Start to finish – in just six months

Ian Hinitt, deputy estates director at Bradford Teaching Hospitals NHS Foundation Trust, and project director of an ambitious "ultra fast-track" modular ward development at Bradford Royal Infirmary, describes the numerous challenges in getting the building completed in just six months, extolling the virtues of Partnering and Framework Agreements and a systems approach to project managing ultra-fast track hospital accommodation construction developments.

One might be excused for considering Bradford Teaching Hospitals NHS Foundation Trust (BTHFT) just another stereotypical NHS facility. However, despite having suffered several abortive strategic redevelopment schemes, including withdrawing from a PFI Northern Batch development, Bradford Teaching Hospitals NHS Foundation Trust boasts the safest healthcare in the north of England.[1] This is despite its ageing hospital accommodation, which is in need of significant redevelopment.

Dated premises

Bradford Royal Infirmary was developed in 1934 for the formation of the NHS, at which time it was considered a "state-of-the-art" hospital, providing acute healthcare services from Nightingale ward accommodation for the City of Bradford. In common with many UK hospitals, it has a high demand for beds, but also suffers the additional pressures of dated premises and infrastructures, now requiring significant investment to redevelop to meet stakeholder expectations and those which accord with modern healthcare practice and standards, as recommended by Lord Darzi.[2]

Lack of any decant ward facilities has been particularly restrictive in facilitating a much needed Nightingale ward refurbishment programme, and the perennial winter pressures associated with increased emergency admissions compound matters further by significantly increasing the risk of failure to meet Department of Health (DH) infection reduction targets, such as the *Clostridium difficile* target set out in the Government's comprehensive spending review.[3]

In response to the issues around ward accommodation, and in an urgent response to minimise the human and financial impact of failure to meet DH-imposed *Clostridium difficile* targets, BTHFT began recently to consider the merits of modular ward construction as a potential solution.

Construction innovation, and particularly modular construction, was not new to BTHFT; the Trust had partnered successfully with Yorkon in 2002 in constructing what was known to be Europe's largest modular hospital construction of its type, providing six operating theatres and three wards within a 15-month programme, from inception to completion.

> BTHFT recognised the risks in overdeveloping its estate in an uncertain local health economy

Uncertain health economy

BTHFT recognised the risks in overdeveloping its estate in an uncertain local health economy, where traditional services are being relocated and re-provided within community-based hospitals and local treatment centres. It was thus felt important to provide additional ward accommodation that met the immediate need to provide decant wards and expansion for winter pressures, while leaving scope for a continuing and future phased site redevelopment.

The Trust's Business Planning team had established the need for an additional two wards to service the immediate seasonal requirements, and the estates department was tasked with investigating the feasibility of a short-term temporary modular ward development project, which would need to be completed before the

Construction work in various stages of progress; the close proximity of existing hospital structures led to a number of challenges for the on-site team.

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Three-dimensional rendered images of the ward interiors within the new building.

onset of winter this year, and the season's accompanying clinical pressures, traditionally occurring with the rapid and exponential onset of norovirus outbreaks in January.[4] The estates team concluded that, due to the site topography and the high costs associated with extensive enabling and ground excavations, a short-term temporary modular development would be uneconomical.

However, a permanent ward development was another question, and one which would now require further investigation and significant innovation. In returning to the brief on 1 July this year the Trust's executive directors instructed a feasibility study into a permanent 3,000 m^2, three-storey extension building, comprising ground floor clinical and non-clinical general accommodation, with the first and second floors incorporating two 28-bed wards.

Seemingly impossible challenge

However, the seemingly impossible challenge was to complete the ward accommodation before the commencement of winter pressures, i.e. before Christmas 2008, and within a six-month turnaround from inception.

Traditional construction techniques were immediately discounted, as it was impossible to conceive the construction of a 3,000 m^2 facility within a six-month time frame. However, modular construction was a remotely conceivable solution.

As Miles Scott, Bradford Teaching Hospitals chief executive, explains: "The estates department rose to the challenge and immediately briefed its recently appointed Design Framework Partners, established through innovation and in anticipation of the need for fast-track developments at Bradford Hospitals. While Bradford Teaching Hospitals NHS Foundation Trust is a true commercial trading entity, like all public sector organisations it is still required to satisfy organisational Standing Orders and Financial Instructions, for the sake of public accountability."

The BTHFT Construction Design Framework agreements had been established based upon traditional tendering of construction models for a host of professional services, including project management, architectural design, quantity surveying and cost management, structural and civil engineering, and building services engineering. The BTHFT Estates team had developed their Framework Agreements in the spirit of the NHS response to the Egan Report, "Rethinking Construction",[5] resulting in the renowned NHS ProCure21 initiative. The Trust had also engaged with local construction and design specialists, in support of its commitment to working within its local community.

