

SKANSKA



Capital Hospitals and Barts and the Royal London

Transforming London's historic hospitals



Overview

Capital Hospitals is a Skanska-led availability payment-based design, build, finance and operate (DBFO) Public Private Partnership (PPP) designed to redevelop two historic hospitals in central London. The construction project included two components:

- Demolishing 13 buildings at the Royal London and creating a new 17-story building, making it Europe's largest hospital at the time..
- Transforming the 900-year-old St Bartholomew's into a state-of-the-art cancer and cardiac center, demolishing a 1930s building and using the site for new build.

Capital Hospitals is also responsible for delivering a very wide range of services through five further sub-contracts covering: Hard Facilities Management, Soft Facilities Management, Sterile Services, Managed Equipment, and Radiotherapy Managed

Equipment. The 42-year concession with Barts and the London NHS' Trust (which was enlarged and renamed Barts Health NHS Trust in 2012) is the UK's largest ever healthcare PPP.

Construction on these busy sites was extremely complex, not least because both hospitals had to remain fully operational at all times, and was completed in several phases.

At the Royal London, phase one covered the demolition of the buildings and the delivery of 148,500m² of new build in three new towers and was completed in 2011; phase two renovated 15,600m² and was completed in 2014.

At Barts, two phases of work delivered 54,500m² of new and 13,000m² of renovated space and were completed in March 2010 and

*National Health Service

September 2014; a final phase of demolition, structural work and changes is due for completion in February 2016.

Operation, maintenance and service provision are on going at both hospitals, and the concession runs to April 2048, with services having started in April 2006 on financial close. The entire contract was worth US\$9.42bn* at Financial Close.

Construction accounts for \$1.94bn of this and facilities services the remainder, split between Skanska Facilities Services (Hard FM*), Carillion (Soft FM**), Synergy (Sterile Services), Siemens (Managed Equipment), and Varian (Radiotherapy Managed Equipment).

Skanska has 37.5% in Capital Hospitals (an investment of \$85 million), alongside Innisfree (50%), and Dutch Infrastructure Fund (12.5%). Construction was delivered by Skanska UK, with HOK as architects. Capital Hospitals, under the management of consultancy HCP, has responsibility for all service delivery and lifecycle management.

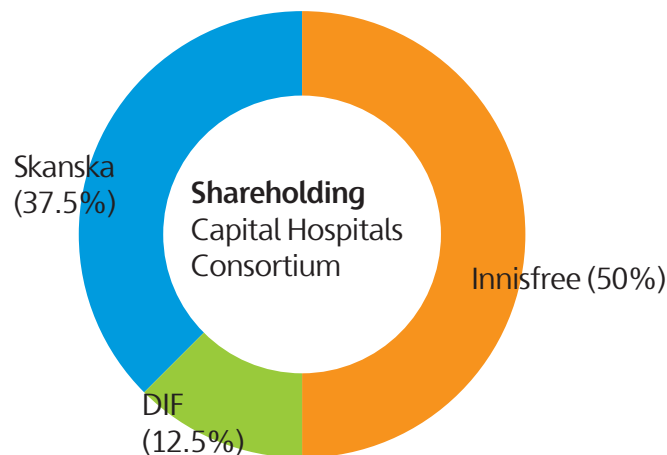
The \$1.96bn project funding was made up of \$1.32bn of Index Linked Bonds issued by Deutsche Bank and Morgan Stanley, a separate \$436 million Index Linked Loan from the European Investment Bank and \$192 million of mezzanine and subordinated debt.

Except for an 11 day delayed handover of Phase two at Barts, the construction has been delivered on-time and to budget, with the Royal London becoming one of the city's designated hospitals for the 2012 Olympic Games. In addition to working successfully on these intensely busy sites in the heart of one of the world's most densely populated cities, the Facilities Team have implemented a twenty-first century approach to building and asset management in two of the UK's oldest hospitals, and continue to invest in leading edge technologies in areas such as energy management.

* Exchange rate based on prevailing rates, from British Pound to US Dollar, at Financial Close.

