Integrated Apron Management Solutions

The impact of automation and analytics on airport and airline gate operations

ADB SAFEGATE

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The Key Challenges Facing Aviation Today

Driven by the affordability and accessibility of air travel and a strong world economy, air traffic is doubling every 15 years. The International Air Transport Association (IATA) expects 7.8 billion passengers to travel in 2036, a near doubling of the 4 billion air travelers estimated to fly this year. Capacity shortages are expected at half of the world's airports if no action is taken. In fact, many airports are already running at full to stretched capacity leading to congestion, delays and overall inefficient operations. Heavy traffic has another dire consequence – it is the cause of an increasing number of aviation accidents in and around the apron. The busiest area at an airport, safety on the apron is top of mind for airports and airlines alike.

SAFETY

According to the Flight Safety Foundation, 80% of airport accidents occur at the gate and apron area and approximately 8% of incidents result in personal injury. IATA confirms that more than 27,000 ramp incidents and accidents happen each year, with 22% of all incidents resulting in damage to the aircraft. The total direct and non-direct costs of ramp accidents costs the industry more than US$10 (or €8.82) billion annually. Safety remains paramount.

EFFICIENCY

According to an ACI Europe position paper on airport capacity, by 2035, airports will be unable to meet 12% of air passenger traffic if no action is taken to address capacity issues. Since it is not always economically feasible to invest more in infrastructure, efficient operations at stands and gates is key. This puts the focus on performance - increasing on-time departures and shortening gate turn times, thereby reducing the cost of every minute an aircraft sits on the ground.

SUSTAINABILITY

According to an analysis based on 438,000 total annual operations, a one-minute reduction in taxi time can save 4.2 million litres of fuel and 10.5 million kgs of CO_2 each year. It goes without saying that airport operators can influence greenhouse gas emissions from aircraft taxi and ground idle through more efficient gate operations.

Handling the increasing air traffic in a safe, green and profitable way are challenges that face every airport and airline. The need of the hour is to harmonize operations at the gate, on the airfield and in the tower to ensure a better flow of traffic, from approach to departure. This supports the highest operational efficiency to minimize aircraft time on the ground. It is also the most cost-effective way for airports to meet today's traffic demand and future growth. ADB SAFEGATE calls this AIRPORT PERFORMANCE. A key element of this approach is Integrated Apron Management Solutions that reduce turnaround times and increase aircraft movements, while ensuring a high level of safety.

Integrated Apron Management Solutions Address Aviation's Key Challenges

Impact on Safety

- By decreasing accidents and related costs, Integrated Apron Management Solutions can help an airport with 200,000 annual movements save as much as €2 million ($2.25m) yearly

Impact on Efficiency

- By shortening taxi and turnaround times, Integrated Apron Management Solutions can improve on-time arrivals and departures and increase gate capacity and aircraft utilization
- Delays and disruptions are further avoided by allowing operations to continue during irregular conditions, such as lightning. In the US, this can help airlines avoid fines for extended tarmac delays (up to $27,000 per seat)
- Based on 219,000 arrivals, a one-minute reduction in taxi-in times could save airlines as much as €13.2 million ($15m) in direct operating costs

Impact on Sustainability

- By reducing taxi-in times by even one minute, Integrated Apron Management Solutions can help lower CO_2 emissions by 10.5 million kgs (based on 219,000 arrivals)

Integrated Apron Management Solutions

An Overview

The continuous arrival and departure of aircraft in the apron and gate area needs to be sequenced and managed to maintain optimum throughput and ensure safety. The swarm of ground support vehicles and personnel traversing around docked and taxiing aircraft must be choreographed with precision to maintain safety, deliver on-time departures and create a great passenger experience. The pressure on apron management systems has never been greater and will grow as traffic demand continues to soar.

ADB SAFEGATE understands this and is using its docking guidance systems and apron management solutions to bring automation and integration to the apron to improve predictability, efficiency and throughput.

