



The Future of Aviation in China

How innovation is vital to support
China's aviation ambitions

ADBE
Airfield Solutions

Safety, sustainability and innovation - the pillars of China's growth in aviation



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China is a huge country with a huge population. It also has huge ambitions to continue the rapid economic growth it has achieved in the last two decades, with a substantially larger share of world trade underpinning its plans. Air transport will play a fundamental role in helping China to meet its global and domestic aims.

China's air transport sector is already the world's second largest in terms of domestic passengers and seventh for international passengers.

"Of the 877 million additional global air travelers expected to fly in 2015 than in 2010, more than 212 million will be on journeys within or connected to China," said Tony Tyler, IATA's Director General and CEO at the China Civil Aviation Development Forum 2012 in Beijing. "Already it is prioritizing investments in airport and air navigation infrastructure. The challenge is to keep pace with rapidly growing demand, based on the global standards which underpin safe and efficient global connectivity."

Airport construction will not fade

Five-year plans of the central government have been marked by great optimism about the continued growth, with the ambitious target of more than 50 new airports to be built across the country over the next few years. "The Chinese government has identified aviation as a strategic enabler," says Zhang Baojian, IATA regional vice-president for North Asia. "There is a well-documented five-year civil aviation development plan. It is unlikely that airport construction will slow down because of the local government debt. That is not the way the Chinese system works."

"While new airports are critical to unlocking the potential of the economic development of the different regions and the cities, airports with less than 3 million passengers are loss-making. Some airports could make more money, but are congested. Operational efficiency is key to enable a higher volume of flights and to justify investments with a better return because of lower costs per passenger and higher revenues," explains Qi Wu of leading consultant Roland Berger. "Many of the airports are congested because they are not very well designed, but also because of poor operational procedures. Their performance could be improved by shortening the turnaround time through the integration of high-tech systems that allow planes to move more quickly to the terminal after landing and leave faster. Better allocation of the gates can also decrease congestion."

Achieving the required growth through expansion of facilities and improved efficiency must be accompanied by an improvement in the sustainability of that growth and, of course, an unrelenting focus on safety.

The role of innovation

Maintaining growth, improving sustainability and guaranteeing safety - funding alone cannot ensure that all these objectives are met. Innovation is also vital.

Innovation in air traffic control (ATC) will help to alleviate much of the congestion currently affecting China air travel and will ensure that safety standards can be met in the face of extreme expansion. More sustainable airports will depend on innovation in infrastructure such as airfield lighting, with modern LED technology promising substantial energy savings and reduced maintenance - fewer airport vehicles maintaining lighting is a further contributor to airfield safety by reducing the risk of runway incursions.

"Environmental awareness that currently impacts the airport operation includes airport clearance distance, bird strike prevention, noise problems etc. Environmental friendliness is a hot topic right now in the local market. It is possible to reduce emissions, improve operational efficiency - these are long-term targets," says Professor Wang Wei of the China Civil Aviation University. "There is a need for co-operation between airports and airlines. The airports can reduce consumption by recycling water, solar power and use of LED products and the airline companies can use advanced plane engines, reasonable schedules and route planning - all this can reduce emissions and increase profits."

The Smart Airport

Productivity, sustainability, safety and cost efficiency are not just buzzwords for the aviation industry. In today's competitive landscape where the complexity of airside operations is increasing and escalating costs are a concern, airports must

Who is Roland Berger?

Roland Berger is the most active consulting firm in China, serving the main Chinese carriers like China Southern, China Eastern, Air China, Hainan Airlines, Shenzhen airlines and others, as well as helping the largest airports like the Shanghai Airport Group to define their strategies.

Roland Berger is also one of the founding members of China's Business Jet Alliance together with a big Chinese bank and the State Aviation Fund.

It is also responsible for the yearly annual report of the CAAC for which the consultant analyzes the operational development for the main airports in China using key data for about 80 airports.

The experts speak

This special report by ADB Airfield Solutions draws on expert opinion in China and abroad to look at the future prospects for China's air transport industry and describes the key issues that will shape the development of the world's fastest growing aviation sector. Covering growth, sustainability, safety and innovation, the report concludes with a look at future prospects.

If successful in achieving its ambitions, China will, in future, possess one of the world's leading reservoirs of air transport expertise. "China is a strong export-driven economy and it is only logical that it will ultimately be in a strong position to export the expertise and skills it is building up internally," concludes Roland Berger's Qi Wu. ■

look at intelligently managing airside operations in a greener, more productive, cost-effective and safer manner. ADB's 'Smart Airport' concept enables airports achieve these goals by offering a smarter way to manage all aspects from landing and docking, to take-off.

Growth: Maintaining the momentum

China's airports handled twice as many passengers in 2013 as they did in 2006. What's more, the Chinese aviation industry is continuing to expand at an enviable rate, enjoying double-digit growth in 2013, according to analysts.

Overall, Chinese airports handled 11% more travelers in 2013, equating to a total of 753.4 million passengers. This performance was ahead of 2011 and 2012 year-on-year growth of 10% and 9.5% growth, respectively. But 2013 growth fell short of the performance that the industry enjoyed a few years ago, such as 16.8% in 2007, 19.8% in 2009 and 16.1% in 2010¹.

