Saab r-TWR™ handbook

Welcome

Since Saab was started, we have striven to keep people and society safe. Saab serves the global military and civil market with world-leading products, services and solutions. Saab's market offering is broad, comprising complex systems involving extensive research and development as well as services with a high degree of repetition. With operations on every continent, Saab continuously develops, adapts and improves new technology to meet customers' changing needs. Innovation is critical for Saab's future and we believe it's something that can be learned, managed and measured so that we can create and sustain an innovative company culture. Our aim is that our values, attitudes and behaviours bring out our people's innovative sides, letting their talents shine.

Saab r-TWR is a perfect example of how we are innovating the future of Air Traffic Management, today and tomorrow. By choosing Saab r-TWR for your services you will get leading technology and a sustainable partnership – welcome to the r-TWR Family.

Per Ahl
Chief Executive Officer,
Saab Digital Air Traffic Solutions

The future of air traffic

Our world is changing, and the future is digital. As technology advances, we too must evolve. AI, drones and other emerging technologies are becoming operational, and at Saab, we are focused on meeting these future challenges. We invest in innovation and are proud to be thought leaders in our industry, working on producing cleaner and more efficient air traffic solutions. This encompasses both our civil and military Air Traffic Management (ATM) solutions.

Saab's ATM systems for Air Navigation Service Providers (ANSPs), airports, air forces and airlines are in operation in over 45 countries. A next-generation range that is built on Saab's operational experience, proven video processing, visual presentation and automation solutions, the r-TWR modules are flexible, role-based and can be selected to meet our customers' ambitions. All models are based on the same core software and hardware and host the complete functionality offering – your digital towers, our complete coverage.

Contents

What are digital towers?

Air Traffic Services
Digital towers enable the remote use of air traffic services (ATS) from any location. Being at an airport, air base or at a centralised location, distance is no longer a factor. Digital tower functions can be integrated to a traditional tower as a hybrid solution, and can support the ramp and apron management using the same information. A digital tower can also be deployed and put in place when needed.

Through the use of digital camera technology and sensors, operators can effectively conduct and manage various services remotely, based on visual surveillance. This removes the need to be on-site and occupying critical space at an airport, in favour of a chosen location.

Generic digital tower setup

Typical digital towers include:

Optical sensors	Network	Module	HMI	RTC

Our industry is changing and digitalisation is becoming the standard. This global digital transformation is essential for facilitating the growth of air traffic management.

Read the CANSO report for further guidance on digital towers and their impact on air traffic management.

Barriers to success – current industry pains

Civil and military
Civil and military ANSPs seldom work collaboratively, hindering success through a lack of information sharing.

Cost and time efficiency
Replacing existing towers and supporting infrastructure is highly costly and time consuming.

Operating many towers makes it difficult for ANSPs to improve efficiency and create economy of scale factors.

New technologies
Due to a lack digitalisation, ANSPs are currently missing out on the adoption of new technologies.

Attract the next generation of staff
Many ANSPs find it difficult to attract and recruit staff to operate their towers.

Competition and new entrants
ANSPs are struggling to compete with competition and new entrants into the market due to inferior technology.

New services and new ecosystems
Currently there is a fear of adopting a new business model, new systems and new airspace.

Digital tower gains – addressing your needs

Civil and military
Digital towers enable the integration of military Air Traffic Control (ATC) into civilian centres, enabling them to stay operational in case of emergencies, whilst increasing the military's mobility in response to threats. Military and civilian air traffic technology roadmaps can also be aligned, enabling both sectors to share and utilise crucial cyber security and other technologies.

Cost and time efficiency
Building a digital tower will significantly reduce the investment cost for a new tower and reduce the time to operation by over 50 percent.

New technologies
By adopting digital towers, new technologies including cyber security, AI, cloud computing and space-based satellites, can be seamlessly integrated and continuously updated.

Environmental impact
Digital towers can dramatically reduce an ANSP's carbon footprint, helping them reach sector goals through a reduction in physical towers and the introduction of airspace performance-based navigation (PBN).

Attract the next generation of staff
A new digital working environment, which can even be centralised, supporting multiple airports, is attractive for new recruits.

New services and ecosystems
Digital towers enable the adoption of a unmanned traffic management (UTM) business model, taking on new systems and new airspace to manage, boosting business growth and operational efficiency.

Digital towers – a summary:

- It's essential for airports to have a flexible solution that works effectively and reliably within the global air traffic network

- There is a growing need to support smaller regional airports as well as larger commercial airports

- Larger airports require the space currently taken up by localised towers to expand

- Older, physical solutions are expensive to upgrade or replace, and maintaining cyber resilience is difficult due to disparate systems and numerous suppliers

- Digital towers are more attractive and accessible to staff, improving recruitment and staff turnover

- Digital towers are able to adapt and update quickly to meet the demands of ever-changing operational needs and mitigate new threats

- Digital towers meet the needs of new business models and the demand for embracing new technologies

Why you need a digital tower

The decision to implement a digital tower comes down to a balance of taking business needs, benefits, risks and rewards into consideration. It is also linked to future proofing operations for tomorrow's aviation ecosystem and the people that will operate it.

Increased safety

Greater cost efficiency

Greater flexibility

Enhanced operational performance

Better operational resilience and contingency options

Centralisation of services and information

Greater level of service provision, cyber resilience and availability

Safety
Safety enhancements are linked to the deployment of enhanced controller support tools, including enhanced visibility and support by detecting and resolving safety-critical situations.

Operational resilience
The use of additional cameras and the integration of surveillance tracking supports and improves operational resilience in adverse conditions.

Improved contingency
A high percentage of capacity to be maintained if the conventional tower becomes unserviceable. Additional resilience can be provided during times of crisis.

Flexibility
Digital towers enable a level of flexibility that is not currently achievable when operating from a conventional tower.

Digital tower solutions enable resource to be shared between many aerodromes, ensuring that staff are matched accordingly to traffic volumes without generating additional costs.

ATS can be provided more easily in hostile or extreme environments where previously it would not be safe, or possible, to place controllers.

Enhanced service delivery
New and evolving technologies enable more integration and automation.

Centralisation
The digital tower can be co-located at a centralised facility, improving cost management, social benefits, staffing efficiency, data sharing and increasing collaboration.

Cost efficiency
The operational costs of maintaining and building new physical towers can be significant. The adoption of a digital tower reduces these costs considerably.

Potential savings can also be achieved by managing staff more efficiently, maximising the efficiency of future operational expenditure.

Further resource savings can be made if resources can be shared between co-located aerodromes within a digital tower centre.

Saab's r-TWR solutions conform to all necessary regulations whilst addressing the three main areas of need: **operations**, **technology** and **organisation**.

Our r-TWR technology achieved its regulatory approval for H24 ATC services in 2015 at Sundsvall airport. The Saab r-TWR continues to prove its efficiency at airports around the world.

Regulations

Operations

Technology

Organisation

Regulations

- The approved concept involves approved training plans, competence assurance plans, transition plans from conventional towers to digital towers and much more.

- All of this exists and complies with the standards and regulations used for regulatory authority review.

- Saab r-TWR is a multi-national platform, approved in several countries with the same foundations and principles.

Operations

- By using a digital tower in a centre, an ANSP can roster its staff in a more flexible way, increasing availability.

Organisation

- Management, training and rostering resources can be shared thanks to a digital tower centre.

- Digital tower centres provide attractive working places with colleagues and career opportunities.

- ANSPs can foster a common company culture, having more direct contact with its staff.

Technology

- The need for a physical tower at an airport is removed, enabling staff to operate the aerodrome remotely, increasing the airport's flexibility.

- With a digital tower centre, ANSPs have a common system for multiple airports with a common set of spares, improving the overall maintenance and access to trained staff.

- Adopting a fully digitalized environment means information and various supporting tools can be displayed and used in a user-friendly way.

Powerful innovation, safe hands

With Saab, you'll be getting cutting-edge innovation supported by our rich history and extensive industry experience.

Technology

Saab's market-leading technology offers the next generation of video processing, visual presentation and automation with a flexible and scalable solution.

Innovation

Thanks to our rich history of innovation, we offer a diverse family of r-TWR models. Operator usability and safety is paramount.

Military heritage

Our extensive military experience enables us to produce market-leading digital tower solutions for military use that can be deployed with speed and ease.

Active feedback

Our active feedback loop enables us to efficiently address our customers' needs, empowering them to focus on business growth knowing they are in safe hands.

The digital future

Digitalisation is vital for moving forward in the air traffic industry, no matter the current phase of your existing tower(s).

The Saab r-TWR solutions enable the digitalisation of your civil or military air traffic services, where you can pick and choose any optional extras needed to meet your unique goals.
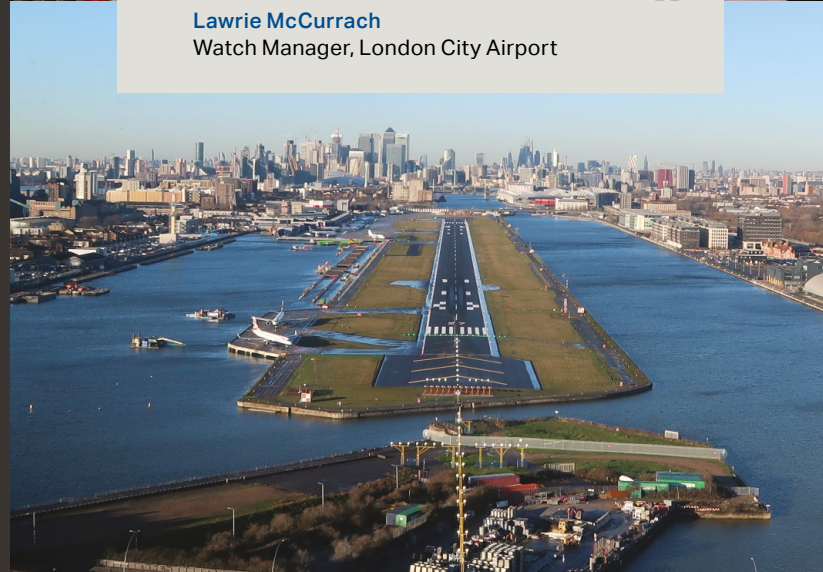
USE CASE:

London City Airport, UK

In 2021, London City Airport adopted a Saab r-TWR to become the first major international airport in the world to be fully controlled by a remote digital air traffic control tower.

