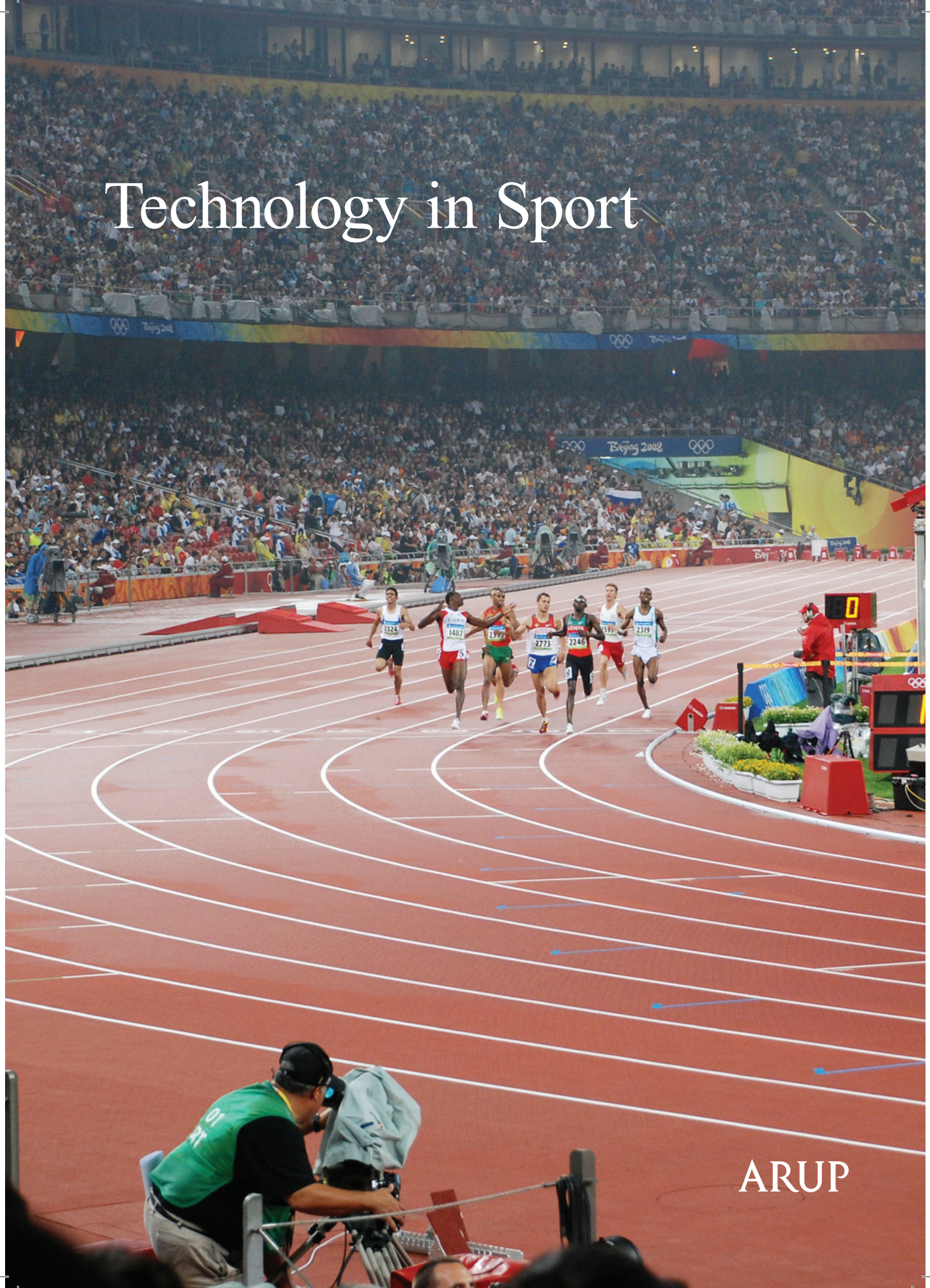


Technology in Sport



ARUP



Image Wanderers Cricket Stadium in Johannesburg during the 2003 Cricket World Cup final trophy presentation

Technology in sport – a changing world

If facebook was a country it would be the largest in the world,
3rd largest in the world,
600 million facebook users
January 2011
www.wikipedia.com

Technology is transforming our experience of modern sporting events and the venues that host them

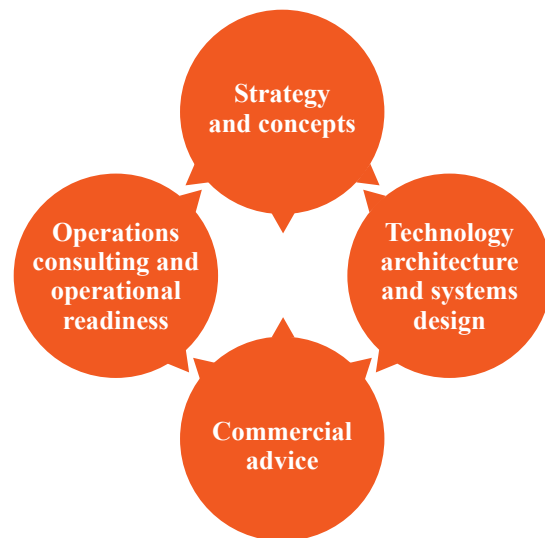


Spectators, governing bodies, event organisers, venue operators and clubs are demanding more from their sporting events. Technology provides the platform to reach global audiences and personalise events through the use of TV, mobile and internet solutions.

Spectators are demanding more from their media

Advances in technology have meant that information is now more accessible than ever. High bandwidth, increasingly powerful devices and most recently, the advent of HD and 3D TV, have raised the bar. In addition, the rise of social media has enhanced fans' expectations regarding the frequency and interactivity of engagement. Venues now rely heavily on the web and smart phone applications to create touch points and converse with the sports community.

Time has become a high value commodity and people want technology to enhance their sporting lives. After all, why would you travel to a venue 10 miles away unless you knew a court was available and you could park nearby? In this scenario it is the role of technology to provide participants with the real-time information they need.