As an aircraft approaches the gate, SafeControl Apron Management software connects the Safedock Advanced Visual Docking Guidance System (A-VDGS) to flight information systems and other equipment on the apron to enable fully-automated aircraft docking and data sharing. Gate availability, equipment status and turn milestone information is shared, allowing optimized use of resources and improved predictability, with a focus on aircraft turnaround and pre-departure sequencing. Following is the step-by-step process:

Safedock is automatically prepared for expected aircraft
SafeControl Apron Management provides up-to-date flight information from flight information system or AODB.

Gate preparation
The system checks compatibility of the assigned aircraft with the gate and adjacent gates and ensures the boarding bridge is in a safe position.

Checking GSE availability
SafeControl Apron Management can check whether integrated equipment (PBB, GPU, PCA etc.) is ready for use and indicate if they are not.

Automatic initiation of docking procedure
The docking procedure is initiated automatically via SafeControl Apron Management or can be manually activated, either locally via the operator panel or remotely via the HMI.

Apron scan*
Safedock A-VDGS scans the apron, making sure there are no vehicles or objects in the way.

Verify position of PBB
Safedock A-VDGS verifies the position of the PBB.

Aircraft type check
Safedock A-VDGS uses patented 3D laser scanning technique to measure the arriving aircraft to verify gate compatibility and ensure safe docking.

Parking
Safedock A-VDGS guides an aircraft to its correct position by providing the pilot with intuitive signals, via a high-intensity LED display.

Stop position
Allows for a wide range of aircraft stop positions, providing greater flexibility and future-proofing for new aircraft types.

Capturing on-block time
Safedock A-VDGS captures the moment the aircraft stops. Block times are tracked for all flights and can be reported back to flight information system or AODB.

A-VDGS is a prime sub-system for delivering capabilities such as compliance with Airport Collaborative Decision Making (A-CDM) and expanded coverage for Advanced Surface Movement Guidance Control Systems (A-SMGCS). The latest A-SMGCS technology covers the complete route from touchdown to in-block, and vice versa for departures. To eliminate blind spots and areas with limited surveillance coverage, Safedock A-VDGS can be used as an A-SMGCS sensor. By integrating the A-VDGS with A-SMGCS, a positive ID of the aircraft can be maintained at all times, enabling constant monitoring of docking procedures and pushback movements. This is vital to achieve the highest level of safety and efficiency in a complex apron environment. SafeControl Apron Management uses A-SMGCS data to automatically activate the docking system based on the proximity of the aircraft to the gate. The A-VDGS sends positional data of the aircraft, via SafeControl Apron Management, to the A-SMGCS during docking, while displaying precise steering directions to the pilot and indicating how many meters remain to the exact aircraft stop position. Once the aircraft has parked at the gate, the docking system generates the on-block time and ground handling teams are automatically alerted. Precise parking allows the passenger boarding bridge to be quickly connected to the aircraft. Pushback sequencing is more efficient and safety during pushback and taxi-out is maintained by the A-VDGS and A-SMGCS through constant monitoring of apron movement.

When the A-VDGS is not actively docking an aircraft, it can double as a Ramp Information Display System (RIDS), receiving information from SafeControl Apron Management and displaying critical arrival or departure information for pilots and ground crew. Information is sent to the Safedock display via an automatic feed from a connected system or as free text entered from a SafeControl Apron Management work station. As the ground crews can see real time updates of the arrival time, resources can be better managed and moved into place at the right time.

By collecting information throughout the process and sharing it with tower and airfield in real time, A-VDGS helps the gate and apron area become part of one, integrated solution.

*Optional function available with Safedock A-VDGS, T1 model.

