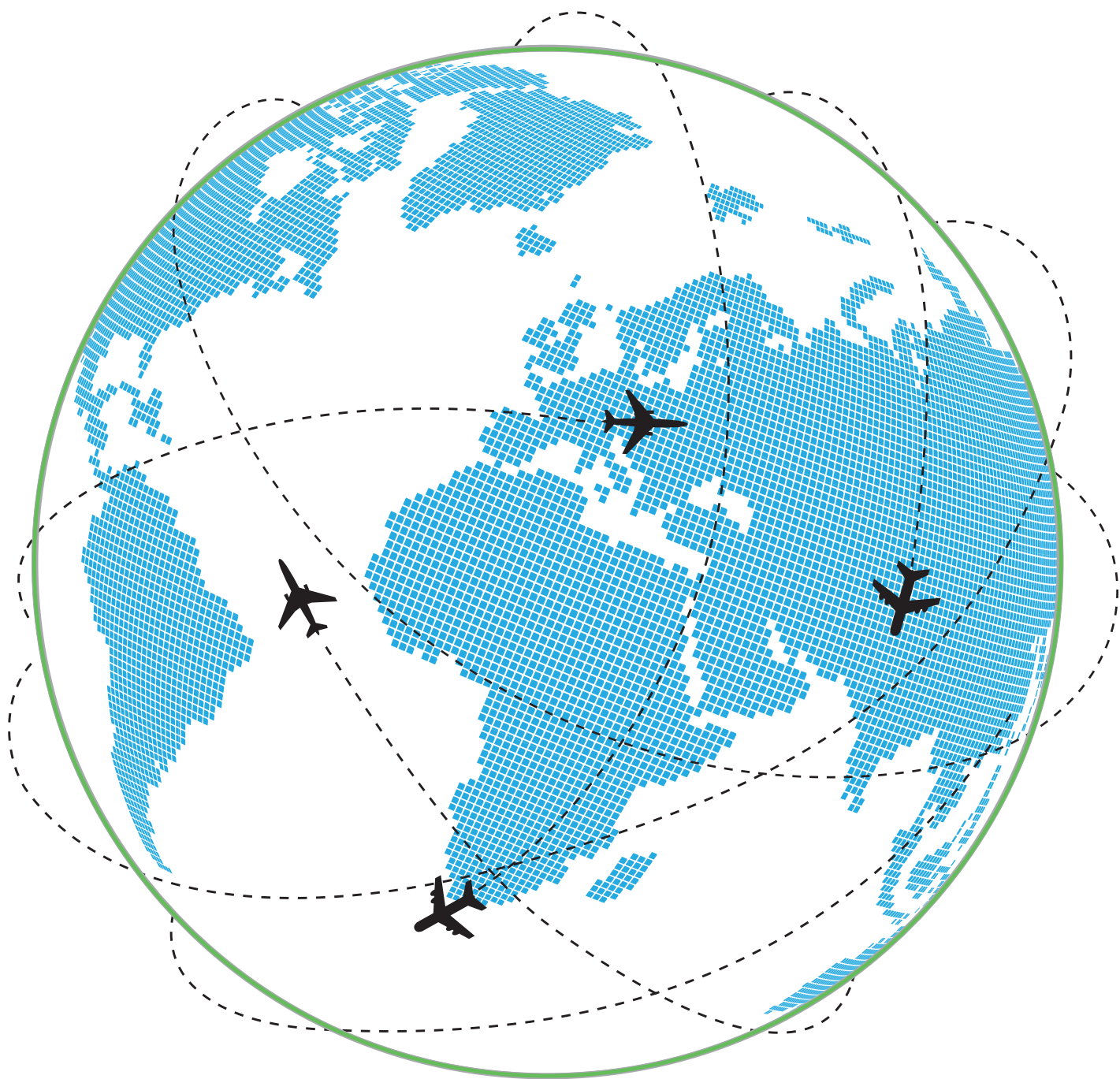


Aviation

Global experts, local solutions



ARUP

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Arup in aviation

We have been involved in aviation development for more than 50 years, with experience gained through a wide range of assignments at more than 100 airports worldwide. We have advised the majority of the world's leading airports and are recognised globally as a leader in airport masterplanning, delivering airport terminal and support facility designs, and specialist aviation services.

We support funders, owners, operators and users to develop safe, secure and sustainable solutions that deliver customer service excellence on a sound commercial basis. We add value to our clients' business through close collaboration with the client team and stakeholders, and drawing on in-depth knowledge to deliver robust, resilient and efficient solutions.

SELECTION OF OUR AVIATION PROJECTS LOCATIONS:

Abu Dhabi	Chongqing	Lagos	Salalah
Adelaide	Chubu	Lisbon	Samara
Amman	Copenhagen	Long Beach	San Diego
Amsterdam	Crete	Los Angeles	San Francisco
Ankara	Dalian	Macau	San Jose
Antalya	Dar Es Salaam	Makassar	San Juan
Ashgabat	Darwin	Manchester	Sao Paulo
Athens	Delhi	Manila	Seattle
Atlanta	Doha	Melbourne	Seoul
Auckland	Dubai	Mexico City	Shanghai
Baku	Dublin	Miami	Shenzhen
Bali	Durban	Montreal	Siem Reap
Bangalore	Dushanbe	Moscow	Singapore
Bangkok	Edinburgh	Mumbai	Sunshine Coast
Beijing	Fort Lauderdale	Murcia	Sydney
Berlin	Frankfurt	Muscat	Taiwan
Bilbao	Gatwick	Nanning	Toronto
Birmingham	Gold Coast	Nantes	Ulaanbaatar
Bogota	Gran Canaria	Newark	Vancouver
Bologna	Hainan	Newfoundland	Venice
Boston	Heathrow	New York JFK	Viracopos
Brasilia	Hobart	Osaka	Warsaw
Brisbane	Hong Kong	Ottawa	Washington DC
Cairo	Hyderabad	Panama	Winnipeg
Calgary	Istanbul	Perth	Wroclaw
Cancun	Jeddah	Phnom Penh	Xi'an
Cape Town	Johannesburg	Quebec City	Yangon
Cebu	Kingston	Raleigh/Durham	Zagreb
Central Queensland	Kuala Lumpur	Riga	
Chengdu	Kunming	Rio de Janeiro	
Chicago	Kuwait City	Rome	

WE HAVE ADVISED THE

MAJORITY



OF THE WORLD'S
LEADING AIRPORTS AND
ARE GLOBALLY RECOGNISED
AS LEADERS IN AVIATION

Arup aviation services

We have the breadth of skills covering the whole lifecycle of aviation projects that can respond to the challenges of the aviation industry: strategic and commercial planning, technical design and project delivery; operational and implementation management skills. Our international presence enables us to apply our global expertise to meet the particular local requirements of projects of any scale ranging from many of the world's largest international hubs to award winning smaller regional airports.

At Arup, airport planners, designers and business consultants work in conjunction with experts in other disciplines including fire safety, vibrations and acoustics, baggage, security, energy, waste, geotechnics, tunnels, environmental engineering, transport planning, economic planning, contracting and project management, and transport planning.

Our projects cover airport strategic and masterplanning, traffic demand analysis and the programming, planning and design of: passenger terminals; cargo terminals; airside infrastructure; landside infrastructure; control towers and control rooms; maintenance repair and overhaul facilities; utilities; airport cities and urban development.



OUR INTERNATIONAL PRESENCE
ENABLES US TO APPLY OUR GLOBAL
EXPERTISE TO MEET THE PARTICULAR
LOCAL REQUIREMENTS OF PROJECTS

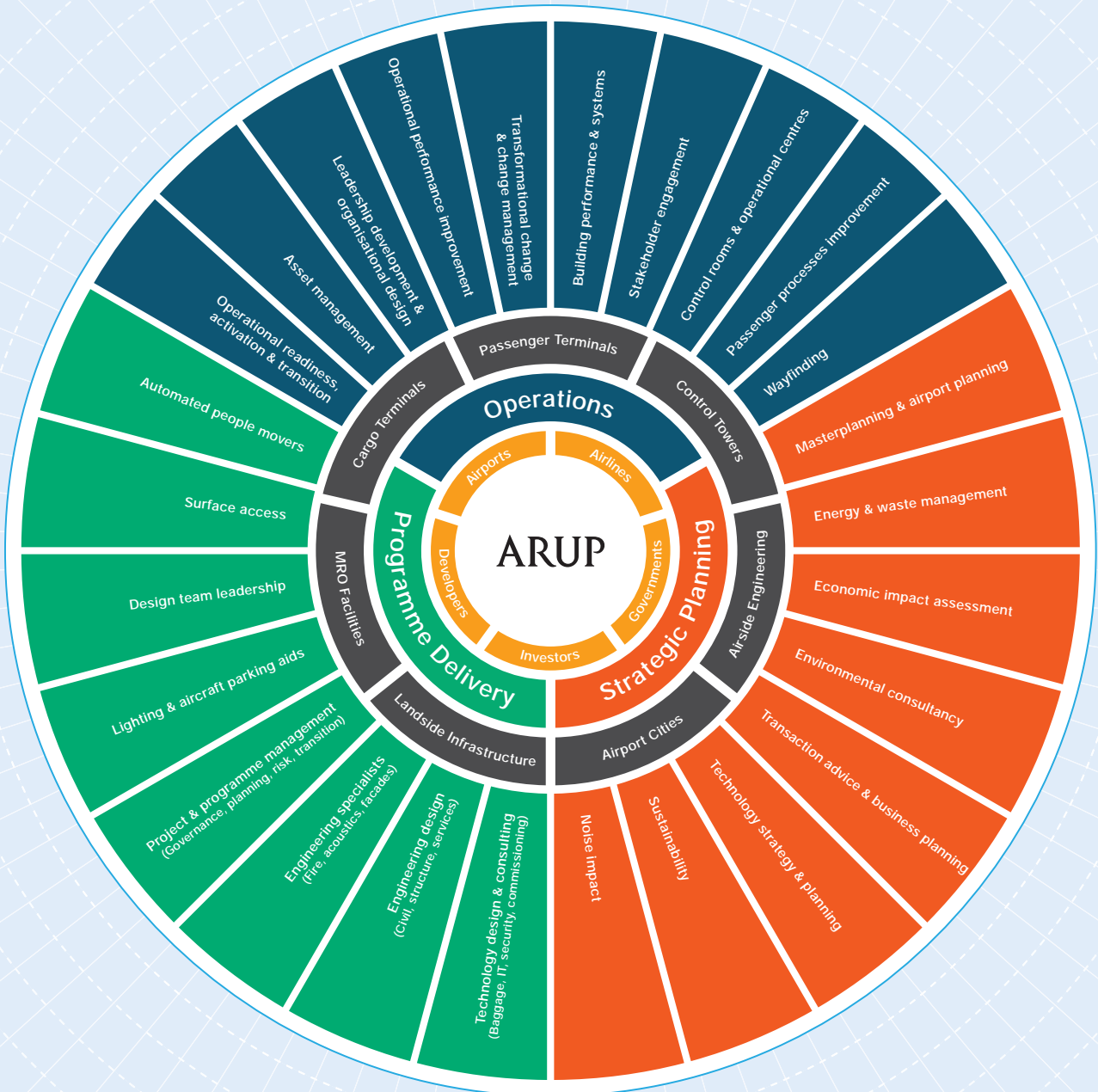
ASSIGNMENTS AT

>hundred

AIRPORTS WORLDWIDE



Holistic approach



Our aviation business

Today, the aviation industry faces increasingly complex challenges. It connects more people, further afield. It must also meet higher demands in security and sustainability and plan for ever changing market conditions. Reducing cost and increasing revenue in both aeronautical and non-aeronautical offerings is critical to the success of airports and airlines. Around the globe, airlines, airport operators, investors, developers and regulators come to Arup for holistic solutions, from transaction advice to airport development to operational readiness, to balance their competing issues.

We have the expertise to put forward-thinking strategy, design and technology into practice, whether advising clients on aviation planning, policy or finance, or delivering smarter airport operations and infrastructure. Our solutions deliver real business benefit by balancing the needs of people, operational processes, technology solutions and the facilities and environments in which solutions are implemented.

The eye-catching terminal buildings, delivered in collaboration with architects, often steal the limelight. However, our planning, design and consultancy services encompass everything from air traffic control towers to cargo handling, information and control systems to operational readiness with equal importance.

Our innovation in technology, acoustics, security, IT and communications, integrated transport, logistics and infrastructure design gives our aviation clients a leading edge, particularly in automation of the passenger process.

Negotiating demand, capacity, regulation and investment constraints can mean tough choices in aviation. However, our pragmatic approach and wide-ranging skills in economics and planning, sustainability consulting, energy strategy and carbon management enable us to shape solutions that meet business objectives while balancing social, environmental and economic issues.

Aviation businesses often work globally, but success depends on seeing through local eyes and meeting local requirements. Likewise, while we bring together top international experts that can realise world-leading ideas anywhere, we see each project as an individual challenge. And so our solutions work in context.

Arup has the breadth of strategic, technical, operational and implementation management skills to support our clients in responding to current and future challenges. If you would like any further information please contact me. We look forward to the opportunity of working with you in the future and in supporting the success of your aviation business.



Ian Taylor
Global Aviation Business Leader
aviation@arup.com



Total design

- Total airport development
- International passenger terminals
- Regional airport facilities
- Airside engineering
- Landside infrastructure
- Aviation support facilities
- Cargo handling facilities
- Control towers
- Hangars - maintenance, repairs and overhaul
- Test and training facilities
- Airport cities



Total airport development



© Foster+Partners

Mexico City International Airport



© Ronald Malsome

Montreal-Trudeau International Airport, Canada



© IGA

Istanbul New Airport, Turkey

We provide an integrated approach to total airport development - enabling clients to achieve an appropriate balance between their commercial, operational, social and environmental objectives. Our work with operators, developers, investors, airlines and regulators includes the development of both long-term strategic masterplans and mid-term capital investment plans for both regulated and non-regulated airport assets.

Working in collaboration with our clients' own teams and key external stakeholders, we draw together an appropriate combination of our own experts and other professionals to suit the particular needs of the airport development.

Our skills include:

- Airport masterplanning and business planning
- Capital investment planning
- Demand/capacity analysis and simulations
- Benchmarking
- Terminal, airfield and support facility planning
- Surface access planning
- Technology strategy
- Economic, employment, and community impact assessment
- Sustainability and environmental impact assessment
- Phasing and constructability
- Design and project management
- Stakeholder engagement

Our work draws on in-depth knowledge of relevant international and local codes and standards, internal and external benchmark data, and detailed understanding of the different components of a comprehensive airport masterplan including:

- Passenger terminal buildings
- Surface access infrastructure
- Airside infrastructure
- Commercial areas (Airport Cities)
- Aviation support facilities

This enables us to develop robust, deliverable and affordable solutions that gain support from industry stakeholders, regulators and investors.