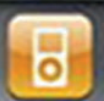


**Homebush
Light Rail**
Departs 4 mins

Australia vs. Italy
ko 1745

Barangaroo Station
Entrance

Map view



Phone

Mail

Web

iPod

A changing world of broadcast and media services

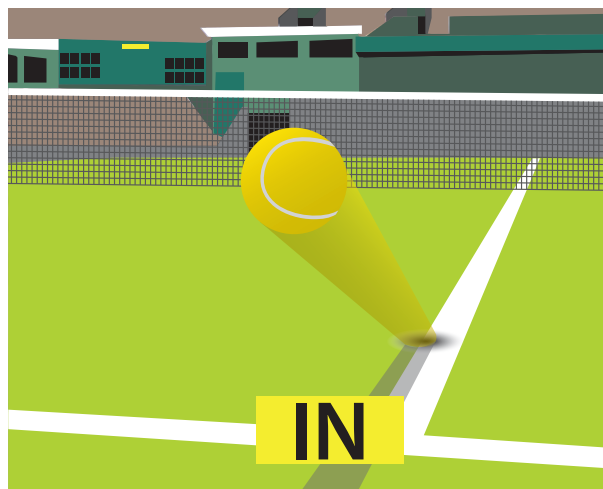
The record-breaking TV audience for the 2010 football World Cup™ was estimated at 28 billion. Around 70 million people viewed the event online. This trend is set to continue as both broadcasters and viewers become more comfortable with streaming content direct to home TVs and computers. At the next World Cup™, we will watch the games on TV, computers, mobile phones, tablet computers, and interact with other fans.

The rise of the virtual umpire

Fans now expect technology to be used for controversial decisions. For example, cricket umpires can now use Hawk-Eye's motion analysis technology, and rugby referees can consult a video replay. Not all federations may agree with this approach but it does need to at least be considered when designing a venue.

Technology convergence and smart systems

Major events and venues use smart systems to optimise security, transport and facilities management. For example, UK football clubs are leading the way with smart cards that act as membership, loyalty and payment cards, enhancing efficiency for spectators. Technology also enables these venues to conduct environmental and energy management in real-time by linking the event schedule and occupancy information with building management systems to optimise on stadium bowl or concourse cooling.



Technology links sport and money

From broadcast and media rights to retail and membership, technology plays a vital role in the sports business. High profile advertising panels can get sponsors' messages to fans in increasingly sophisticated ways. Smart stadium access is used to track people's spending and behaviour patterns, enabling operators to offer spectators a more personal experience.

An integrated approach

Realising the full potential of this changing world demands a deep understanding of venue architecture, the visitor experience, and the role of technology in sport.

Arup specialises in designing venues, appraising investment in them and delivering the state-of-the-art technology that enables venue operators to create rich visitor experiences. We offer specialist services that can be tailored to deliver smarter sports projects for events, venues, sports parks or even entire sport cities.

Our services cover:

- Spectator experience
- Broadcast, media and content services
- Safety and security
- Event operations and lights, sound and vision
- Transport, logistics and wayfinding
- Technology and sustainability
- Sustainable stadia cooling
- Integrating technology with design and construction
- Sports federation compliance
- Venue management
- Elite athlete performance
- Commercial strategy
- Systems integration and IT management
- Major event operational readiness



Spectator experience

The emergence of sports-related technology has put **spectators at the heart of the action**

4bn

people have mobile phones today

Source: www.ft.com

In the past, catering for spectators at a sporting event meant giving them a seat or a place to stand that had reasonable sightlines to the field of play. This is no longer sufficient. Converged technologies now enable spectators to interact with an event long before they reach the venue. Shared information platforms deliver the same information to you whether you're at home or on the move.

Enhancing the spectator experience

Venue operators use technology to enhance the spectator experience and create unforgettable sporting events:

- Customer relationship management systems use information about past preferences in order to tailor promotional offers
- Internet technology makes it easy to buy a ticket (which might be an electronic ticket you carry on your smartphone)
- Wayfinding technologies can guide spectators to their seat
- In-venue technology enhances the spectator experience by showing action and analysis on giant screens or streaming it to smartphones
- Phones may even point spectators to their favourite catering outlet at the venue and allow them to pay using contactless payment



Main image Arsenal Emirates Stadium

Left Lord's Cricket Ground, London

Right 2008 Beijing Olympics



Increasing opportunities for venue operators

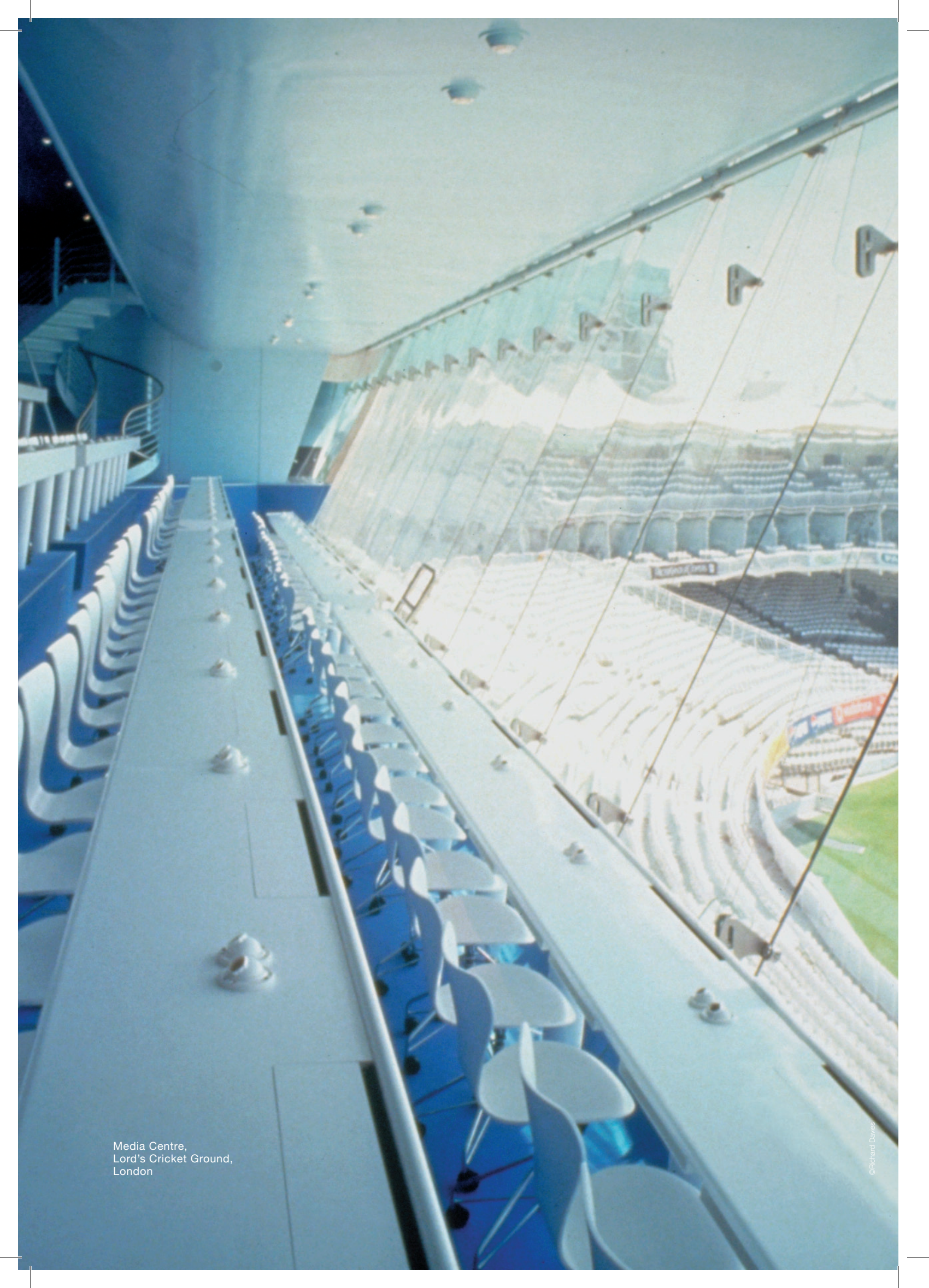
Technology can deliver an improved service by creating more interactive touch points with spectators, encouraging repeat attendance, increasing sales of additional services and reducing staffing and administration costs.

