

Introducing the world of megaprojects

Andrew Davies



Professor in The Management of Projects

Pre-sessional introduction
Wednesday 10th August 2016

Overview

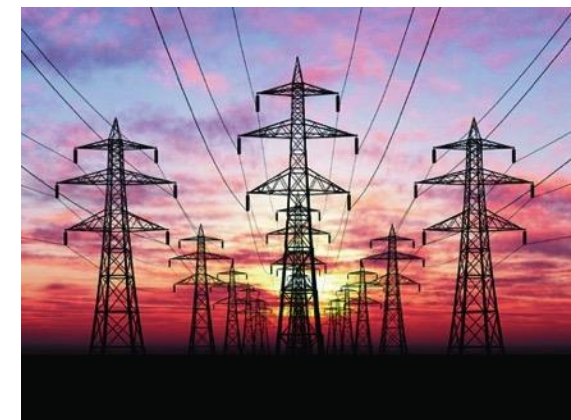
1. Megaprojects
2. Case study of London 2012 Olympics
3. Research-led teaching

Overview

1. Megaprojects
2. Case study of London 2012 Olympics
3. Research-led teaching

Megaprojects

- Strategic high-risk infrastructure projects \$1bn or more (US dollars 2003)
- Large temporary coalition of clients and contractors
- Investment in infrastructure \$57 trillion 2012-2030 (McKinsey 2013)
- ‘Productivity paradox’ (Flyvbjerg et al 2003)
- 90% are over budget (Flyvbjerg 2014)
- Need to build client and contractor capabilities to improve megaproject performance



Cost overruns in megaprojects*



* Flyvbjerg (2014) “What you should know about megaprojects and why: an overview” *Project Management Journal* 45(2)

Project	Cost Overrun (%)
Suez Canal, Egypt	1,900
Scottish Parliament Building, Scotland	1,600
Sydney Opera House, Australia	1,400
Montreal Summer Olympics, Canada	1,300
Concorde Supersonic Aeroplane, UK, France	1,100
Troy and Greenfield Railroad, USA	900
Excalibur Smart Projectile, USA, Sweden	650
Canadian Firearms Registry, Canada	590
Lake Placid Winter Olympics, USA	560
Medicare transaction system, USA	560
Bank of Norway headquarters, Norway	440
Furka Base Tunnel, Switzerland	300
Verrazano Narrows Bridge, USA	280
Boston's Big Dig Artery/Tunnel project, USA	220
Denver International Airport, USA	200
Panama Canal, Panama	200
Minneapolis Hiawatha light rail line, USA	190
Humber Bridge, UK	180
Dublin Port Tunnel, Ireland	160
Montreal Metro Laval extension, Canada	160
Copenhagen Metro, Denmark	150
Boston–New York–Washington Railway, USA	130
Great Belt Rail Tunnel, Denmark	120
London Limehouse Road Tunnel, UK	110
Brooklyn Bridge, USA	100
Shinkansen Joetsu high-speed rail line, Japan	100
Channel Tunnel, UK, France	80
Karlsruhe–Bretten light rail, Germany	80
London Jubilee Line extension, UK	80
Bangkok Metro, Thailand	70
Mexico City Metroline, Mexico	60
High-speed Rail Line South, The Netherlands	60
Great Belt East Bridge, Denmark	50

Table 2: Large-scale projects have a calamitous history of cost overrun.

The traditional delivery model

- The traditional process used to delivery megaprojects
 - Resist innovation
 - Fixed-price contracts
 - Transfer risk to the contractor
 - Client selects lowest price bid
 - Neglect learning from other projects and industries



Channel Tunnel



Wembley



National Air Traffic

London's megaproject laboratory

Heathrow Terminal 5



2002-2008

London 2012 Olympics



2006-2012

Crossrail



2007-2018

Clients lead the way

Repeat client

- “Permanent organisation”
- Strong client with in-house capability
- Participates in integrated project teams



One-off client

- “Temporary organisation”
- Strong client team works with delivery partner
- Appoints delivery partner(s) to manage programme