Selected projects

Istanbul New Airport, Turkey
Mexico City International Airport
Galeão-Antonio Carlos Jobim International Airport, Rio de Janeiro, Brazil
Auckland International Airport, New Zealand
Kunming Xiaoshao International Airport, China
New Lisbon International Airport, Portugal
London Heathrow Airport, UK
London Luton Airport, UK
Montréal Airports System, Canada
Berlin Brandenburg Airport, Germany
Sabiha Gökçen International Airport, Istanbul, Turkey
Copenhagen International Airport, Denmark
Hobart International Airport, Australia



International passenger terminals



© Abu Dhabi International Airport

New Midfield Terminal, Abu Dhabi International Airport, UAE



© PID

Terminal 3, Beijing Capital International Airport, China



© Airport Authority Hong Kong

Hong Kong International Airport

We bring our global expertise and understanding of the aviation industry to the planning, design and upgrading of international passenger terminals. Working closely with our clients and architectural partners, we provide total technical, management and financial planning services, to create passenger terminals which meet the most stringent operating criteria whilst providing iconic statements as international gateways.

Our understanding of the rapidly changing security, environmental and business demands on operators and airlines, enables us to develop designs which are flexible but keep within strict financial constraints.

Sustainability is a key criterion in our designs, resulting in low carbon footprint and energy efficient buildings and supporting sustainable business and operating plans.

Our objective is to address client aspirations for their terminals, meeting current demands whilst providing capacity and flexibility for future growth.

Our core skills for terminal planning and design include:

- Terminal planning
- Passenger movement simulations
- Baggage handling system design
- Integrated ground transportation systems
- Structural, civil and building engineering design
- Environmental impact assessment
- Fire safety and security planning
- ICT and wayfinding design
- Acoustics design
- Lighting design
- LEED™ Assessment
- Commissioning management
- Operational readiness
- Design leadership
- Project, programme and cost management

Selected projects

JetBlue Terminal 5i Expansion, JFK International Airport, New York, USA
Terminal 4, JFK International Airport, New York, USA
New Midfield Concourse, Hong Kong International Airport
International Departures Expansion, Perth Airport, Australia
Terminal 1 and New Midfield Terminal, Abu Dhabi International Airport, UAE
Terminal 1 Extension, Kempegowda International Airport, Bangalore, India
Terminal 2, Kuwait International Airport
Terminal 2, Dublin International Airport, Ireland
Kunming Xiaoshao International Airport, China
Terminal 3, Beijing Capital International Airport, China
Terminal 5, London Heathrow Airport, UK
Rajiv Gandhi International Airport, Hyderabad, India
Lester B Pearson International Airport, Toronto, Canada
Montreal-Trudeau International Airport, Canada
Brisbane Airport, Australia
Terminal A+, Frankfurt Airport, Germany
Zurich Airport, Switzerland
Raleigh Durham International Airport, North Carolina, USA



Regional airport facilities



Bristol Airport, UK



Wrocław Nicolaus Copernicus Airport, Poland



Hobart International Airport, Tasmania, Australia

We have extensive experience in the provision of a broad spectrum of aviation facilities. We understand how the markets and traffic profiles at regional airports differ from those at larger hubs and what impact this has on business models, commercial imperatives, infrastructure provision and capital expenditure requirements. We recognise the particular demands that low cost carriers can place on regional airports and how planning and designing for these demands need to be balanced with the requirements of other users where necessary.

Whether upgrading existing facilities or providing new ones, we pay particular attention to long-term flexibility and systems adaptability, enabling airports to respond efficiently and cost effectively to changes in market drivers.

By applying sustainability principles, we also help operators address the challenges that come from infrastructure provision while at the same time maintaining the local environmental and social structure.

In addition, our understanding and experience of airport operating practices is invaluable in allowing us to deliver projects in the live operating environment.

Our regional airport skills include:

- Demand assessment and traffic forecasting
- Business case assessment
- Terminal and support facilities planning
- Airside planning
- Landside planning
- Operational performance improvement
- Structural, civil and building engineering design
- Integrated ground transportation
- Fire safety and security planning
- Acoustics design
- Design and project management

Selected projects

Hobart International Airport, Australia
Heydar Aliyev International Airport, Baku, Azerbaijan
Québec City, Jean Lesage International Airport, Canada
Ottawa MacDonald-Cartier International Airport, Canada
St John's International Airport, Newfoundland, Canada
Riga International Airport, Latvia
Copernicus Airport, Wrocław, Poland
Murcia Airport, Spain
Leeds and Bradford International Airport, UK
Durham Tees Valley Airport, Darlington, UK
Bristol Airport, UK
Long Beach Airport, California, USA
Logan International Airport, Boston, USA



Airside engineering



JFK International Airport, New York, USA



Sydney Airport, Australia



London Gatwick Airport, UK

We address the challenge of optimising airport use within the constraints imposed by airside capacity, whether in the design of new airports or the upgrading of existing facilities, notably to meet the needs of larger aircraft.

We ensure the delivery of safe, flexible, efficient and easily maintainable airside facilities through a rigorous integrated total engineering process. Our teams bring a detailed understanding of international aviation standards, together with the lifecycles of equipment, aircraft and the built infrastructure. An essential element of our design is to ensure that all of our projects meet the highest levels of environmental protection and sustainability.

Being a global practice, with local delivery, we provide a unique offering of knowledge of international best practice and local regulatory regimes and operational environments, thus delivering optimum value to our clients.

Our airside engineering skills include:

- Airfield planning and runway layouts
- Runway and electronic zoning evaluation
- Runway capacity assessment
- Apron planning
- Aircraft gate layouts and markings
- Aircraft bridging and servicing
- Hydrant fuelling
- Pavement engineering
- Airfield lighting and navigation systems
- Automated People Movers
- Civil engineering, utilities and drainage
- Environmental assessment and mitigation
- Noise abatement
- De-icing systems
- Commercial analysis
- Project management

Selected projects

Kunming Xiaoshao International Airport, China
Cancun International Airport, Mexico
Lester B Pearson International Airport, Toronto, Canada
Brisbane Airport, Australia
Delta JFK Redevelopment, JFK International Airport, New York, USA
London Gatwick Airport, UK
RAF Waddington, UK
Athens International Airport, Greece
Sabiha Gökçen International Airport, Istanbul, Turkey
Melbourne Airport, Australia
Code F Operations, Sydney Airport, Australia
Code F Stands, Terminal 4, London Heathrow Airport, UK



Landside infrastructure



Terminal 2, Dublin International Airport, Ireland



Terminal 4, JFK International Airport, New York, USA



Brisbane Airport, Australia

We are a leader in the planning, design and project management of landside infrastructure for airports. Our aim is to plan facilities and develop infrastructure that allow for long-term sustainable growth, while ensuring that the surrounding environment is protected.

The landside infrastructure forms the primary physical interface between the core aviation functions of the airport and the surrounding communities and commercial developments. The successful development of this infrastructure will ensure efficient and sustainable surface access, promote local economic development, and help to minimise the impact of airport operations on local communities.

Our work on the planning and development of landside infrastructure benefits from our wider corporate cross experience - both on other forms of transport infrastructure and in other property sectors.

Our work on landside infrastructure includes the planning and design of:

- Highways access - car parking and rental car facilities
- Terminal curbs and forecourts
- Automated people movers
- High speed, regional and metro rail connections
- Public transport interchanges
- Utilities infrastructure
- On-airport hotels, offices and amenities
- Surrounding airport city commercial developments
- Personal Rapid Transit

Selected projects

Terminal 2, Dublin International Airport, Ireland
Multi-Level Car Park, Brisbane Airport, Australia
Melbourne Airport, Australia
JFK International Airport, New York, USA
Warsaw Chopin Airport, Poland
Manchester Airport, UK
Ground Transport Centre and Approach Roads, Hong Kong International Airport
Kunming Xiaoshao International Airport, China
VISSIM Model, Newark Liberty International Airport, New York, USA
Terminal 5, London Heathrow Airport, UK



Aviation support facilities



© LHR Airports Limited

London Heathrow Airport, UK



© Craig Shimahara Gruen Associates

Central Utility Plant, Los Angeles International Airport, USA

We have over 50 years' experience in the planning and design of aviation support facilities. Commencing with military aircraft hangars, our services now cover every aspect of the sophisticated demands of airlines and airport operators, meeting the most stringent safety and operational standards.

For airport operators we provide rapid and economic design of hangars, from simple single span structures to complex, highly serviced maintenance buildings for the largest Boeing and Airbus aircraft in production.

For major world airlines we have collaborated in the designs of some of the world's most sophisticated aircraft maintenance, training and test facilities.

We have taken the lead role in the planning and design of technically advanced air cargo handling facilities, together with the provision of all ancillary requirements including fire stations, flight kitchens and GSE maintenance buildings.

Our aviation support facilities include:

- New and upgrading of hangars
- Maintenance, repair and overhaul hangars
- Aircraft painting hangars
- Engine test facilities
- Flight simulation facilities
- Air cargo handling facilities
- Control towers
- Firefighting systems and stations
- Flight kitchens
- Customs and freight forwarding
- Security infrastructure
- Planning and design management
- Cost control and management
- Lounges
- Utilities buildings

Selected projects

Customs and Border Protection Facility, Terminal 5,
JFK International Airport, NY, USA
A330 Maintenance Hangar, RAF Brize Norton, UK
Air Traffic Control Tower, London Heathrow Airport, UK
48-Bay Fast Jet Maintenance Facility, RAF St Athan, UK
Korean Air Cargo Terminal, JFK International Airport, New York, USA
British Airways World Cargo Centre, London Heathrow Airport, UK
Lufthansa Catering Facility, Hong Kong International Airport
HACTL Super Terminal 1, Hong Kong International Airport
British Airways Heavy Maintenance Hangar, Cardiff International
Airport, UK
Central Utility Plant, Los Angeles International Airport, USA
Flight Catering Facility, Hamad International Airport, Doha, Qatar



Cargo handling facilities



HACTL Super Terminal 1, Hong Kong International Airport



© HKIA

We provide a comprehensive range of consultancy services for the development and enhancement of cargo handling facilities, systems and operations. Our work with a wide range of stakeholders in the air cargo industry - including airport authorities, airlines, cargo handlers and developers - involves both the implementation of new terminals and the improvement of existing operations. We are focused on the development of efficient and effective operational processes and supporting infrastructure to minimise costs and optimise service levels.

Our specific knowledge of air cargo is complemented by wider experience within the logistics and distribution sector worldwide - providing an unrivalled understanding of the business drivers for the cargo industry and of the regulatory context for global shipment of goods. Access to the wider Arup experience in the road, rail and sea transport sectors also provides us with a unique insight into the planning of multi-modal infrastructure and operations.

Our cargo handling skills include:

- Demand and capacity analysis
- Business case development
- User requirements definition
- Cargo area masterplanning
- Facilities and infrastructure planning and design
- Materials handling and control system design
- Tender documentation and procurement support
- Implementation and commissioning management
- Operations planning and process improvement

Selected projects

Cargo Terminal, Aeroporto Leonardo da Vinci, Fiumicino, Italy
Container Handling and Storage Facility, Terminal 5, London Heathrow Airport, UK
Parcelforce UK and International Hubs, Coventry, UK
British Airways World Cargo Centre, London Heathrow Airport, UK
HACTL Super Terminal 1 Air Cargo Terminal, Hong Kong International Airport



Control towers



© LHR Airports Limited

London Heathrow Airport, UK



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Chhatrapati Shivaji International Airport, Mumbai, India



Sydney Airport, Australia

Control Towers are landmark symbols of airports across the globe. Air traffic controllers must coordinate the movements of thousands of aircraft every day. The need for high tech operational control rooms is key to these operations and airports cannot function without highly efficient control towers in which controllers are able to maintain visual contact with the aircraft at all times, ground or air bound.

We work closely with the airport operator and air traffic controllers to establish the ideal height and location of the air traffic control and apron control towers - taking account of sight lines and views to all parts of the airfield to facilitate the efficient and safe operation of an airport. We assess the operational safety of the tower, including development of rigorous fire safety plans and analysis of single points of system failure.

For the cab design, we ensure a high quality physical environment by the analysis of solar gain and specification of heating and cooling systems. We analyse tower dynamics for wind loading and where appropriate design passive and active damper systems to reduce sway movement, ensuring operator comfort. We develop appropriate desk and seating layouts for the Visual Control Room and maximise day and night airfield visibility by the selection of lighting, cab glazing, solar blinds and anti-condensation systems.

The construction of a tall tower in an operational airport requires strong construction planning skills and often knowledge of specialised jacking and craneage techniques to be used. We work with contractors and operating staff to optimise our designs to suit these specific methods of erection.

Our control tower skills include:

- Site location and assessment
- Line-of-Sight studies
- Civil, structural and dynamic engineering
- Building services design
- Environmental control systems
- Security and fire engineering
- Lighting engineering
- Façade engineering
- ICT systems
- Plant specification and assessment
- Cost, project and design management

Selected projects

Chhatrapati Shivaji International Airport, Mumbai, India
London Heathrow Airport, UK
Cancun International Airport, Mexico
Rajiv Gandhi International Airport, Hyderabad, India
Newcastle International Airport, UK
Edinburgh Airport, UK
Birmingham International Airport, UK
Dublin International Airport, Ireland
Sabiha Gökçen International Airport, Turkey
Sydney Airport, Australia



Hangars - maintenance, repairs and overhaul



Heavy Maintenance Hangar, Cardiff International Airport, Wales, UK



A380 Hangar, London Heathrow Airport, UK

We have extensive international experience in the planning, design and commissioning of aircraft maintenance and painting hangars, for a wide range of civil and military aircraft. These vary from complex heavy maintenance facilities able to accommodate a range of both wide and narrow bodied aircraft, to facilities specifically designed for an operator's fleet.

Working closely with the client's management team we develop innovative integrated solutions which meet both the current operational needs and provide flexibility for future changes in the industry, all contained within strict budgetary control.

Our hangar expertise includes:

- Peer review services
- Site selection and assessment
- Masterplanning and feasibility studies
- Environmental management
- Civil and structural engineering design
- Building and operational services design
- Fire safety, site and operational security
- Acoustic control
- Refurbishment of existing facilities
- Cranes and teleplatforms
- Access docking systems
- Aircraft washing, stripping and painting
- Materials handling and automated storage systems
- ICT systems
- Procurement specification and assessment
- Monitoring the construction process
- Operational readiness

Selected projects

Aircraft Maintenance Hangars, Hamad International Airport, Doha, Qatar
Double-Bay A330 Maintenance Hangar, RAF Brize Norton, UK
British Airways Maintenance Base, London Heathrow Airport, UK
Turkish Airlines Multi-Bay Heavy Maintenance Centre, Sabiha Gökçen International Airport, Istanbul, Turkey
GAMCO Double-Bay Multi Stand Aircraft Hangar, Abu Dhabi International Airport, UAE
Lufthansa, Shannon Airport, Co Clare, Ireland
48-Bay Fast Jet Maintenance Facility, RAF St Athan, Wales, UK
Cargolifter Airship Hangar, Brand, Germany
Service Hangar Refurbishment, London Heathrow Airport, UK
British Airways A380 Hangar, London Heathrow Airport, UK
Korean Air Hangar, JFK International Airport, New York, USA



Test and training facilities



GE90 Aircraft Engine Test Cell Facility, Nantgarw, Wales, UK



GE90 Aircraft Engine Test Cell Facility, Nantgarw, Wales, UK



Virgin Blue Simulator Building, Brisbane Airport, Australia

We work with airlines, operators and manufacturers on the design of complex facilities required for the full power testing of engines, external running tests of aircraft and flight simulator test cells. Achieving the exacting performance criteria that are demanded for these facilities requires the integration and input of specialist designers working within the framework of the facility design.