Switching from a physical tower, London City's controllers now manage the runway from Swanwick with 360-degree monitoring thanks to 16 mast-mounted high-definition cameras and sensors.

> **"** The tower is a fantastic piece of kit and I'm always thrilled to show people around! **"**
>
> **Lawrie McCurrach**
> Watch Manager, London City Airport

Image credit NATS

USE CASE:

NATO Air Base Geilenkirchen, Germany

Saab's r-TWR is the first digital tower used in military operations. It's fully operational within NATO and is certified by the the German Military Aviation Authority (LufABw).

NATO's main operation base for its fleet of Boeing E-3A Airborne Warning & Control System (AWACS) in Geilenkirchen, Germany will be using the Saab r-TWR in all weather conditions. The solution will service a complex military airbase, handling additional aircraft types including helicopters and occasional traffic from fighter jets.

Saab around the world

Saab is global, and so is r-TWR.

We have production, training and support facilities, and centres of excellence all over the world, meaning we are here for you wherever you are.

United States

United Kingdom

Sweden

Germany

Australia

Key | Saab office locations | ATM locations

Leesburg, USA

The Saab r-TWR system deployed at Leesburg includes fixed HD cameras and controller displays, manoeuvrable optical and infrared cameras, microphones, and a signal light gun. In addition to live video, controllers have the full suite of tools required to operate the airport in a similar manner as they would in any other ATC tower. This milestone FAA decision has positioned the Leesburg airport – the second-busiest general aviation airport in Virginia – one step closer to permanent ATC services, while avoiding the ever-increasing expense of constructing and maintaining a conventional, multistory ATC tower.

What started in 2014 as a public-private partnership between Saab, Virginia SATSLab Inc. and the Town of Leesburg, the USA launch of Saab's r-TWR system subsequently became the first under the FAA Remote Tower Pilot Program. More than five years of FAA formal evaluations and safety panels led to an initial operational phase, during which time certified controllers safely managed over 75,000 operations at Leesburg. Prior to installation of the r-TWR, the busy airport lacked ATC services.

Cranfield, UK

Cranfield University, one of the top four commercial research universities in the UK, selected Saab's r-TWR solution to deliver a digital air traffic control system to Cranfield Airport.

It enables smarter approaches to air traffic control by digitising and integrating airport functions and improves a controller's situational awareness, enabling quick and informed decisions.

> Digital towers will inform the future of air traffic control because the pooling of resources leads to more cost effectiveness and efficiency, leading to further investment in airports and future technologies.
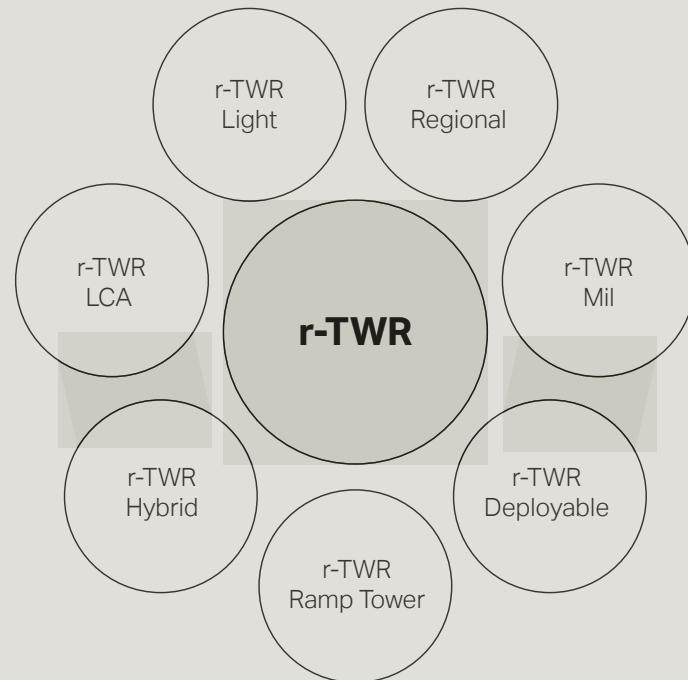
Sophie Hayes
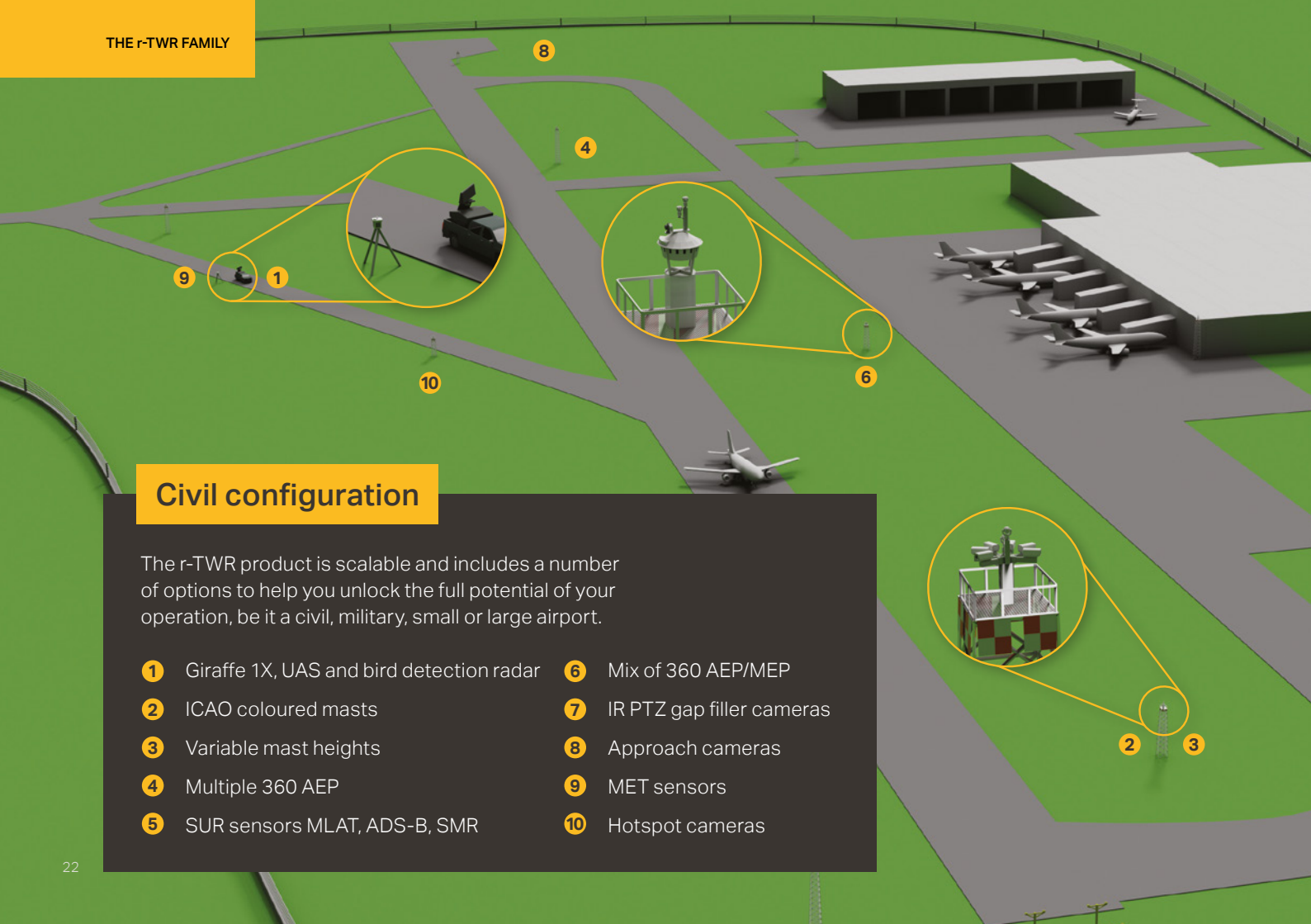Senior Air Traffic Control Officer, Cranfield Airport

Introducing the r-TWR Family

The r-TWR Family has been designed with flexibility and modularity in mind. With our vast range of models, there is an r-TWR for every ANSP and air force that can be tailored even further to meet specific customer needs.

For each model, there is a comprehensive list of optional extras that can be selected to boost your airport's operational efficiency and safety whilst reducing maintenance and labour costs. Further, all r-TWR models are fully integrable with any existing system, boosting efficiency and usability seamlessly in an unintrusive manner.

r-TWR Light

r-TWR Regional

r-TWR LCA

r-TWR Mil

r-TWR

r-TWR Hybrid

r-TWR Deployable

r-TWR Ramp Tower

Civil configuration

The r-TWR product is scalable and includes a number of options to help you unlock the full potential of your operation, be it a civil, military, small or large airport.