Technology also enables venues to engage spectators beyond the gates. Increasingly, spectators are “visiting” the venue online and sampling pre-event video, audio and information. In the future, spectators will expect a richer virtual venue experience even before attending the venue itself.

Meeting these expectations requires an in-depth understanding, not only of the sport and event itself but also what’s most important for spectators and how this could be enhanced by technology.

Arup can identify the opportunities driven by technology and advise venue operators how to capitalise upon these.

Media Centre,
Lord's Cricket Ground,
London



Broadcast, media and content services

Ensuring that venues meet the needs of broadcasters and press requires meticulous planning and engineering

Sports broadcasting and media is big business. The television rights for the UK Premier League were recently valued at £1bn. It is therefore surprising that media and broadcast facilities are one of the most frequently overlooked areas of a sports venue project. Creating functional and tailored facilities within a sports venue is as important as considering the playing surface or the spectator experience. As a result the more established venues have invested in the capture, production and publishing of their own content. These multi media solutions are an integral part of their commercial and spectator strategies.

Catering for the media

World-class media services are vital to a successful sports event. Media requirements vary greatly but service expectations are always high and the largest sports events will need to cater for as many as 20,000 media representatives.

Journalists need to get timely and reliable information about when and where stories might arise, both on and off the field of play, and need to be there when the story breaks. They also need access to facilities where they can create and file their stories.

Facilities for broadcasters

- Camera positions
- Studio space
- Flash interview areas
- Satellite uplink areas
- Broadcast compounds
- Commentator positions
- Permanent or temporary cabling
- Telecommunications links

Facilities for press journalists and photographers

- Work rooms
- Conference rooms
- Interview spaces
- Connectivity to reliable high-speed data services

Permanent or cabling overlay

A permanent broadcast cable installation has advantages for the venue operator and broadcaster. Outside broadcast vehicles can arrive on-site and connect to the permanent cable system. This removes the need for temporary cable runs and ensures broadcasters benefit from a robust, reliable cabling system. It is also usually the case that special events that occur on an infrequent basis will require their own overlay cabling.

Technology and multimedia ready infrastructure

Focused and dependable technology infrastructure is the key to servicing the needs of broadcast and media. Digital multimedia content transmission, storage and manipulation technology has become more widely available. Coupled with the web presence for publishing this content, venues can leverage their existing infrastructure to drive more content creation and distribution.

Arup creates scalable and dependable IT and multimedia ready infrastructure for its sports clients. Our engineers have the skills and expertise to deliver mission-critical broadcast and multimedia projects, on time and to budget.

Safety and security

The appropriate application of technology enables the **creation of safe and secure venues**

A spectrum of uses

Venues are used in many different ways, from providing a training location on a day-to-day basis, to staging major national and international events. These varied uses create many different demands with respect to safety and security that need to be addressed in a flexible and responsive way. In addition, crowded spaces and the attendance of VIPs place additional constraints that need to be addressed.

Integrating technology with security personnel

Technology can be applied and integrated in an effective way to complement the use of guards and stewards, without the need for capital outlay. IP based CCTV systems can provide real-time and recorded images capable of being viewed from multiple locations both on- and off-site using command and control systems employing state-of-the-art situational awareness tools. Real-time 3D models can be produced by using accurate Light Detection and Ranging (LiDAR) scans of the site and surrounding areas, combined with architectural designs to provide an accurate simulation prior to project sign-off.

Our approach

Arup's experience of security for venues with these needs means that we have a clear understanding of the demands on venue managers. These include obtaining venue licences for major events meeting national and international regulations relating to doping and match fixing, managing emergency situations and supporting the daily business. Technology can be a tool in responding to these.

Arup can apply novel technologies that can be used with traditional building techniques and materials to complement the architectural aspirations of world renowned venues, providing a suitable, protective environment. Solutions are fully researched and evaluated in a test environment before being transferred into sporting arenas.



Top Kensington Oval Cricket Stadium, 2007
Cricket World Cup. Architect and Engineer:
Arup Associates

Bottom Hong Kong Jockey Club – strategy
for the integration of security and building
management systems over the IT network

Event operations and lights, sound and vision



Event operations

The challenges of event operations are often overlooked when a sports venue is designed. To foster world-class performance, a venue's design must meet the different requirements of all the events it is expected to support.

The venue needs to be capable of being reconfigured for different events at short notice without incurring significant expenses. For example, permanent systems must be flexible enough to support event-specific VIP operations and pop-up catering outlets.