We are unique in having within our organisation risk analysts, specialist acoustic engineers, fire engineers, vibration engineers, building environment control engineers and information technology specialists who work with the designated design team to ensure that the facility meets the performance criteria and operational readiness.

Our global experience in the design of airports, airport facilities and aircraft maintenance facilities enables us to advise clients on the most appropriate form and location of their test or training facility to meet both operational and business efficiency.

Our test and training skills include:

- Peer review services
- Masterplanning
- Environmental impact assessment
- Architectural and engineering design
- Structural and vibration integrity
- Acoustic control and measurement
- Building environment control
- Information collection and recording
- Fire safety systems
- Mechanical handling systems
- Risk assessment
- Equipment specification and assessment
- Project control and management
- Cost control and management
- Operational readiness

Selected projects

Turkish Airlines Heavy Maintenance Centre, Sabiha Gökçen International Airport, Istanbul, Turkey
Virgin Blue Simulator Building, Brisbane Airport, Australia
Dragon Airlines Headquarters, Hong Kong International Airport
Cathay Pacific Flight Training Centre, Hong Kong International Airport
GE90 Aircraft Engine Test Cell Facility, Nantgarw, Wales, UK
Acoustic Baffle, British Airways Ground Running Facility, Cardiff International Airport, UK



Airport cities



© SOM

Auckland Airport Business District, New Zealand



Airport Technopark, Sabiha Gökçen International Airport, Turkey



© Taoyuan County Government

Taiwan Taoyuan Aerotropolis

Airports are increasingly being seen as business destinations in their own right and as economic generators for the local and regional areas around them. We see office blocks, hotels, convention centres, medical facilities, free trade zones and entertainment areas being developed within or just beyond the airport perimeter.

Our expertise in the built environment enables us to deliver a total package for these airport city developments:

- Smart, sustainable city development
- Integrated transport planning
- Infrastructure improvement
- Economic planning
- Large scale urban planning.

These development planning skills, combined with our global aviation experience, enable us to create integrated solutions that align airport operational and commercial development objectives.

We have developed the “Smart, Green & Resilient” concept for our planning work on airport cities: a synthesised approach to energy, water, waste, communication, transport and building development. We place particular attention on mitigating carbon use through improved public transport (use of Automated People Movers) and multi-modal transportation links. We have also developed sophisticated acoustics consulting to provide appropriate zoning pathways around the airport.

Selected projects

Taiwan Taoyuan Aerotropolis
Beijing New Airport City, China
Hong Kong International Airport North Commercial District Masterplanning
Auckland Airport Business District, New Zealand
Warsaw Chopin Airport City, Poland
Istanbul Sabiha Gökçen Airport Techno-Park
Manchester Airport City Enterprise Zone
Hamad International Airport, Doha, Qatar
Mexico City International Airport



Strategic planning

- Airport planning
- Business planning
- Economic, employment,
community and urbanisation impacts
- Environmental consulting
- Noise impact
- Sustainability
- Technology strategy and planning
- Transaction advice



Airport planning



jetBlue Terminal 5, JFK International Airport, New York, USA



Venice Marco Polo Airport, Italy



Melbourne Airport, Australia

Our airport planners work with clients to solve today's demands and to anticipate future needs. We develop creative planning and operational solutions that balance traffic growth, evolving airline strategy and commercial demands with changing regulatory policy and competing land use and environmental requirements. We provide the professional skills needed to define the strategic, development, business and operational requirements for new airport facilities, as well as optimising the capacity and value of existing assets.

We employ a highly analytical approach to problem definition and solution development, based on an in-depth understanding of airport and airline operations and an appreciation of airports as commercial businesses and public assets. We deliver pragmatic solutions, directed to achieving projects that are affordable, buildable, operationally efficient and which minimise impact on the environment.

Whether working for small regional airports or the world's largest hubs, we apply the same high calibre of analysis, creativity and strategic thinking, focused on understanding and serving our clients' needs.

Our core airport planning skills include:

- Policy advice
- Traffic and demand forecasting
- Demand and capacity analysis
- Terminal, airfield and landside simulation modelling
- Facilities programming
- Terminal planning and conceptual design
- Airfield and apron planning
- Landside and surface access planning
- Support facility planning
- Civil and utilities planning

Selected projects

Brisbane Airport, Australia
Melbourne Airport, Australia
Sydney Airport, Australia
Terminal 1 and New Midfield Terminal, Abu Dhabi International Airport, UAE
Dubai International Airport, UAE
Hamad International Airport, Doha, Qatar
Terminal 1 Domestic Pier and International Departures Extension, Perth Airport, Australia
Development Plan, Montréal-Trudeau International Airport, Canada
Terminal 2, Dublin International Airport, Ireland
JetBlue Terminal 5 and 5i, JFK International Airport, New York, USA
New Terminal Development Plan, Lester B Pearson International Airport, Toronto, Canada
Delta Terminal 4, JFK International Airport, New York, USA
St John's International Airport, Newfoundland, Canada
Midfield Terminal, OR Tambo International Airport, Johannesburg, South Africa
Riga International Airport, Riga, Latvia
Vienna International Airport, Austria
Venice Marco Polo Airport, Italy
London Heathrow Airport, UK
London Gatwick Airport, UK
London Luton Airport, UK
Frankfurt Airport Vision 2020, Germany
Mactan-Cebu International Airport, Philippines

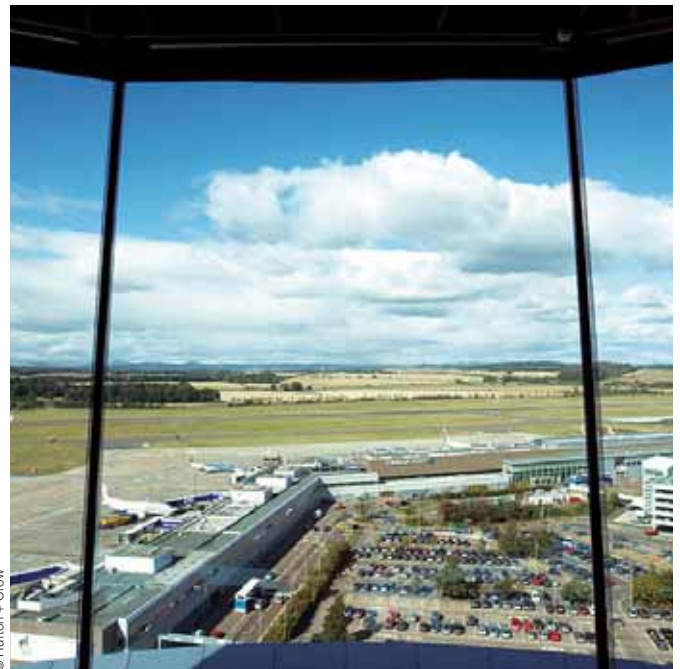


Business planning



© Mir

Istanbul New Airport, Turkey



© Hutton + Crow

Acquisition, Edinburgh International Airport, Scotland, UK

In both challenging and stable markets airport businesses require a road map to guide strategy and decision making. A robust, coherent and feasible business plan will enable airport owners to have a more defined view of the potential benefits, costs and drawbacks of certain business decisions or adoption of alternative business models. The business plan will clearly set out the primary objectives and goals of the business and encapsulate the strategies, decisions, timing and conditions required to deliver the plan.

We have prepared airport business plans for airport operators, investors and financial institutions. Through our profound knowledge and experience of airport commercial and technical operations coupled with wide experience of financial and strategic planning we offer a fully integrated business planning service. In collaboration with our technical experts in the design, operation and management of airports, we offer a wide appreciation of the financial, commercial and strategic drivers to establish robust, feasible and deliverable business plans for airports.

Our airport business planning skills include:

Market analysis:

- Market/industry characteristics analysis, competitor assessment, trend analysis, demand forecasting, regulatory reviews, demographic assessment, macro-economic analysis, benchmarking

Commercial and operational planning:

- Commercial strategy, organisational structure assessment, operating strategy (in-sourcing/out-sourcing), infrastructure and masterplanning, technical feasibility, regulatory reviews

Financial Planning:

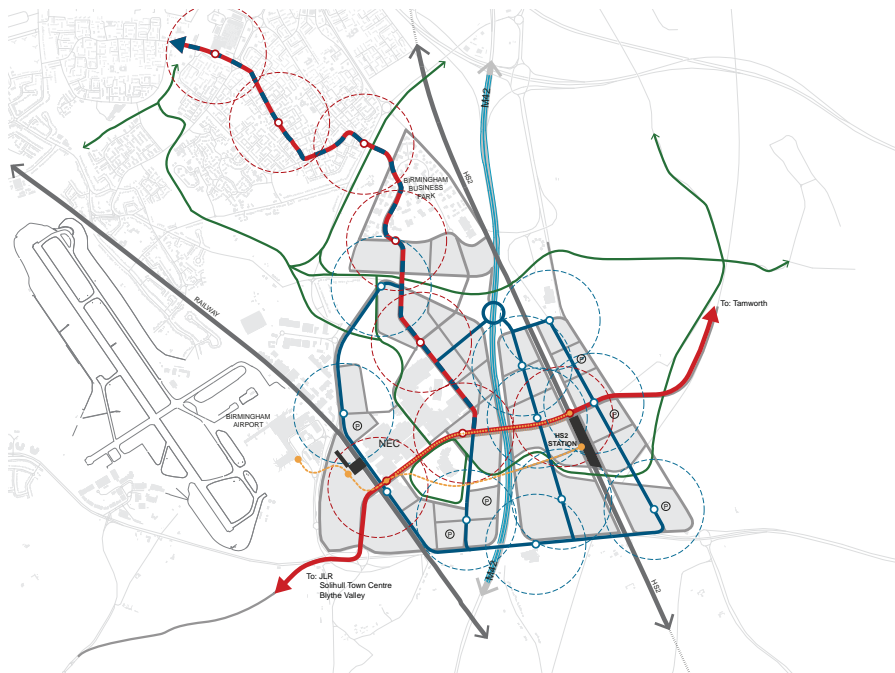
- Corporate finance, financial feasibility studies, financial modelling and appraisal, revenue and cost forecasting, cash-flow analysis, capital investment, life-cycle costing analysis, business case appraisal

Selected projects

Istanbul New Airport, Turkey
Kansai International Airport, Japan
Luanda International Airport, Angola
Business Plan Review, Lelystad Airport, Netherlands
Lekki-Epe International Airport, Nigeria
Air Services Feasibility, Skye Airport, UK
Acquisition, London Stansted Airport, UK
Acquisition, Edinburgh Airport, Scotland, UK
Business Plan Review, Domodedovo International Airport, Moscow, Russia
Mexico City International Airport
TAV Group Acquisition
Air Baltic Terminal Feasibility, Riga International Airport, Latvia
Galway Airport, Ireland
Airport Privatisation, Notre Dame des Landes Airport, Nantes, France
Valuation, Osabi Airport, Nigeria



Economic, employment, community and urbanisation impacts



M42 Economic Gateway, Birmingham, UK



Sabiha Gökçen International Airport, Istanbul, Turkey



Warsaw Chopin Airport, Poland

Our economic and planning specialists have substantial experience in assessing the social and economic impact of airport development, and how the potential positive effects can be maximised. We also have experience in understanding how airport development fits with local, regional and national planning policy and strategies and how this can best be communicated to stakeholders and the general public.

Through integration with other technical disciplines within Arup, we are able to provide a transparent, yet analytical and robust assessment, at a range of spatial levels.

Airports have varied and complex impact on their surroundings. They are a major direct employer, with often significant (on and off-site) indirect employment through contracted and supplier organisations. In turn this workforce presents additional economic growth as purchasers of goods and services (induced benefits). In addition, airports provide connectivity for businesses attracted by the prospect of airport service (catalytic employment).

We can devise planning frameworks to provide capacity for these impacts and deliver solutions that are sensitive to both local communities and wider political and societal objectives.

Our core skills encompass:

- Providing policy advice on the scope for airport development and obtaining necessary planning consents
- Forecasting direct, induced and catalytic impacts of airport development
- Assessing community and social effects
- Providing land use and economic development strategies to maximise the benefits of off-site impacts
- Engaging with relevant planning policy making processes to ensure that associated land use and economic strategies are incorporated in relevant plans
- Engaging with relevant stakeholders

Selected projects

Socio-Economic Impact, London Southend Airport, UK
 Current Operation and Relocation Scenarios, Cambridge City Airport, UK
 Land-use and Urbanisation Study, London Heathrow Airport, UK
 Economic Impact of Expansion, Norwich International Airport, UK
 Proposed Airport Economic Study, Cliffe Marshes, Kent, UK
 Land-use and Capacity Studies, Edinburgh & Glasgow Airports, UK
 Future of Air Transport in Scotland, for the UK Government
 Warsaw Chopin Airport, Poland
 Sabiha Gökçen International Airport, Istanbul, Turkey



Environmental consulting



Environmental Due Diligence, Osaka and Kansai Airports, Japan



London Stansted Airport, UK

We are a leading provider of comprehensive environmental consultancy services to the global aviation industry. Airport development projects are routinely subject to close scrutiny by statutory authorities, local communities and other stakeholders due to potential environmental concerns.

We are leaders in innovative cost-effective environmental design, assessment and mitigation. Our specialists drive the planning and engagement with statutory bodies and community consultation using our leading edge tools to interpret and communicate complex principles to a non-technical audience.

We have proven capability and experience to help airport operators, airlines and other stakeholders through the planning, design, construction and operation of new airports, airport cities, surface access and the management of existing facilities.

Our environmental assessment, mitigation and management skills include:

- Leadership of environmental design, planning, assessment and management process
- Environmental, sustainability, transport and health impact assessment
- Noise and vibration modelling and demonstration via Arup SoundLab
- Air quality modelling, greenhouse gas assessment and carbon footprinting
- Community effects and socio-economic assessment
- Energy and carbon management
- Environmental economic evaluations and ecosystem services assessments
- Landscape design and visual assessment
- Ecological survey, biodiversity and habitat assessment and management
- Water resource management
- Contaminated land and waste management
- Archaeology and heritage assessments
- Third party risk, safety zoning, vortex shedding and bird strike
- Corporate environmental and sustainability strategy
- Environmental management systems
- Construction environmental management
- Environmental due diligence studies
- Animated graphics, 3D visualisations and photomontages

Selected projects

Air Quality Studies, Runway 3 EIA/HIA, Hong Kong International Airport

Environmental & Climate Strategies, Melbourne Airport, Australia

Environmental Due Diligence, Kuwait International Airport

Runway 3 Project EIA Studies, London Heathrow Airport, UK

New Parallel Runway EIA, Brisbane Airport, Australia

North Terminal Extension EIA, London Gatwick Airport, UK

Environmental Due Diligence, Osaka and Kansai Airports, Japan

Generation 2 Second Runway Project EIA, London Stansted Airport, UK

Qantas 3-Bay A380 Maintenance Hanger EIA, Sydney Airport, Australia

Airport Optimisation EIA, London Luton Airport, UK

Terminal 2 EIA, Dublin International Airport, Ireland

Sustainability Appraisal of Masterplan, Leeds-Bradford International Airport, UK

Environmental, Land Use and Capacity Studies EIA, Glasgow and Edinburgh Airports, UK

Airport Sustainability Practices Research for TRB, USA

Aircraft Noise Simulation, Hyatt Aerocity, New Delhi, India



Noise impact



British Airways A380 Project, London Heathrow Airport, UK



Arup SoundLabs



Birmingham International Airport, UK

Aviation growth creates pressure to expand existing facilities and to build new airports. There is therefore a need to quantify potential environmental impacts, in particular assessing changes to the noise environment in the vicinity of airports and aircraft routes.