Time Saved/Efficiency Gained with Integrated Apron Management Solutions	Case Study
When integrated with the Apron Management Solution, follow-the-greens can cut taxi time by around 17%, reducing time from runway to gate by 3.5 mins = 7,300 hours annually saved	A European airport that handles 250,000 aircraft movements annually
Integration of SafeControl Apron Management and the Safedock saves one airline an average of 3 min 45 seconds taxi-in time per flight at one US airport	A US airline that automatically activated A-VDGS at the gate
A-CDM improves on-time performance (OTP) by 0.5 to 2 min per flight	Eurocontrol study
A-CDM improves TOBT (Target Off Block Time) from 8.4 minutes to 7.8 minutes per departure. Overall yearly impact = savings up to 73,000 minutes of aircraft delays and savings of €160,000 in fuel. Annual carbon dioxide emissions were also reduced by 630,000 kg	A Scandinavian airport that studied the benefits of its A-CDM system

Key Elements of an Integrated Apron Management Solution

Safedock A-VDGS and SafeControl Apron Management (SAM) are part of ADB SAFEGATE's Integrated Apron Management Solution.

Safedock Model T1 A-VDGS

Safedock A-VDGS makes every docking at the gate the safest, smoothest and fastest possible. It has become the global standard, enabling the world's busiest airports to handle more aircraft while maintaining a high level of safety. Safedock A-VDGS uses an infrared laser and patented 3D scanning technique to provide active guidance to pilots to support safe, efficient and precise aircraft parking in virtually any weather conditions and without marshallers. This saves time and fuel, reduces CO_2 emissions and enables ground crew to focus on turning aircraft. The automated system improves safety by ensuring aircraft/gate compatibility, verifying the position of the passenger boarding bridge (PBB) and scanning the apron for vehicles or other obstacles.

SafeControl Apron Management is a highly adaptable system that offers centralized management with views based on user role. The system is used to configure adjacent gate rules to ensure aircraft/gate compatibility and to automatically initiate the A-VDGS process. SafeControl Apron Management is the integrator of systems and equipment in the apron area and provides constant monitoring of the A-VDGS and connected systems, allowing ground personnel to know the precise status of gate equipment.

How do the two solutions work together?

- ...SafeControl Apron Management uses Safedock A-VDGS as intelligent sensors to collect and distribute real-time gate intelligence and accurate flight information between airport, airline and air traffic control systems
- Before and after the docking procedure, ...SafeControl Apron Management feeds useful flight and turn milestone information to the Safedock A-VDGS display for pilots and ground personnel. Referred to as the Ramp Information Display System (RIDS), staff become aware of potential issues so that any kind of delay can be avoided
- ...SafeControl Apron Management shares vital information, providing a key step toward implementing A-CDM to improve communication and efficiency

The Case for Integrated Apron Management

1. Improving On-time Performance

Challenge: A leading German airport was keen to improve its performance, availability and overall quality of managing flights. The airport also wanted to keep a check on overall lifecycle costs.

Solution: The airport turned to ADB SAFEGATE's A-VDGS to replace its old docking guidance systems. Today, ADB SAFEGATE A-VDGS have been deployed at all gates and remote parking positions and have been connected to FIS over the airport's central computer system as well as to the central maintenance station.

Benefits: Taxi-out times have reduced by an average of two minutes per flight. IATA punctuality has increased by 4.5%, approximating to 73,000 fewer flight delays annually. Based on 2015 Air Traffic Flow Management (ATFM) regulation volumes, it is estimated that DPI integration has saved approximately 19,800 minutes of ATFM delay, with an estimated tactical delay cost savings of €1.7 million for aircraft operators.

2. Increasing Capacity Efficiently

Challenges: A leading airport felt constrained as a result of operating from a single runway as well as issues around Low Visibility Performance (LVP) resulting in traffic increase and congested gates.

Solution: The airport deployed an A-CDM55 program to:

- Increase and maintain runway capacity during peak operations from 50 to 55 movements per hour
- Improve on-time performance
- Reduce environmental footprint
- Connect to the European network for improved slots during busy periods

The A-CDM55 was integrated with ADB SAFEGATE's A-VDGS and SafeControl Apron Management to extend collaborative decision making to the apron.

Benefits:

- Accuracy of take-off time improved from 7 to 1.5 minutes per flight
- Predictability of take-off time improved from 15.9 to 12.9 minutes
- On average 60 aircrafts departed 20 minutes sooner
- Additional 21 slots per day
- £30M EBITDA, on investment £8M for the A-CDM project
- Increased efficiency due to less interruptions and decreased docking times

3. Minimizing Delays Due to Irregular Operating Conditions – IROPS

Problem: A leading U.S. airline was unable to dock and deplane aircraft at its largest hub when the ramp was closed due to lightning and severe weather occurrences, resulting in delays and unnecessary fuel burn.