Statistics published by the General Administration of Civil Aviation of China (CAAC) show that some 193 airports in mainland China, excluding Hong Kong and Macau, handled 754,309,000 passengers in 2013, up by 11.0% on the previous year. Domestic passenger traffic in 2013 accounted for 690,857,000, or 91.6% of the total, including routes from the mainland to Hong Kong, Macau and Taiwan. International passenger traffic grew by 13.3% to 63,452,000. Four airports in the three municipalities of Beijing, Shanghai and Guangzhou accounted for 30.7% of the total passenger traffic².

"More airports are being built because they are critical to unlocking the economic potential of the different regions and cities. Lots of regions will be served by low cost airlines as the bigger airlines see less profit in doing so. With their lower cost base they can afford to serve less served airports and still make a profit," comments Qi Wu of leading consultant Roland Berger.

Qi Wu believes that airports handling less than 3 million passengers are loss making, while some are congested, making operational efficiency key. He points to the need for better designed airports and better operational procedures. "Performances can be improved by shortening the turnaround time with high tech systems that enable planes to move quicker to the terminal after landing and leave the airport sooner. More airports will be built, so efficiency needs to improve to accommodate all those extra movements."



Maintaining healthy expansion

With growth moderating over the last few years, the big question is whether the aviation industry in China can continue to enjoy healthy expansion going forward.

Several different elements will affect the prospects for future growth, such as airway capacity and ground-based public transport links with aviation infrastructure. But whatever external developments impact on the industry, airports must be a key element in any plan for ongoing expansion.

“Airports and airlines need to co-operate in order to improve their revenues and costs... Changes in passenger demand have forced airlines to change their model of service. Airports will certainly follow.”

*Mr. Jiang, Minister,
Air Traffic Management Bureau*

Successful airports need to be safe, provide great services for airlines and passengers and minimize their impact on the environment - all while maintaining themselves as profitable business operations.

As Guo Yu Feng, Managing Director, ICF International Aviation Division, explains: “There are two aspects to airports making revenue - airlines (take-off, landing, parking and ground service) and non-aeronautical revenues (rental, parking, catering etc). In order to remain profitable, airports need to perform in both areas. I believe airports need to increase services to attract more airlines and also need to research how, when, and why travelers are willing to spend their money there.”

Addressing the growing cargo air transport market is another opportunity for China’s growing airport portfolio.

While Beijing Capital International Airport (PEK), the main international airport serving Beijing, has seen rapid expansion over the past decade, further growth is limited, creating a need for a new airport for China’s capital. The new airport in Daxing district is scheduled for completion in 2017, with commissioning planned in 2018.

The new airport will serve as an international air transportation center that caters to both domestic and international air travel demand. However, while Beijing Capital International focuses mainly on passenger transport, the new airport is expected to also become a capable hub for cargo traffic, positioning itself as an airport that is more internationally competitive.

Further supporting the aim of sustainable growth is the authorities’ plans to establish an airport cluster comprising of the new airport, Beijing Capital International, Tianjian Airport, and Shijiazhuang Airport, with consideration given to building an airport economic zone that can promote coordinated development among the three areas. The new airport is expected to help ease pressure on Beijing Capital International, which remained the world’s second-busiest airport in 2013 in terms of passenger throughput.

Recipe for success

Growth demands that airports find safe, sustainable ways to increase capacity. At the same time, operators are looking to minimize costs in order to maximize the benefits of increased revenues.

Travelers obviously make an important contribution to airport revenues as they shop and eat on their way through. Operators should therefore look at ways to improve the experience and encourage them to make better use of facilities within the terminals.

However, the main business of airports is to get people airborne, and the

Airfield lighting: the lesson from LEDs

Traditional halogen lamps have an operating life of between 4,000 and 6,000 hours, which means that virtually 100% of them need replacing in any one year. With LEDs, the mean time between failure (MTBF) is over 250,000 hours, so the yearly failure rate is reduced from 100% to 1%. The resulting reduction in taxiway disruptions and delays can be so substantial that this alone can sometimes be enough to gain additional slots.

Making the switch to LED lighting is also the change that will bring about the biggest reduction in maintenance costs. Not only that, but the lower power requirement of LEDs means that the light costs substantially less, as does the associated infrastructure, such as cables, transformers and CCR.

So LEDs are now widely accepted globally as one of the most effective cost-saving options available to airports.

more aircraft an airport can turn around, the more revenue it will generate. Going forward, a key goal must therefore be to add extra slots, which will in turn demand new working practices. This means that there will be less time available for maintenance of the taxiways, since they need to remain free and open for extra traffic.

Tackling foreign object debris

As airports strive to increase capacity, they cannot afford to keep closing runways and taxiways for longer than necessary. At the same time, there can be no compromise on safety. Ideally, any maintenance solution will improve safety and reduce airfield downtime simultaneously.

An increased focus on maintenance decreases an airport’s risk of major operational downtime. For example, at one key airport the airfield ground lighting recently provoked a major foreign object debris (FOD) incident when the lights came loose. This debris had the potential to enter an airplane’s engine and cause a serious accident.

FOD damage is estimated to cost the aerospace industry on average \$4 billion a year. Of course, not all FOD is related to airfield ground lighting. It may include catering supplies, building materials, rocks, sand or pieces of luggage, but preventing lighting equipment from becoming FOD is critical.

This is why ADB’s team developed the AirSide solution. This unique approach was developed by ADB’s service engineers based on their field expertise and understanding of airfield lighting

solutions. It takes account of every aspect of maintenance that’s critical in the lighting’s safe functioning, setting out what needs to be inspected and/or monitored when maintaining lights, visual guidance tools and power systems.