Our wide experience in the environmental assessment of aviation noise, combined with the use of internationally accepted noise prediction models, enables us to assess impacts at both local and regional levels.

We consider all sources of aviation noise and demonstrate how these will change the pattern of local noise exposure. This includes the taxiing and flight noise of aircraft operations, the sources of ground power to aircraft and changes to the traffic patterns within the airport boundaries and surrounding infrastructure. Consideration is also given to surface access noise by way of road traffic and railway noise. These effects are categorised and weighed against the effects of other environmental as well as operational and financial factors.

We use sophisticated GIS techniques to present and analyse noise exposure information which can be coordinated with web-based consultation exercises. We can also employ Arup Soundlab and other auralisation techniques to present combined video and audio demonstration to stakeholders and the general public.

Our noise impact skills include:

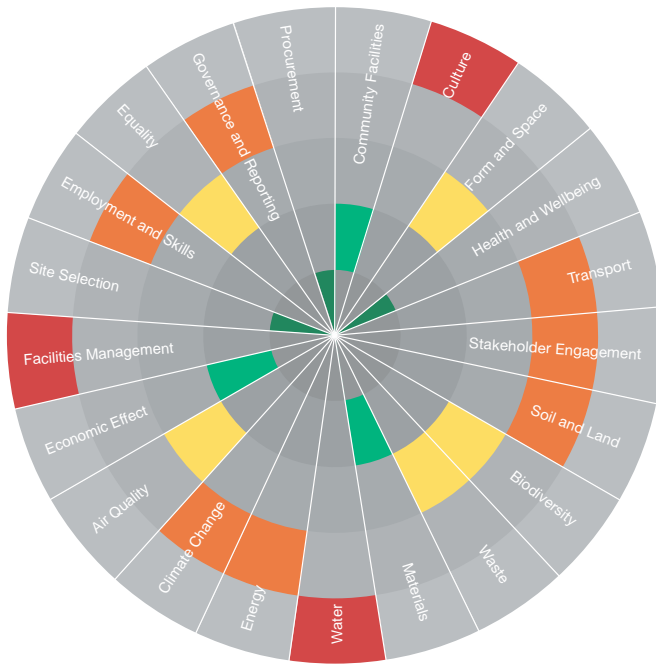
- High level understanding of aviation noise policy and legislation
- Consideration of the aviation inputs into noise exposure pattern production
- Optimisation of flight path and operational parameters in relation to land use planning
- The building and running of airport noise models
- Measurement of ambient noise levels around existing airports
- The assessment of changes in noise exposure against local regional and national guidance
- The preparation of formal environmental statements
- Consultation and stakeholder management

Selected projects

- A380 Ground Running Pens Relocation, London Heathrow Airport, UK
- Airport Masterplanning and Noise Contours, Hobart International Airport, Australia
- Glasgow City Heliport Relocation, UK
- Impact of Runway Extension, Birmingham International Airport, UK
- New Terminal EIA, Cambridge City Airport, UK
- British Airways Ground Running Facility, Cardiff International Airport, UK



Sustainability



We can work with existing framework to ensure compliance against existing framework, and to identify opportunities for further enhancement. Alternatively, Arup's in-house tool, SPeAR® (Sustainable Project Appraisal Routine) enables airport operators, manufacturers and airlines to assess performance against recognised international sustainability indicators. It is a flexible approach that allows the interaction between environmental, economic, social and natural resource issues to be studied and tracked within the design and development process.

SPeAR® can be successfully applied to all forms of projects; including design and delivery of new infrastructure, masterplans and individual buildings, and can be used to monitor and evaluate project performance and support informed decision making throughout the project life cycle. Early on in a project it will have the greatest value and it might be used to carry out a baseline appraisal, gap analysis or identify key performance indicators.

SPeAR®

The challenges facing the aviation sector are clear: meeting the rising demand for travel, developing airports and airline operations on a global scale whilst addressing carbon emissions and effects on climate change. The pressures for competition and economically viable operations are also acute: differentiation and a superb passenger experience are key to ensuring long-term prosperity and growth, requiring solutions that are environmentally-sound and grounded in economic realities.

We have the global experience and expertise to help airport operators and airlines balance the key elements of sustainable development at a corporate, project development and operational level. We bring the best of global experience to develop holistic, innovative and sustainable solutions for the aviation sector.

Our objective and pragmatic approach to sustainability adds value in many ways. This includes reputational management and delivery of cost-effective option analyses, design and operational parameters that contribute to and enhance environmentally and socially sustainable development.

Our integrated skills include:

- Corporate sustainability strategy
- Sustainability appraisal
- Sustainable airport planning/building design
- Project certification (LEED, BREEAM, ISCA, WELL)
- User experience design
- Smart technologies and data insights
- Optimising the systems and energy use
- Carbon management
- Community consultation
- Noise management
- Biodiversity management
- Sustainable construction
- Water resource management
- Waste and spoil management, minimisation strategies and recycling

Selected projects

Terminals 3, 4 and 5 Q6 Study, London Heathrow, UK
 Kuwait International Airport
 Noise Management Strategy, Auckland Airport, New Zealand
 Terminal 2, Dublin International Airport, Ireland
 Mexico City International Airport
 Portland International Airport, Oregon, USA
 Melbourne Airport, Australia
 San Diego County Regional Airport Authority, USA
 New Midfield Concourse, Hong Kong International Airport
 Terminal 3, Shenzhen Bo'an International Airport, China



Technology strategy and planning



© David J Osborn/LHR Airports Limited

London Heathrow Airport, UK



© NATS

National Air Traffic Services



©Eduard Heuber

Terminal 4, JFK International Airport, New York, USA

Our IT and Communications practice offers consulting services to solve complex technology related challenges across the business and project lifecycle from strategy to design and into operations. We are uniquely placed through our strong domain knowledge in key market sectors and deep understanding of the aviation business, the physical and virtual environment in which it works and the technology trends and the challenges that exist.

Our independence allows us to look for the most appropriate technology solution from improving security, reliability, operational efficiency and the passenger experience to generating revenue and reducing whole lifecycle costs. Our global experience allows us to develop innovative technical design and management services through cross market and cross country lessons learnt and detailed knowledge of the most challenging problems facing the industry.

We understand that the deployment of a solution will only be successful if the business it is deployed in understands the benefits gained and is engaged and bought into the process. Our knowledge and skills in integrating the people who use the solutions, the processes they follow and the technology deployed in the physical or virtual environment sets us apart from many of our competitors.

Our technology strategy and planning skills include:

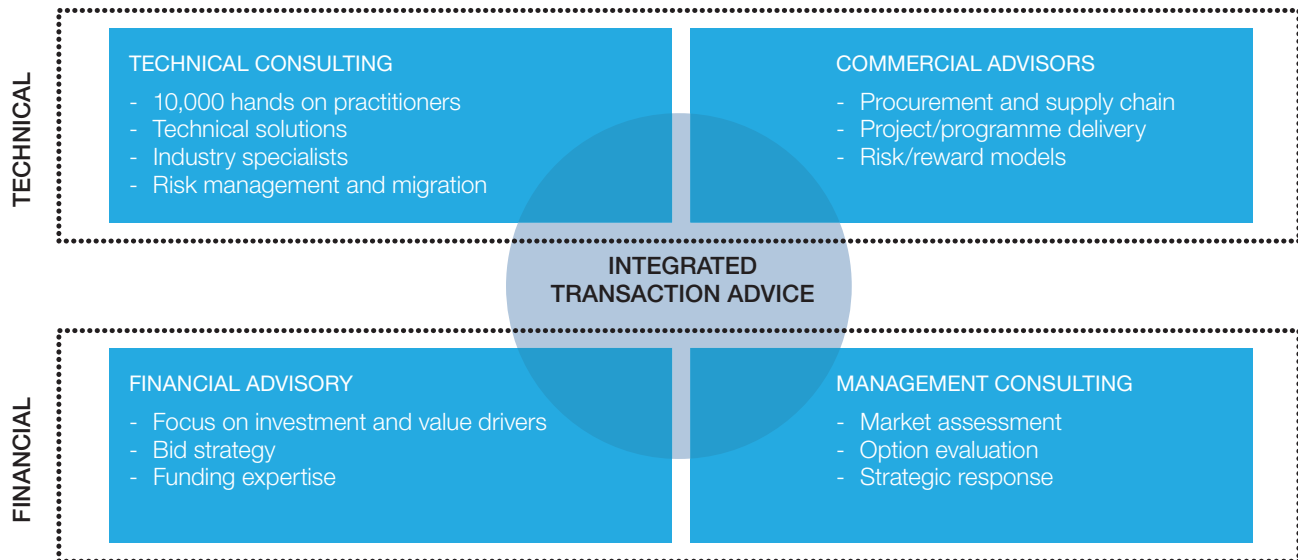
- Strategy, governance, organisation and planning
- IT Programme and project management
- Stakeholder engagement
- Smart mobility
- Technology strategy, design, integration and assurance
- Operational performance improvement
- Passenger processing systems
- Airport operational systems
- Control room integration
- Baggage IT systems
- Communications infrastructure systems
- Security systems
- Building control systems
- Retail IT systems

Selected projects

Dubai International Airport, UAE
London Heathrow Airport, UK
National Air Traffic Services, UK
Hamad International Airport, Doha, Qatar
Terminal 4, JFK International Airport, New York, USA



Transaction advice



Our dedicated transaction advisory team specialises in the provision of business and corporate finance advice in relation to the privatisation, acquisition and sale of airports. We undertake business feasibility, planning, and due diligence studies on behalf of governments, airport owners and financial institutions.

As an integrated aviation strategy service provider, we seek to combine the primary airport business model workstreams of traffic forecasting, commercial and operational strategy, and infrastructure appraisal and asset management, to deliver holistic advice to our clients. In collaboration with our technical experts in the design, operation and management of airports, we offer a wide appreciation of the financial, commercial and strategic drivers to bring real value for potential vendors and buyers of airport assets.

Our airport transaction advisory skills include:

Commercial and technical due diligence

- Traffic forecasting
- Commercial strategy
- Operational strategy
- Capital investment strategy

Corporate finance

- Commercial structuring and negotiation
- Financial and funding models
- Deal valuation, financial business case/investment case
- Fundraising/assisting funding competitions

Strategy and economics

- Market analysis
- Policy and regulatory advice
- Feasibility studies, pricing and incentive regimes
- Cost benefit analysis

Selected projects

Cusco Airport PPP
 Greek Regional Privatisation
 Brazilian Airports
 Kansai and Itami Airports, Japan
 Mexico City Airport
 Chicago Midway PPP, USA
 Luanda Airport, Angola
 Abertis Airports Sale
 Myanmar Airport PPP
 London Stansted Airport, UK
 ANA Airport Privatisation, Japan
 Istanbul New Airport, Turkey
 Luis Muñoz Marín International Airport, San Juan, Puerto Rico
 Lekki-Epe International Airport, Nigeria
 Edinburgh Airport, Scotland
 TAV Group, Turkey
 AENA Privatisation
 Hochtief Airports Sale





Programme delivery

- Acoustic design of airport facilities
- Airfield ground lighting and aircraft parking aids
- Airport logistics
- Automated People Movers
- Baggage handling systems
- Commissioning
- Design team leadership
- Energy management
- Fire safety
- Information and communications technology systems
- Lighting design
- Modelling and simulation
- Passenger terminal planning
- Programme and project management
- Resource and waste management
- Security
- Surface access



Acoustic design of airport facilities



© Ian Bruce Photography

Dublin International Airport, Ireland



© Kohn Pedersen Fox Associates

Midfield Terminal, Abu Dhabi International Airport, UAE

We have experience in the acoustic design of airport facilities around the world. This includes the design of terminal buildings, control towers, transport interchanges, below and above ground rail facilities, workshops, visual control rooms, interview facilities and passenger lounge facilities.

Understanding the needs of the users is central to our acoustic design philosophy. This allows us to set realistic and pragmatic design criteria, which achieves appropriate acoustic control within budgetary and legislative constraints. We are world leaders in the field of auralisation which allows clients to experience acoustic conditions during the design process. This allows an understanding of the acoustic issues first hand by listening in our specialist SoundLab facilities.

We deliver risk-based solutions, which reflect a full understanding of aviation and operational security and the safety requirements of airports, which respond to a dynamic regulatory and operational environment.

Our acoustic design skills include:

- Sound insulation for building envelope
- Internal room acoustic design and control of ambient sound levels
- Public address and voice alarm design
- Control of noise and vibration from mechanical and electrical systems, including baggage handling, ventilation systems, horizontal and vertical transportation
- Prediction of noise and vibration from light and heavy rail systems
- Internal sound insulation for sensitive spaces (interview rooms, management offices etc)

Selected projects

Midfield Terminal, Abu Dhabi International Airport, UAE
Terminal 2, Dublin International Airport, Ireland
Washington Dulles International Airport, USA
Terminal 5 and Control Tower, London Heathrow Airport, UK
Terminal 3, Beijing Capital International Airport, China
Hong Kong International Airport
Lester B Pearson International Airport, Toronto, Canada
Terminal 1, Manchester Airport, UK
Zurich Airport, Switzerland
Kansai International Airport, Osaka, Japan
Kuwait International Airport
Baggage Reclaim Hall Expansion, Terminal 4, London Heathrow Airport, UK
Noise Strategy and Management Plan, Auckland Airport, New Zealand
Delta JFK-IAT Redevelopment, Terminal 4 JFK International Airport, New York, USA



Airfield ground lighting and aircraft parking aids



Leeds Bradford International Airport, UK



Sydney Airport, Australia

Our airfield ground lighting experts have worldwide experience in the assessment and design of airfield lighting systems for both civil and military airports. Through our international experience our designers are fully conversant with the national and international standards which govern the design of ground lighting systems for all airport types wherever located.

Aeronautical ground lighting is defined as 'any light especially provided as an aid to air navigation, other than a light displayed on an aircraft'. The challenge is to meet the ever increasing aircraft speeds and the global increase in air traffic with secure and safe systems. With integrated design and by developing analytical and simulation models, our experts meet these challenges by producing tailored designs for new airports or the upgrading of existing facilities so as to minimise disruption to the existing airport operations.

In cooperation with our civil, pavement and aircraft support engineering experts we also offer an integrated service for airside infrastructure.

Our core skills include:

- Approach lighting
- Supplementary approach lighting
- Threshold lighting
- Touchdown lighting
- Runway lighting
- Taxiway lighting
- Signage
- Obstacle lighting
- Lighting control systems
- Apron/stand lighting
- Airfield docking guidance systems

Selected projects

High Intensity Approach Lighting, Sydney Airport, Australia
Taxiway Lighting, London Heathrow, UK
Taxiway and Stand Lighting, London Gatwick, UK
London Luton Airport, UK
Sabiha Gökçen International Airport, Istanbul, Turkey
Runway Approach, RAF Scampton, UK
Taxiway works, RAF Marham, UK
Terminal 2, Dublin International Airport, Ireland
Athens International Airport, Greece
Western Taxiway Repair, RAF Waddington, UK
Southside Apron Works, Newcastle International Airport, UK
Leeds Bradford International Airport, UK
Chongqing Jiangbei International Airport, China
Birmingham International Airport, UK



Airport logistics



Terminal 3, Shenzhen Airport, China



© Eduard Heuber

JFK International Airport, New York, USA

We possess one of the largest and most experienced airport facilities planning, design and logistics practices in the world. The movement of goods, materials and equipment within and around the passenger terminal is fundamental to effective terminal operations and to the passenger experience. We develop efficient and effective logistics strategies for retail, servicing, trolleys and ground support equipment, which inform the planning, design and operation of airport infrastructure.