Arup recognises that event operations are distinct from business-as-usual venue management but that the two need to function well together to create a successful event. Our approach is to design intelligent, open, modular and cost-effective systems, which will serve different events equally well and can be easily reconfigured.

The **2006**
FIFA World Cup Final
was watched by
715 million
people
Source:
www.fifa.com

Top left image U2 at
Stade de France

Top right image
The 9th FINA World
25m Swimming
Championships 2008,
Manchester

Event overlay - lights, sound and vision

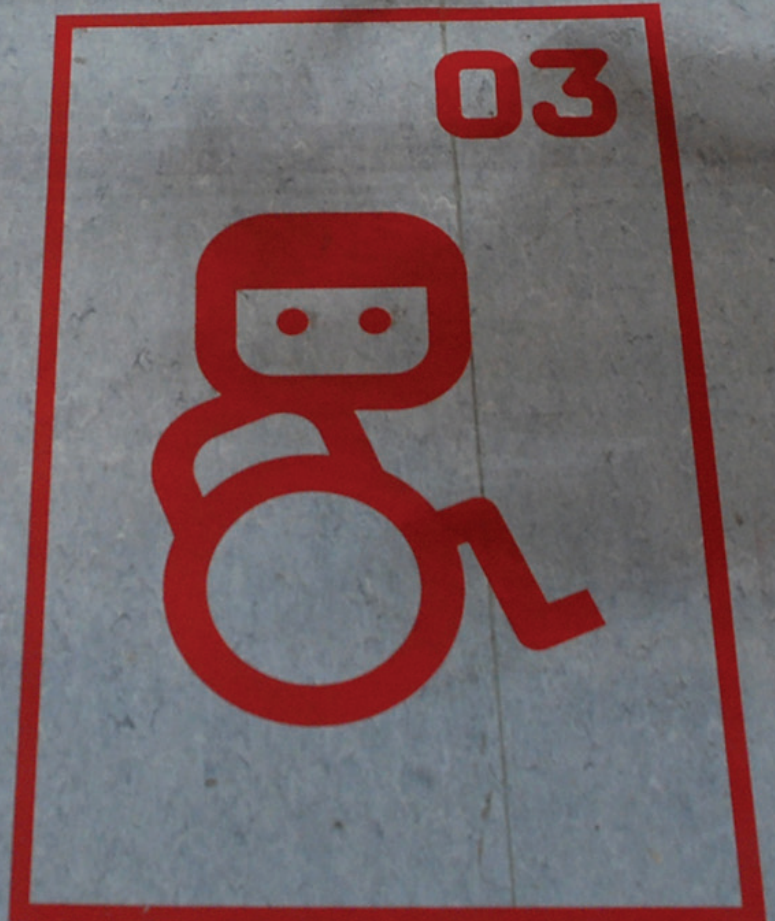
To survive, sports venues need to be able to host other events and it is often the case that an entire venue is created as an overlay. We have the skills to design and engineer put-up and tear-down venues for events like the 9th FINA World 25m Swimming Championships 2008, held in Manchester.

Although sports venues are designed for sports events, other forms of entertainment are often significant money-earners, with stadiums hosting everything from monster truck competitions to rock concerts. Venue designs therefore have to allow all types of media systems, special event lighting and sound systems to be overlaid.

Sightlines and seating options for other types of events need to be studied and decisions made about procurement, storage space, rental and easy access for temporary installation. Roof structural loads should include event-based equipment overlays, as should power provision and temporary containment routes for additional lighting and other electrical equipment.

Easy access to installation locations and strategies for tour and outside broadcast truck parking need to be evaluated. In some building types, technical access ways might be needed to reduce set-up and strip-down time and related operational costs.

Arup understands what makes a venue successful. While we cannot predict the future, we can help to ensure that a venue can adapt and continue to serve its owners cost-effectively for the whole of its expected life.



Transport, logistics and wayfinding

Technology plays a vital part in reducing stress by making spectator journeys as smooth as possible

Sports venues must cope with thousands of spectators arriving and leaving at the same time, together with logistics requirements such as broadcast and delivery trucks. Peak flows in a stadium or large arena create huge stresses on local transport infrastructure.

Modern intelligent transport systems (ITS) technology can soothe these peak flows and help alleviate the stresses.

Intelligent transport systems include:

- CCTV
- Dynamic displays
- Traffic signals
- Sensory technology
- Car park management
- Safety technology
- Transport management systems
- Computer-assisted decision support
- Delivery vehicle scheduling systems

This technology is used to disseminate information such as the right road and street signage, and information displays for spectators. The ticket booking platform, the car park management system and venue access system can be linked together to ensure a seamless spectator journey from home to seat.

To address the transport and wayfinding needs of modern sports venues and events, Arup brings together teams of experts in transport, wayfinding and signage, technology, logistics (delivery servicing and waste management) and venue planning. Together they provide solutions that deliver successful sports events for spectators and organisers.



Main image Signage at the 2008 Beijing Olympics

Top Wayfinding at Gateshead API

Bottom Sydney Olympic Park



Technology and sustainability

A successful approach to sustainability demands a combination of executive strategy and individual feedback

Across the world, sporting clubs, venues, associations and sponsors have begun to address sustainability issues. Internationally recognised best practice examples include the 2006 FIFA Green Goal programme and the Vancouver 2010 Olympics Sustainability Stars programme.

Sustainability frameworks

A sustainability framework that sets out priorities for the organisation can help focus efforts to mitigate impacts, monitor performance and communicate success. Arup's study for the Millennium Stadium in Cardiff, Wales, identified priority initiatives that resulted from creating a framework. These included spectator travel coordination, a sustainable procurement policy and measuring the impact of stadium lighting, heating and ventilation.

Raising awareness, enhancing reputation

Sporting events have a unique opportunity to raise awareness about environmental and societal issues and in doing so, improve their reputations. The Millennium Stadium recognised that rebranding as part of a comprehensive strategy could enhance its reputation for addressing local issues such as health and unemployment.

The importance of data

To manage energy use, resource use and waste, an organisation, event or venue must collect and analyse good quality data. Once baseline data has been established it can be used to model future scenarios and focus efforts. It also gives a clear picture of progress made and can underpin any messaging or reporting to stakeholders giving a greater level of credibility to claims made about improvement.