** Facilities Management





Health Sector

Hospitals

Project Similarities

Complex Design-Build contract
DBFO PPP in the UK
Large financing size
Large participation by developer/contractor

Reference

Barts Health NHS Trust

The Royal London Hospital

Whitechapel Road
Whitechapel
London E1 1BB
United Kingdom

St Bartholomew's Hospital

West Smithfield
London EC1A 7BE
United Kingdom

The project in brief

Concession: 2006-2048
Construction: 2006-2016
Construction: Skanska 100%
Construction value to Skanska: \$1.94bn
Skanska investment: \$85 million
Shareholding: Capital Hospitals Consortium – Skanska (37.5%), Innisfree (50%), DIF (12.5%)

Payment Mechanism: Availability
Date of Financial Close: April 27, 2006
Construction Start Date: April 27, 2006
Concession Period Length: 42 years
Concession Period Year End: 2048
Project Value at time of Financial Close (FC) \$9.42bn

Equity Investment/Financing Size at time of FC: \$225m / \$1.96bn
ID's Equity Investment at time of FC (and percentage): \$85m (37.5%)
O&M Value at time of FC: \$7.48bn

Design and construction of the Royal London Hospital

Phase one – demolition of existing buildings and delivery of 148,500m² in three new towers – completed 2011
Phase two – refurbishment of 15,600m², completed 2014

Design and construction of Barts Hospital

Phase one – begin construction of new hospital and refurbish existing building as catering facility for whole hospital – completed 2010
Phase two – complete construction by joining new and ancient buildings under a single roof (a total of 54,500m² new and 13,000m² refurbished space) – completed 2014
Phase three – final demolition, structural work, new car park and changes to Phase one – completion due 2016

Management by HCP of Capital Hospitals and its six contracts:

Construction – Skanska, plus architect HOK
Hard FM – Skanska Facilities Services
Soft FM – Carillion
Sterile Services – Synergy
Managed Equipment – Siemens
Radiotherapy Managed Equipment – Varian



The challenge

Barts Health NHS Trust is the largest hospital group in the UK's National Health Service, with government revenue of £1.25bn and 14,000 staff providing healthcare to 2.5 million people to the east of London. At the heart of the Trust are two historic hospitals, St Bartholomew's (Barts) and the Royal London that have been operational for hundreds of years. Barts, near St Paul's in the City of London, was founded in 1123, making it the UK's oldest hospital. The Royal London in the city's culturally diverse East End was founded in 1740 and has been on its current site since 1757. It was once the home of the so-called 'elephant man'.

Although the Trust has a long tradition of clinical excellence, by the mid 1990s the buildings themselves, some of them up to 200 years old, were out dated and in poor condition. The UK government decided that a new hospital at the Royal London and upgraded capabilities at Barts should be created to provide 21st century healthcare for local people, putting patients at the heart of a transformed hospital experience and developing buildings that would adapt to future needs.

After many years of complex planning and review, a Public Private Partnership project embracing both hospitals was awarded to a Skanska-led consortium in 2006 covering:

- A new hospital at the Royal London, at the time Europe's largest hospital.

- A cancer and cardiac center of excellence at Barts.
- A 42-year concession to operate and maintain the hospitals, including sub-contracts to deliver a broad range of services including clinical support services, such as cleaning, catering and laundry, medical and radiotherapy equipment and sterile services, as well as Hard FM.

The program is one of Skanska's largest ever developments and one of the largest PPPs in Europe. In addition to the new hospitals' 1,248 patient beds, Barts will have eight operating theaters and the Royal London 22. Both hospitals are now fully operational and the construction project will complete in 2016.

Making sure that the hospitals' services continued with minimum disruption throughout the construction period (final completion due 2016) was critical and has delivered the following benefits across two new hospitals:

- Better access to care through co-located clinical services
- Improved quality of care by allowing new clinical models
- Better environment
- More cases treated (1.4 million outpatient attendances in 2014 up from 868,000 in 2010)
- Reduced costs
- Improved staff recruitment and retention.

Two separate construction programs, each with unique challenges

Overall

- 203,000m² new build
- 28,600m² refurbished
- 30 operating theaters
- 9,955 rooms
- 1,248 patient beds
- 1,070 showers
- 2,000 WCs

The project has covered the challenges facing a unique mix of new and old buildings, from dealing with Roman remains in the basement to integrating state-of-the-art structures with 18th century landmarks. It consistently demonstrates a number of Skanska's unique capabilities:

- Scale – coordinating two overlapping healthcare construction projects several miles apart in one of the world's busiest cities is a massive challenge. Few companies but Skanska would have the resources to deliver it.
- Working on tight city sites – both hospitals were constructed alongside existing, working hospital buildings. Barts is a very constrained site subject to unusual planning regulations. The Royal London required

construction alongside live neonatal wards and completion of 5,000 rooms on a single day. Planning, innovation and care were critical.

