Located close to the centre of Wolverhampton on a 24-hectare site, the New Cross Hospital is the largest acute healthcare facility run by the Royal Wolverhampton Hospitals NHS Trust. Offering a comprehensive range of healthcare services to the people of Wolverhampton, the wider Black Country, Staffordshire, North Worcestershire, and Shropshire, the facility is the Black Country’s largest teaching hospital, and provides training to around 130 medical students on rotation from the University of Birmingham Medical School. It also trains nurses, midwives, and allied health professionals, via well-established links with the University of Wolverhampton. The Trust, meanwhile, has an operating budget of £363 million, some 650 beds, and a staff of around 6,700.

The hospital has 17 theatres, including a number, for specialist disciplines such as eye surgery and cardiothoracics, in proximity to, but not actually located within, the main complex. Prior to MTX’s completion of the new twin operating theatres – located close to the existing main theatres (numbers 3-10) at the heart of the main complex – pressure on surgical facilities had grown to the extent that additional capacity had become essential. Consequently, in early 2010, a team headed by Marion Washer, the Trust’s directorate manager for critical care services, and her colleague, Ian Bowen, specialty lead for general, urology, and vascular theatres, was tasked with producing a formal business case for a new twin-theatre suite and ancillary accommodation.

Pressure for extra capacity

Marion Washer elaborated on the background: “Over the past 4-5 years particularly, pressure on our existing main theatres, some of which are at least 20 years old, had begun mounting, with a significant increase in demand for many surgical procedures.” (in fact, between May 2010 and May 2011, a press statement issued to coincide with the new surgical facility’s opening reported, the Trust’s caseload was up by 1,800 cases on the previous year).

The Trust’s project manager, estates development, Robert Hogg, went on to explain that it was decided to opt for modular construction for the twin-theatre surgical suite and five-bed recovery room (the latter was built as a separate entity within an extremely confined courtyard close to wards, offices, and other surgical accommodation) principally due to the need to get the new facilities completed and fully operational as quickly as possible. He said: “I actually came on board in April 2010 after the project’s inception, and admit that I am generally an advocate of traditional build. However, such was the rate at which demand for many types of surgery was increasing, that it was essential to get the new theatres and recovery room built in good time to meet our clinical and surgical activity demands.”

Scott McCaskie, the MTX project manager, said: “To build a facility of this type using traditional methods would have taken perhaps 2-3 times longer than the 13 weeks it took us to complete the work once the modules had been delivered. One of modular construction’s...
key advantages is that, as happened here, we can incorporate elements such as first-fix electrics, door and window openings, internal partitions, and service penetrations, off site. This means that, by the time the modules are delivered, much of the intricate fitting out work is already done.”

First-class presentations
Robert Hogg explained that MTX won the job via a traditional tender process, with the Trust project team so keen to ensure the facility actually delivered by the selected contractor would meet all its requirements, that each “candidate” company was interviewed on three separate occasions. He added: “Although MTX was not the lowest bidder, it finished top of the previously agreed tender scoring matrix, and its staff gave excellent presentations, and produced first-class documentation, which convinced us that it would deliver the high standard of modular buildings we required.”

Marion Washer explained, when I met her and the other key project team members at the hospital, that significant interest from the hospital’s surgical team in the benefits to patients, in particular from prostate cancer specialist and urologist, Peter Cooke, initiated the drawing up of a business case that saw the Trust’s Board approve the purchase of a da Vinci surgical robot for the larger of the two new theatres, “Theatre 2”. She said: “I personally had never actually seen robot-assisted surgery, but had heard positive reports. However it was the surgeons here that convinced the Board, and our CEO, David Loughton, in particular, that we should equip one of the new theatres with what is proving a very sophisticated surgical tool.”

Before construction of the new theatre suite and recovery bay could start, separate civil engineering and

About da Vinci robotic surgery systems
The original prototype for first da Vinci robots, which, in the latest Mark III guise (says manufacturer, Intuitive Surgical), “allow even complex procedures such as heart valve and cancer surgery to be carried out through 1-2 cm incisions”, was developed in the late 1980s at the former Stanford Research Institute in America under contract to the U.S. Army.

The company explains: “While initial work was funded in the interest of developing a system for performing battlefield surgery remotely, possible commercial applications were even more compelling. It was clear to those involved that this technology could accelerate the application of a minimally invasive surgical approach to a broader range of procedures.”

