A VISION FOR THE INTEGRATED TOWER

HOW ADB SAFEGATE IS DELIVERING SAFER, MORE EFFICIENT AND SUSTAINABLE AIR TRAFFIC MANAGEMENT WITH A MORE CONNECTED AIRPORT

ADB SAFEGATE

Air Traffic Control is highly complex, and extremely demanding

With air traffic exploding, today's Air Traffic Controllers (ATCOs) probably work in one of the most challenging environments. Airport capacity is strained, and tower systems and personnel are expected to manage more and more traffic, much more efficiently at a lower cost. All this, while putting safety first and working towards more efficient yet sustainable guidance.

More traffic, fewer delays, at a lower cost: As Air Navigation Service Providers (ANSPs) become more transparent in their operations and financial performance, there is pressure to reduce fees while also having to invest heavily in future technology and training. This places unrealistic demands on finances. This focus on cost-effective guidance is compelling ANSPs to consider new approaches such as digital tower operations where a centralized control room from one location provides guidance to multiple remote airports. This eliminates the need for a high building at the airport to host the Visual Control Room.

Demand for more efficient, sustainable guidance: Aviation today accounts for 2% of global carbon emissions, and the industry is focused on bringing down emissions to 2005 levels by 2050. Sometimes, environmental goals conflict with each other: re-routing aircraft from noise-sensitive areas can lengthen the route, increase fuel use and emissions. How can ATCOs balance the environmental impact of their decisions with the need for growing capacity?

Life-critical decisions based on massive data volumes, across diverse, disparate systems: The sheer number of data points ATCOs review to decide what's best, is both daunting and impressive. Not long ago, they only needed to know the aircraft type, runway, arrival or departure route, and surface wind. ATCOs must now consider how much time each part of the turnaround takes, numerous push back procedures, night curfews, environment-based runway and SID assignment, Hold Over Times, meteorological data, and size specific airport data.

Given how control rooms have evolved over the years, today they are often a mix of non-interoperable hardware and software. Traditionally, each system, such as the Advanced Surface Movement Guidance and Control System (A-SMGCS), electronic flight strip system and various information systems, has its own screen and interface that the controller must monitor. Each system will also typically have its own visual representation and input method, further adding to the complexity of the task facing controllers. Identifying what data to get from where, and what input to enter where, and in which form, using diverse human machine interfaces (HMIs), adds to work pressure.

Evolving regulations, flight procedures and coping with unmanned aircraft systems: Naturally, regulations are evolving. ATCOs must know a magnitude of navigational and regulatory flight procedures, across aircraft systems - from the top-modern plane flying RNP-AR approaches to legacy aircraft, from better performing jets to helicopters, hot air balloons, training flights, and now, drones. Is the current setup and team adequately equipped to manage the exponential growth in unmanned systems?

Is the Tower Infrastructure up for the challenge?

Conventionally, towers at airports, are controlled by ATCOs employed by Air Navigation Service Providers. In some countries, ATC operations are managed by the defense forces. Visibility is sometimes hindered either because of height restrictions or new buildings that obstruct the view.

At some airports, a single tower handles all movements while in other cases, one tower is assigned for apron movements while another focuses solely on runway movements. This "degree of separation" from other aspects of airport operations, presents an additional layer of challenges for tower operations and substantially impacts tower productivity.

Lack of insightful data, and poor situational awareness: While data about aircraft movements in the air and on the ground is available from airfield surveillance systems, aircraft transponders, airline systems and other sources, it is disjointed and typically unprocessed. This is a missed opportunity for the tower. Moreover, ATCOs lack visibility into airport-wide operations, specifically more accurate aircraft landing times, better awareness of apron operations and how the aircraft is faring across different stages of the turn process. This can hamper the quicker and safer movement of air traffic from arrival to departure.

Not enough integration, and automation: With safety always at the forefront, the tower has been slower to bring automation into its operations. New technologies are adopted only when they have proven beyond doubt their ability to deliver substantial benefits without any potential degradation in safety. While some degree of automation has reduced the risk of human error and brought in greater efficiencies, at many airports around the world, ATCOS still often rely on manual or semi-automated systems, and have to constantly track multiple computer screens for information.