1 Giraffe 1X, UAS and bird detection radar

2 ICAO coloured masts

3 Variable mast heights

4 Multiple 360 AEP

5 SUR sensors MLAT, ADS-B, SMR

6 Mix of 360 AEP/MEP

7 IR PTZ gap filler cameras

8 Approach cameras

9 MET sensors

10 Hotspot cameras
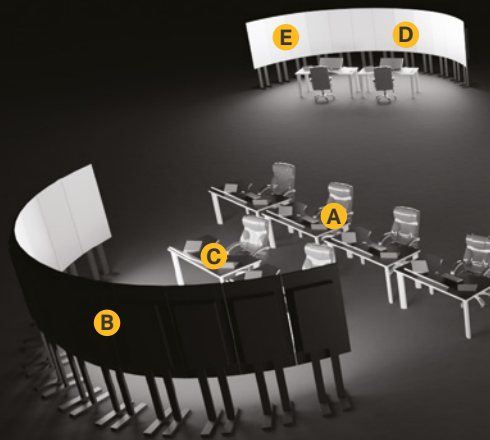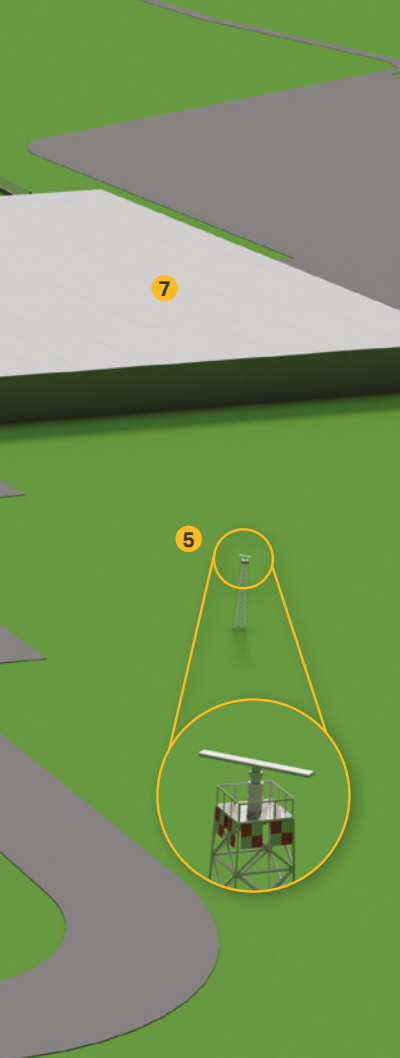
RTM configuration

A	Operational/technical supervisory positions
B	Integrated simulation and training
C	Multiple working positions
D	Test and Development System (TDS)
E	Information export to, for example, APOC
F	Mix of module sizes
G	AeroBahn CDM support
H	Slide and zoom
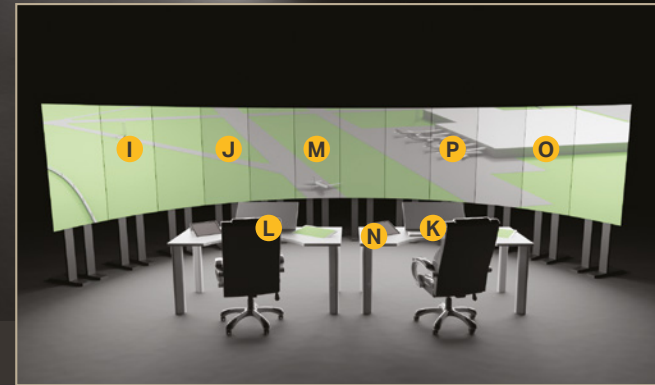
I	On-screen labels
J	Legal record and replay
K	Saab I-ATS integrated working position
L	Centre rostering tools
M	Integrated UTM support
N	Saab TactiCall VCS
O	Additional airports in the same module
P	Box-and-follow/PTZ tracking

LCAs demand a complete visual flexibility and capacity.

View example videos of LCA configuration

r-TWR LCA

Our most flexible model is designed to support LCAs with multiple runways of differing lengths and configurations where availability and capacity are paramount.

FEATURES

- 100 percent capacity contingency for a traditional tower

- Alternative to building new tower structures

- Supports multiple 360 AEP/MEP sensors with masts (up to 50 m), runway end cameras and multiple gap-filler cameras

The r-TWR LCA can be configured to work with a mix of standard and compact RTMs and can be fully integrated with the Saab I-ATS automation suite.

r-TWR Regional

This is our most widely used model, optimised for single runway operations, standardised implementation and operational transition.

FEATURES

- Compatible with AEP and/or MEP 360 systems

- Variable mast heights between 20–50 m (all in 3 m increments)

- Comes with a standard RTM for two or more operators (can be replaced by a smaller compact RTM on request)

- Prepared for Multiple Airport Control if there are two or more airports in the centre

The r-TWR Regional is our bestseller and has an impressive track record of hours and years in operation.

Single runway operations are our most used application of r-TWR Regional

View example videos of an r-TWR Regional configuration

r-TWR Hybrid

The r-TWR Hybrid provides airports and ANSPs with the capability to integrate digital tower information and capability into existing tower cabs.

FEATURES

• Can combine any camera variants onto a display area of selectable size

• System can be adapted to fit the available space

Similar to the r-TWR LCA, an existing tower's automation system with standard interfaces can be integrated onto the visual presentation.
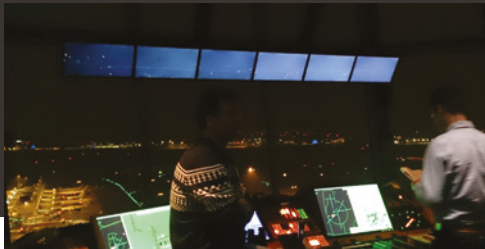
r-TWR Ramp

VRC (Virtual Ramp Control)

The apron/ramp control area enables airlines or airports to control and drive significant value before aircraft are handed to the Area Control Centre (ACC).

FEATURES

- Simultaneously provides a comprehensive 360 view view with Picture-in-Picture (PiP) gap filling cameras augmented by dual wavelength PTZ cameras

- Seamless integration with Saab's Aerobahn CDM platform, providing flight ID associated with each aircraft

- Enables the creation of holistic Non-Movement-Area control centers to improve in-and-out gate flow
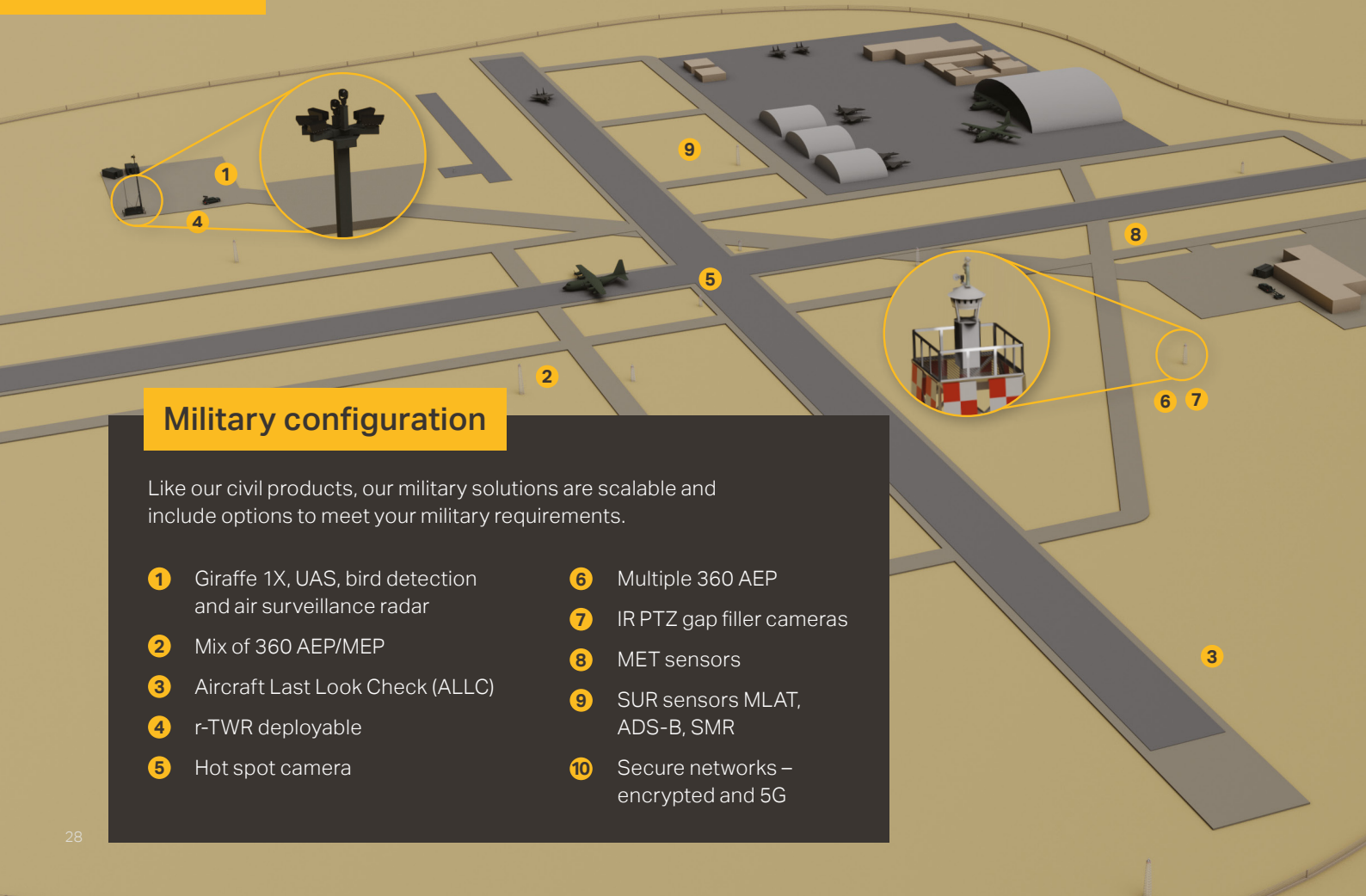
Military configuration

Like our civil products, our military solutions are scalable and include options to meet your military requirements.