Intuitive Surgical was subsequently founded, “to test this theory”, in 1995, and, in January 1999, launched the da Vinci Surgical System; a year later it became the first robotic surgical system cleared by America’s FDA for general laparoscopic surgery. The company adds: “In the following years, the FDA cleared the da Vinci Surgical System for thoracoscopic surgery, cardiac procedures performed with adjunctive incisions, urologic, gynaecological, paediatric, and transoral otolaryngology procedures.”

Today, there are apparently 1,933 da Vinci Systems at over 1,450 hospitals worldwide; the first to be installed in the UK, 11 years ago, was supplied to London’s St Mary’s Hospital in Paddington, there are now 24 da Vinci robots in healthcare facilities UK-wide.

Intuitive Surgery claims the da Vinci Surgical System “improves patient experiences and outcomes by fundamentally changing surgery in three ways”:

- “simplifying many existing minimally invasive procedures”.
- “da Vinci surgery makes difficult operations routine”. Intuitive Surgical says: “Traditional laparoscopic surgery has never been widely used except for routine procedures. The da Vinci Surgical System allows more surgeons to perform complex procedures using a minimally invasive approach – routinely, and with confidence.”
- A number of procedures that could not be performed using traditional minimally invasive technologies can
now be performed using the da Vinci Surgical System, thanks to “the advanced features and extensive EndoWrist instrumentation of the da Vinci System”.

Colin Eke, the da Vinci clinical sales representative responsible for the New Cross “package” of da Vinci robotic surgical equipment, explains, in simple terms, how the surgeon would use the device: “The New Cross Hospital has a dual console set-up, with two surgeon consoles, each incorporating a vision port where, by effectively putting his or her head through a large aperture, the surgeon, and, say, their assistant at the other console, get a magnified, 3D, high definition view of the procedure, with the ‘picture’ being supplied by the camera instrument inserted through one of the ports on the patient’s body at the point of surgery before the procedure starts. "Each robot has four arms, one for the camera, and the other three for the instruments, and, where two consoles are used in the same procedure, by using the console controls it is possible to assign control of each arm, and thus the instrument held by it, to one or other console. Using their thumb and forefinger through two loops fitted just below the vision panel, the surgeon can very precisely position and control the instrument held by each arm; rotation is actually possible through 540°, whereas with the human hand this is normally restricted to around 270°. "The software includes a tremor filtration feature, which eliminates any slight tremor in the surgeon’s movements, for absolute precision. Typically a fairly routine, say, urological procedure, would require the incision of four or five ports into the patient’s body: – one for each robotic arm, plus perhaps three to four others for anaesthetic lines, suturing etc.

The operative screen.

indeed it is quite possible now for surgeons to conduct operations remotely from a console transmitting ‘instructions’ to a robot in another country.”

Intuitive Surgical says of the overall system “ergonomics”: “da Vinci is the only surgical system that allows doctors to operate while seated. This is not only more comfortable, but may also be clinically advantageous due to reduced surgeon fatigue. The system’s design allows for natural hand-eye positioning at the surgeon’s console, which provides better ergonomics than traditional open and laparoscopic technology, while the robotic arms hold the camera and instruments steady. For the patient that means less potential for torque and trauma to the body, while for the surgeon, it can mean less assistance needed, and reduced fatigue. Finally, with the robotic arms providing added mechanical strength, surgeons can now offer a minimally invasive approach to higher-BMI patients who are considered obese.” The system specified by the New Cross Hospital is the latest twin-console da Vinci Si configuration. Key features include:

- Dual-console capability to support training and collaboration during minimally invasive surgery.
- Enhanced high-definition 1080i 3D vision, “for superior clinical capability”.
- An updated user interface, “for streamlined set-up and OR turnover”.
- “Extensibility” for digital OR integration.
- Multiple ergonomic console adjustments, allowing surgeons to customise four different parameters for added comfort during surgery.
- An integrated surgeon control interface for “comprehensive control of video, audio, and system settings”. Settings are stored to a unique user profile, providing automatic recall for future cases.
- Enhanced master controllers “allow for precise, dexterous control” of the EndoWrist instruments. Motion scaling settings enable “seamless adjustments of hand-to-instrument movement ratios”.
- A footswitch panel that enables surgeons to perform tasks such as swapping between different types of energy instruments, which is “scalable” to support future instrument applications.