- Partnership – these two major sites affect many stakeholder groups, both within and beyond the hospital. Our team has made consistent progress by creating strong partnerships that embrace all the groups affected by the projects, from staff and patients to the local community.

The redeveloped hospitals are designed to create indoor environments that promote patient healing and enhance the experience of both employees and visitors. The wards are light and airy and have large windows and glass atria to allow natural light into the buildings. The buildings are fully air-conditioned and incoming air is filtered to ensure that pollutants from the surrounding city do not compromise the sterile hospital environments. Non-toxic and water-based substances, such as vinyl floor adhesives, were also used indoors to avoid air pollution.





The Royal London

- Two 17-story and one 10-story towers
- 4.5 million man-hours at construction peak (1,800 people on site)
- 175,000 tonnes of concrete – 1.5 times the weight of a Boeing 787 “Dreamliner”
- 12,000 deliveries of concrete – 50 to 100 truck deliveries every day
- 7,000km of metal reinforcement – the distance from London to Miami
- Total floor area equal to 23 soccer fields with a total perimeter of 16km
- London Air Ambulance helideck at 85 meters – as tall as Big Ben

The hospital was largely rebuilt with 738 beds, a relatively small number, being complemented by very extensive day care facilities to increase the number of treatments while reducing the need for expensive overnight stays. Most clinical services, including London’s leading trauma and emergency care center, the capital’s second largest children’s hospital and one of Europe’s largest renal units, are housed in a new landmark 17-story building that was completed in 2012 in time for the Olympic Games. London’s Air Ambulance, which is based at the hospital, operates from the top of the new building.

The project involved demolishing 13 buildings and building the new space all within meters of the existing hospital, which continued its work throughout the entire program. In addition to relatively simple measures, such as scheduling noisy activities around quiet hospital periods,

and using low-vibration rigs in areas close to hospital buildings, we also adopted more innovative approaches, including:

- An acoustic screen of the type typically used at rock festivals, was used to reduce noise and vibration disturbance in the children’s intensive care unit, which is 2.5m from the building site. The six-story high screen covers the entire façade and reduces noise by around 25 decibels. The screen has a design lifespan of 25 years and is supported by a scaffold, which avoided the need to excavate and create waste spoil.
- Dust and noise disturbance was minimized during demolition by demolishing buildings floor by floor. Demolition sites were sealed off and designated drop zones were established to reduce dust pollution. Monitoring stations, linked to the UK Air Quality Network, were established at both sites. The stations send text message and email alerts to the construction team when the level of small dust particles (PM10s) exceeds background levels. The sensors are so sensitive that they have recorded PM10 dust from forest fires in Eastern Europe and high pollen counts in the Netherlands.

These activities were so effective that at one point piling work taking place only a meter away from the children’s hospital went completely unnoticed by its occupants. One clinician said that she felt the hospital had been ‘wrapped in cotton-wool’.



Barts

The site of St Bartholomew's Hospital is extraordinary by any standard. It has been the location of a hospital since 1123, with a range of nationally important eighteenth century buildings crowding available space on the ground. It is also very close to St Paul's Cathedral in an area governed by unique planning regulations designed to protect the line of sight to the cathedral from miles around, which limits the scope for building upwards. To maximize the use of available space and meet the needs of clinicians for future proof space, our design incorporated a number of important elements:

- Using the site of a historically unimportant 1930s building for a new building that would be joined to an existing structure under a new atrium. Having created the standalone new build, we then had to take the back off the existing, 100-year-old King George V building and 'jack' it up with two hydraulic columns while we underpinned it and integrated it with the new structure via the new roof.
- Working with clinicians to develop a design that would meet their needs now as well as being flexible for new and possibly larger diagnostic and treatment equipment in



future. The first floor alone was set aside for imaging, including MRI, CT and ultrasound scanners, plus catheterization theaters and seminar rooms, all of which have different and competing demands. In most cases, the selection of medical technology increases the complexity of design, with clinicians understandably wanting to wait for the latest equipment without wanting to be constrained by its physical dimensions. Our approach here has been to create a ‘future proof’ floor design with a considerably larger than normal grid, but then to ensure that any

equipment selected fits into this space. The first floor design was not completed until 2009, after the selection of the two MRI scanners, on CT scanners and eight X-ray machines. The walls are designed to be removable to allow equipment to be delivered and changed.