Moreover, even at airports where automation has resolved many challenges, what's still missing is the integration of individual systems. Most airports still operate largely in silos. The collaboration between systems and personnel at the landside and airside, and between apron, gate and the tower, is little to non-existent. For example, gate management has a big influence on operational decisions made in the tower but is traditionally not part of tower operations.

The Tower cannot stay isolated

Tower systems and ATCOs must meet the demands of air traffic management today, and in the future. Tower operations must become more flexible, more automated and crucially, more integrated with the other major airport systems for the airfield, apron, gate and other landside processes.

Consider the benefits of an integrated setup:

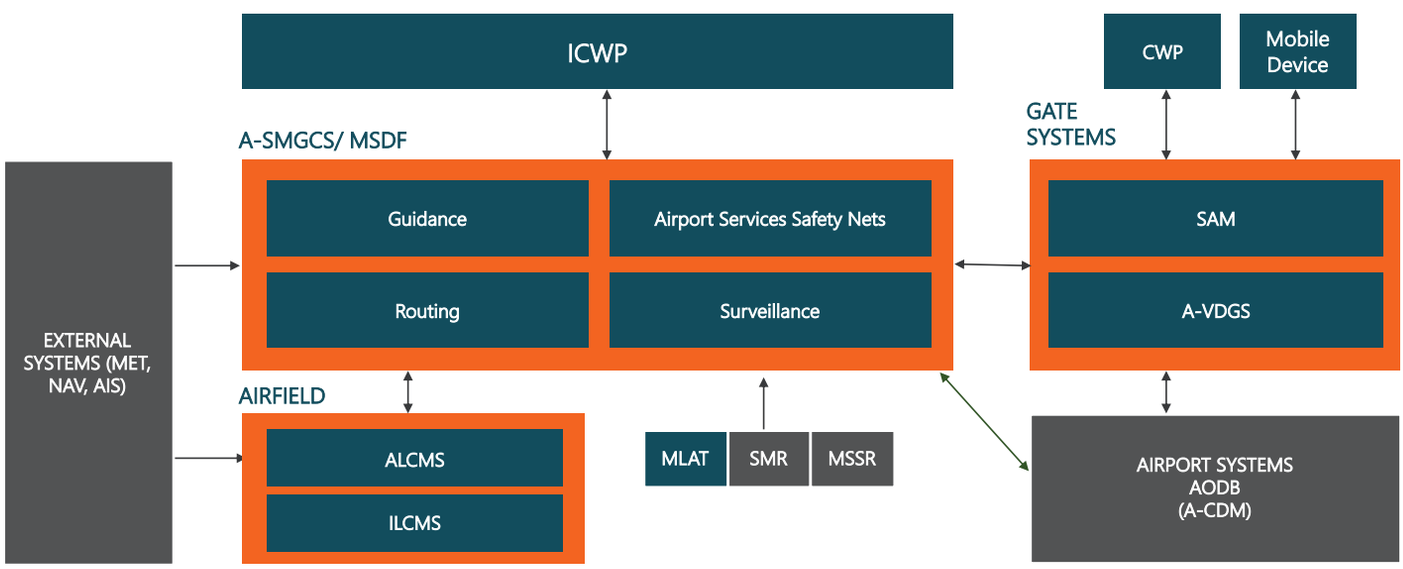
Improved predictability: With all systems being quite interdependent, integrating different airside systems, as well as interlinking airside and landside systems, helps to improve the predictability of how much time each aircraft has spent on the ground. Runway optimization is vital and must run in parallel with gate and apron optimization. With the data being shared, stakeholders across the airport are able to work together, more cohesively.

Leveraging data to improve capacity: Integrating en-route and terminal maneuvering area (TMA) data with airport operations data, including accurate turn information from the gate, could improve aircraft arrival and departure sequencing to boost runway capacity. With access to all the relevant information, controllers are able to make accurate decisions, more quickly.