Empowering the individual

For the consumer to be empowered to play their part and make meaningful choices, they need more detailed and personalised feedback about their consumption. On a community level, informatics can show how an individual's choices contribute to the overall impact and people's natural competitiveness motivates them to keep improving their scores.

Technology can also be part of the problem

Arup has found that behavioural change can produce almost as much in energy savings as changing the technology. In a recent modelling study for the Low2No sustainable development design competition in Helsinki, Arup identified that approximately 20% savings could result from behavioural change and 20-30% savings could result from physical interventions. This suggests that a sensible approach would be to start with behavioural change interventions to reduce demand, so that fewer physical interventions are needed to reduce emissions from the supply.

In the past, IT has been identified as mission critical for an organisation, event or venue and as such, has been over specified. This is clearly unsustainable and open to risk over time. A clear strategy for IT energy demand is critical to reduce the impact of energy use whilst making sure that the business runs smoothly.

Our approach

Arup's global team of specialists offer services in assessing impact, creative design and implementation, gaining regulatory approvals, reporting publicly, stakeholder consultation, managing risk and controlling costs.



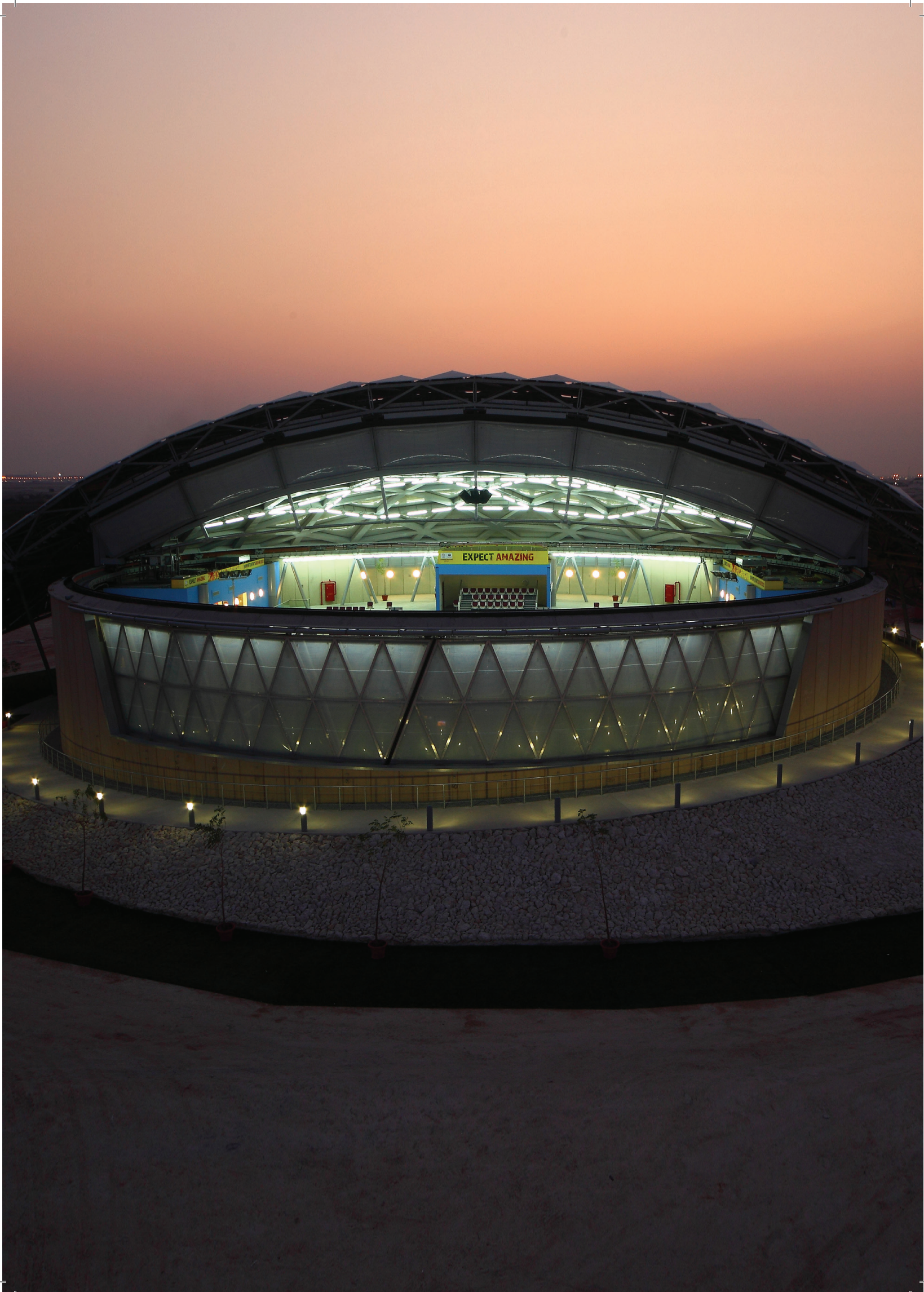
The 2011 Cricket World Cup India and Pakistan semi-final was watched by

lbn

Source: www.guardian.co.uk

Main image Millennium Stadium, Cardiff

Above Arup carbon footprinted the Concert for Diana 2007, Wembley Stadium, UK





Sustainable stadia cooling

Spectator comfort and athlete safety is of particular concern in hot climates where soaring temperatures can heat stadia to uncomfortable levels and can lead to players suffering from heat stress injury

In hot climates, such as the Middle East where outside temperatures can reach 50°C, stadia may need to be cooled by at least 20°C to reach bearable comfort levels for spectators and athletes. This is not only expensive but can consume vast amounts of energy.

Sustainable stadia cooling presents a new solution for venue operators. Adopting a low carbon cooling approach and combining this with photovoltaic systems can reduce costs and result in zero carbon stadia.

Arup has conducted extensive research into the creation of technically complex, comfortable and sustainable stadia. In 2010, Arup Associates designed the Qatar 2022 FIFA World Cup™ 500-seat demonstration stadium, which was sustainably cooled and zero carbon.