Getting the design right has been a fundamental part of our success, and BIM and virtual reality design techniques pioneered here are now helping the next generation of hospitals we are designing.



Keeping London moving in two intensely constrained sites

A key feature of the Royal London site was that it had only one entrance, by which all personnel and materials had to enter and all construction waste had to leave, using the narrow local streets in this historic part of London. At Barts, the extremely constrained site created numerous challenges: where to create the new facilities, how to gain access for staff and materials, where to store construction materials, what to do with waste, how to

maintain the normal flow of the heavy traffic around the site, how to deal with neighbors, both commercial and residential, including the Merrill Lynch HQ and Bank of America financial trading floors, which are both adjacent neighbors. These businesses were extremely concerned that vibration from the construction site might affect their IT systems, interrupting the performance of applications



Skanska's programs integrated design, construction, prefabrication, logistics and stakeholder management to work effectively within the constraints of the sites. Our successful delivery of the programs was based on a number of specific activities:

- Pre-construction planning embraced traffic assessment and a traffic management plan, co-ordinated with off-site prefabrication of many elements of the buildings.
- 'Just In Time' delivery used an off-site Construction Consolidation Center to store construction materials before they were transported to the site exactly when needed. Consolidated loads from the center reduced transport emissions and vehicle journeys into central London by around 75 percent. The initiative restricted the volume of material on site, reduced waste and contributed to a safer working environment.
- A detailed access plan covered all vehicles in and out of the site, with trained traffic stewards dealing with pedestrians and traffic throughout the day.

- Communications, we combined regular updates to local residents and other stakeholders about general traffic conditions, with warnings and alerts about specific activities that would disrupt traffic. We reached out effectively to Merrill Lynch and the Bank of America to reassure them that our noise and vibration protocols (described above) would ensure we did not disrupt their activities.

To meet the St Paul's sightlines considerations, a specially constructed roller blind disguises rooftop plant units.

Both of the new hospitals have been built on difficult sites in the middle of busy city streets where heavy daily pedestrian and road traffic is a fact of life.



Creating a sustainable solution

The Barts and the London project was constructed to meet the NHS Environmental Assessment Tool (NEAT) rating of Excellent. To achieve this rating, we incorporated sustainability into every stage of building design, construction, commissioning and management, and the new buildings use as many elements prefabricated offsite as possible. These include 1,200 external stone and concrete cladding panels and 1,000 pipe modules that carry up to nine services, such as duct work, oxygen, nitrogen, water and cable trays. The prefabricated materials were manufactured in a purpose-built Skanska factory with excellent recycling facilities to avoid waste.

We also focused on a number of key areas to ensure the sustainability of our processes, such as:

- Demolition waste management – at the Royal London we demolished 12 six-story

buildings, a seven-story building and several low-rise structures and recycled a total of 96 percent of the demolition waste. Buildings to be demolished were first soft stripped by removing all fixtures, fittings and salvageable recyclable materials, along with hazardous and non-recyclable materials. Many salvaged materials were sorted on site and sold to private buyers, such as sinks, ceiling tiles, chimneystacks, railings, radiators and 250,000 bricks.

The buildings were then systematically demolished, which generated approximately 37,000 tons of material, 4,500m³ of which was crushed and reused at the Royal London for the piling mat. Other inert materials were segregated and sent off site for crushing, screening and recycling at a Materials Recovery Centre with a high recovery rate.