Overview

1. Megaprojects
2. Case study of London 2012 Olympics
3. Research-led teaching

London 2012 Olympics



Winning the bid in July 2005



Project goals

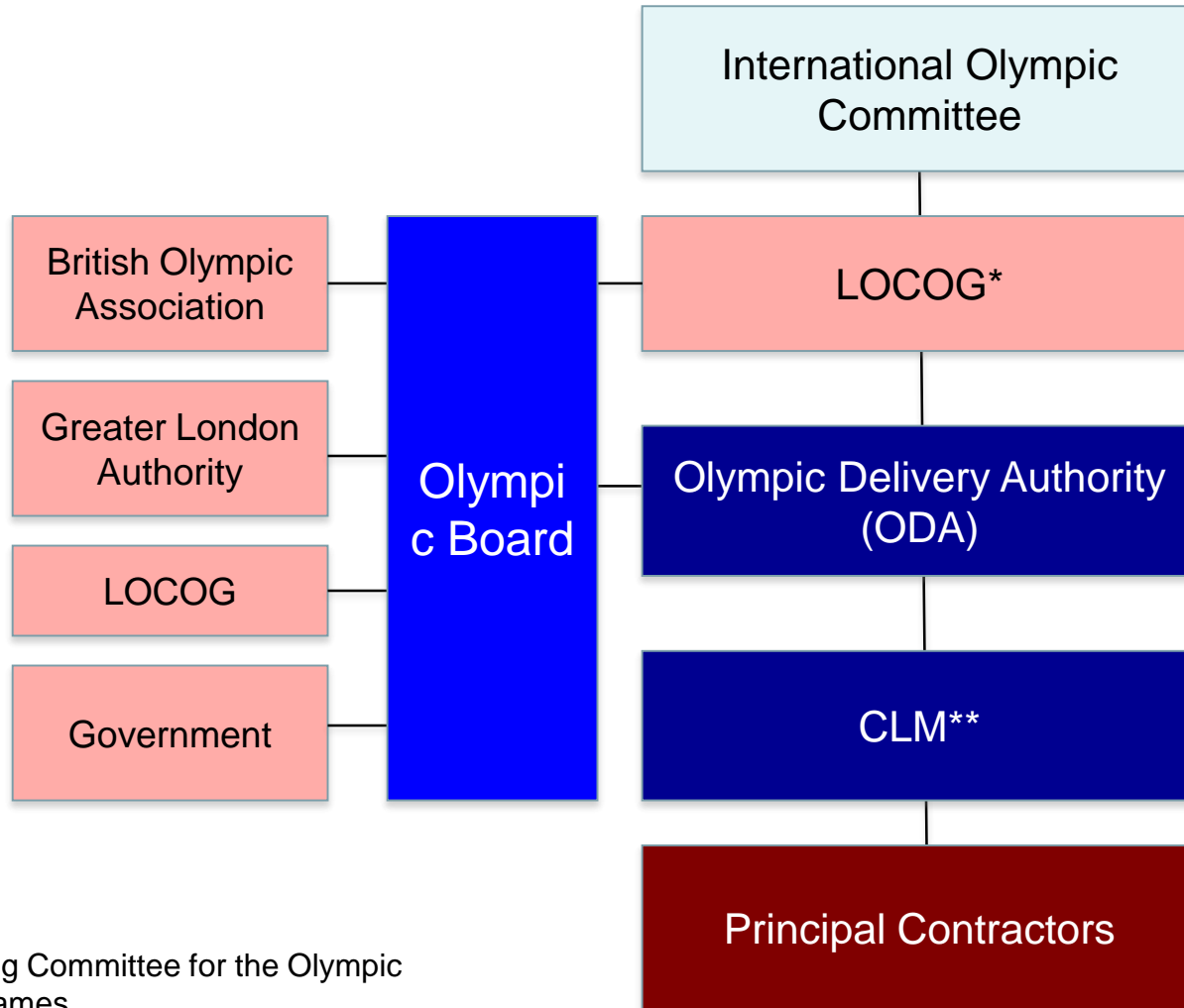
- Olympic Delivery Authority (client) created as executive public body (accountable to UK government)
- Mission: to deliver venues, infrastructure and transport for the ‘the world’s biggest event’
- Construct London 2012 and Paralympic Games on time and to budget
- Leave a lasting legacy of benefits for London and the UK (6 priority themes)
- Revised budget for construction of £8.1 billion
- Opening one year early on 27th July 2011



Timeline

- **Year 1** (2006-2007) Planning
- **Year 2** (to Beijing 2008) Demolish, Dig, Design
- **Year 3** (to 27 July 2009) The Big Build (Foundations)
- **Year 4** (to 27 July 2010) The Big Build (Structures)
- **Year 5** (to 27 July 2011) The Big Build (Completion)
- **Year 6** (to 27 July 2012) Testing, commissioning and handover for the Games