Left Qatar 2022 FIFA World Cup™ 500-seat demonstration stadium



Integrating technology with design and construction

Giving early consideration to how a venue will be operated and managed can mitigate project variation and costly changes

All too often, the design and construction of a sports venue proceeds with little input from the operations team. When the operator's requirements are provided, construction is already well underway. This is one of the primary causes of project variations and costly changes.

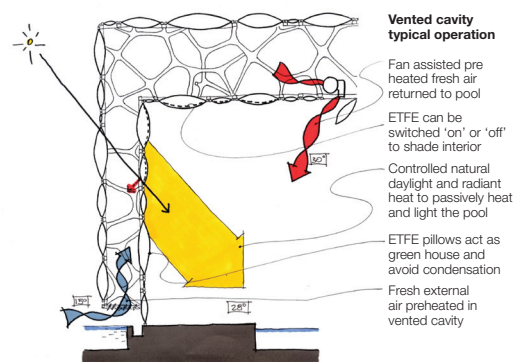
Technology-to-operations methodology

To avoid this problem, Arup has developed a joined-up technology-to-operations methodology where operations and management are considered at the briefing and planning stages of the construction project. Timely information is provided by specialists with operational experience and insight, adding value to a design and build project.



Images Beijing National Aquatics Centre

The bubble-wrapped building behaves like an insulated green house.



Sports federation compliance

With over 100 federations recognised by the IOC alone and many venues built to cater for multiple sports, there is a **large and complex body of procedures and regulations to comply with**

International Sports Federations

International Sports Federations (IFs) regulate the sports and events under their jurisdiction. Most IFs also have technical standards that venue designs must adhere to. These standards impact directly on space planning, on the choice of specialist sports timing and scoring equipment, and on the technical provisions required for competitive events.

Rigorous requirements for compliance

The governing bodies like the IOC have rigorous requirements at both procedural level (programme and process, candidate application and selection) and technical level (facilities, equipment and operations). Organisers of Olympic Games face major challenges around the timely delivery of venues and other facilities. For example, the Olympic Games bidding procedure involves the submission of full evidence and complete compliance within 17 major themes, to very strict deadlines.

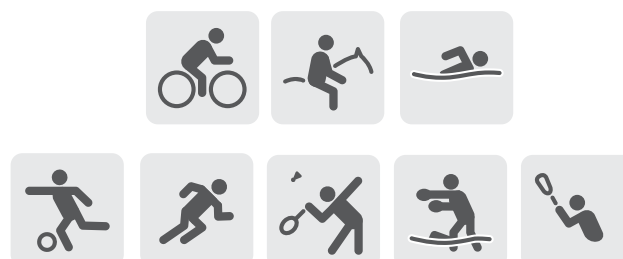
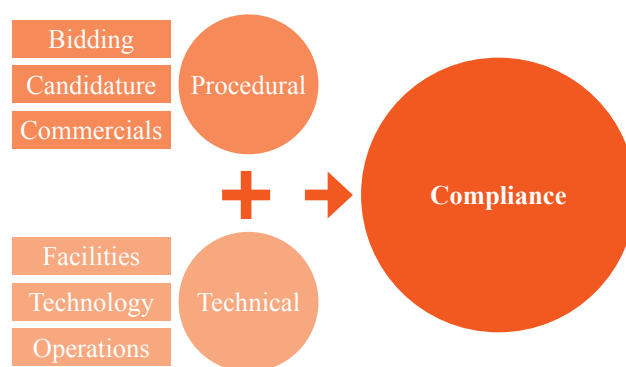
From vision to realisation, a major event life-cycle, including bidding, being shortlisted, and a design, build and deliver programme, is 12-14 years. Maximising legacy utility for the community requires upfront feasibility studies, intelligent planning and macro-economic input as well as both private finance and government backing.

Hosting a major sporting event may also mean upgrading the IT infrastructure of a whole region while integrating the technology used by IFs with existing systems and infrastructure in venues.

Our approach

Our experience in major events and working with governing bodies and IFs on sports and events compliance enables us to assist prospective candidates in applying, bidding for and creating a technical and economic plan involving facilities, technology and operations.

At a venue or park level we can define the appropriate spaces, design and specify the technology infrastructure for a range of sporting events, whether it is a 58-camera set-up for televising a FIFA World Cup™ Final or the timing and scoring system needed for a FINA national event swimming competition.



Venue management

Ensuring the built environment and technology can support all the different demands of a modern sporting venue is a key challenge

Major event venues are designed for world-class events, often major multi-sport events like the Olympic Games or a large single-sport event like the FIFA World Cup™. However, they must also cater for everyday use. As a consequence, the built environment and the technology used must retain a significant degree of flexibility.

Increased demand on intelligent information

Venue management systems must be able to handle the daily requirements of the venue management team. If a major event is planned, the number of stakeholders will multiply demand and a system with flexibility and increased capacity will be required.

There are an increasing number of affordable software packages available to venue operators. However, each of these carries out a different function. The challenge for venue operators is how to combine these different tools to derive added intelligence and data. As a result, the reliance on interfaces and integration between different tools and systems is increasing.

Long lifespan, minimal costs

Arup's approach is to design intelligent, open, modular and cost-effective systems with current and future uses in mind. We aim to design and specify systems that are leading edge but not bleeding edge, ensuring they enjoy a long technical lifespan with minimal costs.

Effective facilities management

A venue needs to have the appropriate mix of people, organisation and technology infrastructure to derive efficiencies in operation. Arup can assist both new and existing venue operators to work through the key areas of venue and facilities management in producing 'concept of operations' and technology blueprint documentation. This is invaluable when embarking on new investments, changing working practices or driving projects.





Elite athlete performance

World-class sports performances require world-class venues, and **technology is a vital ingredient in creating the perfect sporting event**

The architecture, acoustics and technology of sports venues all help to create the right atmosphere for an athlete to produce a truly great performance. Of course, a world-class sporting performance is about more than an athlete or a team - it's about creating a memorable occasion for spectators, the media and international federations.

Essential ingredients for excellent performance:

- Back-of-house facilities that operate seamlessly
- A field of play that is produced to the highest standards
- Acoustics that generate a sense of excitement, while limiting disruption to the local community
- Giant screens that add replays and analysis to the spectator experience
- Technology that enables spectators around the world to enjoy the event via TV, radio or the internet
- Availability and access to performance analytics for both coaches and players

Technology such as performance analysis software, field of play sensors, timing devices, and video and motion replay cameras is integral to an elite athlete training regime.