1 Giraffe 1X, UAS, bird detection and air surveillance radar

2 Mix of 360 AEP/MEP

3 Aircraft Last Look Check (ALLC)

4 r-TWR deployable

5 Hot spot camera

6 Multiple 360 AEP

7 IR PTZ gap filler cameras

8 MET sensors

9 SUR sensors MLAT, ADS-B, SMR

10 Secure networks – encrypted and 5G
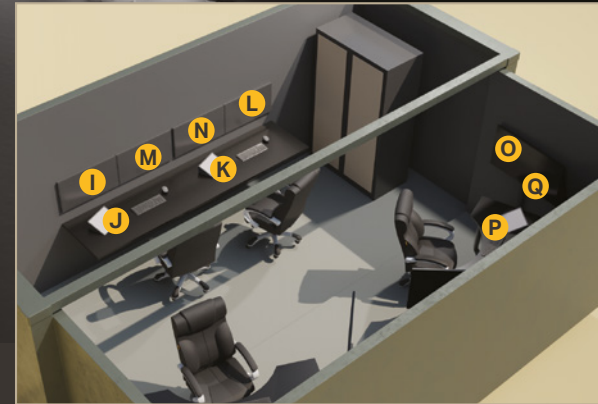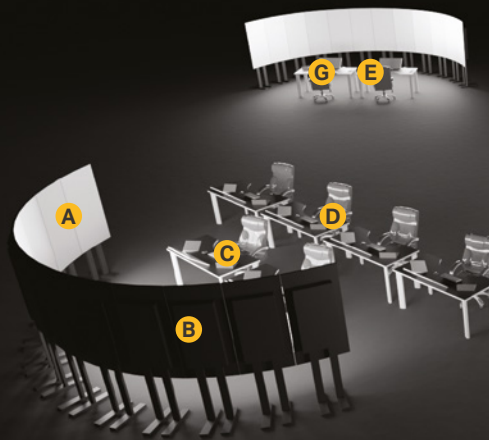
RTM configuration

A	Integrated simulation and training
B	Networked information
C	Test and Development System (TDS)
D	Operational/technical supervisory positions
E	Secure information sharing to tactical and strategic assets
F	Legal record and replay
G	Multiple working positions
H	Presentation at different sites for awareness

I	Slide and zoom
J	Saab i-ATS integrated working position
K	On-screen labels
L	Saab TactiCall VCS Civ/Mil
M	Integrated UTM support
N	G1X air situation
O	ALLC handling
P	MET/AWOS
Q	Box-and-follow/PTZ tracking

r-TWR Mil

Our r-TWR Mil model utilises all features offered to civil customers, with added functions more tailored to meet military requirements.

FEATURES

- Increased cyber security protection
- Connectivity to external military systems and functions used in everyday military operations
- Fully integrated UAS and bird detection function
- Primary air situation display capability when combined with the Saab Giraffe 1X sensor

The r-TWR Mil can be supplied with a full or compact RTM, dependant on the operation and requirement, and all-weather AEP 360 camera housing to ensure maximum detection even in the most adverse conditions. The r-TWR Mil can also include the Aircraft Last Look Check (ALLC) capability if required, which replicates traditional safety tasks as well as enhancing safety by seeing areas of an airfield that might currently be blind to the controller.

Aircraft Last Look Check (ALLC)

r-TWR Deployable

The r-TWR Deployable has been designed for military and relief operations, or as a home base contingency in the case of significant equipment failure.

FEATURES

- Based on the same camera/sensor (MEP 360) technology as the Main Operating Base solutions, which reduce training

- Inherently and easily transportable with a reduced airlift footprint – full system can be transported on a trailer or truck and be operational in 30 minutes

- Includes a camera array integrated with an erectable hydraulic mast and compact RTM installed in a transportable shelter – ballistic protection can be added if required

- Subject to connectivity, data can be sent to a protected shelter on the airfield or to a remote location away from the hostile/emergency areas

This model is a must for a versatile, safe and flexible base operation for your organisation.

RTC Stockholm, Sweden

On the first of June 2021, Luftfartsverket (LFV), a Swedish ANSP, commissioned a new Remote Tower Centre, RTC Stockholm, providing remote air traffic control for some of Swedavia's airports. In the first phase, Kiruna Airport was connected to the centre and was soon followed by Östersund, Umeå and Malmö.

RTC Stockholm has adopted the second generation of r-TWR and aims to support more than 20 airports with service provided from any module. RTC Stockholm includes an r-TWR Integrated Training and Simulation facility.

RTC Stockholm is directly linked to ATCC Stockholm, LFV's Area Control Centre at Arlanda, providing air traffic control for large parts of Sweden.

USE CASE:

Houston, USA

Saab's r-TWR has been in continuous operation at Houston since November 2019. Since its inception, United Airlines has seen tremendous operational benefits from its VRC (Virtual Ramp Control) centre that combines two ramp towers into one facility.

These benefits are further enabled by a seamless integration with Saab's Surface Management platform, Aerobahn, in tandem with MLAT and ADS-B sensors for an optimal working environment.

> The facility is truly state of the art and we've seen an increase in the arrival rates.
>
> **Daniel Reed**
> United Airlines Ramp Tower Manager

About visual requirements

The visual performance requirements of a digital solution depend on the specific operational context, which is dependent on the aerodrome and the type and scope of the services to be provided. The requirements are unique for each digital tower solution.

The optical system will be adapted to address the specific Areas-of-Interests (AoI) and Objects-of-Interests (OoI), which must be defined by the ANSP – the technical solution for the optical system meets the aerodrome-specific operational needs of what to see and where to see it.

Guidance for ANSPs, industry and other stakeholders can be found in the EUROCAE ED-240 MASPS.

For the most challenging object sizes and distances, the operator-specified visual requirements will be used by the industry to derive the Detection and Recognition Range Performance (DRRP) criteria. These defined criteria can be used for verifying the technical system in fixed environmental reference conditions.

AEP 360

The AEP 360, or **Advanced Environmental Protection** sensor pack, is the logical choice for airports and services requiring maximum image quality during all types of weather and supporting demanding operations. The AEP 360 is field proven with over 150,000 hours.

14
Cameras

360°
Field of view

Complete weather protection

Feature	Included	Data	Information
Horizontal coverage		360 degrees	14 cameras
Vertical coverage		+/- 22.5 degrees	
Weather protection	●		
Operative temperature range		-40°C – +50°C	
Internal heating	●		
External heating	●		
Internal cooling	●		Vortex cooling
Double shell design	●		To reduce heat dissipation
Recessed camera window	●		To reduce environmental impact
Overpressured camera house	●		To reduce impact of moisture and pollution
Camera window cleaning	●	Air Blades	Clear view solution with compressed air
Time to remove contamination		1 second	Saab clear view system
Sun filters	●	Controlled from VP	To reduce impact of direct sunlight
Bird spikes	●		
Standard camera	●	Bosch, 2K, 30 fps	
Gapfiller camera(s)		Bosch, 2K, 30 fps	
Standard mast type		Scanmast lattice tower	
Footprint 24 m mast		5 x 5 m²	
Mast pointing error		< 0.10 degrees	Severe storm
Mast operational		120 km/h	Severe storm
Mast survival		210 km/h	Hurricane
Pan/Tilt/Zoom (PTZ) camera	●	Bosch, 30x zoom, 2K, 30 fps	IR as an option
Signal Light Gun (SLG)	●	Saab COTS	
Technical cabinet	●	120 kg	Designed for Saab r-TWR
Technical shelter	●	7.5 x 3 m²	Designed for Saab r-TWR
Weight of sensor pack	●	245 kg	
Weight of PTZ	●	10 kg	
Weight of SLG including PT unit	●	10 kg	
Weight of pedestal including ladder	●	260 kg	
Service balcony including 4 lightning rods and 1 obstacle light		3 x 3 m², 890 kg	Optional

MEP (ATC/AFIS/FIS)

The MEP 360, or **Modular Environmental Protection** sensor pack is the choice for airports and services where a basic level of weather protection for the cameras is required. The MEP 360 can also be applicable for sites requiring a lighter weight, reduced footprint and specific camera types.

1–8
Cameras

30–360°
Field of view

Feature	Included	Data	Information
Horizontal coverage		30–360 degrees	1–8 cameras
Vertical coverage		+/- 13.0 degrees (adjustable)	Other lens combinations are available
Weather protection	●		
Operative temperature range		-40°C – +55°C	
Internal heating	●		
External heating	●		
Internal cooling	●		
Recessed camera window			
Camera window cleaning	●	Wiper	
Time to remove contamination		1 second	
Sun filters	●	Controlled from VP	To reduce impact of direct sunlight
Bird spikes	●		
Standard camera	●	2K/3K/4K, 30 fps	
Gapfiller camera(s)		2K/3K/4K, 30 fps	
Standard mast type		Scanmast lattice tower	
Footprint 24 m mast		5 x 5 m^2	
Mast pointing error		< 0.10 degrees	Severe storm
Mast operational		120 km/h	Severe storm
Mast survival		210 km/h	Hurricane
Pan/Tilt/Zoom (PTZ) camera	●	Bosch, 30x zoom, 2K, 30 fps	IR as an option
Signal Light Gun (SLG)	●	Saab COTS	
Technical cabinet	●	50–100 kg	Designed for Saab r-TWR
Weight of sensor pack	●	15 kg per camera	
Weight of PTZ	●	10 kg	
Weight of SLG including PT-unit	●	10 kg	
Weight of pedestal	●	150–200 kg	
Service balcony including 4 lightning rods and 1 obstacle light		3 x 3 m^2, 890 kg	Optional

USE CASE:

Brasov, Romania

Brasov-Ghimbav International Airport is the first newly built airport in Romania for over 20 years and will be operated using a Saab r-TWR from the offset. With a tight schedule of preparing infrastructure, installations and training, the Saab r-TWR system was installed and ready for testing within 11 months after contract signing. The project is a cooperation between the Airport of Brasov, UTI and Bog'Art, ROMATSA and Saab.

The airport will be operated remotely by the Romanian ANSP, ROMATSA, from an RTC in Arad, more than 400 km away.