AirSide starts from the maintenance engineer’s point of view. What maintenance needs to be done, when, where and how? It also keeps track of where the engineer is on the airfield. It outlines in real time the work to be done by the engineer, understands when the maintenance work has been correctly undertaken and it can keep track of any anomalies that have been seen and reported by the technician using the visual inspection functionality of AirSide.

AirSide uses RFID tags and GPS coordinates to identify each maintained asset. AirSide is coupled to a webtool that manages the entire database of assets, the webtool is the interface for both the supervisor (via a desktop) and the technician (via an iOS device such as an iPad).

Every action taken is documented in real time so the supervisor can see what work is being done, by which team and where. Notifications highlight any urgent issues that must be resolved as soon as possible. In view of proving that maintenance was done the supervisor can create a report that can be used to present the current maintenance situation to the management or other controlling authorities. ■

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Sustainable aviation: Reducing the environmental impact of airports

With China's aviation industry growing rapidly, the potential impact on Chinese citizens and the wider environment is enormous. Extra flights are a source of noise and air pollution and there will be a big increase in airport-related ground traffic around new airports as user numbers continue to climb.

These negatives must be weighed against the positive economic contribution made by aviation. In countries such as the UK, for example, air travel contributes several percentage points of growth in GDP. What's more, airport operators are increasingly investing in best-in-class infrastructure to offset any negative impact.

Governments and airport operators need to work closely together to mitigate any environmental impact, starting from the location and design, as well as in airport operations and by pressing airplane manufacturers to continue to decrease their impact on the environment, through further decreases in engine emissions.

In 2008, ACI Europe's member airports adopted a policy in which they committed to reduce their carbon emissions with the ultimate goal of becoming carbon neutral. In June 2009, this resulted in the Airport Carbon Accreditation program. Since then, many airports have accelerated their investment programs to become carbon neutral much faster than the official targets. Currently, 102 airports on four continents are actively addressing their carbon emissions, representing 23.6% of global air passenger traffic. The first airport to join the program in Asia was Hong Kong International in March 2013.

"As long as there is flying, there will be CO₂ emissions and airports will continue to reduce their CO₂ emissions by recycling energy such as wastewater treatment, solar power and use of LED light bulbs," says Wang Qing Wei, Section Chief, Henan Civil Aviation Authority - airport division.

Whether they are part of a formal scheme or not, leading airports around the world are focusing on minimizing their environmental impact. Of course, measures such as reducing their energy consumption also reduce costs and boost profitability at the same time. Examples of airports that have taken a front seat include:

- Schiphol airport in the Netherlands, which reduced energy consumption using smart on and off switches for lighting and air conditioning, by introducing LED lighting and installing 3,200m² of solar panels across its eight locations.
- The UK's Manchester airport, which is committed to becoming carbon neutral by 2015 and buying 100% of its electricity from renewable sources. Any remaining shortfall will be offset. Wind turbines are being trialed as part of a commitment to generate 20% of its own energy by 2020.
- Orlando airport's sustainability management plan even extends to the food vendors, requiring them to commit to recycle in the food court. It also focuses on maintenance activities and the extension of building automation systems.
- In Singapore, Changi airport has introduced initiatives such as dimming terminal lights up to 50% during off-peak hours, using more natural lighting and installing motion sensors in areas such as toilets and offices. The target is to cut electricity consumption at the terminals by 13.5 million kWh, generating savings of S\$2.4 million over the next three years. The airport is also tackling water consumption, recycling rainwater for irrigation and installing tap flow regulators in all toilet taps, reducing the flow per minute by two thirds.
- Beijing's new airport in Daxing district is being designed under the guidance of a user and environment-friendly concept. Passengers will

only need to walk 8 minutes, or about 630 m to reach the furthest boarding gate, as opposed to 26 minutes required at Terminal 3 of Beijing Capital International Airport. In order to better utilize space and let in natural light and ventilation, the height of the terminal building will be reduced from 80 m to 50 m, greatly enhancing efficiency. Moreover, the lighting and air-conditioning systems will be adjusted in accordance with the time of the day; energy-saving technologies such as geothermal energy and eco-friendly building materials will be used as well. Several infrastructural projects will kick off successively in 2014, including a 66 km subway line from Mudanyuan to the new airport, which is also expected to complete in 2018.

What does this mean for China?

China has already shown that it's committed to reducing the environmental impact of its expanding aviation industry.

"In China, the focus is more on pollution prevention than CO₂ emissions. Energy management is critical because it affects the bottom line of the airport," explains Qi Wu of leading consultant Roland Berger. "A lot of savings can be made by tackling airport design, such as the layout of the terminals, which

has tended to be overlooked over the years. A good design can realize substantial savings. For example, bad design makes take offs and landings more cumbersome and more energy consuming, while time is lost and thus also money. Besides getting these basics right, China's airports are looking at all the different elements that can save energy, including heating, air conditioning, lighting and so on."

In 2011, the Civil Aviation Administration of China (CAAC) issued guidance intended to accelerate energy conservation and emissions reduction. The staged plan includes the ultimate target of a full 22% reduction in energy consumption and emissions by 2020.

In 2012, China also announced that it was channelling part of the Civil Aviation Development Fund into energy-saving initiatives among its domestic airlines and plane manufacturers. Under the deal, companies may be granted subsidies ranging from 30% to 60% of the total investment for emission reduction efforts.