With passenger movements increasing, there is a growing trend in the development of retail facilities within airport terminals. This increase in retail space, brings with it challenges in goods delivery, storage and distribution. Servicing strategies need to incorporate the movement of all types of products including waste, maintenance equipment, airport and airline supplies throughout the airport.

We design solutions for baggage trolley movements, storage, and replenishment through the forecasting of baggage trolley requirements. We plan sufficient storage and parking areas for ground support equipment to deliver an operationally efficient solution.

Our airport logistics services include:

- Feasibility studies
- Conceptual design
- Strategic planning
- Trolley logistics
- Retail goods movement
- Goods lift studies
- Waste servicing strategies
- Service yard design
- Product specification for automation
- Baggage handling

Selected projects

Dublin International Airport, Ireland
Abu Dhabi International Airport, UAE
New Lisbon International Airport, Portugal
Kuwait International Airport
Perth Airport, Australia
Beijing Capital International Airport, China
Istanbul New Airport, Turkey
BA world cargo, London Heathrow, UK
New Terminal Logistics Strategy, JFK International Airport, New York, USA
London Heathrow Airport, UK
Cargo Handling and security, Rome Airport, Italy
Consolidation Centre Study, Montreal-Trudeau International Airport, Canada



Automated People Movers (APM)



London Heathrow Airport, UK



Hong Kong International Airport

We are a world leader in the planning and design of passenger transport systems and have experience of the development of innovative Automated People Mover (APM) and Personal Rapid Transit (PRT) systems for airports and other major infrastructure developments.

Our specialist skills in railway engineering, airport planning, urban and transportation planning, fire engineering, acoustic and vibration design, environmental impact assessment and communications enables us to provide an holistic approach to the solution of each project.

Our service ensures that client needs are met to cost and time and add value through technical excellence, innovation and efficient organisation.

Our specialised APM consultancy services include:

- Feasibility studies
- Alignment planning and design
- Passenger flow/ridership studies
- Simulation and modelling analysis
- Multi-disciplinary engineering
- Station planning and architecture
- Railway systems engineering
- Specification and procurement
- Project management and supervision
- Acceptance testing, start-up and reliability monitoring

Selected projects

Personal Rapid Transit System, London Heathrow Airport, UK
Sky Plaza, Terminal 2, Hong Kong International Airport
Planning and Design, Suvarnabhumi International Airport, Bangkok, Thailand
Automated People Mover System, Birmingham International Airport, UK
Venice Marco Polo Airport, Italy
San Jose Automated Transit Network Feasibility, California, USA
Abu Dhabi International Airport, UAE



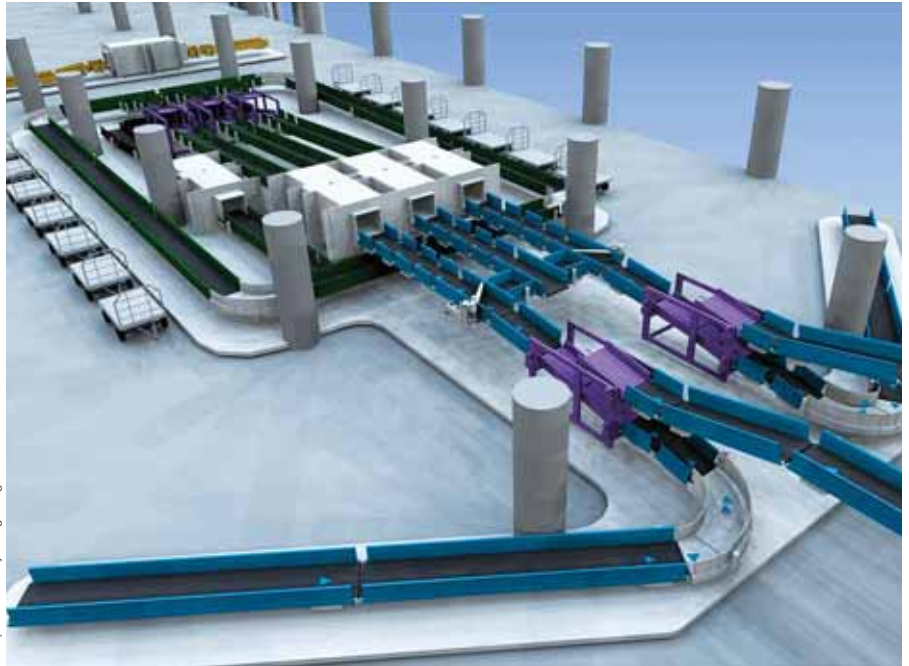
Baggage handling systems



Liverpool John Lennon Airport, UK



Dublin International Airport, Ireland



Midfield Terminal, Hong Kong International Airport

We provide an independent and integrated service for the development of airport automation solutions covering baggage, cargo and package handling. Our teams have experience from concept development to final commissioning on projects ranging from small regional airports to large international hubs.

Baggage handling is central to the success and efficiency of airport operations. With a team of experts drawn from airlines, airports and system suppliers, we are able to provide an independent and pragmatic approach to planning, design and implementation of systems and operations. We are uniquely able to achieve baggage solutions, fully integrated and coordinated with passenger processes and IT systems with terminal and airside infrastructure, be they for new facilities or upgrade of existing installations.

We have practical experience of the application of both established and emerging technologies, including X-ray and CT based in-line checked baggage screening, destination coded vehicles and tray systems, and RFID.

Our baggage systems skills include:

- Demand and capacity analysis
- Operations analysis and performance improvement
- Service level development and measurement
- Facilities planning
- Baggage and cargo handling system design
- Controls system design and integration management
- System and operations simulation
- Implementation planning and phasing
- Tender documentation and procurement support
- Commissioning

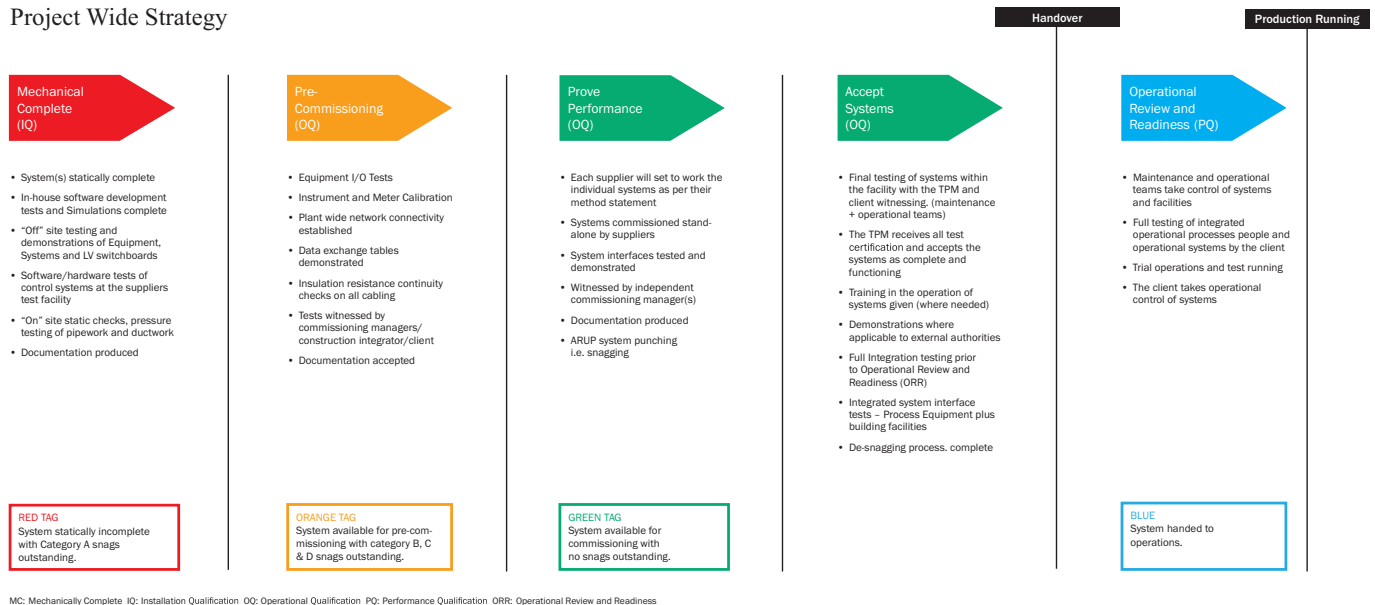
Selected projects

Hong Kong International Airport
Terminal 2, Dublin International Airport, Ireland
Terminal 1 Extension, Kempegowda International Airport, Bangalore, India
Rajiv Gandhi International Airport, Hyderabad, India
Melbourne Airport, Australia
Perth Airport, Australia
Transfer Operations, Abu Dhabi International Airport, UAE
Seattle-Tacoma International Airport, Seattle, USA
Terminal 2, Antalya Airport, Turkey
Kuwait International Airport
Liverpool John Lennon Airport, UK
Chopin Airport, Warsaw, Poland
Hold Baggage Screening Replacement, Manchester Airport, UK
London Heathrow Airport, UK



Commissioning

Project Wide Strategy



Commissioning is a systematic process of ensuring that new building systems perform interactively according to the documented design intent and the owner's operational needs, and that specified system documentation and training are provided to the facility staff.

Our Commissioning experts advise airport operators on how to provide the best possible environment for the users of their buildings and facilities, by designing and improving operational efficiency of their plant and service control systems.

These experts bring their knowledge, experience and leadership to the Commissioning process ensuring that all of the key elements are captured by early stage planning and continuous control, monitoring and tracking of the activity.

Integrated Delivery Management (IDM)

As an integral part of our Project Delivery services we have developed the concept of Integrated Delivery Management (IDM), where system design, installation and commissioning are merged into one system delivery. We encourage integrated design at an early stage by developing an understanding of "Design for Delivery", to avoid some of the errors caused by poor coordination and integration of disciplines and of how to encourage people to consider buildability and commissionability within the design process.

IDM starts once the design has been completed and finishes when the plant or building is operational. We understand and can provide the competencies required to manage the IDM process - design reviews, resident engineers, test and commissioning, validation, ORAT (Operational Readiness Activation Transition) etc.

Our commissioning skills include:

- Improving future flexibility by specifying open system technologies
- Airport operational systems and communications infrastructure specialists
- Commissioning and operational readiness management

Selected projects

Terminal 2, Dublin International Airport, Ireland
 Terminal 3, Beijing Capital International Airport, China
 Terminal 5, London Heathrow Airport, UK
 HACTL Super Terminal 1, Hong Kong International Airport
 Lester B Pearson International Airport, Toronto, Canada
 JetBlue Terminal 5, JFK International Airport, New York, USA
 Terminal 3, Dubai International Airport, UAE
 Delta JFK-IAT Redevelopment, JFK International Airport, New York, USA

Design team leadership



JetBlue Terminal 5, JFK International Airport, New York, USA

The design of airport facilities requires the intellectual input and integration of many distinct planning and design disciplines and technical specialists. With our breadth of aviation experience and capability, together with our inherent multidisciplinary design approach, we are well suited to take on the role of 'Design Team Leadership' on airport projects.

Our design team leaders direct, channel and focus the creative force of all design disciplines to successfully deliver the project. We act as lead consultant, leading projects from inception to completion. We employ sub-consultants to work with us and to deliver integrated design solutions.

Whilst the design team leader role does not take away from the individual designers' responsibility to create and document the design, it does provide oversight, leadership and a point of focus for the wider team and the client.

Our skills as design team leader include:

Design direction

- Establishing client goals and aspirations
- Directing the multi-disciplinary design team
- Holding the project design vision

Design review

- Facilitating design team and client design meetings
- Ensuring holistic design concepts
- Removing roadblocks within the design team

Design team management

- Managing the design team programme
- Overseeing client and stakeholder input
- Coordinating design information

Design value

- Understanding the project budget and client key priorities
- Aligning cost and design
- Design led value management

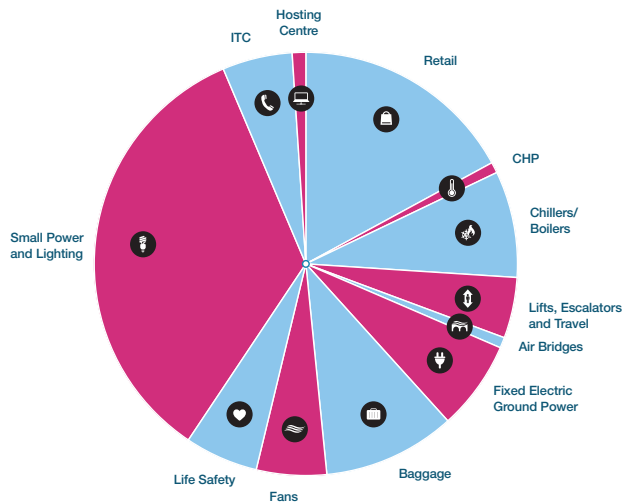
Selected projects

Terminal 2, Dublin International Airport, Ireland
Terminal 5, London Heathrow Airport, UK
Midfield Terminal, OR Tambo International Airport, Johannesburg, South Africa
JetBlue Terminal 5, JFK International Airport, New York, USA
Development Strategy, London Heathrow Airport, UK
Q6 Programme Design, London Heathrow Airport, UK
Istanbul New Airport, Turkey

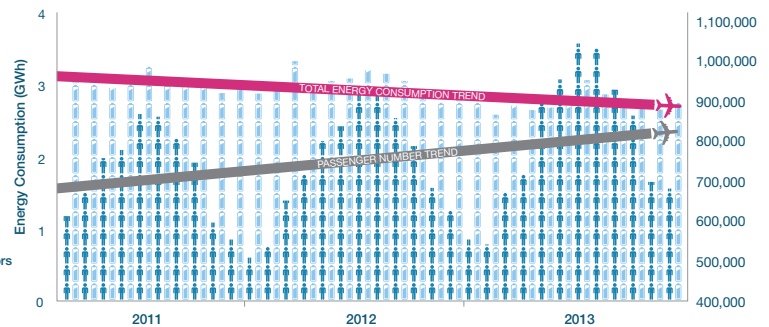


Energy management

POWER CONSUMPTION PROFILE/BY SYSTEM



POWER CONSUMPTION



Note: Year on year reduction in energy consumption despite growth in passenger numbers. This is contrary to what would normally be expected but has been possible via continuous improvement, challenging user set points/norms and refining the building controls.

We have an abundance of detailed design experience gathered from major airport developments around the world. As part of our work we have been collecting measured airport data of both utilities consumption and from energy sub metering systems from our projects.

This detailed experience, backed up by extensive hard data, enables us to understand in detail how energy is actually consumed within an airport development and to establish realistic energy models and utilities requirements for new projects going forward.