Better situational awareness and forecasting: Applying advanced analytics will provide a much wider and more precise picture of airport operations and help to improve ATC situational awareness and traffic forecasting. Analytics can be used in two ways - real-time or almost real-time - to resolve bottlenecks that cause delays and reduce capacity, and to plan future airport expansion or to optimize procedures.

Improve an ATCO's working environment: Ultimately, integration harmonizes the operational process, so the systems take on critical tasks and reduce ATCO workload.

Infrastructure is used more efficiently: Overall, better usage of infrastructure reduces congestion on ground, reduces fuel consumption and carbon emissions, and reduces the need to invest in additional buildings, taxiways and runways – money that can be spent otherwise to further improve operations.



Solving air traffic management's most pressing challenges with integration

Part of an interconnected airport, the Integrated Tower concept is one where all the systems that impact tower operations – whether they are in tower, apron or airfield, are integrated so they communicate with, and support each other. Operational silos across the airport are broken, and processes and people are in 'sync'. This enables timely and accurate sharing of information between airport stakeholders, which forms the basis for operational concepts like Airport Collaborative Decision Making (A-CDM), Airport Operations Plan (AOP) and Network Operations Plan (NOP).

The Advanced Surface Movement Guidance and Control System (A-SMGCS) provides situational awareness even if visibility is hindered either because of height restrictions, new buildings that obstruct the view or simply bad weather. It covers the complete route from touchdown to in-block, with active airfield lighting (AGL) and guidance from the Advanced Visual Docking Guidance System (A-VDGS) from runway exit to the assigned taxiways, into the apron area and all the way into the gate.

This level of integration reduces complexity and optimizes ATCO workload. It improves predictability and common situational awareness, facilitating the tracking of significant events such as A-CDM turnaround milestones more easily. There is greater efficiency in traffic management with a more automated approach that supports flight sequencing, routing and guidance in all weather conditions. Unnecessary delays that contribute to higher carbon emissions are reduced, and harmony in the operational process raises safety and sustainability.

Tower-based Integration

At the heart of the Integrated Tower is the **Integrated Controller Working Position (ICWP)**, which simplifies the ATCOs workload by ensuring they get the vital information they need, at the right time, without distraction. Required information is displayed clearly.

With the ICWP, ATCOs are now able to view data from traditionally disparate systems on a single user interface - for example surveillance and advanced airport safety support, apron management, routing and guidance service, AGL or workflow support. Additional information is available on demand. This might include flight strips for building a sequence of flights, information views containing all available weather data, Navaids and other interface status, runway operation mode, CCTV cameras, flight sequence windows, and so on. Plus, it can connect with external functions involved in ground movement through web-based clients and mobile applications.

ATCOs are still expected to monitor what is happening "outside the window", and the ICWP proves particularly useful in low visibility operations and in areas with poor visibility. Overall, it reduces the complexity of air traffic management, and optimizes the ATCO workload.

A multitude of capabilities

Optimized traffic flow, improved safety and surveillance: The ICWP offers a view of the current ground and air traffic situation via the A-SMGCS and ASD systems. The **Multi-Sensor Data Fusion (MSDF)** is a key enabler of the ICWP. It which combines data from surveillance sensors and multiple external systems - Surface Movement Radar (SMR), Multilateration (MLAT), Secondary Surveillance Radar (SSR), and ADS-B – based on different ASTERIX categories. The MLAT plays a crucial role in optimizing traffic flow, improving safety and situational awareness by providing accurate secondary ground surveillance in all weather conditions.

Integration of all this surveillance data means ATCOs can track aircraft and movements on runways and taxiways, ascertain the position of and identify cooperative mobiles, and extend tracker coverage. Integration with the A-VDGS improves tracker coverage and accuracy at the gate. This surveillance data is vital in the early detection and avoidance of safety conflicts through warnings and alerts.