Now, with hundreds of airports elsewhere in the world also taking their own measures to reduce emissions and other environmental impacts, China is in an ideal position to learn from international

The need for smarter integration of the different transportation networks

The integration between air and ground transportation is actually an efficient way for China to expand its transportation networks while reducing carbon emissions. Air travel between China's main hubs continues to remain profitable for airports and operators.

More high-speed rail links between provincial capitals would maximise China's transportation structure while minimising unnecessary flights

with low passenger flow. Most importantly, it would reduce the carbon footprint of medium-range intercity transportation.

What China needs is not more airports but smarter integration of its different transportation networks.

Author: Wang Tao, a resident scholar at the Carnegie-Tsinghua Center for Global Policy

best practices, using these lessons to improve the sustainability of its own airports and meet its own emissions targets. Beyond this, the country's strong commitment to emissions reduction should help position Chinese aviation at the leading edge when it comes to implementing sustainable solutions. Key measures include improved infrastructure and ground transport links, as well as innovative design in the terminals and across the airstrips.

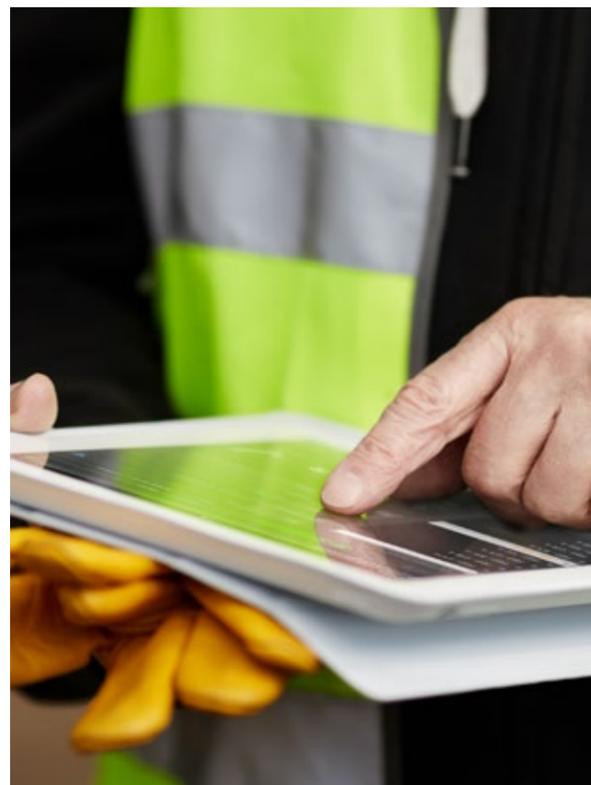
In the terminals, automated solutions can save electricity and water and generate less waste. Across the airfield, electrical mobility solutions and low-power technologies such as LED lighting have a big role to play. However, it's not just about implementing high-tech solutions. It's also about the way the sites and workflows are organized and managed, such as minimizing maintenance, limiting movements on the airfield and automating previously manual processes.

How LED technology boosts energy efficiency

ADB has focused development effort on enabling substantial efficiency gains. ADB LED lighting can boost efficiency by up to 84%, for instance, while its power systems can slash the energy required by up to 90% through a combination of measures, including solar powered lights and control systems that automatically adapt the light intensity to meet visibility needs.

In summary, ADB's approach includes five key elements:

- Create tools that allow customers to calculate the energy saving potential of novel solutions.
- Consider every sale as an opportunity to save energy, proposing efficiency-boosting measures throughout.
- Design solutions that meet each customer's efficiency requirements and indicate potential extra energy savings for the short- and long-term.
- Create new products or use existing products in collaboration with customers to meet their CO₂ reduction goals.
- Create win-win situations that benefit all airport users and the environment. ■



Xi'an Xianyang Airport pursues green strategy with ADB LEDs

Xi'an Xianyang International Airport, the busiest airport in China's north western region, is to use ADB LED taxiway lighting. The deal involves a wide range of more than 2,000 inset and elevated lights, as well as Approach Lighting System (ALS) - 1,400 of these are LED lights.

The airport, which supports more than 20 million passengers and 130,000 tons of cargo annually, began upgrading to LED lighting from ADB in 2012.

"Our airport is very clear about becoming China's truly first green airport," said Ma Wei, Xi'an Xianyang International Airport. "We are very happy to continue our collaboration with ADB to achieve our vision, and benefit from the vast experience the ADB team has in enabling similar efforts at many other airports around the world."

ADB will deliver an Approach Lighting System (ALS) which includes the Precision Approach Path Indicator (PAPI) and Approach lighting.

Innovation: The lifeblood of China's aviation future



Shanghai Pudong International Airport

Having emerged as a leading powerhouse of the global economy, China is an ambitious nation with high-flying ambitions for its aviation industry.

As far back as 2010, China's first aviation industry fund, the China Aviation Industry Fund, was announced. The fund, set up by the Aviation Industry Corporation of China (AVIC) and China Construction Bank, planned to raise up to 5 billion yuan in the first phase, and 1.5 billion to 2.5 billion yuan in the second phase. Its long-term objective is to raise 20 billion yuan. AVIC is an ultra large state-owned enterprise and investment institution, authorized and managed by the Central People's Government. It is managed through ten business units: defense, transport aircraft, aviation engine, helicopters, avionics, general aviation aircraft, aviation research and development, flight test, trade & logistics, and asset management.