- Environmentally responsible construction materials - each supplier had to identify any high Volatile Organic Compound (VOC) or toxic materials at the project planning stage, which resulted in the early elimination of potentially harmful substances. Skanska also worked to improve the environmental performance of its contractors, one of which became the first block work company to achieve ISO 14001 certification in the UK. All timber used on the project was from sustainable sources certified by either the Forest Stewardship Council (FSC) or the Program for the Endorsement of Forest Certification (PEFC).
- Packaging, inspired by the automotive and retail sectors we pioneered the use of Returnable Transit Packaging (RTP) to transport mechanical and electrical products, such as 30,000 light fittings. RTP uses robust plastic crates that can be collapsed and returned to suppliers for reuse. The technique reduced cardboard packaging waste by approximately 8 tons. RTP further reduced waste by decreasing the incidence of damaged goods, which can be as high as five percent for light fittings when delivered on conventional pallets.
- Waste targets – we agreed strict targets with suppliers and developed a real-time waste management database tool to monitor them for each waste stream. Subcontractors are held responsible for any waste they create and receive financial rewards or penalties of \$160 per ton if their estimated waste quotas are either met or exceeded.

As a result of our strong waste management culture and skill at segregating and recycling general demolition waste, we sent 0% of the project's waste to landfill.

The project has won numerous sustainability-related awards, including a Corporate Social Responsibility Award from Construction News, a national Innovation Award from Constructing Excellence, a Waste Management Award from the Chartered Institute of Waste Management and a Sustainable Procurement Award at the national Sustainable City Awards.



Improving quality and reducing cost throughout the life of the concession

Our consortium provides services to operate and maintain equipment including:

- 5 linear particle accelerators (Linacs)
- 5 MRI scanners
- 6 CT scanners
- 17MVA standby generation
- 18MW chiller capacity
- 28 operating theaters
- 39MW boiler capacity
- 48 x-ray units (including dental)
- 90 baths
- 240 air-handling units
- 10,000 medical gas points
- 27,500 sprinkler heads
- 350 circulating pumps
- 21,000 fire alarm devices
- 30,000 voice and data outlets
- 35,000 luminaries
- Power Outlets; ERM total is circa 90,500

The Barts and the London New Hospitals includes one of the broadest service packages ever developed for a Public Private Partnership. Five subcontractors, including Skanska for Hard FM, are managed against strict budgets and service targets by a Capital Hospitals team supplied by the consultancy HCP.

While the initial investment in the new building was carefully controlled to provide value for money, the unusual length of the concession (42 years) means that there are further opportunities to create substantial savings in the decades to come. To this end, all of the service providers are focused on innovation that reduces cost while maintaining or improving quality. For service staff, many of whom transferred into the service partners from jobs in the old hospitals, the culture shock has been intense. The transition from patching and mending a 200-year-old building to



proactive maintenance on a high-tech, airtight hospital has been described as like getting a new job on a spaceship.

A culture change program for staff such as these has encouraged innovation and begun to deliver ideas and performance improvements in areas such as:

- Energy efficiency - hospitals typically use large quantities of energy for clinical processes and efficient medical equipment combined with high performance insulation and glazing was built into the design, saving energy we are contracted to provide. However, our team has pushed beyond our contract and helped fund a new Combined Cooling, Heating and Power (CCHP) system in the new Barts energy center. The \$3.75m, 1.4MW GE Jenbacher system will be installed by 2016 and is expected to deliver substantial savings and additional electricity that can be sold to the national grid. The system is also being painted bright pink to raise money for breast cancer research. Our FM team is also working hard on generating innovative ideas. Some of these may seem small scale, but add up to major savings over the lifecycle of the buildings. For example, simply replacing tube lights with LEDs in the 25 elevators at the Royal London will save approaching \$2m during the concession.

- Asset management – Concept, a new Computer Aided Facilities Management (CAFM) system allows the maintenance team to use mobile technology to report on their activities, which will reduce administration time and cost as well as eliminating paper reports. Combined with advanced telemetry to report on many of the 200,000 different components that require maintenance, Concept is transforming the quality and efficiency of maintenance. Biometric sign-in terminals for maintenance staff instantly show the control room which operatives are on site to support rapid and accurate planning.
- Infection control – Hospital Acquired Infections (HAIs) are a real concern in healthcare environments and Soft FM partner Carillion is running the first UK trial of a US system that uses both ultraviolet light and ozone gas to wipe out harmful bacteria.

Our work at the hospitals runs through a unique range of facilities and services. From a simulation showing operations captured by surgeons wearing Google Glass, and advanced Linac radiotherapy equipment for treating 100 cancer patients a day, to meals specifically designed to speed up healing, we're making a genuine difference to patients and the clinicians who are treating them.

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