Project organisation



*London Organising Committee for the Olympic and Paralympic Games

**CH2M Hill, Laing O'Rourke & Mace

The challenge facing the ODA

Transform

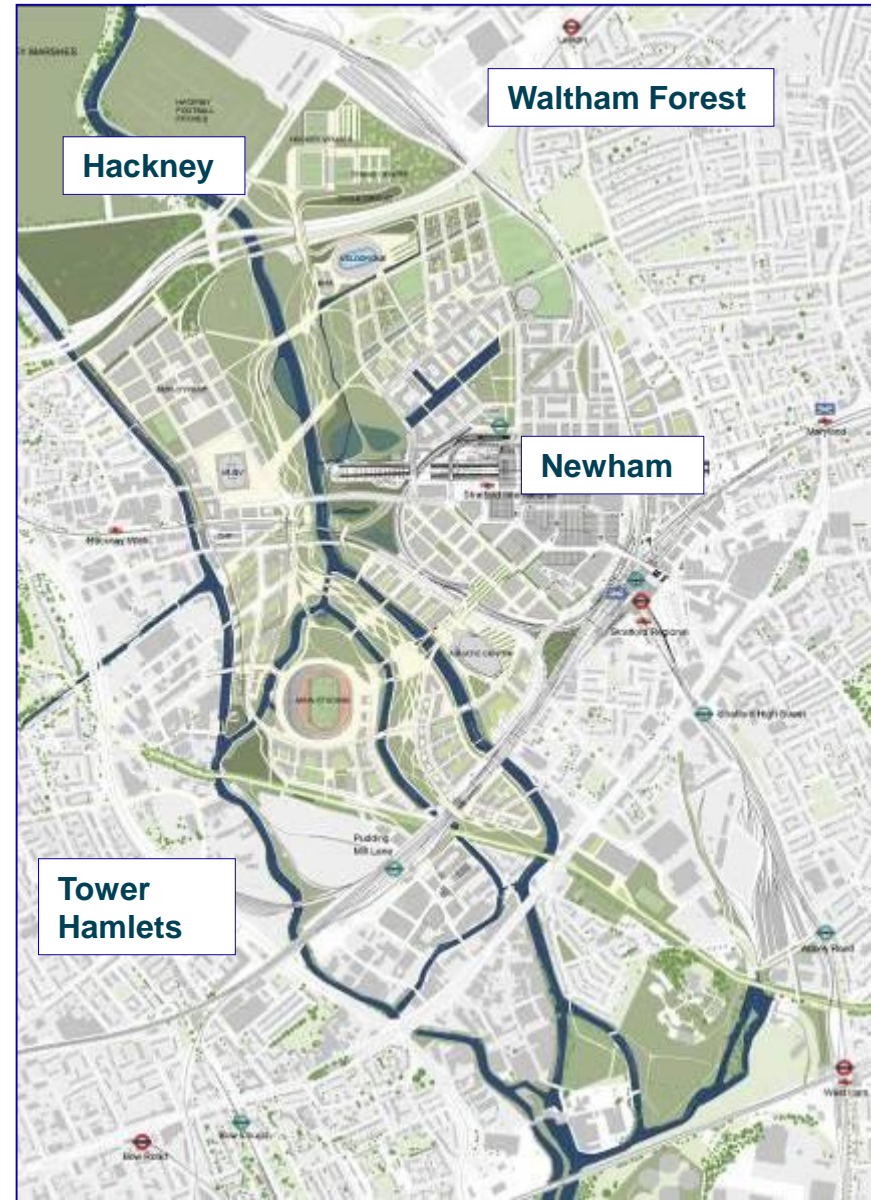
- 200 Hectares of Brownfield land across 4 London Boroughs
- Waterways and rail lines
- 200 buildings, 52 electricity pylons in situ

To

- 14 permanent and temporary sporting venues
- 20km new roads, 13km tunnels, 26 bridges, new utilities infrastructure
- 80 hectares of new parklands
- The Olympic Village

via

- Masterplanning and submission of around 750 planning applications
- Around 70 individual projects
- 300 contracts



Delivery strategic challenges

- Immoveable deadline – 27th July 2012
- Defining the budget (Original Baseline Budget – Yellow Book Nov. 2007)
- Highly visible public interest and scrutiny
- Dual objectives of venues “fit for purpose” for both Games and legacy
- Scale and complexity = delivery partner approach
- Multiple clients, often with conflicting objectives & working to different timescales
- Potential (global) reputational impact for the UK
- Large and visible public investment = requires transparency & scrutiny