'Marathon task'

Andy Bridger, project architect and director at architects Healthcare Design Partnership, (HDP) comments: "This project has been HDP's most challenging and exciting to date – a marathon task that has required total commitment from all stakeholders, enabling the team to move the project forward at an astounding pace. The embryonic idea came from a 'blue skies' discussion between Ian Hinitt and myself. How could we unlock the complex issues surrounding the Trust's need for a decant ward and also alleviate the winter bed pressures while maintaining flexibility for the future development of the hospital site?

"With extensive healthcare sector experience we were confident our proven design methodology could meet the Trust's hopes and aspirations. This was invaluable for delivering the project within the demanding timeframes. In addition to the usual design team consultations, we worked closely with the system build manufacturer so as to be confident our scheme could be translated into its prefabricated units.

"The quality of the patient spaces and staff working environment has been critical to the design – with generous ward accommodation and large windows to maximise natural daylight and ventilation."

Rapid decision-making

Matthew Day, regional partner at (services engineers) DSSR, says: "The client and design teams' expertise enabled rapid evaluation and decision-making with regard to energy and sustainability issues, drawing on recent experience from other projects to arrive at the most appropriate solution, while also taking account the need to future proof."

Based upon Departmental Cost Allowance Guides (DCAGs), the design team quickly established a budget estimate of £10 million for the proposed development, and on this advice the executive directors instructed the scheme to proceed to outline feasibility stage.

The initial challenge was to establish a fast-track procurement route and prospective suppliers were selected from the OGC Framework Agreements as approved suppliers. Ultimately, we were looking for a modular build system which was flexible in design, to suit our specific site conditions.

Once feasibility had been proved, in terms of enabling groundworks and off-site modular construction, and the budget outturn cost estimates verified, the BTHFT board of directors gave approval for detailed design and tender for the scheme. This was established by the close of week one from inception – in itself is a remarkable deviation from the normally acceptable NHS approvals process.

Confidence in delivery

So as to demonstrate public accountability in the procurement process, two modular construction companies were invited to tender, to preferred bidder status. The successful tender, based on value and ability to meet the programme, was awarded to Cheltenham-based PKL, whose system promised to meet the extraordinarily tight programme demands and provided an acceptable confidence in delivery. The PKL system provided a flexible internal

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space as it featured minimal internal columns, and could therefore be adapted to suit the Trust's future needs. The design of the modular building also offered flexibility in terms of future cladding options.

The major challenge for the project team was now to ensure that the modular construction could be delivered and erected on a site which presented such significant topographical challenges, in an unprecedented timescale.

So as to maximise the development footprint in providing future phased development options for a new feature main entrance to Bradford Royal Infirmary, the modular development would have to marry in to the existing hospital street, and main entrance at site level 1. This would necessitate the removal of 12,000 m^3 of substrate soil, shale and bedrock, identified through the topographical surveys, as the site is built on a slope, dropping across the proposed construction site towards the existing hospital street.

Peter Lynes, director of Robinson Consulting Civil and Structural Engineers, says of the challenges unique to the project: "The fast-track programme allowed eight weeks for the steel frame fabrication process, including receipt of loads, steel frame design, construction drawings, connection and base plate designs, steel fabricator drawings, approval, fabrication and delivery to site – a process that would normally take a minimum of 12 weeks."

The close proximity of the existing hospital structures led to challenges with five metre high retaining walls, support positions for a 300-tonne crane, and the linking of the proposed and existing buildings. Service tunnels housing life-critical mechanical and electrical equipment also resulted in site access issues. Overcoming these necessitated forming a reinforced concrete bridge through the existing nurses tunnel to facilitate full site access for construction vehicles.

The capacity and condition of the hospital's existing drainage system was unknown and, taking account of recent flood issues, a strict discharge rate had to be imposed to minimise any adverse impact on the aging system. The new drainage system included full attenuation to allow for a 1 in 100-year flood event, as well as any future phases.

'Can-do' attitude

The success of this project is attributable to many factors, but in my view it would be fair to say that an inspirational client, and an open, honest, focused team with a can-do attitude, has restored my faith in the construction industry.

To minimise construction risk and maximise site development control, the decision was taken to appoint a principal contractor for the entire development, and the design team engaged in fast-track tendering to local specialist contractors, selected based on their track record. Harrogate-based HACS Construction Group was duly appointed as a result of a detailed qualitative and quantitative tender analysis techniques applied by construction cost consultants Derrick Kershaw Partnership.