Solution: The airline turned to ADB SAFEGATE's Safedock solution to help guide its pilots to within 10 cm of the stop position in a consistent, safe and time-saving manner, regardless of the weather, time of day or size of the aircraft. ADB SAFEGATE also worked closely with the airline to develop and deliver the world's first multi-station SafeControl Apron Management (SAM) system providing a centralized view of gate operations at the airline's major hubs and the ability to monitor activity and control A-VDGS functions from one system.

Benefits:

- Saved $5-6 million in first year at one hub airport, primarily due to reduced taxi-in times
- Saved an average of 3 minutes 45 seconds in taxi-in time

A Technology Overview of VDGS and A-VDGS

It is important to investigate further into whether the docking guidance system uses camera or laser-based technology. A camera-based system uses image processing to capture and track the movement of the aircraft, while a system equipped with laser technology uses a laser range finder combined with a scanner for the same purpose.

The main difference between a camera-based system and a system using laser scanning is that the former relies on reflected ambient light and is, in this sense, a passive system. It simply processes what the technology tells us is present; an interpretation of a still picture. In comparison, an infrared laser scans a specific part of the apron (independent of external light source) and processes the actual findings the sensor picks up.

Infrared laser scanning systems scan in either two or three dimensions. VDGS using camera technology and laser-based systems with 2D scanning (vertical scan only) have a narrower performance envelope – these systems lack the ability to actively verify the type of the approaching aircraft and hence provide less consistent guidance to the pilot. These systems are also unable to alert the pilot when it is not safe to proceed especially in the case of non-optimal operating conditions such as low visibility, wide variation of stop positions, etc.

Three-dimension technology is exclusive to ADB SAFEGATE and the Safedock A-VDGS. The Safedock sensor technology includes infrared laser and a 3D scanning technique to scan both vertically and horizontally to measure height, distance and lateral position of the aircraft relative to the centerline and provide active guidance to both pilots. It is the only technology on the market that addresses the most important safety and availability factors in automated docking guidance:

- Detect and adjust for less than ideal conditions, such as low visibility, so availability is maintained even in bad weather conditions
- Actively discriminate between critical aircraft type and subtypes to confirm safety
- Provide the same level of accuracy for a wide range of parking distances and curved approaches; combined with flexibility in the location of the laser range finder to the centerline, expanding the operational envelope
- High availability, reliability and trust maximizes value to customers

The Benefits of 3D A-VDGS Versus Other Technologies on the Market

The sensor is the core of the docking guidance system and the differentiator. The infrared laser combined with a 3D scanning technique utilized by the Safedock A-VDGS brings essential new capabilities over and above those of VDGS or A-VDGS with other sensors.

	A-VDGS with 3D Laser Scanning	Other Technologies on the Market
Safety	A 3D scanning technique allows the A-VDGS to scan both vertically and horizontally to measure parts of the aircraft on either side of the centerline and discriminate between aircraft types and subtypes. Measurements of the actual aircraft entering the gate are compared to a profile of the expected aircraft type and the A-VDGS verifies that the approaching aircraft is compatible with the gate and adjacent gates. A-VDGS actively and positively performs a safety assessment that not only ensures the aircraft fits at the gate, but also ensures it is approaching on the correct centerline. Advanced safety features include an apron scan to detect objects in the way of arriving aircraft, a passenger boarding bridge (PBB) interlock to ensure the bridge is in a safe position and a low visibility mode for safe docking in low visibility conditions. Safety is also improved in an integrated set up when the A-VDGS automatically feeds positional data from the gate area to surveillance systems.	Other docking guidance technologies in use today would mostly be classfied as VDGS or low tech passive systems designed for one purpose – to get aircraft to the correct stop position when the pilot cannot see ground crew. It typically requires a manual start and the level of automation varies between different systems. Systems utilizing a 2D laser scan do not make a safety assessment of incoming aircraft and predominantly rely on passive acceptance of transponder data to identify the aircraft type. If the transponder system is down, operators must revert to manual docking. Transponders are not always accurate and there is an additional risk of receiving incorrect aircraft type information when multiple aircraft are in the vicinity. Camera-based docking guidance systems may have difficulty detecting and identifying aircraft types in low contrast visibility conditions. Therefore, use may be limited during irregular operating conditions where operators must revert to manual docking, leading to an increased risk of accidents. Other technologies may require multiple systems for multiple centerline gates, risking pilot confusion particularly with converging centerlines. Guidance to pilots is passive and can be ambiguous with a different view/information for pilots and co-pilots.