Outcome

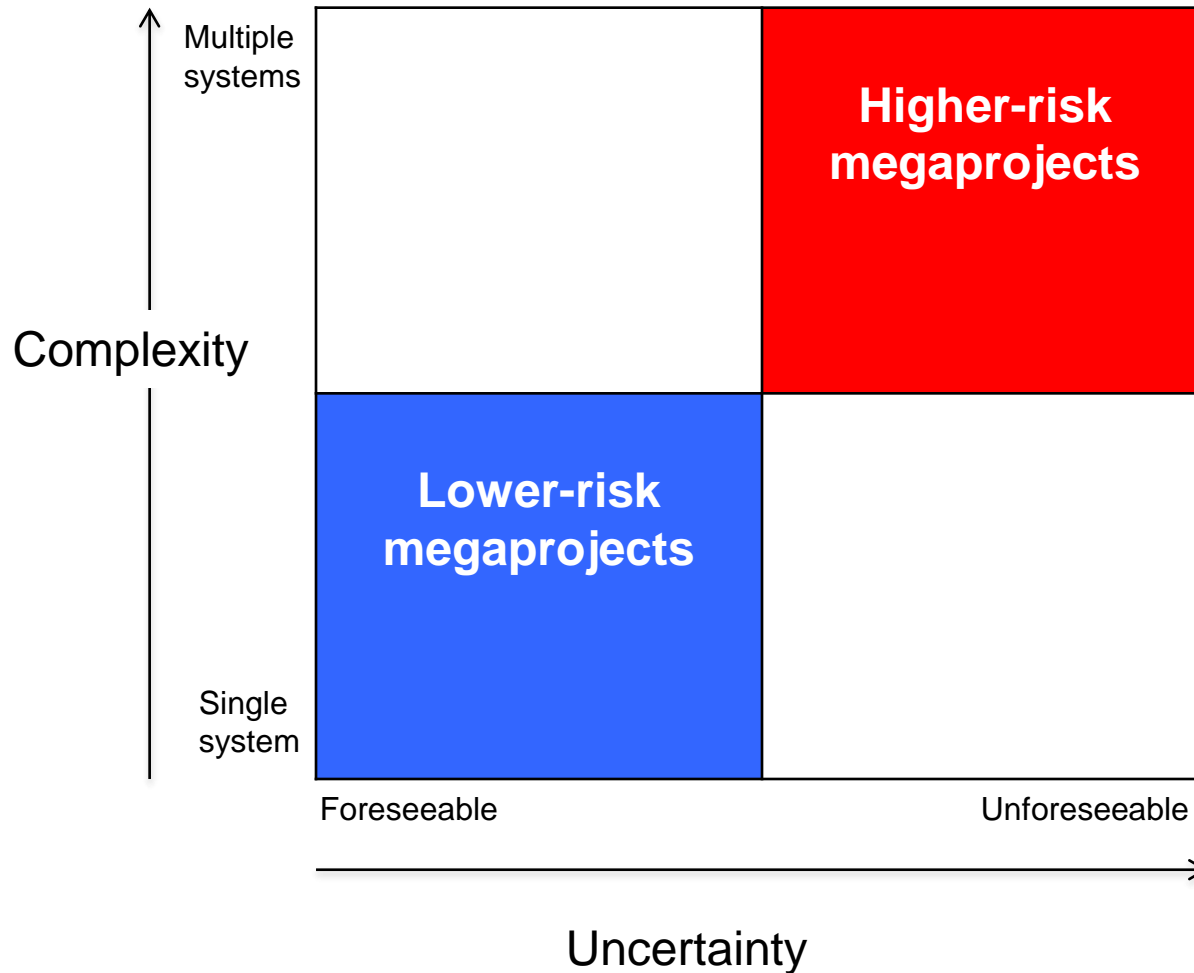
- Opened for testing on 27th July 2011
- Ready for the games on 27th July 2012
- Construction was within revised budget £6.8 billion (£8.1 billion)
- Achieved Priority Themes (sustainability, employment, health & safety, diversity, etc)
- Longer term legacy for London?



Overview

1. Megaprojects
2. Case study of London 2012 Olympics
3. **Research-led teaching**

What can we learn from the case?