More efficient flight and departure sequencing: Electronic Flight Strips (EFS) combine the well-established benefits of a paper strip system with the advantages offered by electronic data handling. With the ICWP, ATCOs can arrange these in in logical strip bays to plan a flight sequence for a clear view of a particular air traffic situation, automatically synchronize the content of these strips with external sources or update the strips manually.

It is also possible to calculate efficient departure sequences, based on the medium- to long-term predictions of future traffic flows, according to A-CDM principles. Runway changes, closures, including temporary closure of taxiways, can easily be taken into consideration in order to deliver precise Target Startup Approval Times (TSATs).

More efficient routing: Routing algorithms can recommend the most appropriate route for each movement by taking the different criteria like standard patterns, aircraft classification, restrictions or visibility conditions into consideration. Integrating this into the ICWP allows the controller to monitor deviations, re-route when needed, and respond quickly to changes in the traffic situation.

The ICWP is still evolving. The future lies in integration with airfield ground lighting, apron and airport systems as well as integrating approach tools like Arrival Manager (AMAN) systems or time-based separation (TBS). These are just some of the areas that ADB SAFEGATE is exploring for OneControl, its ICWP.

Better gate visibility for smoother operations: The Digital Apron

Integrating the A-VDGS with tower systems can enhance and support A-SMGCS surveillance, routing, guidance and safety net services. This increases the situational awareness of the ATC and extends flight crew guidance into the gate area. The A-VDGS as a sensor can be integrated into A-SMGCS, EFS or other ATC systems to automatically provide stand availability, route aircraft to the planned parking position and trigger workflow actions for ATCOs.

Integrating the A-VDGS with the A-SMGCS allows the ATCO know aircraft position at all times, and support:

- Automatic activation of the docking process based on the actual aircraft position, not on estimated stand arrival time
- Use of secondary surveillance to identify the call sign or registration of an aircraft via its

transponder. This eliminates the possibility of pilots docking at the wrong gate and further delaying the turnaround process.

- More precise aircraft tracking in the gate area, especially where A-SMGCS coverage may be limited and there is reduced line of sight.

- A-VDGS surveillance can also be used to track aircraft when they push back from the gate. With a centralized system at the airport connecting all A-VDGS at the gates, it is possible to obtain full surveillance coverage at the gate– filling the gaps that are not covered by the traditional ATC surveillance. Data on the stand status, aircraft position and docking accuracy is sent to the A-SMGCS. The ATC is alerted if no digital clearance input has been provided via the EFS, but a push back movement has been detected by the A-VDGS.

- The A-VDGS display could also be used to automatically alert the pilot and pushback driver with a warning, for example "No pushback clearance", or to confirm that pushback clearance has been given. The system can also detect and alert when an aircraft hasn't moved, despite having pushback clearance.

Better, and more sustainable guidance: Integrating with the Airfield

Integrating the tower surveillance and surface management with the AGL supports better guidance, reduces taxi time, fuel burn and carbon emissions. Early detection of conflicts on the runways, taxiways and restricted areas is possible by integrating the A-SMGCS, AGL and EFS. Alerts can be sent quickly, to support safer operations.

With innovative concepts such as Follow the Greens (FtG) with floating guidance, ATCOs benefit from improved situational awareness. Pilots know they need to follow green taxiway centerline lights, preceding their aircraft and the absence of these green lights, i.e. a black hole means they must stop. Some airports eliminate black holes with stop bar installations.

With integration, automated FtG can be supported and ATCO workload further reduced:

- The system can automatically switch on taxiway centerline lights for a specific distance when a ground vehicle approaches, and turn it off, once it has passed. Using the centerline lights for guidance of mobiles is most effective when the AGL system supports

single lamp control. Single-Lamp Control systems are available and can be provided by ADB SAFEGATE.

- The system can control stop bars so the pilot or driver of a mobile only needs to follow the green lights to reach the proper destination. Automatic stop bar control provides ATCOs vital operational support and reduces workload. In the future it will be possible to provide the route via data link directly to an aircraft for further safety support to pilots.