Due to the precise nature of some of the procedures to be undertaken in the theatres above, the support structure also had to provide a vibration factor of no more than 1.6, requiring careful design of the beams and supports. “While the whole project was challenging,” said Robert Hogg, “the need to minimise noise, and any other disruption, both to nearby clinical activities, and to local site traffic, meant that getting the pre-constructed modules in for the 5-bed recovery bay was especially difficult. The location of that part of the new development is an extremely tight, ‘land-locked’ courtyard. Nevertheless, with the MTX’s help, and liaison with other key hospital departments, all eight modules for the

Steel stanchions

“Once the main groundsworks had been undertaken,” MTX Contracts’ Scott McCaskie explained, “AM Griffiths built a series of steel stanchions supporting concrete first floor slabs, which provided a base for the modular buildings, which are at first-floor level on what, in this part of the hospital, is a sloping site.”

Robert Hogg elaborated: “In fact, casting the concrete slab posed quite a challenge, as, with last winter’s extremely cold weather, it was a job to get the concrete to set properly; I remember that the steel supports were actually erected during a very heavy snowstorm.”

groundworks had to be completed on the site. This saw specialist contractor AM Griffiths excavate, and remove, a large volume of spoil, a process made considerably more difficult by the limited site access, and the need to minimise disruption to hospital traffic. The company also had to ensure that access to the hospital’s main tug ways – a series of underground “corridors” providing essential services to many parts of the hospital, which were immediately below where the new development would “sit” – was maintained, and that there was no long-term impact on the activities of the nearby Sterile Services Department. One of the company’s key tasks was to build a new tug way roof, while it also had to re-site storage bins, and be conscious throughout that there was a vital ambulance turning point close by.
The existing ones, and the three separate modules for the recovery bay, were transported and craned in over a single weekend.

All eight modules for the twin-theatre suite, two for new “clean” and “dirty” linkway corridors to connect the new theatres to the existing ones, and the three separate modules for the recovery bay, were transported and craned in over a single weekend.

Reinforcing the access road
“...“To enable the crane to safely reach the required location, however,” Robert Hogg continued, “we had to reinforce the access road with concrete pads – effectively temporary footings for the crane’s riggers. Once they arrived, the MTX-built modules were stored off site, to ensure that the site roads could remain operational, and then brought on site as required, as per a pre-agreed lifting schedule, for lowering into place.”

The project manager, estates development, added that one of the key “selling points” of MTX’s modular build system was that the company can tailor the size and “shape” of its modules to meet individual client requirements, a capability he believed not all modular construction specialists offered.

The new twin-theatre suite incorporates not only two new theatres – designated Numbers 1 and 2 by the Trust, but also accompanying “scrub” facilities, a sizeable area for storing theatre and surgical equipment when cleaning is in progress, (this is undertaken after every operating session), anaesthetic rooms, and storage space for the substantial da Vinci robot, which can be wheeled from the theatre into this space when not in use. The storage facility incorporates a door one and a half times the size of a “conventional” doorway, to enable the robot to be moved to and fro.

“...Scott McCaskie said: “As with any hospital project, one of our main priorities was to have as little impact on nearby clinical and surgical activity as possible. We thus constructed a special access stairway for our site personnel linking in to one of the two new first-floor linkway corridors which connect the old and new theatres, and, in conjunction with the Trust’s estates team, used partitioning and screening to ensure that noise, dust, and any other impact on patients and staff, were minimised.

High specification
Scott McCaskie describes the two new theatres as “highly specified”; internal “fixtures and fittings”, for instance, include anti-bacterial Trovex Diamond PVC cladding and Sterisheen sprayed paint finishes, Polyflor antibacterial flooring, Maquet surgical lighting, surgeons’ panels from Bender UK, and Rada “Sense” “no touch” taps. Also incorporated were Dortek GRP sliding doors to the anaesthetic rooms, as patients are often wheeled to the suite on their bed, and this door design facilitates opening of the doors to let them though via a porter simply pushing a wall-mounted button.

There is also an automatic lockdown system, whereby the theatre doors can be automatically locked, and a sign above them illuminated when, for instance, X-ray or laser-facilitated procedures are ongoing, while the main room lights are proximity sensor-activated to reduce energy consumption.