> It is fantastic that our new airport will benefit from the most advanced technology in the field and make operations more efficient from the start.
>
> **Adrian Vestea**
> President of the Brasov County Council

Scandinavian Mountains Airport, Sweden

Scandinavian Mountains Airport in Sälen, Sweden, was the first airport built in Sweden in over 20 years, and and the world's first greenfield airport to use the Saab r-TWR solution from day one. The airport hosts an on-site camera tower in Sälen, while the air traffic control services are provided by Saab Digital Air Traffic Solutions (SDATS) from the RTC in Sundsvall. The airport is seasonal and can benefit from the flexibility of opening the airport only when needed, without requiring additional staff in RTC Sundsvall.

> **"** Saab's Remote Tower technology and services were the natural choice for us when we built our new airport. It enables us to future-proof our business and ensure cost-effective and flexible services. **"**
>
> **Gunnar Lenman**
> CEO of Scandinavian Mountains Airport

Masts and additional components

The camera housing is normally mounted on, or near, the top of a camera mast. The height of the mast is dependent on the airport layout, runway length and topography. The equipment shelter on the ground hosts the majority of the technical equipment, though masts can also be mounted to existing buildings without the shelter.

Saab now has years of experience from live operations at different locations, including severe storms in Sweden and Hurricane Ophelia that hit Ireland in October 2017. Despite this, no image distortions have been registered to date. Saab's standard equipment shelter comes pre-installed alongside the camera tower and other equipment. All installations are designed to integrate with the existing airport infrastructure to ensure optimum performance.
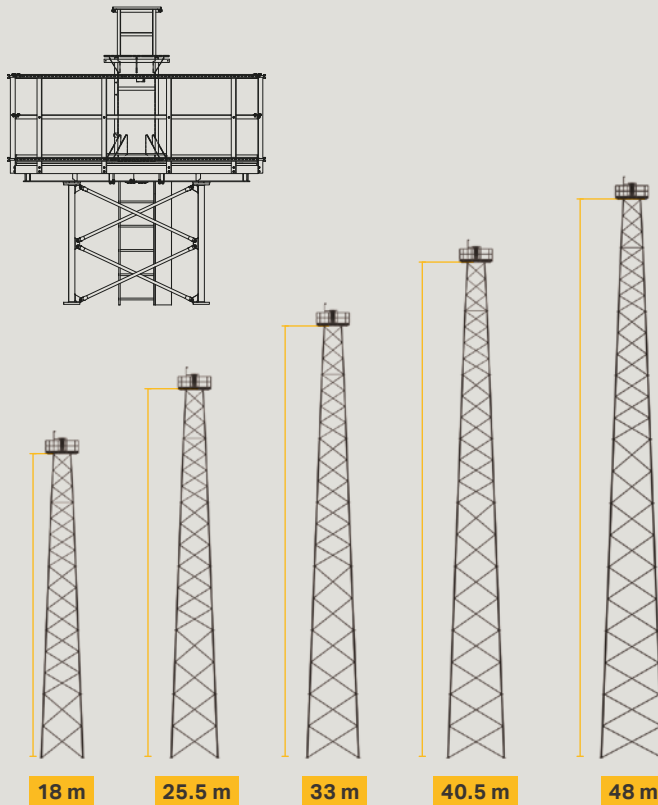
Height from 18 to 48 m in step of 1.5 m as standard

18 m   25.5 m   33 m   40.5 m   48 m

Scanmast is a company that specialises in designing and building towers and masts. Saab has chosen to work with Scanmast due to their extensive industry experience, knowledge and adaptability.

The strength of a truss mast is its efficiency – it's very stable relative to its material weight. It is a proven product that effectively supports technology in a variety of uses and is easily adaptable to meet the customer's requirements.

Scanmast's calculations consider wind loads, types of terrain, safety classes, the airport's layout, runway length and topography; everything to be able to deliver a product adapted to its environment regardless of country.

scanmast

r-TWR Centre

Saab r-TWR offers the ability to operate multiple airports from a centralized facility – a centre of digital towers. We call these Remote Tower Centres (RTC). An RTC can be a standalone facility or can be combined with an Approach or Area Control Centre, for example.
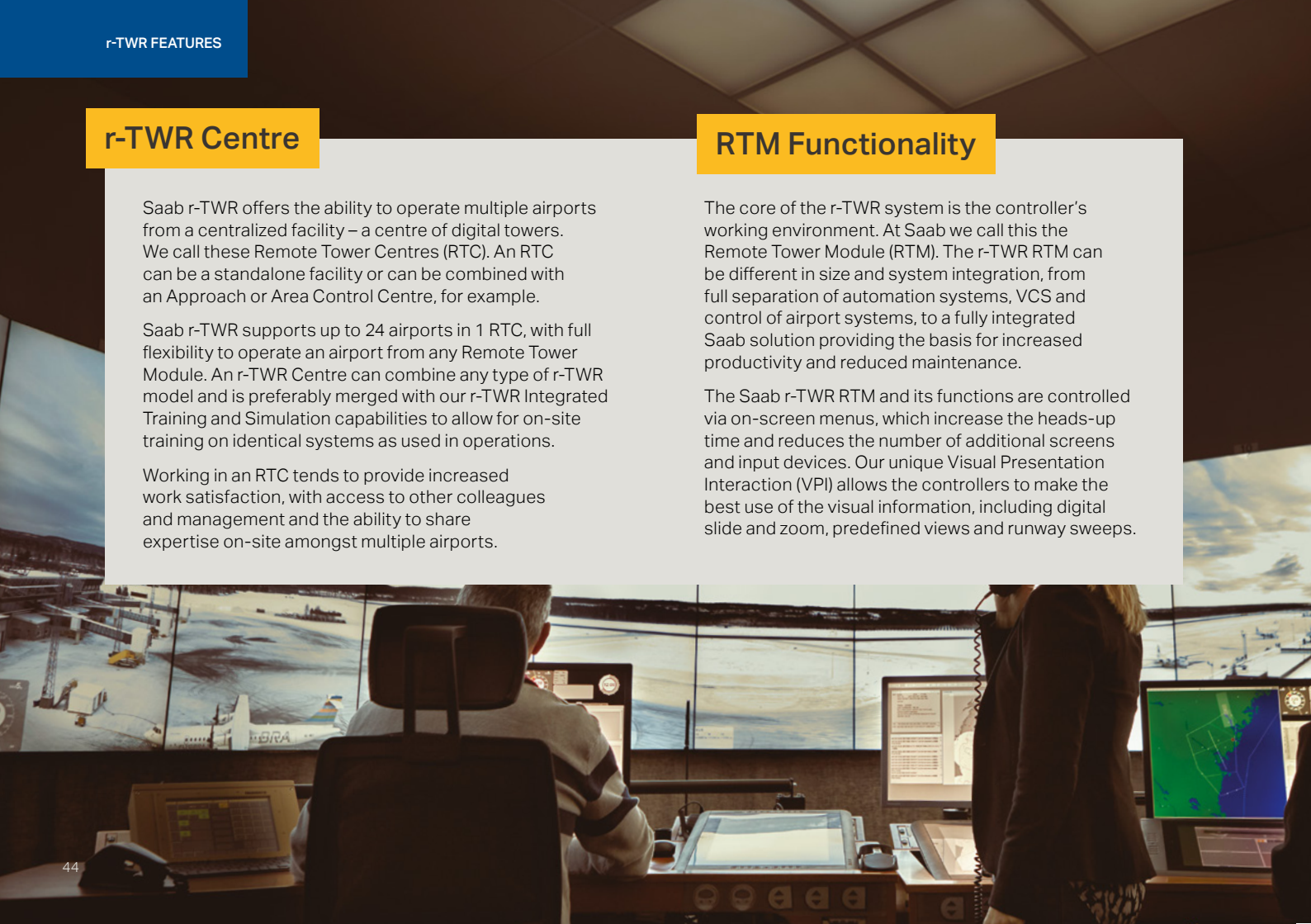
Saab r-TWR supports up to 24 airports in 1 RTC, with full flexibility to operate an airport from any Remote Tower Module. An r-TWR Centre can combine any type of r-TWR model and is preferably merged with our r-TWR Integrated Training and Simulation capabilities to allow for on-site training on identical systems as used in operations.

Working in an RTC tends to provide increased work satisfaction, with access to other colleagues and management and the ability to share expertise on-site amongst multiple airports.

RTM Functionality

The core of the r-TWR system is the controller's working environment. At Saab we call this the Remote Tower Module (RTM). The r-TWR RTM can be different in size and system integration, from full separation of automation systems, VCS and control of airport systems, to a fully integrated Saab solution providing the basis for increased productivity and reduced maintenance.

The Saab r-TWR RTM and its functions are controlled via on-screen menus, which increase the heads-up time and reduces the number of additional screens and input devices. Our unique Visual Presentation Interaction (VPI) allows the controllers to make the best use of the visual information, including digital slide and zoom, predefined views and runway sweeps.

HMI

In over 10 years of development and operational validations, the HMI has evolved from being initially controlled from the traditional location, at the desk, to being controlled where the operator is looking, on the Visual Presentation (VP).

This is the reason why Saab, in close cooperation with operators, has developed the new concept of context menus in the VP. These context menus are dynamic, meaning that only the available functionality in each specific situation is selectable and displayed as a semi-transparent overlay on the VP.