Mark Smith, HACS Group managing director, says of the development: "The Bradford Royal Infirmary project is one of the most demanding we have ever undertaken, and when the gauntlet was thrown down I knew the only way the targets were going to be achieved was with the full commitment and resolve, not only from ourselves, but also from the specialist modular construction team at PKL, the client, project managers, and the entire professional design team.

"In truth, I could not have imagined how well all parties would work together, and how the teamwork and collaboration would overcome every hurdle to date, allowing progress on site to continue at the rate required by programme. Whenever circumstances have required, the design teams have been on site, down the trenches, and even up the scaffolds, there and then, to resolve every issue.

> An open, honest, focused team with a can-do attitude, has restored my faith in the construction industry

This 3D image shows a potential cladding option for the new modular ward building.

Without that approach, the programme would never have been achievable."

Focused project team

It was essential that there should be a systems approach to the project management of what had become a "high risk of failure" project, to ensure every chance of success. To date there has been a highly focused project team to move the project through the early design and sign-off stages. Full stakeholder commitment and close collaboration were vital to a successful scheme implementation.

The scheme has been designed as an integral part of the strategic site redevelopment of the hospital, so as to meet the healthcare demands of the 21st Century. Bradford City Council's planning department was engaged with the process from an early stage, and worked closely with the project team and the Trust to meet the demanding timeframes. To assist the process, the planners agreed to fast-track the initial planning applications, and to approve the cladding of the system build units under a separate application, which would be undertaken following the occupation of the wards.

Building Control personnel have correspondingly committed to assist in achieving our tight timeframes, co-operating in supportive construction process inspections on a timely basis.

In essence the project's success to date has only been achievable through the best principles of partnering and via all stakeholders' recognition of shared objectives.

PKL chief operating officer Paul Rogers says: "In our experience of over 90 healthcare projects, this is proving to be

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one of the most impressively client-run projects we have seen."

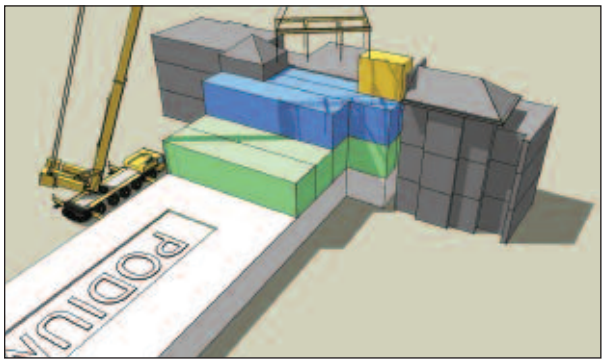
Project manager, Richard Webster of Derrick Kershaw Partnership, summarises the project activity from his journal thus:

Week 1 – Was the task possible? Utilising the Trust's Framework team of consultants, the core team was already in place. With briefing undertaken, rapid investigation of procurement possibilities took place; obviously a modular design and construction solution. The site location was determined; the hospital street levels required – levels 2 & 3; now the wards had to interface with the existing hospital at a level adjacent to the hospital way above ground level. Initial programme prepared, which is still valid today.

Week 2 – Scheme prepared and planning submitted. A structural design solution proposed to position modular units on a steel frame "podium", and construct the ground floor underneath at a later date. On the sloping site, should we excavate out all the area for the ground floor, potentially in rock? Yes, the Trust still wanted the maximum flexibility for future space utilisation.

Week 3 – Surveys undertaken, designs prepared, contractors reviewed, sites visited, procurement strategy developed, budgets proposed. A whirlwind of activity in various offices, with all team members now giving 150%. Breakfast coordination meetings proved essential to allow daily progress. Risk! Yes, risks to be reviewed; a formal risk register was formulated and assessed by the team on a probability, time and cost basis that highlighted the biggest risks in driving the project through. Risk mitigation statements were evolved to reduce and avoid the potential pitfalls.

Week 4 – Contractor selection process formalised. Pre-qualification documentation issued and scoring system agreed on a best value basis. Financial vetting process of contractors and validation of OGC compliance of the modular contractors. Tender documentation issued. Tri-partite procurement process utilising the skills of a contractor to provide all the infrastructure for the modular units to sit on. Existing Trust services contractors to provide the energy to the new wards and selected modular contractors.



A structural design solution proposed to position modular units on a steel frame "podium", and construct the ground floor underneath later.

Week 5 – Designs enhanced and developed, further risks assessed, layouts signed off, users consulted. A problem was encountered: the site access route for the crane delivering the modular units will cross an existing duct carrying essential life-critical services. The solution? Services lowered, bridge designed.