Newer concepts such as intelligent lights with alternating displays aim to remove the ambiguity associated with "black hole" and eliminate the need for stop bars. ADB SAFEGATE's innovative taxiway centerline light can alternate between red and green displays, allowing controllers to guide the aircraft on when to stop or proceed.

Making full use of data with tower services and analytics

Services such as site surveys and audits, design, consulting, installation and commissioning, project management, training, maintenance, upgrades, and service level agreements (SLAs) play a key role in supporting continued operations, and boosting systems and operational performance.

ADB SAFEGATE is well placed to provide ATC services with the highest quality data analysis to help improve airport performance. While data is available in various airport systems, it is not currently used to its fullest extent. Gathering and integrating data, then applying advanced analytics can greatly improve predictability and ATC situational awareness.

Analytics will provide better forecasting, extending ATC view of operations from just a few minutes ahead to an hour or more and with greater accuracy. Artificial intelligence will recognize patterns and issues in shared data and suggest actions to further increase efficiency under changing circumstances, leaving controllers free to focus on their core control responsibilities.

Bringing it all together with integration

Typical airport infrastructure includes diverse and disparate systems across the airside, apron, landside and tower, sometimes sourced from multiple preferred vendors who are specialists in their respective domains. These best-in-class systems must work cohesively. Integration services play a vital role in enabling these systems to work, and communicate with each other, seamlessly to harmonize the operational process.

System integrators need to be able to collaborate with these specialist manufacturers, to design, install, and implement these systems. A holistic and more complete understanding of the airport setup is a much-valued asset in such instances.

ADB SAFEGATE works with a growing portfolio of specialist partners to incorporate additional capabilities. Our systems can be combined with other solutions installed in the tower, allowing for one integrated airport setup.

Tower of the Future

Greater autonomy in operations, support for autonomous vehicles and UAVs, the push for automation and digitization will impact how tower systems evolve in the future.

Autonomous operations and UAVs

Autonomous taxiing of aircraft to and from the runway will improve the predictability of taxi times by eliminating the variable taxiing speed of aircraft. Putting autonomous operations in place wherever possible will reduce ATC workload and cut costs as staff resources are used more effectively.