HMI-integrated operator menus – context menus
It is extremely important for an operator to have the best situational awareness possible in the working environment. Maximizing the heads-up time is therefore a crucial step in achieving the best possible situational awareness.
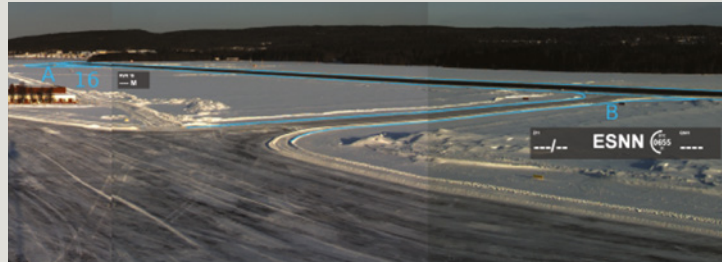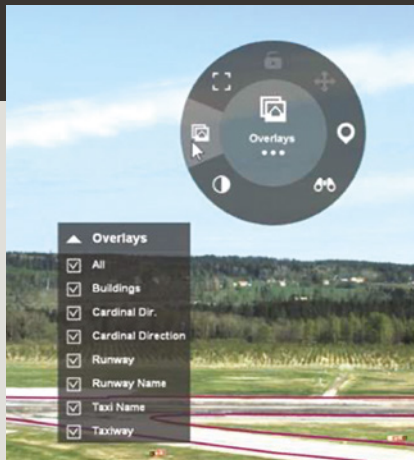
Overlays

The system implements overlay functionality as transparent bitmaps that are overlaid on the VP. The transparency allows the operator to see objects moving behind the overlays. This is considered a safety requirement. The overlays are built in customizable layers that can be toggled on or off by the operator.

Geographical overlays are used to highlight specific parts of the airport, such as taxiway labels, apron and gate numbers, static warnings or any other text, symbols or numbering that can help raise the awareness of the operators. These overlays are particularly beneficial as points of reference in low-visibility scenarios.

The geographical overlays can support the operator to assess the current visual range at the aerodrome. Known landmarks can be highlighted with overlays with corresponding distances. If the specific landmark can be seen by the operator, the visual range is at least "this far". In the image to the right, landmarks have overlays with distances in statute miles (sm).

Weather information, such as wind information, RVR-values and MET reports can be presented as overlays on the VP (Visual presentation).

The Saab r-TWR System uses the static cameras as light meters and calculates a global measurement value that represents the current actual external light intensity (on a unit-less scale). This value (LUX) will be presented on a screen in the RTM so that the operators can use it as a reference to determine the actual external lighting conditions.
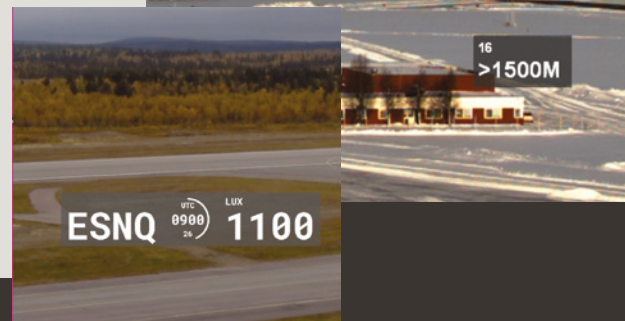
Any pixels. Anywhere.

The visual presentation can be configured to utilize any combination of screens and resolution to provide the optimum user experience for the actual operational use case.

RTM Standard

The RTM Standard is optimised for a working setup comprising multiple controller working positions (CWPs). The screens provide sufficient space for automation tools, including Saab's Integrated Working Position – the I-ATS.

14+1
screens

RTM Compact

The RTM Compact is designed for single or dual-manned towers where space is limited. The RTM Compact reduces the overall footprint significantly and can also be used in a dedicated support role with the RTM Standard.

5–8
screens
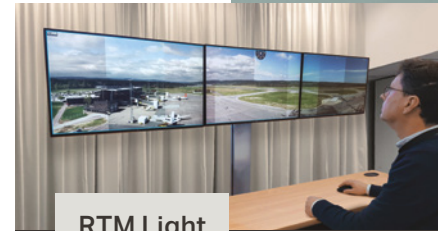
RTM Light

The RTM Light is optimised for very small airports and AFIS. It can also be used in support of other functions like supervisory positions or at an airport operations centre.

2–4
screens

Same software

Multiple Aerodrome Control-capable

All support Saab r-TWR centre architecture

RTM modularity

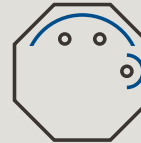Each airport has different needs in terms of air traffic control, including size, traffic, runway layout, concept of operations and the number of operations staff. The type and numbers of RTMs required will differ, especially for larger, more complex airports.

Our RTM system is modular, enabling you to choose modules which will fit together to meet your needs. The VPI software is configurable, and is the same for any setup chosen. We recommend streamlining the RTM setup to allow for maximum flexibility, enabling any airport to be operated at any time.

An airport can use one or multiple RTMs to support the different roles. If Saab's I-ATS Automation suite is used, it is fully role based and can support flexible use of the RTMs.
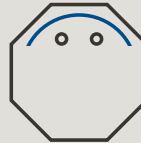
| Single RTM of any type suppporting an airport | Combination of RTM types | Multiple RTM for different roles, e.g., larger airports | Multiple RTM supporting parallel runways, etc. | Multiple RTM supporting, for example, parallel runways with additional roles |
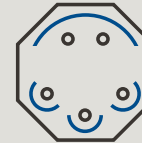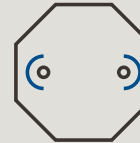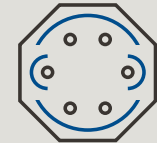
Model comparison chart

● Included   ○ Option

Feature/function	Light	Regional	Large complex airports	Ramp – Apron	Hybrid	Military	Deployable
Box and Follow	●	●	●	●	●	●	●
Lightning protection	●	●	●	●	●	●	●
Centre-compliant architecture – up to 24 airports	●	●	●	●	●	●	●
Saab Visual Presentation Interaction software	●	●	●	●	●	●	●
MEP 30–360 Cameras	●	●	●	●	●	●	●
Camera mast 24 m	●	○	○	○	○	○	
Camera mast 30 m	○	●	●	●	●	●	
Camera mast – other heights	○	○	○	○	○	○	
Signal Light Gun (SLG)	○	●	●	○	○	●	○
PTZ standard	●	●	○	●	●	○	
PTZ IR	○	○	●	○	○	●	
PTZ gap-filler cameras	○	○	●	●	●	○	○
RTM Standard module	○	○	●	●		○	
RTM Compact 5–8	●	●	○	○	○	●	●
RTM Light 2–4	○	○	○	○	○	○	○

● Included   ○ Option

Feature/function	Light	Regional	Large complex airports	Ramp – Apron	Hybrid	Military	Deployable
Airport System Adaptation Unit (ASAU)	○	●	●	○	○	○	
Legal record and replay	○	●	●	○	○	●	○
Technical supervisory position	○	●	●	●	●	●	
Operational supervisory position	○	○	●	○	○	●	
Integrated tower working position	○	○	○	○	○	○	○
EFS ADS, FDP	○	○	○		○	○	○
Multiple Aerodrome Control (MAC)	○	○				○	○
PTZ tracking	○	○	●	○	○	●	○
r-TWR Integrated Training and Simulation (ITS)	○	○	○	○	○	○	○
MET AWOS package	○	○	○	○	○	○	●
UTM integration	○	○	○	○	○	○	○
Aircraft Last Look Check (ALLC)						○	○
Giraffe 1X – multi-purpose radar	○	○	○	○	○	○	○
Saab TactiCall VCS – MAC ready	○	○	○	○	○	○	○
QOMS – Centre planning tool	○	○	○			○	

Automation

**Saab Integrated Air Traffic Control Suite
(I-ATS) – Flexible Air Traffic Control
automation system for digital towers**

I-ATS is a modular and scalable platform that provides air traffic controllers a comprehensive set of tools to safely and efficiently manage air traffic from and to an airport of any size. Key features include a highly configurable controller working position and the high level of integration between different HMIs on a number of displays, including the r-TWR visual presentation. Saab's I-ATS allows for a proven and trusted controller working position, supporting the new generation of digital towers.

I-ATS includes

- Advanced Surface Movement Guidance and Control System (A-SMGCS), including:

    - Surveillance service

    - Airport safety support service

    - Routing service

    - Guidance service

    - Air and Ground Traffic Display

- Electronic Flight Strips (EFS) system

- General Information Display (GID)

- Departure manager (DMAN)

- Web-based supportive airport insight tools

- Integration with:

    - r-TWR

    - System-Wide Information Management (SWIM)

    - Automated Weather Observing System (AWOS)

    - Airfield Ground Lighting (AGL) system

I-ATS includes full support for controllers to work without strips and interact directly in the labels, i.e., 'stripless' workflow. As a fully integrated working position, I-ATS supports touch and selected common input devices. Further more, the I-ATS system is future-ready as it follows applicable standards from, for example, SESAR, EUROCONTROL, EUROCAE and ICAO.

By combining Saab r-TWR and Saab I-ATS, you will have a common platform and a consolidated roadmap for both regional, domestic, small and large airports worldwide. Hence, 1+1=3. Welcome to the Saab family!
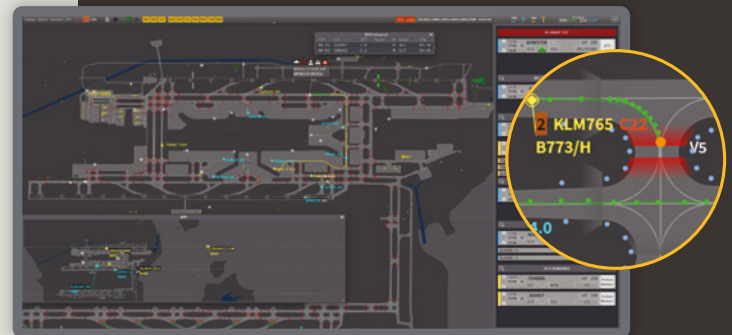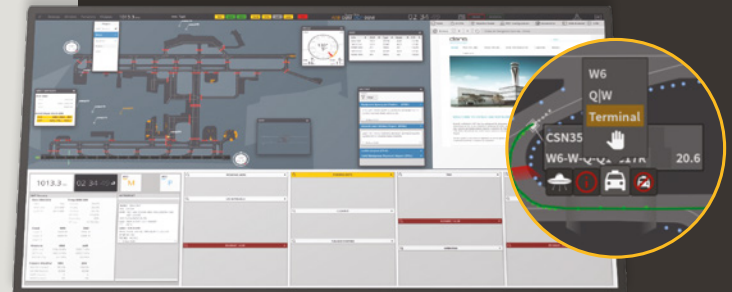
Multiple Aerodrome Control (MAC)

The MAC applies when one operator simultaneously provides ATS for more than one aerodrome from one RTM.