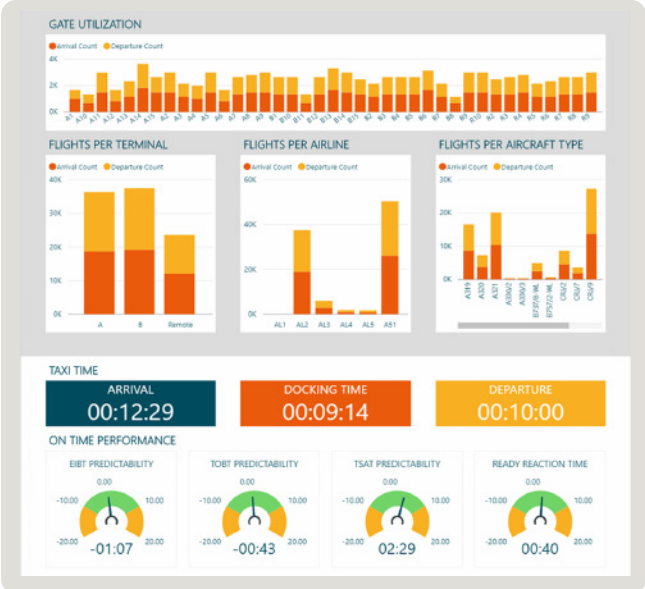
Precision & Flexibility	Because of its unique ability to scan horizontally, the A-VDGS with 3D scanning capabilities offers greater operational flexibility and more precise parking. Even at 65 meters out, the accuracy of the stop indicator is within 10cm of distance and -+10cm laterally. Providing active azimuth guidance and intuitive instructions to both pilots, showing the actual position of the aircraft relative to the centerline and indicating the direction to steer, provides more accurate aircraft dockings. The 3D scan and active guidance also gives the A-VDGS greater flexibility to accommodate curved lead-in lines, multiple centerlines and challenging gate layouts. It is not required that the A-VDGS be placed precisely in front of the lead-in line to accommodate future gate layout changes.	Because VDGS is a passive system that does not know the exact position of the aircraft during the docking procedure, it must rely on the pilot's perception which can lead to loss of accuracy. Different pilot views and different aircraft seating configurations can also cause misalignment. Systems providing passive azimuth guidance can have a higher cost of ownership because they cannot accommodate multiple centerline gates supporting both narrow and wide body aircraft. A separate VDGS must be installed precisely at the front of each and every centerline and the systems must be moved when gate layouts change.
Efficiency	Allowing pilots to self-park speeds up the docking process, aircraft are parked faster in all kinds of weather conditions, fuel burn and emissions are reduced and ground crew are free to focus on preparing the aircraft for departure. The A-VDGS can integrate with other airport systems and gate equipment and fully supports A-CDM on the apron. Full integration enables seamless guidance from the runway to the gate with full awareness for ATC, apron control and ground personnel. Ramp Information Display System capabilities provide up to seven rows (14 with alternating text) of real-time data including the target off block time (TOBT), countdown timers for specific actions or other free text information vital to the operation. The RIDS display is clearly visible from the entire gate area, enabling personnel to synchronize their work to provide more efficient gate operations.	VDGS have reduced availability during low visibility conditions, do not have vast integration capabilities and do not fully support A-CDM resulting in less than optimal gate operations and a diminishing return on investment. VDGS has very limited RIDS capabilities, which is known to improve operational reliability and baggage delivery accuracy.