In another funding initiative, in 2012 agreements were signed between Xi'an Yanliang National Aviation Hi-Tech Industrial Base Administration Commission, Xi'an National Aviation Industry Fund and Investment Management Company, Rose Rock Group and Roland Berger Strategy Consultants

to use investment and globalization to drive the growth of China's aviation industry.

With such backing, the global impact of China's aviation growth is highlighted, for example, by Boeing's recent announcement that it expects China's airlines to require an additional 6,020 aircraft by 2033 with a total value of \$870 billion. These latest figures represent an 8% increase over the airplane maker's 2013 projections, reports Reuters. "China's aviation market is going through dynamic changes," said Randy Tinseth, Boeing Commercial Airplanes vice president of Marketing. "New business models like low-cost carriers and airplane leasing companies, a new generation of fuel-efficient airplanes and evolving consumer needs are driving demand for more direct flights to more destinations."

Foreign aircraft makers will face growing competition as China gears up its own aircraft development. The Commercial Aircraft Company of China (COMAC) is set to take on the might of Boeing and Airbus with a new range of aircraft currently in development, including the C919, C929 and C939.

China also has ambitious plans for its ground-based aviation infrastructure. The country plans to build 73 new airports and scrap nine existing airports to bring the total number of airports up to 244 by 2020 (Source: Chinese Airport Market development, Frost & Sullivan, December 2012).

All this development work is essential to meet growing demand, with passenger numbers still climbing in 2013 to deliver double-digit growth. This rapid expansion also brings its own challenges. More crowded airports and skies mean tighter safety constraints, both on the ground and in the air.

Again, all this development places China in an ideal position to get ahead of the game in international terms, with new airports able to deploy the latest technologies from the start. Rather than simply trying to change the way existing infrastructure operates, as is the case with more saturated air infrastructure in regions such as Western Europe, China has an opportunity to take advantage of the most innovative technologies available.

While much of that leading-edge technology development is being driven by military requirements and commercial aircraft production, civil aviation systems are also ripe for innovation. Although substantial funds are available to promote development, some observers still see risks: "Entrenched monopolistic practices, bureaucratic fragmentation, and compartmentalization are some of the ailments that inflict the defense industry," says Tai Ming Cheung who is the director of the University of California Institute on Global Conflict and Cooperation, and the leader of its project on the Study of Innovation and Technology in China (SITC).

More intelligent air traffic control systems

A good opportunity is China's Air Traffic Control (ATC) systems which are showing signs of strain under the weight of the demand being placed on them. Automation in ATC would allow more planes into the available airspace and cut fuel consumption by avoiding aircraft frequently having to change altitude or heading. Pilots' workloads would also be reduced.

"Certainly we will see more and more intelligence being introduced, which is something we are currently working on. Of course, this will affect



guidance and safety and we are building up our relationship with US traffic control personnel to learn about the differences between us and US traffic control," says Jiang Yan Jun, Minister, Air Traffic Management Bureau.

Trends in ATC worldwide currently focus on integrating different systems and ensuring they work together smoothly. Gus Paterson, General Manager Safety, of the UK NATS Services says: "By integrating ATC systems, airfield lighting and surveillance data we can accurately determine an aircraft's position and then tie this to that flight's clearance status. So, if an erroneous clearance is given, the systems could recognize this and provide an automated warning to pilots.

"In 25 years there will probably not be any need for a voice link with the pilot at all. Communications

will all be done via data links and ground systems may even be able to directly interface with aircraft systems to avoid conflicts. Airborne "self-separation" will be more common."

Yu Dong Fang, Business Development Director, Thales China agrees: "Current airport equipment is getting more advanced, from aircraft avionics technology, airfield navigation technologies, satellite technologies, PR navigation, PRN technologies - all this equipment will help pilots in landing and taking off safely. There will be new visual elements helping pilots to land at future airports, equipment or automatic systems will increase the accuracy and precision during the landing.

"In future, the pilot and traffic controller will not need much communication compared to the current situation - both have equipment to monitor from take-off to landing. If some equipment does not perform correctly, pilots will need support from air traffic controllers. Communication messages between traffic controllers will have 'error correction and analysis capabilities' to automatically analyze and calculate the message to feedback to the traffic controller and pilot for their reference. ATC management will change from control and monitoring flights to only flight management."

Bringing innovation to the airport

A much greater level of innovation is also needed to achieve more efficient operations and higher energy efficiency at airports.

"In 2020, airports will have seen several changes, in accordance with China aviation's twelfth 5 year plan," says Zhang Yun Qing, Deputy Chief Engineer, China Airport Construction Group Corporation.

"The number of airports will increase, the airport configuration will have greatly improved, passenger numbers will have increased, there will be increased traffic density and landing systems will have changed.

"I believe future airports will use more automation systems, recycling energy, LED technology and environmentally friendly products. Future airports will use only two operation modes, alternating between traditional control and automation," says Zhang Yun Qing.

A good example of the application of innovation is in approach systems. From a simple approach, to CAT I or Cat II/III, and whatever an airport's topography, the latest Smart Approach technology delivers superior safety, outstanding energy efficiency and exceptionally low costs. ADB's all-LED solution combines high-performance approach, flashing, threshold and PAPI lighting with frangible lattice masts and poles.

ADB has also brought the smart approach to Precision Approach Path Indicator (PAPI) equipment, transforming these standard systems into a major contributor to an airport's drive for safety and efficiency. The latest LED system improves user-friendliness, visibility and performance, while eliminating the warm-up delays of traditional PAPI systems in colder climates.

