A history of airport technology

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gate, huge expansion programmes were undertaken and new buildings constructed. As a consequence, the walk between the check-in hall and the departure lounge increased dramatically and, by the mid-1970s, distances of 1,500ft (457m) - the length of around five football pitches - were not uncommon at major American airports. For a time, the long concourses at Chicago O’Hare were known colloquially as ‘cardiac alley’ because of the possibility of transfer passengers suffering a heart attack while hurrying along them. In recognition that the distance between check-in and their aircraft was not only tiring passengers but also hindering their on-time arrival at the gate, a technological innovation was deployed that would reshape the airport experience and become a common sight around the world.

Moving walkways

It is widely reported that the first moving walkway was installed in Dallas Love Field in Texas in 1958 to help passengers traverse the 1,000ft (305m)-long concourses between the main terminal and the departure lounges. Travelling at the sedate pace of around one-and-a-half miles an hour, the horizontal moving walkway aided the on-time arrival of passengers at the gate without wearing them out. The device proved a success and, six years later, American Airlines inaugurated its new ‘astroway’ - a rubberised moving walkway - in the terminal at Los Angeles. Instead of having to carry or drag heavy cases, passengers could stand next to them on the walkway and be transported down long corridors with the greatest of ease. Naturally, such walkways could only be installed in linear (straight line) concourses and not in round or curved terminals unless they incorporated linear projections to adjoining satellite terminals (such as Terminal One at Paris Charles de Gaulle) today, although faster and more robust than their predecessors, moving walkways, or travelators remain a key feature of airport technology that has become a common site around the world.

Airbridges

In addition to expediting the movement of passengers through the terminal building, several systems have been developed to accommodate passenger boarding, including airstairs, airbridges, and mobile departure lounges. Historically, aircraft were parked on the apron and aligned either nose-in or nose-out to the terminal for self-taxi in and out. Passengers were escorted across the apron to the aircraft by ground staff and invited to board either via an integral set of airstairs installed in the aircraft or via a flight of steps that was placed at, or wheeled to, the main door of the aircraft. While this system proved adequate for small low-density airport operations in favourable...
climates, passengers reportedly did not like being exposed to the noise, fumes, and weather conditions on the apron, while ground staff expressed concern at the safety and security aspects of escorting growing numbers of people across an active apron. In the 1930s, the foreshadowing of the modern airbridge was put into operation at London’s Gatwick airport. The device consisted of an extendable fabric-covered enclosed walkway that ran on metal rails and was wheeled out onto the apron to meet arriving flights. Disembarking passengers were led through the tunnel into the terminal to protect them from the inclement weather and the dangers on the apron. To facilitate efficient turnarounds and ensure public safety, aircraft movements were strictly choreographed and procedures that had first been practised in the 1930s were enshrined in airport operating manuals. Consequently, passengers always board and disembark an aircraft from its left-hand side, while catering and servicing occurs on the right.

With the arrival of larger aircraft in the 1950s, the idea of constructing permanent aircraft ‘loading sleeves’ was proposed. These devices were to be finger-like extensions, built at right angles to the terminal buildings, that jutted out onto the apron. The aircraft would then be connected to the terminal via four or more flexible corridors that would allow boarding to occur through multiple doors simultaneously.

In 1958, United Airlines introduced the first such ‘aerobridge’ at Chicago’s O’Hare airport to speed up passenger boarding. The device was similar in design to the loading sleeve concept, but featured a single three-section enclosed telescopic ramp that was powered by a small motorised dolly. One end was attached to the side of the terminal building at first-floor level, while the open end could be aligned to fit over the aircraft’s doorway. When an aircraft arrived on stand, the gangplank could swing sideways through a 120° arc and telescope out to meet the aircraft’s main door. The apparatus could extend from its retracted length of 351 ft (107m) to the maximum length of 1071 ft (328m) in 90 seconds and could be elevated at the open end to any height between 4’6” (1.4m) and 31’6” (9.6m) above the ground to allow it to service different aircraft types. The open end was fitted with a rubberised seal that conformed to the contours of the aircraft’s fuselage to keep out wind and rain. Windows and fluorescent lights were installed in the ramp to make the interior appear bright and roomy and the whole device was soundproofed.

In 1959, American Airlines introduced an extension of the aerobridge system at Los Angeles. Unlike its predecessor, this device consisted of not one, but two, elevated corridors that fed from the terminal building and ended at adjustable sections fitted at right angles to the main corridor. This enabled one section to be positioned over the front door of a Boeing 707, while the second section was positioned against the rear. Not only did this system save passengers from climbing the eleven steps up to a 707’s door and braving the elements on the apron, but the airline also claimed it helped them board 112 passengers in less than three minutes. Though fewer ground staff were required to supervise passenger boarding, the high purchase and installation costs associated with the new device meant airbridges were initially only installed at a few airports.