Technically, any RTM in the RTC can run any combination of multiple aerodromes. From an operational point of view, traffic complexity, operator licensing/rating and human factors, etc. must be taken into account.

Airport 3

Airport 1 | Airport 2

Layout configuration

1

Airport 1 | Airport 2

Layout configuration

2

Airport 3

Airport 2

Airport 1

Layout configuration

3
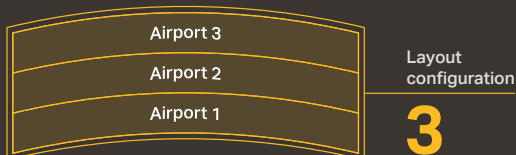
Multiple Remote Tower concept was a part of SESAR2020.

The video shows the demonstration of MAC at COOPANS Open Day in Malmö, Sweden, in September 2022.

TactiCall

TactiCall VCS for Air Traffic Control

The TactiCall Voice Communication System is a modern and fully IP-based system that equips air traffic controllers with a robust and user-friendly communication interface for both remote tower operations and Area Control Centres.

The system includes all the required communication capabilities, including radio communications, telephony, intercom and recording. These capabilities are developed according to the latest EUROCAE VCS and required ATM safety standards.

Our Enterprise VCS management system is capable of controlling and monitoring multiple independent TactiCall VCS systems ranging from single-airport systems to multi-airport systems, all the way to a complete nationwide VCS service.

To meet future requirements for digital tower operations and the trend towards integrated controller working positions, our TactiCall VCS is designed with open APIs for integrations.

Our TactiCall VCS system is an integrated part of Saab's r-TWR solution, supporting multi-airport control from the same VCS control panel.

The VCS system originates from the military domain with a large focus placed on making the solution cyber secure. TactiCall VCS supports encryption of all IP traffic between all the VCS components, IP networks and the remote radios.

Furthermore, all servers and CWP computers feature host and network-based firewalls to protect the individual components against unauthorized access and attacks.

Network

Robust and redundant network connectivity between remotely controlled airports and the Remote Tower Centre is typically achieved with three independently routed network paths. Two network paths are used for simultaneous transmission of all data, while the third can be used for controlled ATS closure in case of reduced redundancy.

For the two main paths, the bandwidth requirement is higher – typically 120 Mbps depending on the number of installed cameras. Bandwidth for the third network is lower as only limited data, such as equipment monitoring and control and voice communication streams, is required for controlled ATS closure.

The transmission on both paths enables instant switching without discontinuous viewing. It also allows continuous and instant network quality monitoring, such as for delay, jitter and packet losses.

Each video frame, captured in cameras, is timestamped with NTP before compression for transmission. This timestamp follows the frame in the video stream over the networks and in the presentation software up to rendering for viewing. The presentation software uses a buffer to manage minor variations in transmission and decompression delay. A smooth video presentation is achieved by frame-by-frame extract from this buffer and render based on the NTP timestamp from the cameras.

RTC

RTM   RTM   RTM
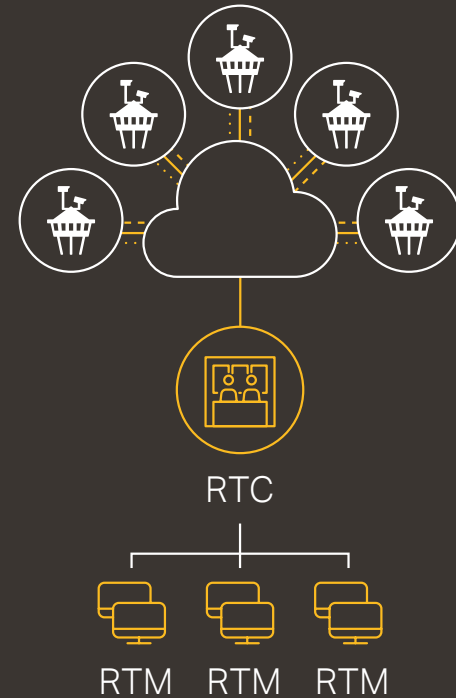
Cyber security

To protect our solution and customers against an ever-increasing threat of cyber-attacks we have taken a number of steps, including:

- hardening according to CIS benchmarks

- encryption of sensitive data

- centralized configuration and user management

- access control

- firewalls and encryption of data in transit

- use of digital signatures to verify system integrity

- monitoring all assets for vulnerabilities

These steps are aligned to national/customer cyber security strategies to the extent possible.

Giraffe 1X – lightweight multi-mission surveillance radar

Giraffe 1X is a small, lightweight, and high-performing 3D radar – the perfect choice when continuous air surveillance is desired as part of short-range surveillance and ground-based air defense. The weight, together with its very low power consumption, allows it to be easily integrated into any type of mobile or fixed platform, such as the Saab r-TWR.

Giraffe 1X provides swift understanding of the air situation, enabling immediate and effective response to changing threats, new tactics and shifting operational conditions. Every second, the compact, high-performing 3D radar covers the entire search volume, detecting any air threat, including low, slow and small (LSS) targets with the Drone Tracker functionality.

The complete radar can be transported on a pickup truck-sized vehicle, by helicopter, or towed on a trailer. It can be permanently installed on a building or a mast, or integrated into a suitable vehicle. The system can be operated either remotely or locally.

The automatic tracking functionality provides quick and reliable feedback to the operator. Giraffe 1X can detect fixed and rotary wing targets, fast missiles and RAM targets as well as small UAVs in high-clutter environments. All information from the radar is well integrated within the Saab's r-TWR solution for the operator to get full situational awareness.

MET AWOS

Automatic Weather Observation System (AWOS)

Automatic acquisition, processing and presentation of sensor data used to generate, edit and distribute meteorological reports intended for aviation.

AWOS has been specially designed to detect, report and disseminate the weather conditions at airports. With flexibility in mind, it can be used at airports of varying sizes, from small domestic landing strips to large international airports with up to four runways.

The weather information is measured by a collection of sensors which gather data presented by the AWOS7 system. The weather data is presented in alphanumerical and graphical form and is stored in a database, retrievable from the historical archive. The weather presentations can be run either locally or remotely.

MET information is fully integrated in both our I-ATS automation system and the RTM visual presentation.
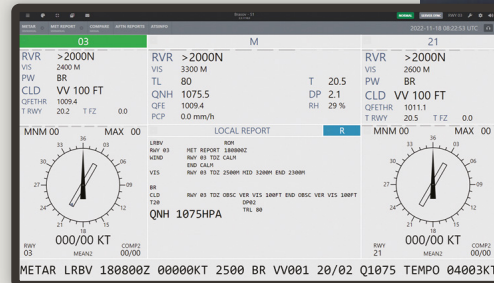
r-TWR simulator

The Saab r-TWR simulator is an extension of our current Air Traffic Control simulator used for civil and military training.

The common synthetic environment simulates airports and the airspace between, covering operators, pseudo-pilots, instructors and the exercise leader. Several exercises can be run in parallel and it includes functions for procedural ATC such as local, ground, approach and area control or combinations of functions in real time. Supported conditions include precipitation, light, and wind, as well as operational incidents. The integrated Voice Communication System (VCS) provides simulated radio and telephony services. The system can be operated in the cloud when used for multiple RTCs.

The subsystem will simulate a failure that is noticeable by the operator at the data origin, so the operational part of the system will detect the failure and present it in the alarm management system.

Failures and degradations that the ITS supports include:

- end-to-end delay or frame rate changes
- corrupt, delayed or frozen image
- loss or degradation of PTZ or gap fillers
- loss of tracking, visual presentation, and radar or surveillance data

The r-TWR simulator is the optimum tool for supporting the change to digital tower(s), and includes the possibility to:

- evaluate software features, upgrades and ATC procedures
- evaluate tower and gap filler camera placement early in the process
- get operators acquainted with a certain airport
- ensure early user acceptance

Integrated training concept

Training is provided for all users at each phase of the project's implementation, including:

• r-TWR familiarisation training – this gives trainees an overview of, and gets them familiar with, the r-TWR system. This is essential in supporting your change management.

• ATSEP training – systems and maintenance training based on live experience in Sweden and the UK.

• ATCO training – system training based on live experience in Sweden and the UK.

• Training comprises classroom lectures, practical exercises in a simulator or RTC environment and competence tests.

Though there are similarities to training in a traditional tower, there are important learning elements unique to r-TWR training, including new alarms and associated actions, different fallback procedures, and human factor/performance training.

We've learnt the importance of using integrated training and simulation to support your transition, and the training plans are closely linked to this, ensuring a smooth transfer to live operation.

Maintenance and support

- As a global security company, maintenance and support is in our DNA.

- Designed and built to last – all our fielded systems are supported until the end of their lifetime.

- Staying ahead of the curve – we can ensure cost efficiency and the ability for our systems to develop over time.

- Obsolescence management process – spare parts and replacement units are readily available if required.

- Half-yearly software updates for the latest and greatest in operation, safety and security.

- Single point of contact to report any issues for dedicated and organised customer service through our Saab Support Portal.

One man. One tool.

One tool to complete the full job. The maintenance of the camera housing must be easy, safe, and work in all weather conditions. The video presents the camera system maintenance.

Standards and transition

The Saab r-TWR system is developed according to EUROCAE ED-153 SWAL3 and ISO 27001:2013.