Data Analytics - Looking to the Future

ADB SAFEGATE believes that data analysis is a critical part of future Total Airport Management (TAM). While A-CDM involves all airport partners in the tactical phase, TAM enables all partners to sit together in Airport Operations Centers (APOCs), working to a more proactive and strategic Airport Operations Plan (AOP).

The scope of TAM is the entire airport, monitoring and guiding airside and landside operations while considering additional information from SWIM (System Wide Information Management), for example from departure airports. It is thus important to consider the opportunities that TAM can bring in the future when designing and specifying the existing expansion infrastructure. In an advanced TAM solution, operational analytics does not only provide the necessary awareness to understand the complete situation at the airport in real time, but can offer predictive decision-making guidance based on what is likely to happen in the coming few hours.

At ADB SAFEGATE we are already working to make this AI-based vision a reality via integration of our A-Lytics data analytics with our SafeControl Apron Management system. The solution enables operational performance to be reviewed from many different aspects. In the longer term it will also offer more direct operational decision support by recognizing operational behavior and patterns and using predictive analytics to propose action to rectify or mitigate risks and delays.



Conclusion

Why ADB SAFEGATE for apron management?

Safedock A-VDGS unbeatable performance

May 17 – February 18

Total Activation	**74012**
Parked	**71889**
Accident/incident prevention	**2503**
Wrong aircraft type detected	*686*
FOD/obstacle collision prevention	*1153*
AVDGS view blocked	*141*
Bridge not in safe position	*366*
Aircraft not configured for the gate	*44*
Laser error	*34*
Auto calibration error	*48*
Temperature Error	*56*
Performance	**99.88%**

Broadest experience

ADB SAFEGATE has delivered more than 8,500 Safedock systems, making it the most widely used and trusted A-VDGS at airports around the world. Every three seconds, or 15 million times each year, an aircraft is safely docked with the Safedock system. With proven reliability and vast experience, ADB SAFEGATE is at the forefront of innovative and world-leading technology within this field.

Safedock A-VDGS is used at 300 of the world's busiest airports, including:

Amsterdam Airport Schiphol has invested in 158 Safedocks since 1980

Bangkok International Airport has 159 gates equipped with Safedocks

The Dallas/Ft. Worth International Airport has chosen Safedock A-VDGS for all of its 165 gates

Dubai International Airport is using our most advanced Safedock T1

Heathrow Airport has invested in 255 Safedocks

AMS	HKG	MNL
ATL	HND	MUC
BCN	IAH	NRT
BKK	ICN	ORD
BOM	IST	PEK
CAN	JFK	PHX
CDG	KMG	PVG
CGK	KUL	SEA
CLT	LAS	SFO
DEL	LAX	SHA
DFW	LGW	SIN
DXB	LHR	SYD
FCO	MAD	SZX
FRA	MCO	YYZ
GRU	MIA	

At ADB SAFEGATE we realize that one solution does not fit all airports and/or airlines. Our consultative approach backed by the necessary situational analysis such as the topology of the airport, number of movements, setup of ATC, airside and landside helps us determine the right strategy an airport needs to adopt. Similarly, we undertake an analysis of operations to plan, design and manage each aspect of the Integrated Apron Management Solution to ensure we offer the best, most future-proof and often cost-effective solution.

ADB SAFEGATE is a leading provider of intelligent solutions that deliver superior airport performance from approach to departure. We partner with airports and airlines to analyze their current structures and operations, and jointly identify and solve bottlenecks. Our consultative approach enables airports to improve efficiency, enhance safety and environmental sustainability, as well as reduce operational costs. Our portfolio includes solutions and services that harmonize airport performance, tackling every aspect of traffic handling and guidance, from approach, runway and taxiway lighting, to tower-based traffic control systems and intelligent gate and docking automation. ADB SAFEGATE has 1,100 employees in more than 25 countries and serves some 2,500+ airports in more than 175 countries.

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