Given the variable distances that exist between the level of the terminal building and height of different aircraft door sills, between the centralline of the stand and the relative position of different aircraft door sills, and between the ground and the height of different aircraft, many variations of telescopic and non-telescopic, mobile and immobile ‘airbridges’ or ‘jetways’ have been developed and installed at the world’s airports. Of these, the generic ‘apron loader bridge’ is perhaps the most versatile, as it can be moved in both the vertical and horizontal planes and can accommodate a wide variety of different aircraft types.

Today, nose-in parking coupled with enclosed passenger airbridges appears to be the preferred configuration for passenger boarding at most of the world’s major airports, as this system consumes less apron space, reduces the time taken for aircraft turnarounds, facilitates efficient passenger boarding, and is superior in terms of passenger comfort, safety and security. The airbridges themselves are usually constructed from solid metal panels, and while some incorporate windows, many do not, and it has been said that this may increase the anxiety experienced by some nervous passengers, as they cannot see the aircraft they are about to board. Even alert to potential marketing and revenue opportunities, however, many airport operators sell advertising space on the sides of airbridges or use them to reinforce the brand identity of the airport. While this practice may enliven their appearance, it has had the effect of turning some airports into giant billboards.

On the whole, today’s airports are a wonder of modern technology, making use of equipment and innovations that we all take for granted. Without the development of such forms the traveler would have a much tougher time boarding an aircraft ‘loading sleeves’ was proposed. These devices were to be finger-like extensions, built at right angles to the terminal buildings, that jutted out onto the apron. The aircraft would then be connected to the terminal via four or more flexible corridors that would allow boarding to occur through multiple doors simultaneously.

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constructing hangars in the apron onto which aircraft would taxi before being rotated onto the stand, while another required (arguably) to be installed under the tarmac. This idea involved seating passengers in self-contained fuselage crates (complete with aircraft seats, galley and lavatories) that could be loaded, in their entirety, into the fuselage of the aircraft like giant freight pallets. It was thought that this system would reduce turnaround times significantly and improve the comfort of passengers. However, the concept never received widespread support. Nevertheless, this problem of aircraft alignment on stand and docking remained a serious one, and so a range of visual docking guidance systems, which provide flight crew with alignment and stopping information, was developed.

**Ground guidance systems**

While airbridges and mobile lounges went some way towards addressing the need for developing safer, more comfortable, and faster boarding procedures, they relied on aircraft being precisely positioned on the stand, as poor manoeuvring and parking could prevent ground support equipment from interfacing with the aircraft. As a consequence, new ground guidance systems were developed to help pilots identify the location of individual stands and position their aircraft correctly on them. During the 1960s and 1970s, some very inventive ideas were planned for the parking of aircraft docking and passenger boarding. One intriguing suggestion involved loading passengers into mobile containers at check-in and then driving them straight onto the stand, while another required 'drag tracks' to be installed under the tarmac where the aircraft would be propelled into position on the stand by the tractor driver exerting differential force on the landing gear. Perhaps unsurprisingly, this idea never received widespread support. Nevertheless, this problem of aircraft alignment on stand and docking remained a serious one, and so a range of visual docking guidance systems, which provide flight crew with alignment and stopping information, was developed.

**Aircraft docking systems**

There are a number of different visual docking guidance systems currently in use at airports around the world, including AGNIS (Azimuth Guidance for Nose-in-Stands), PAPIS (Parking Positioning and Information System), SafeGate, and Airpark. AGNIS provides guidance advice on the stand centreline and is often used in conjunction with either parallel aircraft parking aids (PAPA), side marker boards (SMBs) or side marker lines (SMLs), which provide information on the correct stop point. These systems are designed for use from the left pilot position, and information is usually communicated to the flightdeck through a combination of identification labels and lights. At smaller airports, or on remote stands, marshalling guidance is provided by a number of ground staff who use illuminated light wands or brightly coloured marshalling balls to communicate with the flightdeck by using a series of internationally recognised hand signals and signals.