Our experience in the design and operation of airports enables us to challenge wasteful and conservative approaches and offer quantified savings based on specific change proposals. Costly and wasteful overdesign can be common place in airport developments as a result from the application of inappropriate local design codes, a lack of understanding of the diversities that can and should be applied to the various different airport systems or inadequate understanding of the technologies and opportunities generally.

Basing our design on sound, appropriate and added value assumptions, we use this wealth of data and knowledge to offer our clients new and better services.

Our energy management services include:

- Determining energy baseline for an airport development
- Setting targets for reduction via quantified energy saving proposals
- Identifying energy saving investments through our understanding of how, when and where energy is actually consumed within the site
- Detailed understanding of minimum, maximum and daily fluctuation of the loads for each of the differing airport systems, enabling us to estimate and predict energy consumption profiles more accurately
- Bottom up annual utilities consumption estimates and Opex advice follows from our energy modelling and our measured data
- Assisting clients with the review of and redefining the user configuration of their various different building control systems

Selected projects

Istanbul New Airport, Turkey
 Dublin International Airport, Ireland
 Manchester Airport City, UK
 London Heathrow Airport, UK
 Massport Energy Efficiency Initiatives, Boston, Massachusetts USA
 Landmark Aviation Fixed Base Operations, San Diego International Airport, USA
 Los Angeles World Airports Sustainability Masterplanning and Design and Construction Handbook Policy, Los Angeles, USA



Fire safety



Fire test and performance solution 3, British Airways Heavy Maintenance Hangar, Cardiff International Airport, Wales, UK



Fire Test, HACTL Super Terminal 1, Hong Kong International Airport



Shenzhen Bao'an International Airport, China

Our international team of specialists have provided fire safety consultancy on a global basis for over 30 years. We uniquely understand design, construction, operational readiness, handover and operation.

The adoption of traditional prescriptive design measures to airport facilities, given their scale and functional design requirements, can be prohibitive in terms of aesthetic flair, innovation, cost and operational constraints. Airport terminals need a holistic fire engineering strategy that facilitates security requirements, passenger segregation and business continuity measures whilst maintaining acceptable levels of life safety.

Our integrated project design teams use advanced analytical and simulation techniques, balanced with practical understanding of user experience, local codes and requirements, to develop innovative fire safety solutions. We achieve functional and architectural objectives while significantly reducing capital costs, lowering business and operational risks and improving life safety and security.

Communication and liaison between operational and design teams is fundamental to ensuring the design responds to specific operational needs. This engagement should occur at inception, through design, construction and handover.

Our fire safety skills include:

- Comprehensive yet understandable fire strategies
- Consideration of human behaviour and experience from the outset
- Performance-based design and analysis
- Project specific hazard and risk assessment
- Advanced fire, smoke, structural and evacuation modelling
- Design and analysis of fire protection systems
- Specification of project fire tests
- Safely extended escape distances and times
- On site fire safety inspections, commissioning assistance as well as integrated acceptance testing
- Fire safety management, client/end user liaison and operational readiness

Selected projects

Terminal 2, Dublin Airport, Ireland
Terminal 5, London Heathrow Airport, UK
Terminal 3, Shenzhen Bao'an International Airport, China
Phase 2, Pudong International Airport, Shanghai, China
Terminal 3, Beijing Capital International Airport, China
Hong Kong International Airport
HACTL Cargo Handling Facility, Hong Kong International Airport
Kunming Xiaoshao International Airport, China
Barcelona International Airport, Spain
Dallas Fort Worth International Airport, Texas, USA
Delta JFK-IAT Redevelopment, Terminal 4 JFK International Airport, New York, USA
Kuala Lumpur International Airport, Selangor, Malaysia
Brisbane Airport, Domestic Terminal Expansion, Australia
Perth Airport Terminal 1 Arrivals and Departures Extension, Australia
Rajiv Gandhi International Airport, Hyderabad, India
King Abdulaziz International Airport, Jeddah, Saudi Arabia
Schiphol Airport, Amsterdam, Netherlands
Fire strategy and statutory approvals, Abu Dhabi International Airport, UAE



Information and communications technology systems



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London Heathrow Airport, UK



© Nic Lehoux/Gensler

JetBlue Terminal 5, JFK International Airport, New York, USA

Our Information and Communications Technology (ICT) consultants provide a fully integrated service tailored to meet the airport and airline business and technical needs. Our understanding of the business operation, transformational change and the challenges associated with major construction enables us to undertake an holistic approach to the integration of complex technologies into the building and business process. Our comprehension of an airport's operational needs, airline and control authority requirements and passenger wellbeing, enables us to offer efficient, cost effective solutions, which add value to the airport experience through increasing revenue, reducing cost, minimising risk and improving the passenger experience.

We meet the airport operator's needs for efficient and cost effective operations by designing and specifying technology that enables fast flow through check-in and security. We optimise the use of boarding gates, air bridges and airside facilities. Efficient call to gate systems reduces passenger anxiety and maximises dwell time in retail and catering, thereby enhancing non-aviation revenue.

We also work with our clients to look at commercialising the IT assets as well as helping our clients define and clearly scope projects at the front end of the project lifecycle that will meet the requirements of the business.

Our information and communications technology skills include:

- Strategic ICT masterplanning
- Business analysts, requirements and development management
- Economic, commercial and financial consultancy
- IT Portfolio, Programme and Project Management
- Change Management and Stakeholder Engagement
- Systems design and procurement advice
- Operations centre design
- Master systems integration planning and management
- Airport operational systems and communications infrastructure specialists
- Technical assurance, commissioning and operational readiness management

Selected projects

London Heathrow Airport, UK
Terminal 2, Dublin International Airport, Ireland
Terminal 3, Dubai International Airport, UAE
Hamad International Airport, Doha, Qatar
Terminal 2, Mumbai International Airport Limited, India
Sky Plaza, Terminal 2, Hong Kong International Airport
Terminal 3, Beijing Capital International Airport, China
Lester B Pearson International Airport, Toronto, Canada
Terminal 1-8, Los Angeles International Airport, USA
Terminal 3, McCarran International Airport, Las Vegas, USA
JetBlue Terminal 5, JFK International Airport, New York, USA
Delta Terminal 4, JFK International Airport, NY, USA
ITC Masterplan, Abu Dhabi International Airport, UAE
Julius Nyerere International Airport, Dar es Salaam, Tanzania



Lighting design



Beijing Capital International Airport, China



Dublin International Airport, Ireland



Sacramento International Airport, California, USA

In skilled hands, lighting becomes the fourth dimension of architecture, integrating and enhancing other design disciplines. We offer a comprehensive lighting design service, from initial strategic advice and concept development through to construction documents and on-site support for all markets worldwide.

The creation of authentic, memorable experiences through light can be the most powerful and cost effective tool to establish a top position in the passengers' mindset. Lighting defines the experience and environment through which the staff and passengers will move, whether they are at the start or the end of their journey, passing through retail areas, or going to work.

Engaging our strategic lighting approach prior to any airport expansion or refurbishment programme ensures a sustainable outcome. Our designers have extensive skills and experience in providing an integrated daylight and architectural lighting solutions that ensure visual comfort for passengers and airport operation staff, as well as complying to environmental requirements while in keeping with the architectural vision of the terminal and its interiors.

Lighting at Arup brings together art, science and technology. Our team of designers create expressive, sustainable and award-winning concepts with light. Our commitment to sustainability drives a creative approach to the application of state-of-art technology.

Selected projects

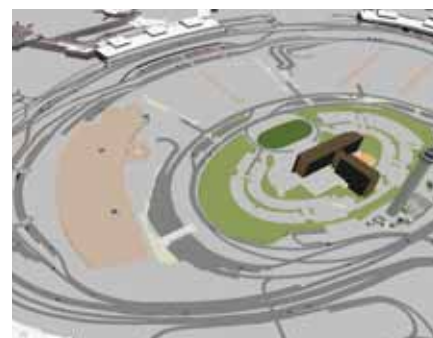
Midfield Terminal Building, Abu Dhabi International Airport, UAE
Midfield Terminal Complex, Hong Kong International Airport
Heydar Aliyev International Airport, Baku, Azerbaijan
Terminal 4, JFK International Airport, New York, USA
Terminal 2, Kuwait International Airport
Terminal 2, Dublin International Airport, Ireland
Sabiha Gökçen International Airport, Istanbul, Turkey
Beijing Capital International Airport, China
Raleigh-Durham Airport Terminal C, North Carolina, USA
Kansai International Airport Terminal Building, Osaka, Japan
Adolfo Suárez Madrid-Barajas Airport, Madrid, Spain
Sacramento International Airport, California, USA



Modelling and simulation



MassMotion Model, Montreal-Trudeau International Airport, Quebec, Canada



VISSIM Model, Newark Liberty International Airport, USA



CAST Aircraft Simulation, Warsaw Chopin Airport, Poland

We employ a highly analytical and multidisciplinary approach to find solutions that holistically meet the needs of owners, passengers, airlines and all other stakeholders. Our analytical tools range from simple spreadsheets and aircraft gating tools, to complex baggage, airfield and passenger flow simulations. We adopt and integrate the tools necessary to meet the needs of each project and problem. Our forecasting and ability to develop realistic and well calibrated future planning schedules provides a key underpinning to most of our analytical work. When coupled with good data, whether drawn from our experience of many airports, or collected locally, we are able to provide a well-integrated understanding of airport system performance.

We rely on simulations of passenger and baggage movement and processing to provide in depth understanding of a facility's performance. We carry out airfield simulation modelling to assess airfield performance and capacity. Simulations allow us to identify system interdependencies, weaknesses, and resilience and can inform improvements to both physical planning and operational processes. We are able to optimise capacity and sometimes delay investment by simple measures to make better use of current facilities and systems. Iterative development of simulations allows designs to be progressively refined and optimal decisions reached.

We have developed expertise in a wide range of simulation tools and methods and have found simulation to be a practical tool for providing valuable input to the dynamic planning and design process. We utilise a variety of advanced simulation software based on the application requirements and the client's preferences, including Simio, CAST Terminal, CAST Aircraft, MassMotion, ARENA and VISSIM.

Selected projects

Mexico City International Airport
Istanbul New Airport, Turkey
Hamad International Airport, Doha, Qatar
Abu Dhabi International Airport, UAE
Dubai International Airport, UAE
Toronto-Pearson International Airport, Canada
Montreal-Trudeau International Airport, Canada
Calgary International Airport, Canada
JFK International Airport, New York, USA
La Guardia Airport, New York, USA
Newark Liberty International Airport, New York, USA
Washington Dulles International Airport, USA
Washington Ronald Regan Airport, USA
Seattle Tacoma International Airport, USA
Boston Logan International Airport, USA
Rio de Janeiro Jobim International Airport, Brazil
Warsaw Chopin Airport, Poland
London Heathrow Airport, UK
London Gatwick Airport, UK
Sabiha Gökçen International Airport, Turkey
Florence Airport, Italy



Passenger terminal planning



© GTAA

Lester B Pearson International Airport, Toronto, Canada



© BOT Company SGIA

Sabiha Gökçen International Airport, Istanbul, Turkey



© Peter Barrow Photography

Terminal 2, Dublin International Airport, Ireland

Our integrated holistic approach provides a unique service to clients in the planning of airport passenger terminals. Passenger terminals are where airport performance is perhaps most visible and where the competing demands of passengers, airlines, the operator and a range of other stakeholders need to be properly addressed and effectively balanced.

We have an acute understanding of this balance and are particularly skilled at helping our clients define their overall strategic development objectives and their aspirations for passenger experience, operational efficiency, commercial performance and environmental and sustainability performance.

Our planning skills centre on how capacity responds to demand, how passenger, baggage and vehicle flows are optimised, how the terminal interacts operationally with the airside and landside systems and how disruption to existing operations can be minimised.

Our comprehensive planning expertise is complemented by our design capability, which covers the full range of services to help us successfully deliver terminal projects tailored precisely to client needs.

Our core skills include:

- Project definition
- Demand/capacity analysis
- Passenger, baggage and vehicle simulation modelling
- Terminal facilities programming
- Operational performance improvement
- Logistics planning
- Conceptual, scheme and detailed design
- Development phasing

Selected projects

Development Plan, Montréal-Trudeau International Airport, Canada
Québec City Jean Lesage International Airport, Canada
New Terminal Development Plan, Lester B Pearson International Airport, Toronto, Canada
JetBlue Terminal Development, JFK International Airport, New York, USA
Terminal 4, JFK International Airport, New York, USA
Terminal 2, Dublin International Airport, Ireland
New Lisbon Airport, Portugal
Sabiha Gökçen International Airport, Istanbul, Turkey
Terminal Expansion, Venice International Airport, Italy
Istanbul New Airport, Turkey
Copenhagen International Airport, Denmark
Vienna International Airport, Austria
Riga International Airport, Latvia
Kunming Xiaoshao International Airport, China
Midfield Terminal, OR Tambo International Airport, Johannesburg, South Africa
Perth Airport, Australia
Melbourne Airport, Australia
Brisbane Airport, Australia
Sydney Airport, Australia
Q6 Strategy, London Heathrow Airport, UK



Programme and project management



Q6, London Heathrow Airport, UK



Dublin International Airport, Ireland



OR Tambo International Airport, Johannesburg, South Africa

We provide a wide range of programme and project management services for capital development, due-diligence and business transformation within the aviation sector. We have cross sector experience of managing complex programmes along with in-depth aviation sector knowledge. This combination helps our clients to implement and activate airport projects safely - to budget, on schedule and to a high standard - without disruption to operations.

Our aviation project management experience includes refurbishment of live facilities, development of new terminals and infrastructure, airline relocations, operational readiness, masterplan capital expenditure advice and business restructuring.

Our wide range of programme and project management skills include:

- Portfolio, programme and project leadership
- Design management
- Project Management Office (PMO) development and reporting
- Benefits management
- Stakeholder engagement
- Procurement management
- Strategic cost advice
- Cost management
- Cost modelling and planning
- Benchmarking analysis
- Risk and opportunity management
- Programme planning
- 4D construction planning
- Transition planning
- Change management
- Health and safety management

Selected projects

Q6 Passenger Experience Programme, London Heathrow Airport, UK
Q6 Baggage Programme, London Heathrow Airport, UK
Terminal 2 ORAT, London Heathrow Airport, UK
Airline Relocation Programme, London Heathrow Airport, UK
Birmingham International Airport, UK
Bristol Airport, UK
Terminal 2, Dublin International Airport, Ireland
Belfast Airport, UK
Bologna Guglielmo Marconi Airport, Italy
OR Tambo International Airport, Johannesburg, South Africa
Istanbul New Airport, Turkey
JetBlue Terminal 5, JFK International Airport, New York, USA



Resource and waste management



London Gatwick Airport, UK



London Heathrow Airport, UK

We provide advice and undertake studies on best practice resource and waste management for a wide range of developments. Waste can have a significant impact on the construction and operational costs of an airport development. Our services cover all stages of a project from early feasibility studies, strategy formulation, planning application stage, environmental assessment and permitting, construction, operation and decommissioning.

Our services include predicting resource use and waste generation, advising on segregation and the space requirements for storage, and identifying recovery and disposal options. We carry out waste management audits and prepare plans for construction and demolition projects, and for the operation of commercial and residential developments and airline waste disposal.