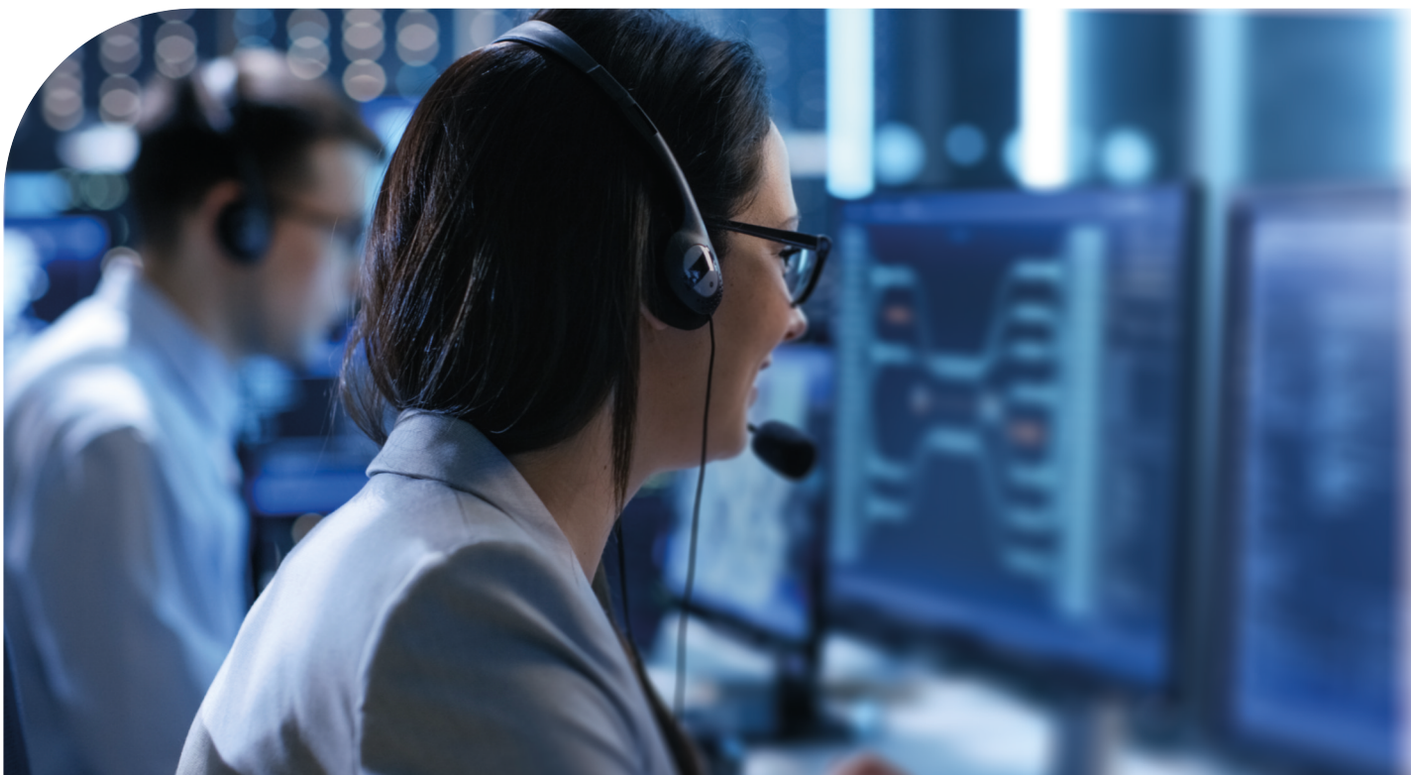
With the growing use of Unmanned Aerial Vehicles (UAVs), or drones, the issue of protecting airport space against unauthorized drones is only part of the story. Drones will be increasingly used by transportation companies delivering goods from airport hubs, while unmanned air taxis are already being tested. This creates challenges around whether regional or tower ATC centers should manage UAV traffic and whether UAVs should have dedicated airspace or use civil airspace. Controlling drone traffic could easily become a major ATC issue in just a few years.

ADB SAFEGATE's OneControl's routing and guidance service will be ready to support self-driving vehicles like tow trucks, snow ploughs or ground handling vehicles.

Automation for higher productivity

Bringing in more automation can further reduce ATC complexity and controller workload. To optimize the airport capacity, also the traffic in the neighboring units has to be considered. There is a high dependency between airport, approach and en-route operations. As an example, the complex process of managing and sequencing arrival and departure flights, especially on a single, mixed mode runway, can be greatly improved through integrated Arrival Manager (AMAN) and Departure Manager (DMAN) systems. Integrating arrival and departure traffic and supporting new methodologies (for example wake vortex recategorization and time-based separation) boosts runway throughput and creates higher airport capacity using the same physical infrastructure.

Integration and automation of the AMAN and DMAN allow the best sequencing of arrivals and departures. Time buffers traditionally needed because of the unpredictability of aircraft touchdown time can be reduced to avoid aircraft waiting several minutes for take-off at the runway. Accurate arrival times also aid gate activity planning as the docking time will be known precisely, enabling better use of ground crew resources.



Remote ATC services with digital towers

Digital towers are increasingly seen as a cost-effective way to provide ATC services for airports large and small. While most current projects are trials, it is expected that a significant share of air traffic services will be delivered by digital towers in the future.

A digital tower replaces the traditional visual control room at the top of a physical tower, enabling it to be located in an office or bunker elsewhere on the airport or even remotely. Camera-based surveillance and display technology replicates the out-of-the-window view of a physical tower. This is integrated with traditional tower systems such as voice control, AGL control, flight plan and surveillance systems, and meteorological systems as well as with apron systems such as the A-VDGS.