The new ADB PAPI can operate in standby mode. However, unlike traditional halogen PAPIs, the ADB PAPI can run in a continuous heating mode with no light output. Here, the unit's outer glass assembly is heated to virtually eliminate moisture and frost. This enables the LEDs to light up with full brightness ten times faster than non-LED methods, ensuring a clear, instant indication for pilots. This allows airport operators to turn the PAPI off when not needed, saving more energy.

Its unique features include a first-of-a-kind light tube which seals off the whole optical system and protects it from moisture and dust for reduced maintenance.

Meanwhile, ADB's LED solution for taxiways and runways covers the full range of inset light applications for airfield ground lighting - Runway Centre Line, Touch-down Zone, Taxiway Centre Line and Stop Bar. Rising just 6 mm above the tarmac, they suffer less damage from vehicles during cleaning with rotating brushes. The optional scratch-resistant coating on the prisms reduces the abrasion from brushes, sand or grit that is sometimes used in winter conditions. The prisms also remain fully above ground level ensuring no loss of photometry even during rain.

This is particularly important for airports expecting significant snowfall, as the low profile allows the use of snow ploughs with less risk of damage. ■

Safety:

Avoiding runway incursions is a growing priority

Air travel is becoming safer all the time, with automated air traffic control systems and improved avionics mitigating against human error and mechanical failure. At the same time, airports are becoming busier, and nowhere is that more true than in China, with its rapid growth in passenger numbers.

According to The Economist the Chinese market has grown almost 20-fold in 20 years. Total passenger traffic is the second-highest in the world, after America, having nearly tripled to 319m in the eight years to 2012¹. Such growth means rising pressure on airspace. While the country's safety record is excellent, the narrow corridors available for aircraft to take off, land and navigate nasty weather, often result in severe delays to airline schedules.

"A big problem related to China's congestion is due to its air traffic control (ATC) systems and an ATC philosophy that reduces the capacity," says Qi Wu of leading consultant Roland Berger. "China

is looking more at automated ATC control systems and providing money to develop these. The country will also need to find another way of managing the ATC and find solutions for the utilization of airspace."

Growing traffic is also creating another increasingly complex challenge, that of managing crowded taxiways and runways, as well as reducing downtimes created by maintenance, for example. Here, the chief safety-related task is preventing runway incursions - the presence of aircraft, people and other vehicles where they should not be.

An existing and effective technology for helping to avoid incursions is runway stop bars. Gus Paterson, General Manager Safety, of the UK NATS Services says: "Today, more than half of the airports where NATS provides an ATC service use runway stop bars at all times, not just in poor visibility. This has reduced serious runway incursions substantially compared to ten years ago."

One example of the serious consequences of a runway incursion was an incident in 2012 when an Airbus A340-600 and a Boeing 777 collided on the runway at a Chinese international airport, as reported by the Aviation Safety Network, Shanghai Daily, the Global Times and other press sources.

The Airbus was waiting to take off when a wing of the Boeing 777 struck the tail of the Airbus. Both aircraft were damaged badly and could not continue with their scheduled departures.

While conventional warning systems, such as runway guard lights and stop bar lights alert pilots when they are about to enter an unauthorized area, they cannot tell whether there is an actual hazard. The latest alerting systems go one step further.

For instance, advanced ground lighting systems are smart and switch on warning lights only when an actual conflict is detected by a local surveillance system. These Runway Incursion Alerting Systems (RIAS) detect an incursion and automatically send a message out to the incurring aircraft or vehicle by lighting up a number of red, flashing, Fast Reaction Lights beyond the stop bar. It also sends a message to air traffic control so they can help resolve the situation.

RIAS proves its value

ADB is one of the leading suppliers of the new generation of RIAS systems, with its Sensor Controlled Incursion Prevention System (SCIPS). ADB recently conducted a test of SCIPS at Aberdeen International Airport in Scotland, as part of a trial organized by the UK's national air traffic control agency,

"I really think that safety is still a priority. Our existing airport design of runway and taxiways are simple, that is, there are no crossing runways, so they are easy to design. Yet, we now see the crossing of runways by aircraft happening every day due to high flight density. Aircraft take-off and landing frequencies are very high, so safety is very important."

Ms. Zhang, Deputy Chief Engineer, China Airport Construction Group Corporation

NATS, and the Civil Aviation Authority (CAA).

The trial project was implemented at the M1 runway holding position, where the risk of runway incursions is higher than elsewhere, owing to the long distance between the holding position and the runway and chances of low winter sun causing glare as the pilots approach the holding point.

The SCIPS system relies on two separate types of sensor to detect when an incursion takes place. Combining microwave sensors and infrared detectors in this way increases the reliability of the system. If both sets of sensors are activated, the system sets off a pattern of Fast Reaction Lights to alert the pilot.

Initial tests have been a success and the trial is still ongoing, paving the way for further installations at other UK airfields.

What is a runway incursion?

The U.S. Federal Aviation Administration (FAA) records four types of runway incursion, all based on human error and loss of appropriate separation between aircraft and/or a vehicle:

- **Operational Errors** is when an air traffic controller inappropriately clears an aircraft or vehicle into a situation that results in a collision hazard.
- **Operational Deviations** is when a pilot moves an aircraft into a position with air traffic control approval, at a wrong time or place (different runway).
- **Pilot Deviations** is when a pilot moves an aircraft into a position, without air traffic control approval, that leads to a loss of separation.
- **Vehicle/Pedestrian Deviations** is one where a vehicle or individual enters a runway without air traffic control approval that leads to a collision hazard.