When Arup plans a high performance training facility, we take into account the space and infrastructure impacts on the building as well as the specification of the tools.



Above
Royal Albert
Regatta
Centre

Bottom
Prozone
performance
analysis tool



lbn
transistors
for every
human being
Source: www.foundation.org.uk

Commercial strategy

The modern sports economy has created new **opportunities and risks in technology design, procurement and operation**

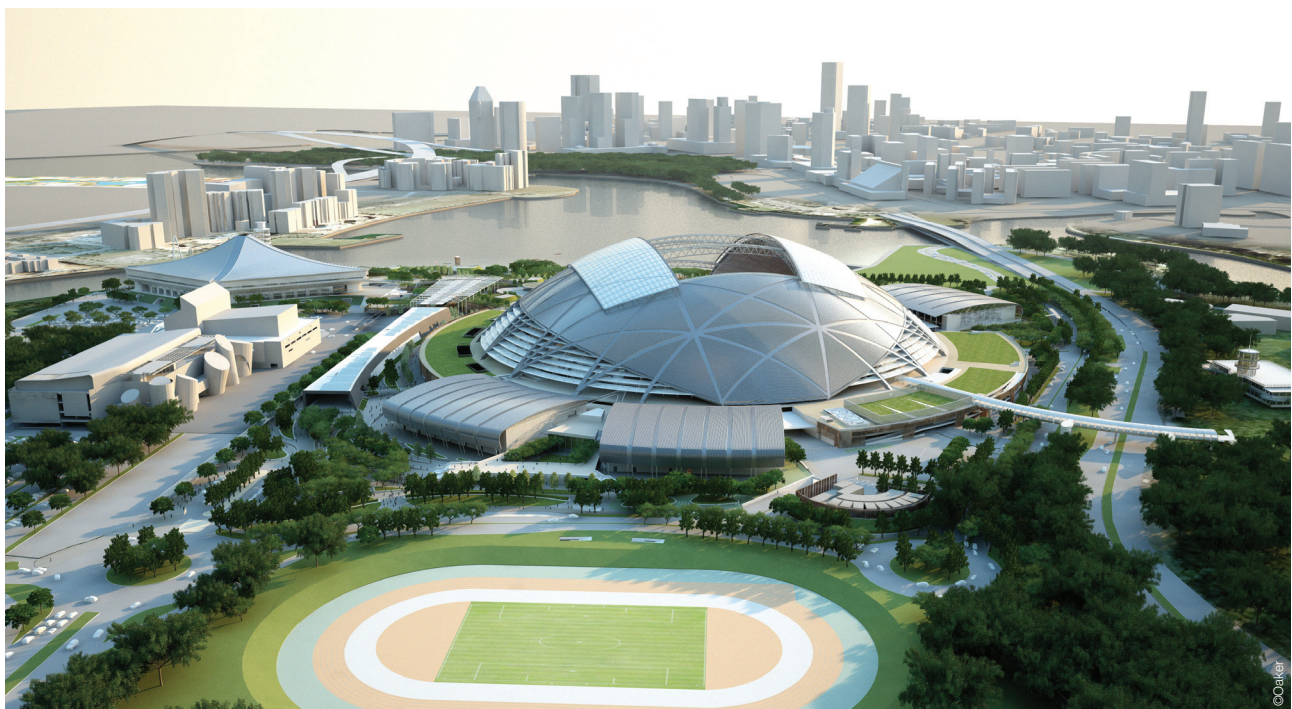
Who pays for what?

Facilities now include a range of systems that are essential for operation and overlay technologies have to be integrated with the permanent facilities. New service requirements have created outsourcing opportunities and for iconic venues there is also the potential for technology companies to sponsor entire venues and supply systems as part of the deal.

Arup advises clients on how to get the best value from technology, how to minimise risk and how to determine who should be responsible for technology provision.

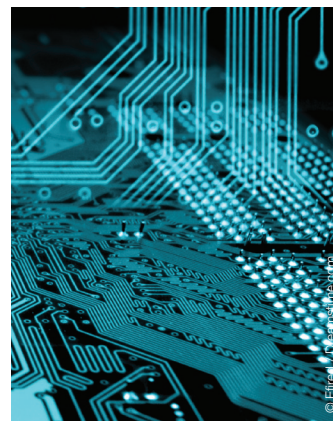
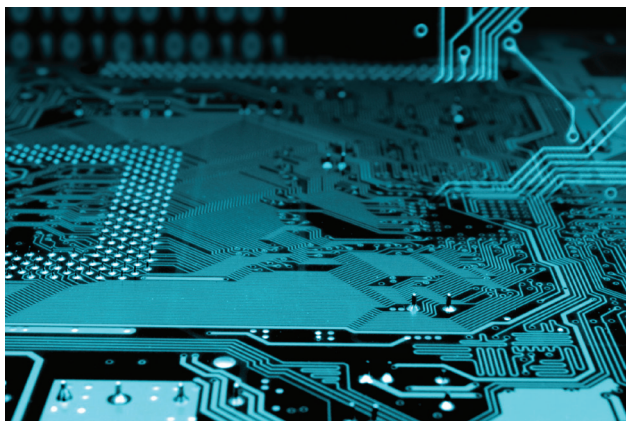
This is an approach we used recently for projects such as the Singapore Sports Hub where we engaged successfully with the project managers, project sponsors and operators to clearly determine what technology to invest in and who would pay for it at the outset. This work formed the basis of our technology strategy and created a clear baseline for the project as a whole.

Below Singapore Sports Hub



Systems integration and IT management

A successful systems integration strategy **helps clients manage the risks of complex technology projects**



50bn

machine to machine interactions by 2020

Source: www.ericsson.com

Integrated systems enable sports venues to be adapted for different uses with minimum disruption and at minimal cost. The challenge is to design, specify and deploy IT sports technology that is flexible, modular and scalable.

Early participation

Information technology and communications systems are not typically implemented until building work on a construction project is nearly complete. But it is vital to plan IT systems early on to ensure seamless compatibility later in the programme.

IT infrastructure can be very complex and requires a lot of space for elements such as duct networks, equipment rooms and cabling routes which all need to be planned from the earliest design stages. For example, a FIFA compliant football stadium could have more than 30 IT/communications rooms as well as several large telecommunications and server rooms. This is in addition to broadcaster and other media spaces.