Our resource and waste management skills include:

- Preparation of waste impact assessments as part of wider Environmental Impact Assessment
- Best practice guidance
- Mapping of airport waste flows
- Waste analysis
- Development of Waste Management Options - validated using mass balances
- Use of Multi-Criteria Analysis to evaluate waste management options and identify preferred option
- Waste servicing strategies - advice on waste separation, storage facilities, waste collection including automated waste collection systems
- Procurement of services - preparation of output based service specifications and associated performance management system
- Review, audit and monitoring - support with regard to service performance and legal compliance

Selected projects

Terminal 2, Dublin International Airport, Ireland
Packaging Data Submission Review and Support, British Airways, UK
Waste Analysis & Options Appraisal, London Heathrow Airport, UK
Waste Flow Map, London Gatwick Airport, UK
Environmental Impact Analysis, London Stansted Airport, UK
Landside Masterplan, Mumbai International Airport, India



Security



© Frank P Palmer

Beijing Capital International Airport, China



© HASSELL

Melbourne Airport, Australia

Our aviation security consulting service comprises a wide spectrum of skills that build on our broad airport, built environment and regulatory experience. We deliver risk-based solutions, which reflect a full understanding of aviation and operational security and the safety requirements of airports in a constantly changing regulatory environment. We provide strategic, design and operational services for regulators, individual operations, terminals and complete airports.

Our security skills include:

Strategic

- Facility planning, modelling and simulations
- Establishment of tailored strategies based on ICAO, ECAC, TSA and individual appropriate authorities' standards
- Security audits of installations
- Development and review of security programmes at national, airline and airport level
- Regulatory reviews and impact assessments
- Integrated corporate resilience assessments
- Operational risk assessments

Operational

- Access control policy and procedures
- Security Management Programme development and implementation
- Security training development and delivery for both aviation security and facilitation

Counter Terrorism for Terminal and Critical Areas

- Blast mitigation design of façades, structures and internal walls
- Hostile vehicle mitigation design and specification

Physical

- Security Restricted and Critical Areas construction
- Innovative passenger and baggage separation measures

Electronic systems

- IP CCTV, access control, search equipment, perimeter detection systems matched to National and Airport security and operational needs
- Control suites and complex operational display systems
- IT based security systems integrated with airport and terminal management systems

Selected projects

Istanbul New Airport, Turkey
 DGCA Safety and Security Review, Kuwait
 Abu Dhabi International Airport, UAE
 Dubai Airports, UAE
 Hamad International Airport, Doha, Qatar
 New Ulaanbaatar International Airport, China
 Midfield Concourse Development, Hong Kong International Airport
 Cathay Pacific Airways Cargo Terminal, Hong Kong
 Terminal 3, Beijing Capital International Airport, China
 JetBlue Terminal 5 and 5i, JFK International Airport, New York, USA
 Delta JFK-IAT Redevelopment, Terminal 4 JFK International Airport, New York, USA
 London Heathrow Airport, UK
 London Gatwick Airport, UK
 Terminal 2, Dublin International Airport, Ireland
 Lester B Pearson International Airport, Toronto, Canada
 Melbourne Airport Southern Precinct Project, Australia
 Federal Department of Infrastructure and Regional Development, Australia



Surface access



Leeds Bradford International Airport, UK



Cairo International Airport, Egypt

We provide a comprehensive range of transport planning and design skills for the development of surface access schemes for airports. Our cross sector transportation experience enables us to support our aviation clients in their integration with transport modes - including road, rail and maritime.

One of the key challenges that airports face is providing high quality and sustainable surface access while recognising that the provision of such infrastructure may not be a core objective of their business. We advise airport owners and operators on the most cost effective solutions for access by all modes of transport and on strategies for optimising the use of various modes as appropriate. The development of integrated and efficient transport systems is a core part of our business. With our team of experienced specialists in rail, highway, metro, light rail, bus, car parking, pedestrian movement and urban planning we bring a long track record of innovative solutions and ground transport excellence.

We have a comprehensive understanding of the transport industry, ensuring strategic solutions are developed to satisfy the needs of the airport, its stakeholders and the public.

Our surface access skills include:

- Planning and feasibility studies
- Transport modelling
- Intermodal systems planning
- Intelligent Transport Systems
- Demand and revenue forecasting
- Transport economics
- Traffic engineering
- Infrastructure design
- Tunnel design
- Project and financial appraisal

Selected projects

Surface Access Study, East Midlands Airport, Castle Donnington, UK
Surface Access Study, Birmingham International Airport, UK
Traffic Management Study, Cairo International Airport, Egypt
Surface Access Study, Leeds Bradford International Airport, UK
Quadrant Four Roadways, JFK International Airport, New York, USA
Istanbul New Airport, Turkey
Warsaw Chopin Airport, Poland



Arup's ability to bring the entire range of services from planning to operational readiness, made them an invaluable partner on this project. It is comforting to know they can handle all that is required for a project of this magnitude, in order to maintain seamless and consistent progress. As a result, we have one of the most technologically advanced, convenient and customer-friendly terminals at JFK.

Richard Smyth, Vice President, Corporate Real Estate, JetBlue Airways,
Terminal 5i, JFK International Airport, NY, USA





Operations consultancy

- Airline migration planning
- Asset management
- Building performance and systems
- Control rooms and operation centres
- Human factors
- Leadership and team development
- Operational performance improvement
- Operational readiness, activation and transition
- Organisational design
- Passenger processing systems
- Stakeholder engagement
- Transformational change and change management
- Wayfinding and signage

Airline migration planning



The migration of a stakeholder's operation is a complex planning exercise. Specifically, the strategy for moving airlines needs to be carefully developed and managed to ensure a seamless transition that assures business continuity and with as little impact to the travelling public as possible.

We have led and supported a number of airline moves programmes; ranging from the overnight migration of airlines to a new common use terminal, to the relocation of multiple airlines to a different airport to alleviate capacity constraints.

We have extensive experience of working with airlines, airport operators and third parties to develop the optimal, risk balanced move plan, which aligns with the stakeholders' operational requirements. We are able to integrate complex migration plans and define the critical path activities for the chosen move date.

We add value by deploying the appropriate individuals to support the client's project teams, with a breadth of experience garnered from over 15 years in operational readiness and airport transfer programmes.

Our airline relocation services include:

- Migration programme planning and integration
- Risk, issue, opportunity and threat management
- Communication planning, design and delivery
- Stakeholder management
- Readiness assessment and tracking
- Pre and post move assurance - training and rehearsal design and delivery
- Pavement modeling
- Process auditing
- Logistics and supply chain modeling

Selected projects

- Relocation, New Common Use Terminal 2, London Heathrow Airport, UK
- Relocation, New Common Use Terminal 2, Chhatrapati Shivaji International Airport, Mumbai, India
- Relocation to Dedicated Terminal 3, Dubai International Airport, UAE
- Temporary Relocation to Dubai World Central, Al Maktoum International Airport, UAE



Asset management



© Los Angeles World Airports

Los Angeles International Airport, USA



© HASSELL/Ethan Rohloff

Brisbane Airport, Australia



© LHR Airports Limited

Terminal 5, London Heathrow Airport, UK

As a trusted adviser and respected provider of aviation design services, our service portfolio includes strategic asset management consultancy. Our specialists propose robust and reliable asset management solutions essential for long-term business stability, preservation and resilience. Whole life considerations of critical assets will ensure they meet the needs of the business and be capable of leaving a lasting legacy.

We advise on line of site from organisational objectives and business drivers, through to priorities for capital expenditure, operations and maintenance. We provide tailored rewards and enhancement programmes with the aim of optimising the performance of aviation assets.

We engage with specialist sub-consultants and through effective integration and team working, we have a proven commitment to deliver the best product possible for our clients.

Our asset management skills include:

- Asset management strategy and plans
- Maturity assessment and system improvement plans
- Cost, performance and risk assessments
- Budget certainty and life cycle costing
- Building and infrastructure performance improvement
- Asset management governance and delivery models
- Asset management capability assessments and development
- Asset information strategy and implementation
- Root cause analysis, process modeling and capability detailing
- Pavement modeling
- Process auditing
- Logistics and supply chain modeling

Selected projects

London Heathrow Airport, UK
Brize Norton, Oxfordshire, UK
Terminal 2, Dublin International Airport, Ireland
Los Angeles International Airport, USA
Brisbane Airport, Australia
Dubai World Central, Al Maktoum International Airport, UAE



Building performance and systems



© LHR Airports Limited/David J Osborn

London Heathrow Airport, UK



© Frank P Palmer

Beijing Capital International Airport, China

Our experts advise airport operators on how to provide the best possible environment for the users of their buildings and facilities, by designing and improving operational efficiency of their building, plant and associated systems.

We achieve this through a soft landings process. Early design stage involvement ensures operational outcomes are clearly defined and checked throughout the design, construction and handover process. This is followed by a strategy to optimise building performance post project completion through aftercare, seasonal commissioning and Post Occupancy Evaluation; thereby maximising the return on our client's investments.

We provide our clients with a complete multi-disciplinary service in a single team, including M&E, control systems, commissioning, facilities management, carbon consultancy and occupant evaluation (health, wellbeing and productivity).

In existing facilities we carry out site-wide surveys, feasibility reports and implementation works, which offer clients a full solution for evaluation and improvement of their airport facilities.

Our building performance and systems skills include:

- Independent consultancy advice, offering total project solutions for new and existing airports
- Reducing operational costs by minimising energy consumption
- Provision of 'Soft Landings' consultancy from design, through to aftercare and Post Occupancy Evaluation
- Design of data collection systems to increase the availability of information, enabling better management of facilities leading to the reduction of energy, response times and maintenance costs

Selected projects

Terminal 3, Beijing Capital International Airport, China
Terminal 5, London Heathrow Airport, UK
HACTL Super Terminal 1, Hong Kong International Airport
Controls Optimisation and Energy Reduction, Terminal 3, London Heathrow Airport, UK
Terminal 2, Dublin International Airport, Ireland



Control rooms and operation centres



Control Tower, Edinburgh Airport, Scotland, UK



National Air Traffic Services, UK

Control, command and communication centres are complex environments at the operational heart of any business. When designed effectively they are proven to enhance the operation of the business, reduce costs, manage risk and deliver business improvement.

Control rooms are everywhere and a key asset in aviation, whether they are ground handling, terminal operation, baggage or air traffic control rooms. They can have multiple purposes and focuses such as on team resourcing and management, security, safety and operational performance.

Through our global experience in strategy, planning, design, human factors, organisational behaviour and operations, we understand the challenges and elements needed to create a successful operational environment. We create tailored, world-class operational environments for the benefit of our clients and their businesses. We provide flexible and practical solutions which are underpinned by a holistic approach and consider the whole operation, including people, process, technology and the environment.

Our multi-disciplinary specialist skills include:

- Business analysts
- Stakeholder engagement
- Fire safety
- Psychology
- Human factors
- Logistics
- Design
- Information technology and communication systems
- Resilience security and risk
- Audio visual
- Project management

Selected projects

Terminal Service Centre, London Heathrow Airport, UK
Baggage Handling Facilities, London Heathrow Airport, UK
Swissport Operational Control Centre, London Gatwick Airport, UK
National Air Traffic Services, UK
Edinburgh Control Tower, Scotland, UK



Human factors



© Mo Baig 2014



People are at the heart of a successful airport; and a mismatch between people, processes, environment and technology can undermine a successful operation. We understand the challenges and elements needed to create a successful operational environment and have global experience in maximising the performance of airports and the people who work in them.

Working closely with aviation clients, we consider people, processes, technology and the environment to design effective organisations and deliver human performance at the highest level.

We understand that designing right first time saves money. Human factors must be integrated into the design and operation of assets and future technologies, so that people can perform effectively and the passenger experience is optimised. By applying a comprehensive understanding of physical ergonomics, cognitive psychology, and organisational behaviour, our human factors specialists ensure: new technology is usable and fit for purpose; operational processes are user-friendly; control room design standards are achieved; and way finding is designed to enhance the passenger journey through your airport.

Our services include:

- Control room design and operations
- Behavioural safety
- Workplace design
- Human factors integration
- Crowd behaviours and wayfinding
- Operational readiness

Selected projects

London Heathrow Airport
Transport for London
Highways Agency, UK
Network Rail, UK



Leadership and team development



Leadership is a key determinant of organisational performance and managing change. Investing in developing effective leaders results in financial success and widespread improvements in morale and motivation. Effective leadership is pivotal for communicating business vision, improving safety culture, working with diverse stakeholder groups, enabling key decision-making, mapping strategic benefits, and navigating through political sensitivities.

Our approach focuses on a leader's sense of meaning and identity as the key source from which they operate. Our chartered occupational psychologists design world-class leadership programmes that take leaders on a journey of discovery, delivering a more profound impact than merely providing tools and techniques. We seek to understand the context in which leaders work and equip them with the relevant skills and strategies to reach their full potential at an individual, team, organisation and system-wide level.

We use a range of solutions including:

- Executive coaching
- Top team/Board development
- Senior leadership programmes
- Establishing leadership networks
- Succession planning
- Top team selection
- Inclusive leadership
- Strategy workshops

Selected projects

Dubai Airports, UAE
London Heathrow Airport, UK
National Health Service, UK
General Medical Council, UK



Operational performance improvement



© Dubai Airports

Dubai International Airport, UAE



© LHR Airports Limited

London Heathrow Airport, UK



© GVK Power and Infrastructure Limited

Chhatrapati Shivaji International Airport, Mumbai, India

Detailed, holistic understanding of a business is essential to successful, sustained performance improvement. This embraces each component of an organisation's operations, physical assets and culture. Our operations consultants ensure that these components work together to support organisational goals.

We provide operations consulting services to support airlines and airport operators in the planning, implementation and ongoing improvement of their business operations. We help our clients to establish and deliver sustainable business improvement through a combination of specific aviation sector experience in operations management and performance improvement with wider cross-industry expertise of best practice for operations strategy and change management.

Our operations consultancy expertise complements the wider Arup activities in planning and implementation of airport infrastructure and technical systems.

Our operation skills include:

- Operational strategy development
- Organisation design and assessment
- Effective team working and work roles
- Human factors of design and operations
- Change management
- Operational process improvement, including lean and six sigma
- Performance measurement system design and implementation
- Sourcing strategy development and implementation
- Service contract development
- Definition of user requirements for capital and operational projects
- Stakeholder engagement

Selected projects

- Terminal 3, Dubai International Airport, UAE
- Terminal 2, Chhatrapati Shivaji International Airport, Mumbai, India
- Terminal 2 London Heathrow Airport, UK



Operational readiness, activation and transition (ORAT)



JetBlue Terminal 5, JFK International Airport, New York, USA



Terminal 2, Perth Airport, Australia

Airports are under increasing pressures to enhance passenger, visitor and staff experience; become operationally more efficient and effective; generate revenues from technology services; effectively integrate technology into capital programmes; successfully bring terminals and airports into operation; and provide sustainable technology solutions.

The process of taking a newly constructed building and turning it into a fully functioning airport that meets these pressures and operates business as usual from day one needs to be carefully and sensitively managed. Although ORAT requires a number of familiar elements - such as stakeholder engagement, change management and governance - the way in which these interact during an airport or terminal opening is completely unique and can pose a significant challenge.