Other factors that could lead to a serious ground incident include:

- **Unfamiliarity of the airport.**
- **Limited visibility of surface movements from the tower.**
- **No surface ground radar and traffic movement monitors.**
- **Language / communication problem.**
- **Airport constructions and signage projects.**



Three guiding principles for airport safety

First, good airfield maintenance is critical. Proper maintenance avoids issues such as lighting fixtures or components becoming loose and being blown onto the runway, creating FOD hazards. ADB's AirSide maintenance services provide a comprehensive approach to maintenance, helping to ensure that all the necessary checks are carried out and properly recorded for future reference.

Second, runway incursions are a growing issue as airports become increasingly busy. RIAS systems such as ADB's SCIPS system have arrived and will fast become the industry benchmark for best practice.

Third, the migration from halogen lamps to LEDs will improve visibility, even in low-visibility conditions such as heavy rain. They are also extremely robust, rising just 6 mm above the tarmac. This makes them less prone to damage from vehicles during cleaning, for instance, or from snow ploughs. Furthermore, and perhaps most importantly, LED systems need less maintenance so fewer people and vehicles need to be deployed onto the runways and taxiways. ■

References:
 1 The Economist: <http://www.economist.com/news/china/21583273-military-control-airspace-and-risk-averse-culture-threaten-cripple-chinas-rapid-growth>

Lighting maintenance is safety-critical

On 6 May 2014, a Boeing 747 operated by Delta Air Lines dislocated a center-line runway light during takeoff at John F. Kennedy Airport in the USA. Less than two weeks before, another Delta plane dislodged a similar light at the same runway while landing. The Federal Aviation Administration subsequently demanded a statement detailing runway and taxiway lighting inspection practices and pavement maintenance. It also asked for self-inspection records.

Even small items on a runway can threaten the safety of an aircraft. The 2000 accident in Paris that destroyed an Air France Concorde supersonic aircraft occurred after one of the plane's wheels struck a titanium strip that had fallen off another plane, the French Office of Investigations and Analysis concluded. All 109 people aboard and four on the ground died.

Future Outlook: Challenges to aviation growth in China

While official government sources have been optimistic in their projection of future growth in aviation, as reflected in the plans for many major new and expanded airports across the country, independent industry observers have pointed to factors that have emerged to challenge the continuation of the rapid growth of the past years.

A recent slowdown in China's economic growth, the result of global and domestic developments, is reflected in slower airline passenger growth. Furthermore, growth at Beijing and other major Chinese airports will slow as slots become increasingly difficult to secure. The highest growth among major Chinese airports is in China's west and northeast regions, home to airports including Chongqing, Shenyang and Urumqi. They are a fraction of the size of Beijing, Shanghai and Guangzhou, which account for 31% of passenger movements, but will increasingly garner international attention.

Ambitious airport projects also follow the trend of debt-fuelled construction that local authorities have used for years to boost their local economies. With more than three-quarters of China's existing airports already running a deficit, some industry experts believe there may be too much emphasis on airport construction. One reason underlining this view is the high-speed railway construction boom since 2002, which has intensified pressure on existing airports. After the opening of the Beijing-Guangzhou line in December 2012, China's 9,000 kilometer rail network is now the world's longest. China's goal is to extend the high-speed railway network

to 16,000 kilometres by 2020. This will increase competitive pressure on airlines and airports.

Most Chinese airlines are currently not earning profits. In order to improve their performance, Chinese airlines have been looking for breakthroughs mainly through two ways: expansion into international markets and tapping into the low-cost airline concept. Among them, China Eastern Airlines, Hainan Airlines, Spring Airlines and Juneyao Airlines have made forays in the low-cost airline business, and many foreign low-cost airlines are also planning to seize the Chinese market. So far only Spring Airlines has succeeded in setting up the low-cost airline operating model in China.

Opportunities for Growth

While Beijing, Shanghai Hongqiao, Shanghai Pudong and Guangzhou have the highest passenger volumes, the large growth rates among China's 20 largest airports are occurring primarily in the west, according to CAPA Centre for Aviation.

Leading this trend with 20.5% growth is Urumqi in China's far Northwest, along the border with West Asia. China Southern has positioned Urumqi as a hub for West Asia/CIS/Russia.



The next fastest-growing major airport in China is Chongqing with 15.8% growth. Chongqing, along with nearby city Chengdu (8.7% growth), are part of China's "Go West" campaign to increase economic activity further inland. Zhengzhou is the third-fastest growing major airport with 15.0% growth.

CAPA predicts that China's megacities will continue to experience growth that may be looked at in China as "slow" but by global measures is fast. The even faster growth will continue to occur at second- and third-tier cities, most of which rival or exceed in size global counterparts. The Chinese market is heavily domestic, and will remain so, but these smaller cities will gradually gain more international recognition, and growth, the researchers say.

China has become increasingly involved in transportation infrastructure projects overseas as part of its political drive to expand its influence around the world. Airports are becoming a Chinese export product, with state-funded and subsidized airport development projects in Asia and especially across Africa. Lately the country's enterprises have even reached out to airport investment opportunities in North America and Europe. In Germany, a Chinese business has taken over the ownership of Lubeck Airport on the Baltic Sea in July of 2014. These activities are part of expanded trade links between China and the markets where it has become involved in infrastructure development. Ultimately, the overseas airport projects will spearhead new and expanded airline links which Chinese airlines will take advantage of and its airports will benefit from.