Identification of technology needs

This planning stage involves identifying all the technologies required, clarifying who provides what and determining which systems need to interface with each other. With these requirements agreed, an IT governance and technical assurance process can ensure systems are delivered efficiently and effectively. This master systems architecture approach identifies efficiency savings and makes it easier to integrate systems.

A master systems architecture can:

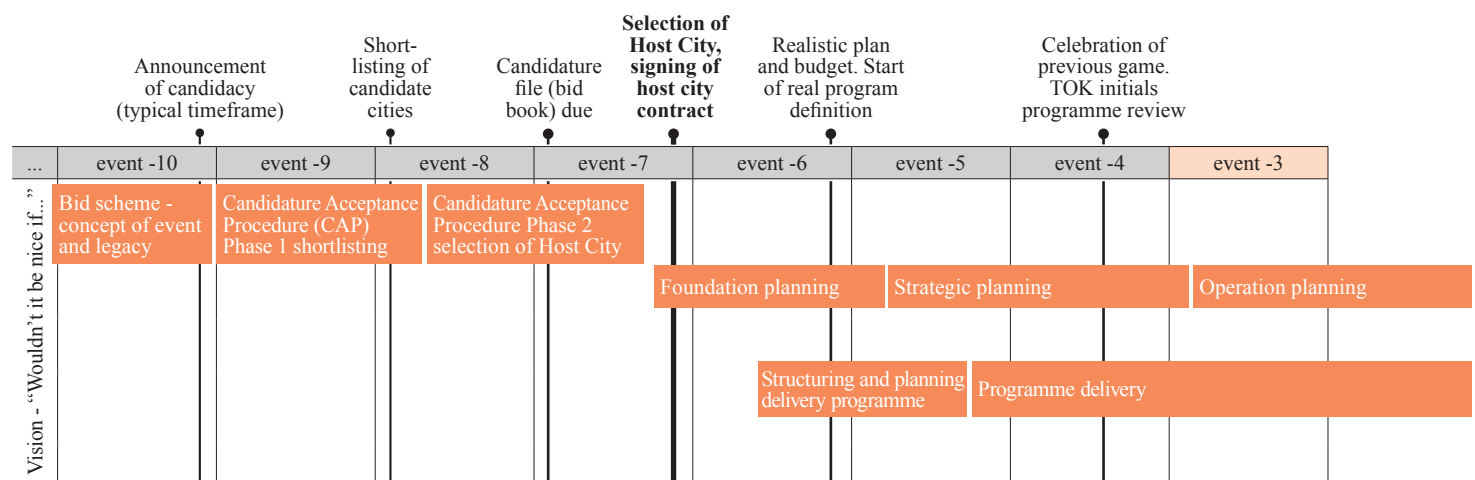
- Minimise potential risks
- Create value
- Mitigate future changes and delays to programme delivery
- Bring cost savings
- Provide systems in an environment aligned with operational requirements

Arup's technical and commercial expertise, combined with our experience of systems used in major sporting projects, is key to delivering this integrated approach. This is what enables us to deliver flexible, practical and integrated AV, IT and media solutions for sports venues.



Major event operational readiness

Major events have absolute deadlines, making it essential for all functional areas to be operating smoothly from day one. Operational readiness is the process of testing these areas to ensure they fulfill their specific roles.





Left Allianz Arena, Munich

200,000'h

are typically spent on testing and operational readiness phases for a major sports event

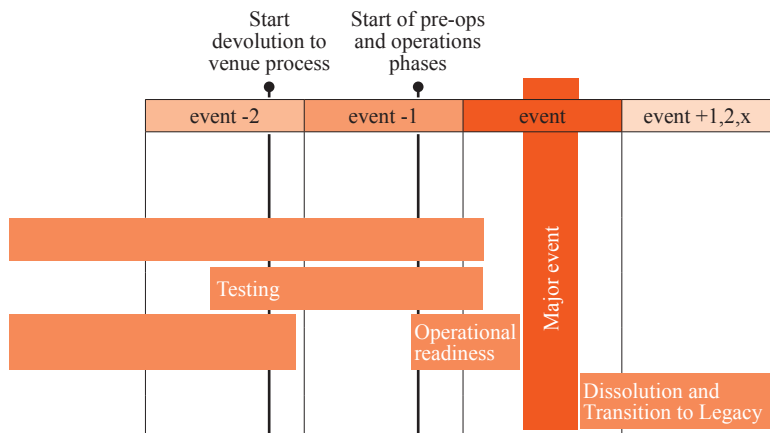
Source: www.insidethegames.biz

In the years and months leading up to the opening day of a major sports event, venues are commissioned, systems implemented and tested, people recruited and trained, and procedures designed and written. Multiple technology sponsors, suppliers and contractors share the delivery responsibility, and dedicate months of technical assurance activities to the delivery and the testing phases.

The Operational Readiness process begins by examining how the venue operates in a normal environment. Once stakeholders are familiar with this scenario, simulated exceptions to the normal operating environment are introduced, in a controlled manner, to determine how technology and people react when things go wrong. The process concludes with exhaustive testing of the operational contingency plans.

Arup deploys operational readiness skills across venue technology, security, controls, transport, IT and broadcast services, to provide a technology management and assurance service for major events.

To manage the operational readiness phase, we have developed a set of tools including behavioural analysis metrics for key staff, templates for operational procedures, table top exercises, and targeted rehearsals. We have successfully applied this toolset on deadline-dependent programmes, such as the opening of airports and for major events such as the Olympic Games.



About Arup

Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. 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 truly global. From 90 offices in 35 countries our 10,000 planners, designers, engineers and consultants deliver innovative projects across the world with creativity and passion.

Founded in 1946 with an enduring set of values, our unique trust ownership fosters a distinctive culture and an intellectual independence that encourages collaborative working. This is reflected in everything we do, allowing us to develop meaningful ideas, help shape agendas and deliver results that frequently surpass the expectations of our clients.

The people at Arup are driven to find a better way and to deliver better solutions for our clients.

We shape a better world

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Arup is a proud partner of:



www.sportsaid.org.uk

2008 Beijing
Olympic
Stadium,
Beijing,
China

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