENTRALISE ALL SOFTWARE DEVELOPMENT ACTIVITIES IN A SINGLE STANDARDIZED AND AUTOMATED FACTORY ACCORDING TO CLEAR PRIORITIES”**
Transformation is crucial for the development and survival of skyguide. If the company does not increase the level of service and reduce costs, advancing technology and disruptive market entrants could make ATM obsolete, says Pascal Matthey, Transformation manager at the technical department by skyguide. Transformation requires fundamentally altered methods, processes, a changing mindset and behavioural adjustment.

Transformation is a broad term. How do you define it?
PASCAL MATTHEY Transformation is a journey, which requires dedicated time, effort and energy from across the organisation. Several factors and elements need to be addressed: an organisation with adequate change competencies, realistic plans, proper resourcing and transformational leadership. Transformational leadership involves an exceptional form of influence that moves followers to accomplish more than what is usually expected of them both by their leaders and by themselves. It also incorporates charismatic and visionary leadership. Transformation efforts have to be based on a holistic view and tackled in an integrated approach. To oversee and coordinate transformation across the company, skyguide has created a Transformation Group constituted of departmental representatives. Through this transformation group, systemic issues have been identified and structured and proper resources have been allocated in dedicated work streams.

The perception could exist that nothing has changed. Where are we today on the transformation process?
P M Looking back two or three years, that perception is wrong. We now have the right organisational frame, we introduced, delivered and tested the new Service-Oriented Infrastructure (SOI) and ensured that the technical organisation is ready to operate SOI together with our partner DXC. First solutions such as CRYSTAL and New Route handling were successfully deployed on SOI. In the ATM environment, this constitutes a real pioneering
achievement. According to HRO and Agile principles, we constantly strive to identify areas of improvement.

Transformation implies changes of work methodology, such as DevOps principles. What is the progress in implementing them?

P.M. Today we have an established team responsible for defining a test automation framework. This framework will enable teams to develop both application-specific and end-to-end automated tests. The teams are working towards building a continuous integration, continuous delivery chain (CI-CD) from SkySoft and other skyguide providers. They are also putting into practice the technical elements of DevOps (integration, deployment, test and monitoring) as well as organisational aspects such as governance, support mechanisms and culture.

You also introduced new IT Infrastructure Services. What does that mean?

P.M. They combine the IT platform, infrastructure and application services, network services and corporate IT. Using lean IT principles, the target is to introduce harmonized practices across all environments and to have an efficient and effective IT service delivery unit in place. This unit will provide aligned and streamlined IT services for all business units across the company, including ATM and AIM.

What are the challenges, and how do you overcome them?

P.M. Currently, we are focusing on the delivery of solutions and new features, as well as keeping the legacy systems running. Unfortunately, this sometimes results in slowing down organisational development.

As of 2020, we expect the first concrete results with respect to productivity, delivery, performance, service and customer satisfaction. Furthermore, by then, monetary benefits should become tangible.

While we see progress in some areas, habits and old thinking continue to create barriers. We need to do more to promote Agile behaviour and mindset in order to achieve the cultural change required. Managers have to learn to give greater autonomy to their staff while supporting them to be successful. At lower levels, a strong sense of ownership is required. We must further increase trust top-down as well as bottom-up. Trust is an essential component of any organisational culture.

“WE MUST FURTHER INCREASE TRUST TOP-DOWN AS WELL AS BOTTOM-UP. TRUST IS AN ESSENTIAL COMPONENT OF ANY ORGANISATIONAL CULTURE”
“IN THIS 2020 EDITION, WE WILL TELL THE STORY WHY CHANGE – WHICH GOES BEYOND TECHNOLOGY – IS CRITICAL AND WE WILL PROVIDE DIFFERENT PERSPECTIVES INTO SUCH A TECHNOLOGY-DRIVEN ORGANISATIONAL AND OPERATIONAL TRANSFORMATION”

– KLAUS MEIER