We understand the challenges and have global experience in successfully transitioning major terminal construction facilities into operational capabilities. We combine our understanding of the built environment, with the operational needs of an airport, our in depth technical knowledge and our people and process specialists to provide a globally experienced team that mitigates client risk to provide a successful opening day of a new facility.

Our ORAT services include:

- Activation of a new facility
- Effective organisation
- Process management and technology implementation
- Time and cost management
- A modular methodology, completely flexible to complement client in-house capabilities

Selected projects

JetBlue Terminal 5 and 5i, JFK International Airport, New York, USA
Terminal 2, London Heathrow Airport, UK
Terminal 2, Chhatrapati Shivaji International Airport, Mumbai, India
Terminal 2, Perth Airport, Australia
Terminal 3, Dubai International Airport, UAE
Lester B Pearson International Airport Toronto, Canada



Organisational design



We have a deep understanding of how to achieve competitive advantage for our clients through understanding the complexities of people in order to improve design, develop organisations and deliver operational improvements. Excellent organisational design is a key enabler of a great passenger journey and this can only be achieved if people are trained, highly organised, and understand their role and responsibilities.

Our organisational design and development capabilities and our practical methodology, which has been developed and refined with the world's leading airports, enable the development of a robust organisational structure that fits with the airport's wider operating model and deliver the target strategy for a high performing organisation.

Our services include:

- Development of organisational structures
- Development of HR strategy
- Development of competency frameworks
- Supporting the organisation to implement organisational changes
- Job descriptions
- Recruitment and selection
- Talent mapping
- Succession planning
- Performance management

Selected projects

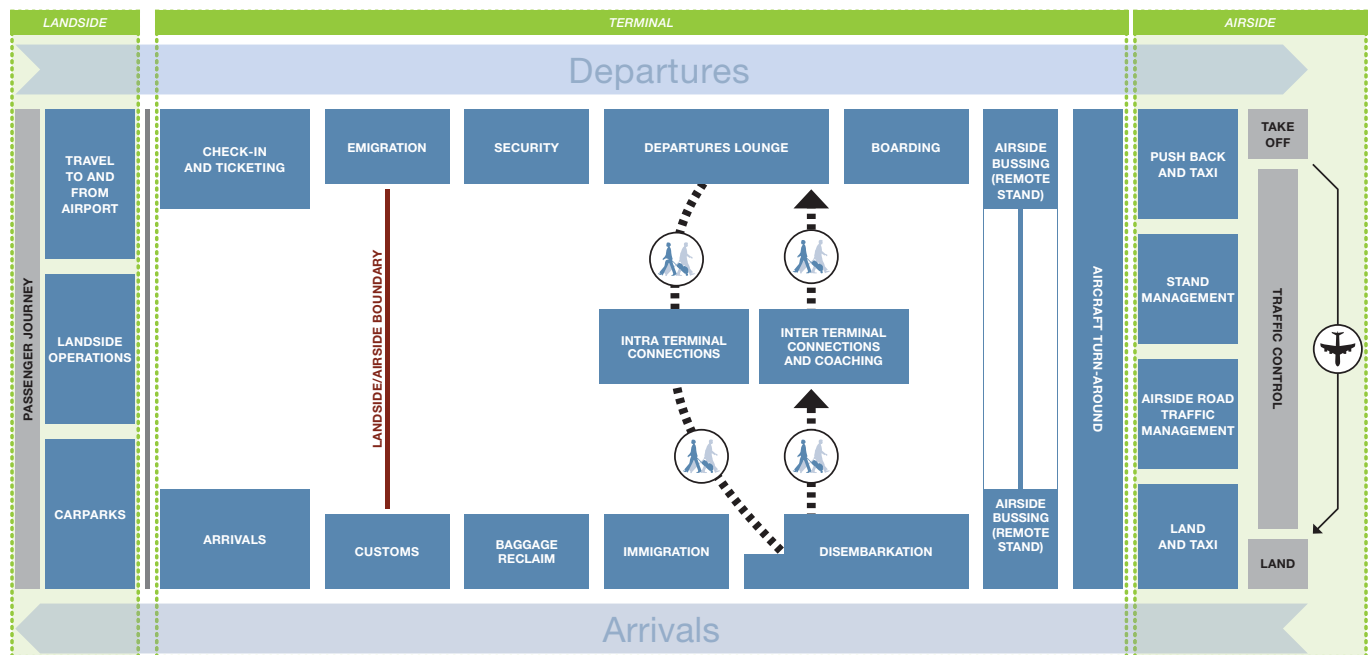
Dubai Airports, UAE

London Heathrow Airport, UK

Chhatrapati Shivaji International Airport, Mumbai, India



Passenger processing systems



In many cases the challenges our clients face are focused on the introduction of new passenger processing procedures designed to enhance the passenger experience. Our airport specialists have significant expertise in assessing how changes in passenger processing impact the business operations of airports, airlines and control authorities and how new technologies best support these process changes.

We work with our clients to determine how passenger facing technology can be used to maximise non-aeronautical revenues and ease passenger stress. We understand the challenges faced by airport operators, airlines and control authorities regarding the use of new technologies throughout the passenger journey and are able to respond to these with real experience from some of the world's leading airports.

Our passenger processing experience includes:

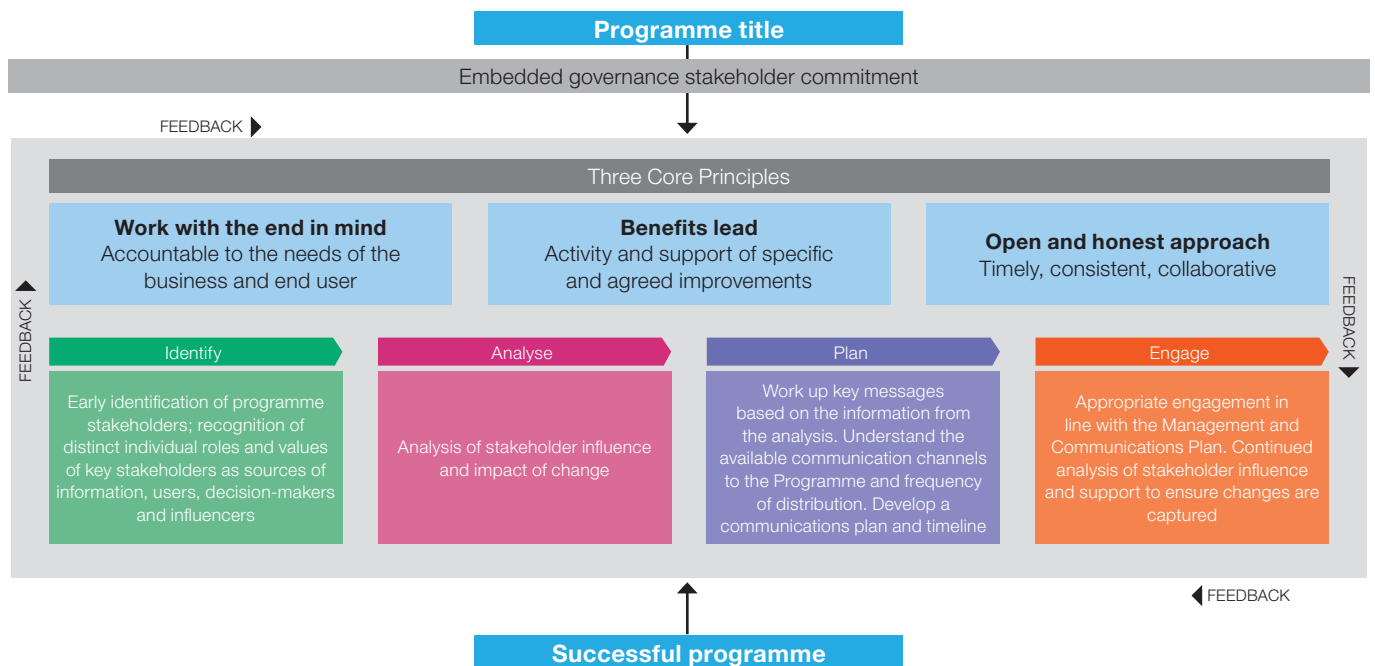
- Diversity of check in technologies include web, mobile, kiosk and traditional
- Automated, staffed and flexible bag drop
- Biometric passenger identification and segregation
- Automated border control (e-gates)
- Transfer passenger prioritisation systems
- Electronic signage and augmented wayfinding
- Electronic advertising systems and large scale displays
- Passenger web access strategies, including kiosks, wifi, content management and security
- Lounge information and content access technologies
- Automated boarding
- Customs risk identification systems

Selected projects

London Heathrow Airport, UK
 Terminal 2, Dublin International Airport, Ireland
 Hamad International Airport, Doha, Qatar
 Terminal 5, London Heathrow Airport, UK
 Lester B Pearson International Airport, Toronto, Canada
 Terminal 3, McCarran International Airport, Las Vegas, Nevada, USA
 JetBlue Terminal 5, JFK International Airport, New York, USA
 Dubai World Central, Al Maktoum International Airport, UAE



Stakeholder engagement



Effective stakeholder engagement is crucial for the success of any complex programme or project. Without it, there can be no common agreement, ownership or support so there is real benefit in knowing that everyone involved in or impacted by an airport or terminal development is being represented at all stages.

We understand the complexity of stakeholders within an airport community and recognise the importance of identifying and engaging them early in a collaborative and cooperative relationship. With their needs established from the outset and aligned with business objectives, the net benefits include more effective and lasting decision making; greater mitigation of risk; alignment and motivation of all parties involved; and on time delivery of project goals. This also makes it much easier to identify and overcome challenges and adapt to opportunities related to the vision and goals of the project as and when they arise.

We also have a breadth of related experience on major projects and programmes beyond aviation.

Our stakeholder services include:

- Defining and articulating business and project outcomes
- Preparing, implementing and reviewing strategy and management plans, with activities to engage with each of the stakeholder categories tailored to their specific needs
- Setting high level objectives for the stakeholder engagement process, clearly linked to these outcomes
- Identifying and analysing stakeholders based on their relationship to, and degree of influence over, the project
- Regular, targeted and inclusive communications to ensure expectation levels are managed throughout the various stages of the programme
- Undertake 'Health checks' at various stages of the project to review the current stakeholder approach and amend as required

Selected projects

London Heathrow Airport, UK
Chhatrapati Shivaji International Airport, Mumbai, India
Dublin International Airport, Ireland
Istanbul New Airport, Turkey
Generation 2 Second Runway Project EIA, London Stansted Airport, UK



Transformational change and change management



Change is inevitable. Organisations are required to continually transform, adapt and be agile in increasingly competitive market conditions. What lies at the heart of successful, sustainable change is a fundamental shift in people's attitudes and behaviours.

We believe that change in any area is best managed, implemented and sustained through people. Our change management experts and organisational psychologists work in partnership with clients to understand the business drivers, and to ensure that people are aligned with the strategy and direction of the organisation, work collaboratively, engage effectively with stakeholders and deliver persuasive communications to facilitate change.

We adopt a holistic approach to facilitate change which combines a deep understanding of the change process and clients' needs together with a robust framework to deliver pragmatic yet sustainable results.

Our approach is underpinned by engagement and co-creation; 'winning hearts and minds' and has three key stages: Defining the future vision 'to be' and assessing the 'as is' state; developing a bespoke plan to bridge the gaps; and engaging stakeholders to lead, own and embed change.

Our services include:

- Visioning workshops
- Strategy workshops
- Change readiness assessments
- High engagement workshop methodologies
- Developing change plans
- Stakeholder engagement
- Knowledge management
- Communications and staff engagement
- Cost/risk benefit analysis
- Benefits analysis
- Implementing change
- Leadership development programmes
- Culture change programmes
- Organisational design

Selected projects

Dubai Airports, UAE
Chhatrapati Shivaji International Airport, Mumbai, India
London Heathrow Airport, UK

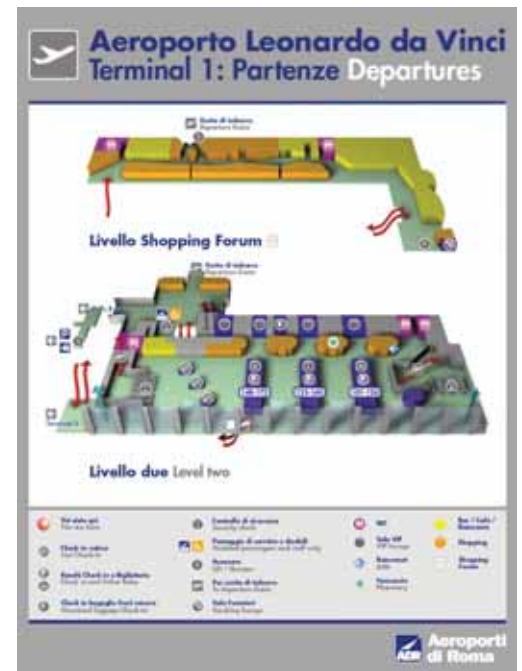


Wayfinding and signage



© Ian Bruce Photography

Dublin International Airport, Ireland



Aeroporto Leonardo da Vinci, Fiumicino, Rome, Italy

Our wayfinding services form an integral part of the ‘airport experience’ adapting to the architectural environment and contributing towards providing a positive impression of the airport, enhancing the passenger experience, and improving both operational efficiency and commercial opportunities. Our integrated team specialises in wayfinding and signage systems for complex environments, where a large number of people circulate.

We take an holistic and user-centric approach to ensure that the wayfinding systems we design meet the needs of both passengers and operators efficiently and cost effectively. We have global experience in the design of both fixed and dynamic signage systems for large multi-modal transport interchanges, providing specialist design services tailored to meet the stringent demands of these complex passenger terminals.

Our innovative use of 3D modelling technologies during the design process allows a scheme to be rigorously tested whilst plans are still ‘on the drawing board’. This approach dramatically improves design coordination, minimises expensive and time consuming iterative design change and provides confidence for the client that any proposed design will work in practice.

Our wayfinding and signage design skills include:

- Signage and information masterplanning
- Graphic design
- Design manual production
- Detailed deployment design
- 3D modelling
- Prototyping and user trialling

Selected projects

- Design Manual, Dublin International Airport, Ireland
- Design Manual, Deployment Schedule and 3D Maps, Aeroporto Leonardo da Vinci, Fiumicino, Rome, Italy
- Design Manual, Hong Kong International Airport
- Schiphol Airport Amsterdam, Netherlands
- Design Manual, Copenhagen Metro, Cityringen, Denmark



The Arup ORAT team brought structure to the chaos that evolves when many stakeholders all need to deliver a multitude of tasks to achieve a common goal.

Guy Thompson, Executive General Manager Assets & Capital Projects,
Perth Airport Pty Ltd



A global practice

About Arup

We are the creative force behind many of the world's most innovative and sustainable building, transport and civil engineering projects and design technologies. We offer a broad range of professional services that combine to make a real difference to our clients and the communities in which we work.

We are a global firm with over 11,000 planners, designers, engineers and business consultants operating from 91 offices in 39 countries. Through strong internal networks we benchmark and share the learning from our aviation and other sector experience to deliver better solutions for our clients. We are committed to delivering cost-effective and high-quality professional service consistently worldwide.

Reliability

Founded in 1946 with an enduring set of values, our independent Trust ownership structure ensures the objectivity of our advice and supports a distinctive culture focused on the development of innovative, integrated and sustainable solutions that respond to the unique needs of our clients and stakeholders.



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