Rising to the challenges

China has been catching up to the industrialized world at an amazing speed over the past decade and its aviation industry has been part of this rapid growth. With this rise to an 'air transport superpower' came a number of challenges that relate to economic, environmental, political and system management issues. It has resulted in traffic congestion on the ground and in the air, safety concerns, growing pollution, lack of profitability at many of China's airlines and airports and transportation infrastructure development that has not always lined up well with demand. China is still on a learning curve, trying to match supply and demand in air transportation and doing so in a viable, sustainable and safe way. A temporary

slowdown in growth in the industrialized heartland may be a blessing, allowing airport facilities to catch up with demand, while less developed regions of the country pick up the growth curve. Combined, China's aviation industry is expected to grow faster than most other regions of the world over the longer term.

The country will find the resources to expand airports to meet demand, but this requires smart planning and implementation processes. Major efforts have to be focused on safety and environmental sustainability. The country's GDP is forecast to grow 6.4% per year over the next two decades. Air traffic in China (domestic and international combined) have grown over 10% in 2012, but 78% of the traffic was domestic. International air travel will grow and this will need to be considered in airport planning. The government needs to address the airway congestion. Civilian and military administrators have to come up with better solutions on how to share the increasingly congested airspace. The use of business jets is just beginning to take off in China now, but some business jet manufacturers predict that 1,000 aircraft will be delivered by 2021. This air travel segment will need dedicated facilities, in many cases in the largest urban areas it will mean specialized business aviation airports.

China has an opportunity to use its central planning structure and adopt the best tools and practices from around the world across the entire nation. After a breakneck speed of airport construction and expansion, the focus needs to shift to sustainability and safe operations. Airports, with the available advanced technologies, need to become leaders in the efforts to reduce their environmental footprint while managing further growth. Like many regions of the world, China needs Smart Airports that are also Green Airports. ■

Airport privatization overview - China

Country	Airport(s)	Remarks
China	Beijing Capital Int.	Beijing Capital International Airport Co. Ltd was floated in 2000 and is listed in Hong Kong. The privately-owned and Hong Kong-based NWS Holding Ltd (NWS) will buy 8.8% of Beijing Capital International Airport Co. for about HKD 2.36 billion (USD 304 million). The purchase of 383 million shares will give the NWS transport unit New World Development Co., a land developer, a 20.4% stake in the airport operator's Hong Kong-listed H shares. Infrastructure and services conglomerate NWS Holdings has a fund of USD 515 million for acquisitions and investments in the first half of 2014, including further investment in Beijing Capital International Airport, according to the firm's Executive Director, Tsang Yam-pui. NWS wanted to increase its interest in the Beijing airport to a substantial minority stake during the year, but it would be less than 50%. By early March 2014, NWS had invested a total of USD 348 million for 23% of the 'H' shares of Beijing Airport, or 9.98% of its entire share capital, making it the second-largest shareholder in the airport operator, Tsang said. Beijing Airport would start producing recurring earnings contributions to NWS in the second half of 2014.
	Guangdong airports	Managed by Guangdong Airport Management Corporation (GAMC) since 2004
	Guangzhou-Baiyun Int.	Listed on domestic stock exchanges
	Hainan-Meilan Int.	Hainan-Meilan International Airport Co. Ltd is part privatized; listed in Hong Kong
	Hainan Airlines	Owns three operation bases in Guangzhou, Shijiazhuang and Changsha
	Hangzhou	IPO planned
	Kunming-Changshui	Owned by Yunnan Airport Group Co., Ltd
	Shanghai-Hongqiao Int.	Listed on domestic stock exchanges
	Shandong Airlines	Currently manages four regional airports - Shandong Linyi, Weifang, Dongying and Guizhou Anshun - and is experienced in revitalizing airport resources
	Shenzhen-Bao'an Int.	Listed on domestic stock exchanges
	Xiamen-Gaoqi Int.	Xiamen International Airport Group Co. Ltd is listed on domestic stock exchanges since 1996
	Xi'an-Xianyang	The airport is a joint venture since 2007 between Germany's Fraport (24.5%), China West Airport Group, and China National Aviation Corporation
	Yichang (Hubei prov.)	Privately-owned Junyao Group acquired a 3% stake in 2003
Zhuhai	Hong Kong Airport interested in acquiring a stake	
Hong Kong	HK Int. Apt	Part-privatization considered
Macao	Macao Int.	The Macao SAR government is a majority shareholder with a 66.97% stake in the airport company, Macao International Airport Company Ltd. Sociedade do Turismo e Diversões de Macau (STDM) has a 33.03% share.

About ADB

ADB Airfield Solutions (ADB) is a market-leading airfield technology company providing end-to-end, integrated and sustainable solutions for visual guidance. Backed by a rich legacy that dates back to 1920s, and a focus on Airfield Ground Lighting (AGL) since 1947, ADB has deep experience in AGL and system-based projects. Our end-to-end approach encompasses AGL design expertise, market-leading AGL products and systems, system engineering experience, and training programs backed by full service support that allow airports to improve their performance and ensure 24x7 reliability.

- Present in more than 2,000 airports globally
- 600,000-plus AGL LED Installations at more than 450 airports
- Delivered 100-plus AGL design projects

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