Week 6 – Tenders returned, cost checks undertaken, reports written. Risks reduced as the Trust board sign off the scheme. Contractors appointed.

Week 7 – Works start, site set-up. Steelwork design confirmed and timescales agreed.

Week 14 – 9,000 m^3 of material excavated, including 300 m^3 of rock broken out and removed from the middle of an acute hospital site in seven weeks. No stoppages for noise, no complaints, no muddy roads. Bases cast and ready for steel. Podium steel delivered and erected.

At the outset of the project it was recognised that an innovative approach to project management, rather than a traditional style of management, must be adopted, if there was to be any chance of a successful outcome.

The decision was made to deliver the project through "systems thinking", and a systems approach to planning, scheduling and controlling, as opposed to the traditional project management style of "command and control thinking".

Inspired by Kerzner's Project Management – A Systems Approach to Planning, Scheduling and Controlling,[6] and Seddon's Systems Thinking in the Public Sector,[7] Bradford's "Ultra Fast Track Modular Wards Project" has been driven by engaging and inspiring all stakeholders with the firm belief that the seemingly impossible can be achieved, through team working and a systematic approach. The key project management mandates were:

- Effective communications.
- Effective cooperation.
- Effective teamwork.
- Trust.

It was considered that the traditional styles of project management of command and control were bound by a core management paradigm culture, where project managers are concerned about:-

- How much work there is to complete.
- How many people are available.
- How long it takes to complete a task.

In the "systems thinking" approach adopted at Bradford, the role of the project manager has shifted from an adversarial, hierarchical one, to a complementary one in understanding the "internal" and "external" project and customer demands, which focus on systems and decision-making flow.

Figure 1 demonstrates the fundamental differences in the project management approach adopted by the Bradford project management team.

The design team recognised at the project's outset that this development was significantly different in style and attitude to the normal methodology of NHS construction, and, as a result, a decision was made to film the entire construction process on high definition time lapsed photography. This process has not only seen the ultra-fast track process recorded for posterity, but will also assist in post-project evaluation and, should the project be delivered successfully, will offer certain post-project marketing opportunities for all concerned. Consequently, the cost of filming is being shared by the client and design and construction teams.

The following internet link will take readers straight through to the team's high definition camera, which shows the construction site at five-minute time lapse intervals from 18 August onwards:

Figure 1: Command and control versus systems thinking[8]

Command-and-control thinking		Systems thinking
Top-down, hierarchy	**Perspective**	Outside-in system
Functional	**Design**	Demand, value and flow
Separated from work	**Design-making**	Integrated with work
Output, targets, standards: related to budget	**Measurement**	Capability, variation: related to purpose
Contractual	**Attitude to customers**	What matters?
Contractual	**Attitude to suppliers**	Cooperative
Manage people and budgets	**Role of management**	Act on the system
Control	**Ethos**	Learning
Reactive, projects	**Change**	Adaptive, integral
Extrinsic	**Motivation**	Intrinsic

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http://www.lobsterlapse.tv/index.html# Those accessing the facility will need to enter the user name: "bradford", and the password: "bradford".

In summary, the project time line is:

Project inception
– 1 July 2008.

Construction commencement
– 18 August.

Client sign-off of ward design layout
– 2 September.

Planning consent granted
– 1 September.

Modular units delivery scheduled
– 18 October.

Handover of ward accommodation
– scheduled for 22 December, with the wards due to be occupied before Christmas 2008.

Final 'burning questions'

In conclusion, the burning questions are:

- Can the project succeed to deliver an ultra fast-track solution to hospital ward accommodation, in providing state-of-the-art, future-proof facilities?
- Can the new modular wards complement an ageing estate through contemporary design?
- Can the project engage Bradford's health economy stakeholders and inspire confidence in healthcare interventions, through built environment design?

The key project players

The project design team comprises:

- Project manager and cost consultant – Derrick Kershaw Partnership, Harrogate.
- Architects – Healthcare Design Partnership, Shipley.
- Civil and structural engineers – Robinsons, Shipley.
- Services engineers – DSSR, Harrogate.
- Clerk of Works – COWL, Leeds.

The construction team comprises:

- Principal contractor – HACS, Harrogate.
- Modular building specialist – PKL, Cheltenham.
- Services enabling contractors – R E Wrights (Electrical), Bradford and Floway (Mechanical), Leeds.

At the time of writing (October 10), the project is in week 14 from project inception. The project is currently on programme and within budget, and the critical path is maintained.

A follow-up post project evaluation based upon the NHS Achieving Excellence Design Evaluation Toolkit (AEDET) is to be conducted by the design team, and will be the subject of a future IHEEM review.

References

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