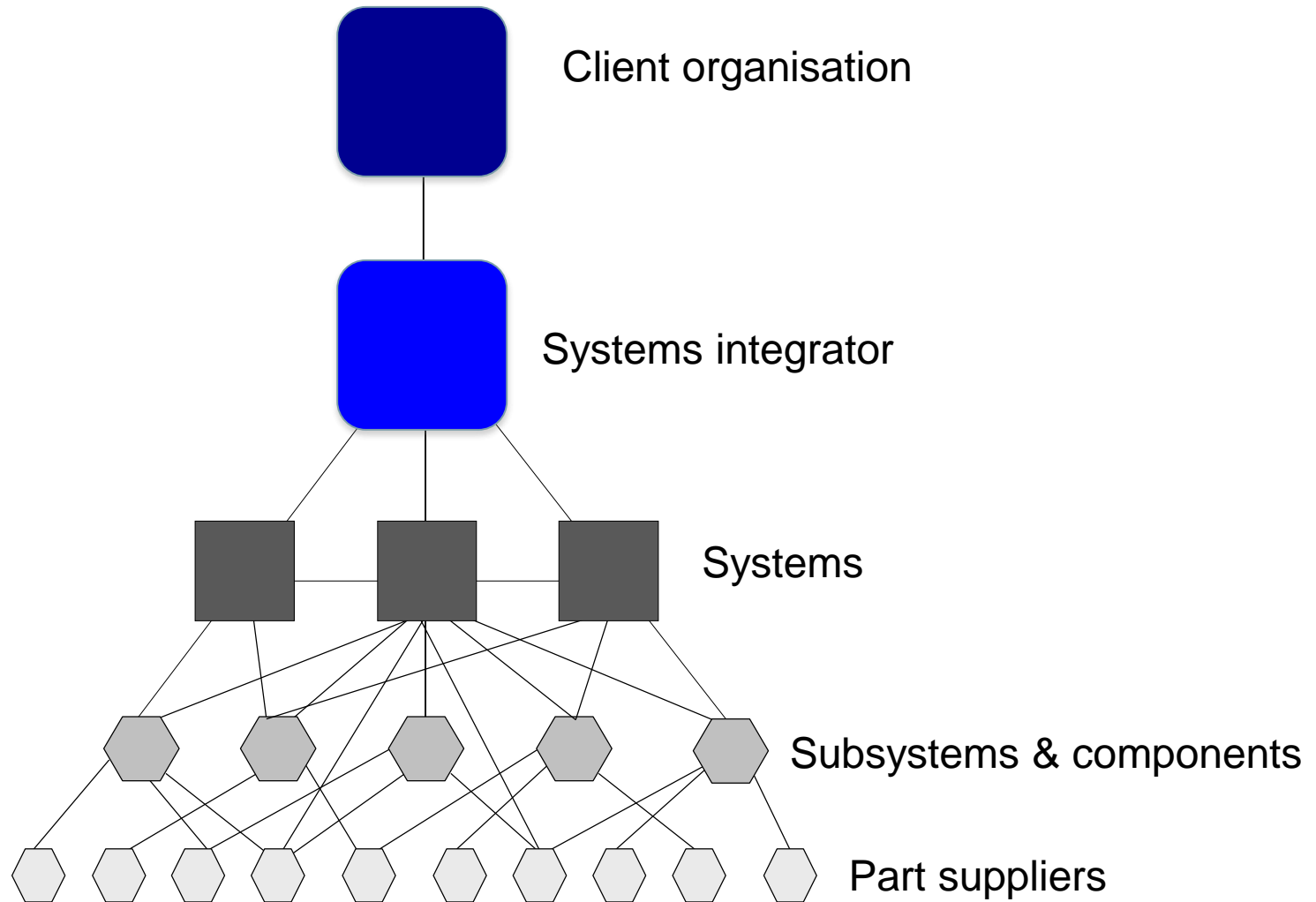
Research-led teaching: lesson 1

- How did the project cope with complexity?

System of systems project



Coping with complexity



Delivery model

- Needed mature delivery capability quickly
 - Appointed Delivery Partner with turnkey capability
 - CH2M Hill, Laing O'Rourke and Mace (CLM)
 - CLM role – project and programme management
- ODA “intelligent” (not “thin”) client
 - Stakeholder management, effective internal and external communications
 - Allowed CLM to focus on delivery
- Collaborative arrangements with principal contractors
 - Menu of contracts (New Engineering Contracts)
 - Encourage alignment of targets between contractors with differing interests
 - Contracts incorporated priority themes targets

Olympics: client and delivery partner

Sponsor
Dept of Culture,
Media & Sport

London Organising Committee of
the Olympic Games and
Paralympic Games (LOCOG)