**Tractors, tug bars and tow bars**

Suitable pushback facilities are a prerequisite of airports where even-in parking is used. Traditionally, aircraft pushback was performed using special tugs and towbars and, depending on the airport and airline, required between two and four people to perform. One person would drive the tug, another would raise the flightdeck, while the third (and occasionally, fourth) would act as a ‘wingwalker’ or look-out. Given the different dimensions and weights of individual aircrafts, the size and strength of the tug and towbar was crucial, and a strict series of safety procedures had to be followed to prevent injury to the crew or damage to the aircraft or tug. One of the biggest dangers was the risk of an aircraft ‘jack-knifing’ and a new technique of towbarless pushback and towing was developed to combat this. The idea of towbarless pushback and towing was first proposed during the oil crisis of the mid-1970s as a way of lowering fuel costs by reducing the length of time an aircraft’s engines were running. Under this proposed regime, the aircraft would be pushed back from its stand and towed to the runway threshold before starting its engines. The first towbarless design was fairly crude and involved a ramp that was forced under the aircraft’s nose gear assembly and clamped in place around it. While undoubtedly attractive to economists, pilots and aircraft manufacturers did not great the idea with much enthusiasm, the former expressing concern that responsibility for ground manoeuvring was relinquished to a tug driver, and the latter cautioning that the practice could damage the aircraft. The method was also found to be time-consuming and inefficient, and generated additional workload for ground controllers. Nevertheless, the concept of towbarless tugs and dispatch towing was not dismissed entirely, and in the 1980s, Lufthansa developed the PTS-1 towbarless tug. Through this machine overcame many of the problems that had beset its predecessor, flight crews were still opposed to the idea of an aircraft being under the control of a tug driver and aircraft manufacturers were reluctant to approve high-speed towing because of the potential risk of damage to the nose gear assembly during acceleration and braking. Today, the application of new technology and the introduction of a new generation of tugs mean that towbarless towing is a more viable proposition. Modern towbarless tugs feature a hydraulic cradle that surrounds the nose landing gear assembly and lifts it 8 between 6 and 11in (150-280mm) off the ground. As

**The Airbus A380 needs a giant tug – as illustrated here at London/Heathrow on March 18, 2008, the inaugural date of Singapore Airlines A380 flights to London from Changi. (KEY – Tom Allett)**

**Above:** Push back is the most common use of the bar and tug, and will be familiar to most passengers. But the system is also used to move aircraft to remote stands, or across the airport to maintainance hangars etc. (KEY – Tom Allett)

**Today many airports have automated aircraft docking systems which use a series of lights to guide the pilot and flightdeck to the correct position.**

**The simplest way to guide an aircraft on to its stand is using markings painted on the tarmac/concrete surface. But these alone do not tell a pilot exactly when to stop so that he is aligned with the airbridge and ground equipment. (KEY Collection)**

**Outsize cargo is often loaded aboard specialist freighter aircraft, such as this B747F from Singapore Airlines A380 flights to London from Changi. (KEY Collection)**
the weight of the aircraft is transferred to the tug through the cradle assembly, the danger of damaging the nose gear is reduced.

Platforms, power units and pallets

As the physical size, systems complexity and passenger capacity of aircraft increased, a range of dedicated vehicles and ground support equipment, including pallet loaders, scissor-lifts, and refueling bowsers, was developed to meet the needs of ever-larger aircraft. Today as soon as an aircraft arrives on stand and shuts down its engines, various aircraft to maintain a stable internal cabin and replenish it before its next flight.

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Baggage handling facilities

Baggage handling is one of the most important systems in an airport terminal and perhaps one of the most maligned. Thought may sound ironic today, baggage systems and carousels were initially conceived and designed to speed up the processing of baggage and to ensure bags were loaded onto the correct flight(s) and quickly delivered undamaged to the baggage reclaim hall on arrival. Though the precise specifications of the various systems installed at individual airports may differ from one another, all are designed to increase the speed with which passengers are reunited with their baggage. At smaller airports, much of the baggage handling activity is done by hand, whereas at larger airports, particularly those that have a higher proportion of transfer traffic, have more elaborate systems that can process thousands of bags an hour (theoretically at least) keep track of individual pieces of baggage as they move along the miles of conveyor belts and guideways.

De-icing ganttries that shower the airframe in de-icing compounds. The spent de-icing solution is subsequently collected in special conduits and treated to minimise the risk of environmental contamination. To reduce the quantity of glycols and other chemical de-icers that are used, some airports have installed infra-red de-icing ganttries that gently thaw any ice or snow that has accumulated on the airframe.

In addition to these pieces of equipment, new ground support technologies had to be developed to assist in the loading and unloading of increasing volumes of baggage and freight. In 1959, United Airlines developed fibreglass baggage containers for use in their DC-8s. These containers could be pre-loaded on the aircraft in sealed containers that were raised up on high-riser scissor-lifts and wheeled into place in the galley. On the apron, ground power units (GPUs) and trucks supplying compressed air were required to provide electrical power and pneumatic support while the aircraft was on stand.

Most aircraft are fitted with auxiliary power units (APUs). GPUS remain the preferred method for supplying power to aircraft once they are on stand as they are cheaper, less polluting and quieter to run than APUs. If an aircraft is on the ground for some time, auxiliary mobile heating or cooling units may also be required. These fixed air units supply ‘preconditioned’ air to the aircraft to maintain a state internal cabin temperature. In cold climates, provision must also be made for de-icing aircraft. Multi-use high-hand luggage and high-pressure hoses can be employed to spray de-icing fluid over the airframe, or an aircraft can be towed beneath de-icing gantries that shower the airframe in de-icing compounds. The spent de-icing solution is subsequently collected in special conduits and treated to minimise the risk of environmental contamination. To reduce the quantity of glycols and other chemical de-icers that are used, some airports have installed infra-red de-icing ganttries that gently thaw any ice or snow that has accumulated on the airframe.

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