The Saab r-TWR system supports applicable parts of the following standards:

- ICAO Annex 3, 18th Edition including amendments 1-76
- ICAO Annex 10, Volume 1, 6th Edition, amdt 1-88A
- ICAO Annex 10 Volume 2, 6th Edition, amdt 1-88A
- ICAO Annex 10 Volume 4, 4th Edition, amdt 1-88A
- ICAO Annex 11, 13th Edition, amdt 1-49
- ICAO Annex 14 Vol 1, 6th edition, including amendments 1-11B
- ICAO Annex 15, 14th edition, including amendments 1-37
- ICAO Doc 4444, 15th Edition amendment 1-6
- ICAO Doc 7030 5th Edition European Supplementary Procedures
- Eurocontrol Specification for Online Data Interchange (OLDI), edition 4.3
- Eurocontrol Standards for data processing - ATC procedures (ADEXP) v. 2.1
- Eurocontrol Standards for Communication (FDE-ICD), edition 1.0
- ASTERIX Structure (Part 1), Edition 1.30
- CAT001 - Monoradar Target Reports (Part 2a), Edition 1.1
- CAT002 - Monoradar Service Messages (Part 2b), Edition 1.0
- CAT004 - Safety Net Messages (Part 17), edition 1.1
- CAT048 - Monoradar Target Reports (Part 4 - next version of Cat 001), edition 1.14
- CAT034 - Monoradar Service Messages (Part 2b - next version of Cat 002), edition 1.26
- CAT062 - System Track Data (Part 9), edition 1.13
- CAT063 - Sensor Status Messages (Part 10), edition 1.3
- CAT065 - SDPS Service Status Messages (Part 15), edition 1.3
- CAT247 - Version Number Exchange (Part 20), edition 1.2
- CFMU Handbook ATFCM Users Manual Ed.15
- EUROCAE ED-240

Saab r-TWR user group

The Saab r-TWR user group is pivotal to the growth of the r-TWR product and concept, and helps us establish a common roadmap for development. Open to all customers using the r-TWR product, the joint forum encourages the sharing of experiences and knowledge around needs and requirements, implementation issues, change management and the benefits of going digital. The support network between members is very much appreciated and enables our customers to be part of a global user community and to learn from each other.

Welcome to the r-TWR Family!

2030: The roadmap

With our r-TWR solutions, it's not a one-and-done deal. We're proud to offer long-term commitment – a future-proofed solution that evolves and grows not only in line with the market (updated regulations, new services etc.) but with your ambitions. Our customers buy into our trusted and upgradable system to see them through the years ahead.

Our current generation, the Saab R-TWR 3.0, offers a complete set of standardised models with a wide range of validated options, including training support, Multiple Airport Control functions, Saab TactiCall VCS integration, a variety of surveillance sensors, Saab I-ATS-integrated controller working positions, improved maintenance procedures and IT security with reduced hardware and scalable HMI to mention a few.

In parallel, Saab continues researching – together with our partners in Europe, the USA and Asia – the ways in which we introduce UTM and advanced air mobility as well as enablers like AI in a safe and acceptable way. We like to say, "think big, start small".

We're partnered with you today and tomorrow.

Same basic operational concept

r-TWR 1.0

- 360-degree with 220-degree arc
- Camera solution
- EFS, RDP, FDP integration
- Alarms
- Basic functions

Offered to market

RTC Sundsvall
Pilot airports

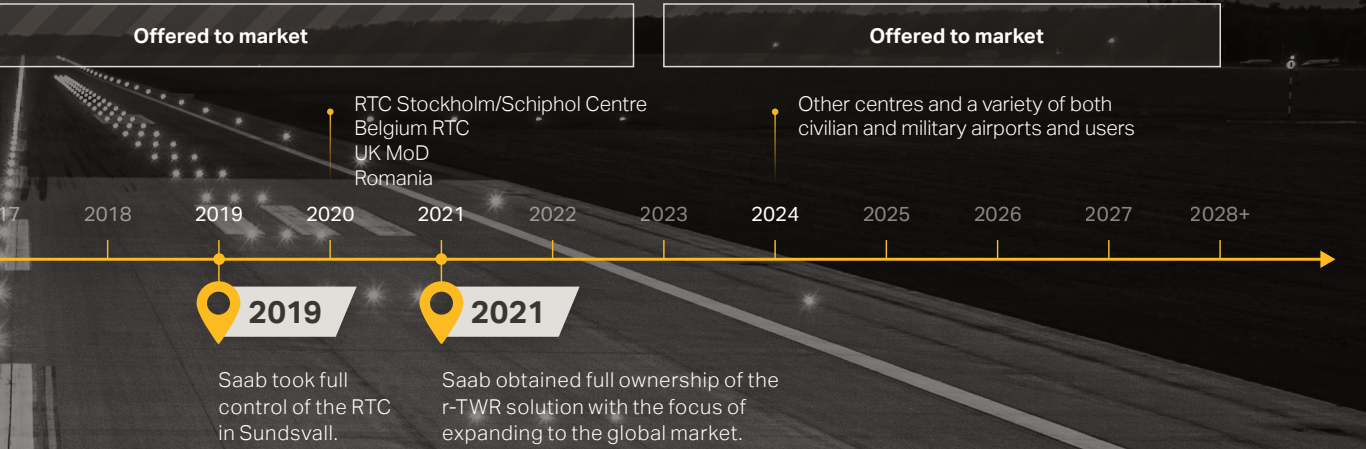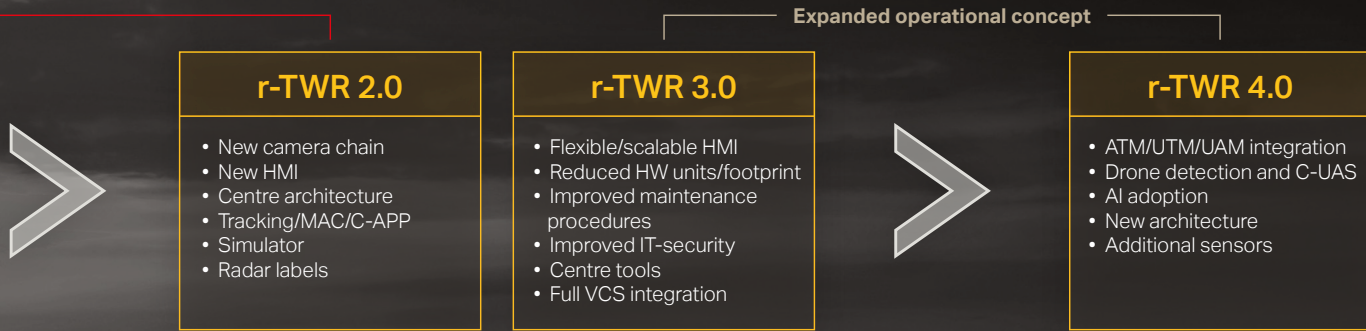2011   2012   2013   2014   2015   2016   20

2006

r-TWR was created, becoming the world's first digital air traffic solution.

2015

The first digital tower became operational at Örnsköldsvik Airport in Sweden.

Expanded operational concept

r-TWR 2.0

- New camera chain
- New HMI
- Centre architecture
- Tracking/MAC/C-APP
- Simulator
- Radar labels

r-TWR 3.0

- Flexible/scalable HMI
- Reduced HW units/footprint
- Improved maintenance procedures
- Improved IT-security
- Centre tools
- Full VCS integration

r-TWR 4.0

- ATM/UTM/UAM integration
- Drone detection and C-UAS
- AI adoption
- New architecture
- Additional sensors

Offered to market

Offered to market

RTC Stockholm/Schiphol Centre
Belgium RTC
UK MoD
Romania

Other centres and a variety of both civilian and military airports and users

17 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028+

2019

Saab took full control of the RTC in Sundsvall.

2021

Saab obtained full ownership of the r-TWR solution with the focus of expanding to the global market.

Digital tower implementation playbook

Having been instrumental and leading the development and implementation process for well over a decade, we have selected the top 10 take aways that are important to bring with you on your journey towards becoming digital.

1

No major ops change required – our system is designed to support your current way of working.

2

Work with your regulator – decide on your endgame and the steps to get there.

3

Seek approval for the basic functional level – add to this once live.

6

Initiate your change of management from day one – find the champions and key stakeholders within your organisation to work effectively with other users.

7

Re-use regulatory validation and documentation from other countries – focus on the differences.

8

Choosing a vendor and plan – be aware that building a hub is not the same as making one or a few airports remote; it requires new infrastructure.

4

Use standard in-use systems or suppliers – avoid new developments, but ensure you have a roadmap and vision.

5

Maintain focus on your programme objectives – implement developments with structure.

9

The most successful digital tower projects are executed with less than 300 functional requirements – focus on the operational needs, not the technology; don't design the system.

10

Integrated simulation and training – initiate early in the programme.

Saab r-TWR Talks

Saab presents r-TWR Talks. The series explores future technologies, production and development, and other digital tower insights. Join us!

Episode 1
Saab presents five key lessons learnt from r-TWR installations around the world.

Episode 2
The journey to Saab r-TWR 2.0. Discover the industry, scale and sustainability developments that led to Air Traffic Service 24/7 being realized.

Episode 3
Take a look at Saab's evolving edge of technology concept and our plans for r-TWR 3.0.

Episode 4
Meet the teams developing and producing Saab's next generation of digital towers from their production facilities in Sweden. Part 1.

Episode 5
Hear again from the team developing and producing Saab's next generation of digital towers. Learn the safety and security aspects of r-TWR development and see the test facilities. Part 2.

"Saab is world-leading and a front-runner in the digital tower industry, both by technology expertise and operational experience. The modular solution within the r-TWR Family makes it superior for both civil and military use."

Peter Engberg
Vice President, Head of Traffic Management

saab.com/digitaltower