**Olympic Delivery Authority
ODA**

Project Delivery Partner – CLM

CH2MHill
Laing O'Rourke
Mace

Principal contractors

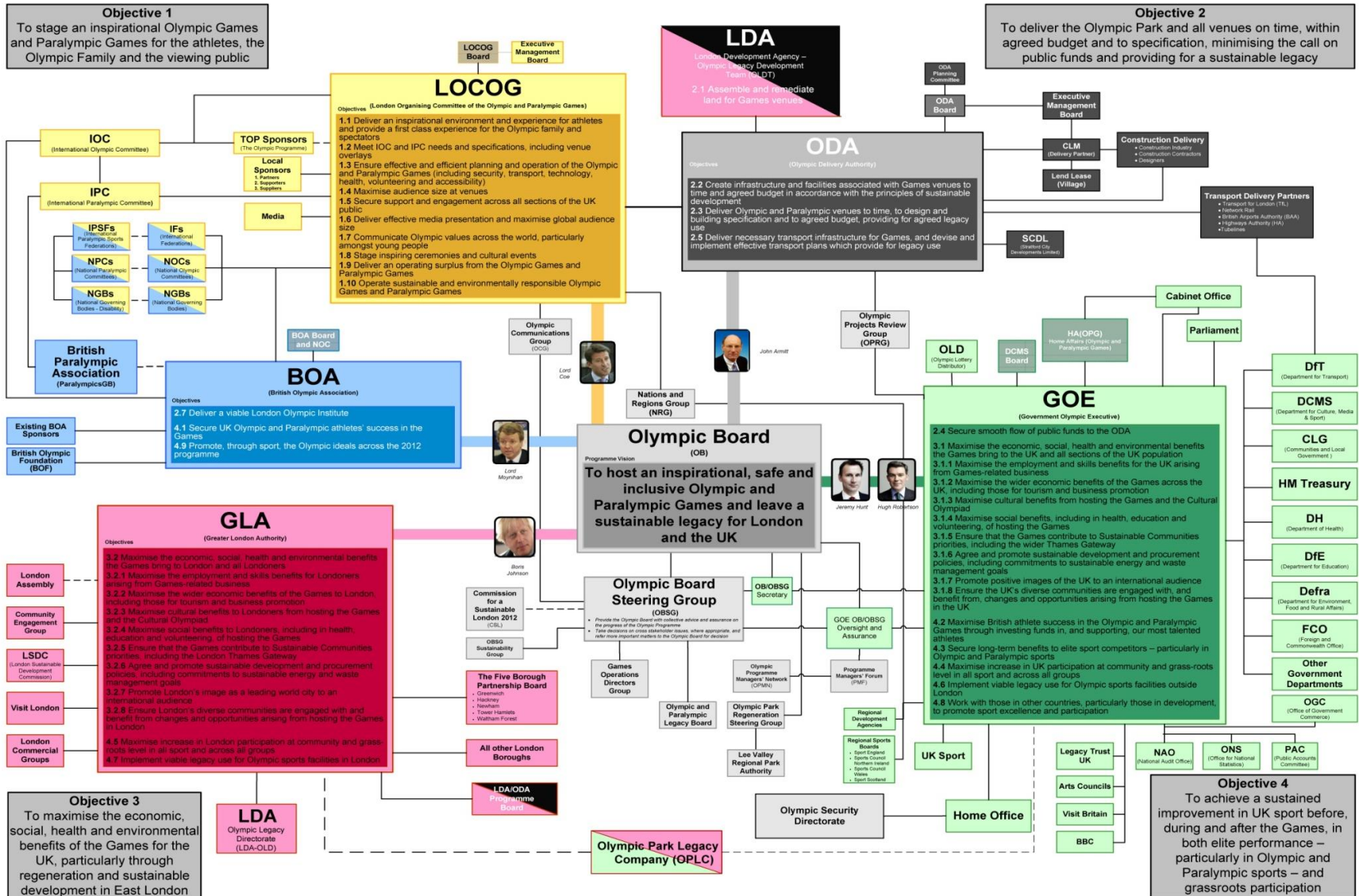
Supply chain



Integrated Project Team

Suite of NEC contracts

The ODA's stakeholder network



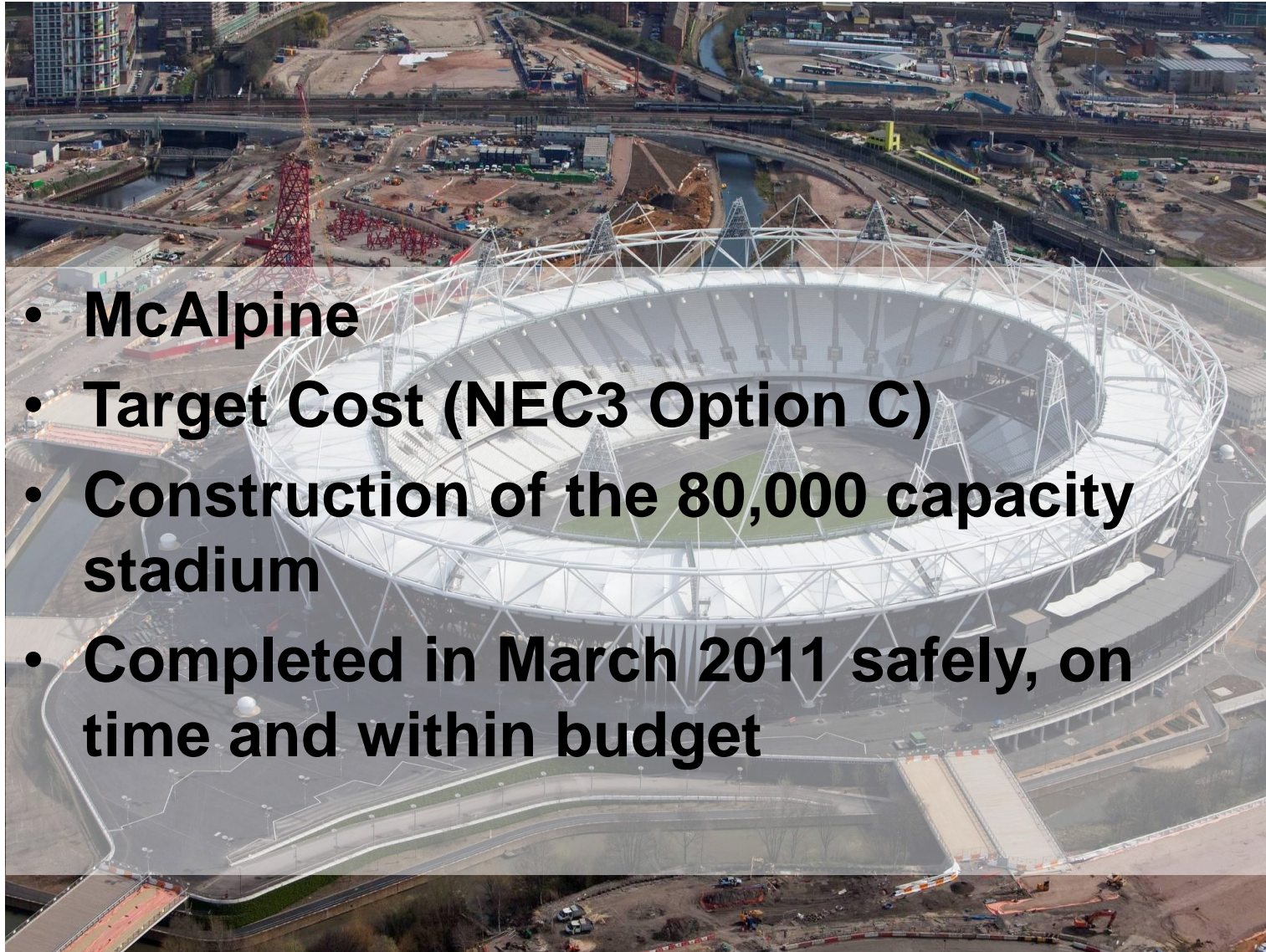
Research-led teaching: lesson 2

- How did the project deal with uncertainty?

Two types of uncertainty

- **Foreseen uncertainty**
 - Known unknowns
 - Identifiable and understood influences that the team cannot be sure will occur
 - Requires risk management with alternative plans
- **Unforeseen uncertainty**
 - Unknown unknowns
 - Can't be identified during project planning
 - Requires collaborative problem-solving and innovation

Olympic Stadium



- **McAlpine**
- **Target Cost (NEC3 Option C)**
- **Construction of the 80,000 capacity stadium**
- **Completed in March 2011 safely, on time and within budget**

Aquatics Centre



- **Balfour Beatty**
- **Target Cost (NEC3 Option C)**
- **Completed in July 2011**
- **Architect Zaha Hadid**
- **2 swimming pools & 2 temporary “wings”**
- **17,500 capacity during the games & 2,500 capacity in legacy**

Athletes Village

- **Lend Lease**
- **Changed from Construction Management (CM) to mix of CM and Design & Build (fixed price NEC3 Option A)**
- **Completed in December 2011**
- **17,000 athletes and officials**
- **2,818 new homes in legacy**



Velodrome

- ISG
- Target Cost (NEC3 Option C)
- Construction of the cycling track completed in February 2011