Augmented Reality (AR) overlays on displays could provide information not available in traditional towers, for e.g. night vision cameras or zoom functionality. Taking the concept further, multiple views of the airport could be delivered from cameras situated in the best places on the airfield, for example in blind spots behind buildings or at the runway ends, to give controllers a much better view of critical points. Sensor technology is also expected to play a key role in the evolution of digital towers and will enable full 'heads-down' instead of 'heads-up' surveillance in future operational concepts.

Benefits of digital towers:

- Eliminate costs associated with building a second or new tower to service new areas of an expanding airport, or refurbishing/ replacing a physical tower
- ATC services to several small airfields that would not be able to afford their own facility, elevating them from being uncontrolled to controlled.
- Ease controller recruitment and rostering in locations where finding skilled resources is a challenge
- Provide continuity of air traffic services at medium and large airports should the main tower be compromised.

ADB SAFEGATE's OneControl offers an excellent platform to integrate advanced camera and sensor technology. We can combine our OneControl capabilities with solutions offered by camera and camera tracking software providers. We are also working with two key partners. The focus is to offer cost-effective, out-of-the-window visualization through remote towers, and added capabilities like image recognition and artificial intelligence (AI).

Demonstrating our expertise

Clearly, the complexity facing air traffic management will grow. Digitization, data analytics and automation will be primary tools in helping the tower to meet new demands. ADB SAFEGATE has deep know-how in airport operations, across the apron, airfield and tower, gained from many years of close cooperation with airports worldwide and from our own staff, several of whom are former air traffic controllers.

We know how interconnected these domains are, and the transformative power of integration and automation. By combining our expertise and our wide-ranging portfolio with leading systems from our expert specialist partners, we can integrate tower systems and processes with other airport-wide operations. We can apply advanced analytics on a wide range of data collected from our and other systems, to help airports, ANSPs and airlines collaborate better to resolve the most pressing challenges of air traffic management at any airport.

Our experience in integration spans airports around the world including Abu Dhabi Intertional Airport, Beijing Daxing International Airport, Hamburg Airport, Lahore Allama Iqbal International Airport, and Taiwan Taoyuan International Airport.

Succes: From 0-29 movements, Lahore Airport weather proofed in under a year

At Pakistan's second largest, **Lahore Allama Iqbal International Airport (AIIP)**, dense fog often lasting several weeks in winter affects visibility, and has historically impacted airport operations. Flight delays, diversions and cancelations inconvenience passengers, and diversions prove extremely expensive particularly for airlines and airports.

Weather proofing Lahore's airport in only 12 months: Pakistan Civil Aviation Authority (PCAA) decided to partner with ADB SAFEGATE in 2015, setting an ambitious deadline of weather proofing the airport in only 12 months!

Phase 1: Enable the airport to remain open and operational during fog, and support landing of aircraft in low visibility. This guaranteed five movements per hour. CAT III b landing conditions for approach were enabled with new Airfield Ground Lighting Systems (AGL) and Instrument Landing System (ILS). AIIP was previously using ILS since 1999, which allowed the aircrafts to land in visibility down to 350 meters only, whereas ILS category III b operates in visibility as low as down to 50 meters. AIIP became the second airport in South East Asia using such an advanced ILS.

Phase 2: Maintain throughput in all weather conditions: The target was set at handling 25 movements per hour. This included installation and commissioning of ASP and Airfield Lighting equipment for taxiways and apron, 11 new Advanced Visual Docking Guidance Systems, new tower systems as Electronic Flight Strips, A-SMGCS including SMR and MLATs together with completely new Concept of Operations (CONOPS). The airport is now able to manage as many as 29 movements per hour even during bad weather conditions, four more hourly movements than the original target.

More capacity, more economic opportunities

Since the completion of the project in Lahore, AIIP is among the world's few airports with the capacity to handle and maintain the same throughput in all visibility conditions. With a complete integrated system in operation, from approach to departure, Lahore is now reaping benefits of increased capacity – existing airlines as well as new airlines want to increase their number of flights!

Rashid Hussain, Airport manager, Pakistan Civil Aviation said, "With more flights, more economic doors are being opened for the city".

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