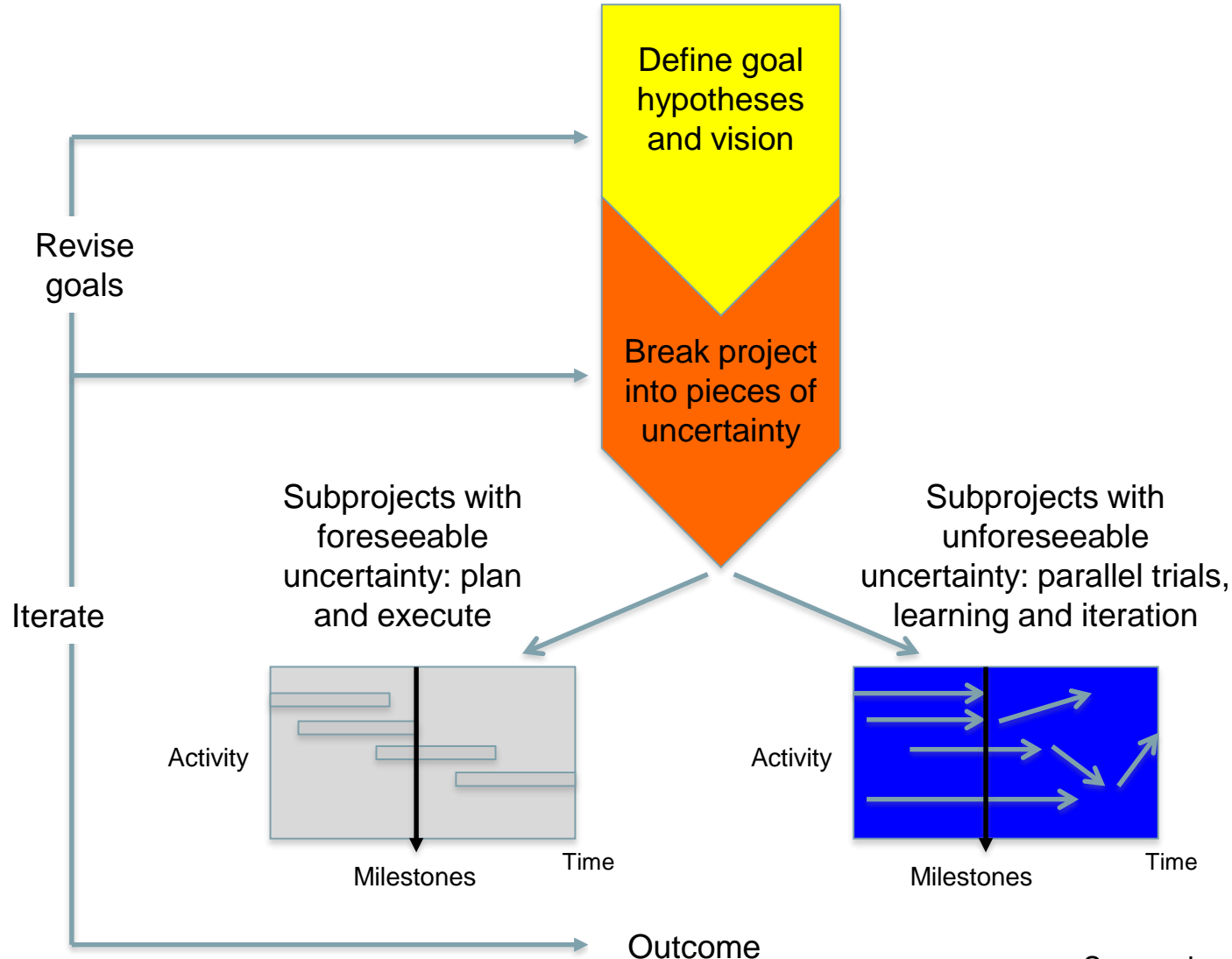


International Broadcast Centre/Press Centre



- **Carillion**
- **Design & Build (fixed price NEC Option A)**
- **Completed in July 2011**
- **Venue supported 20,000 broadcasters and journalists during the games**

Dealing with uncertainty



London's megaproject learning legacy

Heathrow Terminal 5



2002-2008

London 2012 Olympics



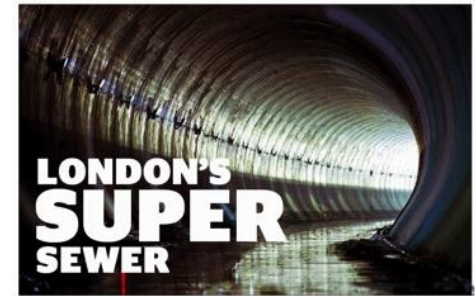
2006-2012

Crossrail



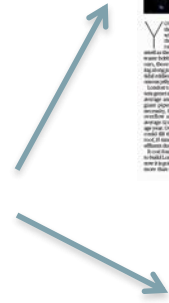
2007-2018

Thames Tideway Tunnel



LONDON'S SUPER SEWER

You'll find the companies that designed the tunnel and the ones that built it. The Thames Tideway Tunnel is a 25km long, 2.8m diameter tunnel that will carry 100 million litres of raw sewage a day from central London to the Thames estuary. It's the largest sewer in the world and will be the longest in the world. The tunnel is being built using a tunnel boring machine (TBM) and will be the longest in the world. The tunnel is being built using a tunnel boring machine (TBM) and will be the longest in the world. The tunnel is being built using a tunnel boring machine (TBM) and will be the longest in the world.



High-Speed 2



- Thanks for listening
- Any questions?