Recovery area will ease the pressure
The separate, five-bedded recovery area is light and spacious, and, Marion Washer explained, will help to reduce the pressure on some of the hospital’s existing surgical recovery areas.

Scott McCaskie said: “While we designed, built, and fitted out the new theatres, ‘scrub’, clean and dirty utility, and anaesthetic ‘prep’ rooms, to an extremely high standard, once the modules were in place the job was actually a fairly straightforward one for us; we are highly experienced in modular construction. The incorporation of the da Vinci robot planned for the larger theatre posed no particular complications either; it simply meant fitting extra data and power sockets.”

Additional services work
In addition to the its main construction work – the company worked with scheme architects Strategic Healthcare Planning’s Telford office in the initial stages (the healthcare planning practice produced the original drawings/plans) – MTX also fitted a new Carrier air-cooled chiller into a nearby existing rooftop plant room to provide chilled water to both the new and existing theatres, and the recovery bay plant, and fitted out a new plant room. The “shell” for the latter was built separately by AM Griffiths directly under the new theatres once they were complete.

Scott McCaskie said: “This new plant room, which incorporates electrical switchgear, the anti-gas scavenging system, and air handling plant for the new theatres, is of sheet metal construction, using a Kingspan system, built up from a...
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Light and spacious, the new recovery area will help to reduce the pressure on some of the hospital’s existing surgical recovery areas.

Less invasive surgery
According to the former nurse (and these are also among the key advantages cited by the da Vinci robot’s manufacturer, US company, Intuitive Surgical), robot-assisted surgery is not only less “invasive” than both “conventional” open surgery (where incisions may, in bowel surgery, for instance, be around 8-10 inches long), but also than existing laparoscopic techniques.

Peter Cooke, the urological surgeon who argued for the acquisition of the da Vinci robot, explained that, using the device, a prostatectomy, one of the operations the Trust expects to be among the most common undertaken in this way, could be completed with “just a few tiny incisions” using instruments “narrower than a thumbnail”.

He said: “Robot-assisted surgery is less invasive, causes less blood loss, minimises both post-operative scarring, and any pain the patient may feel post-operatively, and generally means recovery times in hospital following, for example, many of the more common urological procedures, of as little as one or two days. In contrast, following open surgery, a patient may need to stay in hospital for several days. Additionally, although movement of the instruments within the patient’s body is very carefully controlled by the surgeon using the controls on the robotic console, the robust, but flexible robotic arms can offer a degree of precision that no human can, while, with the latest models, the surgeon has a high definition 3D view of the area being operated on, at up to 10 times magnification.”

Control of the camera
While in conventional laparoscopy an “assistant” would often be required to move the handheld camera to give the surgeon the best possible view, with the da Vinci robot the surgeon can control the camera themselves, with the 3D HD image giving a precise view that enables incision, suturing, diathermy, and other surgical procedures, to be carried out with great precision.

After performing the first robot-assisted procedure in the region using the da Vinci system, involving removal of a prostate gland showing early signs of cancer from deep within a patient’s pelvis, and subsequently reconstructing the bladder to the urethra, Peter Cooke, said: “The operation went without hitch, and took around four hours to complete, so I am absolutely over the moon. I do not feel tired in the least either, which I normally might. Here at the Trust keyhole surgery is already commonplace for many of our procedures, so this was a natural progression for us.”

Marion Washer admits that, when she began preparing the business case for the new theatres and surgical robot, she was “unsure how some surgeons would find using it”. However, a few months on, she is delighted that the general response has been “extremely positive”. She said: “To date three surgeons have undertaken about eight operations using the robot – a combination of urological and colorectal procedures, each mentored by a ‘proctor’ – a ‘keyhole’ surgeon from another hospital with more experience of using the robot.” (this practice, will, in fact, continue for the first few procedures per surgeon; until the proctor is satisfied that the individual is ready to be left to work on his or her own).

Ian Bowen added: “The surgeons who will be using the robots have also undertaken, or will undertake, residential training at Intuitive Surgical facilities in Strasbourg and Paris before they undertake any ‘live’ surgery, and indeed the supplier has recently introduced a range of simulators on which new users can familiarise themselves with all the controls.

Expanding use in the future
“By early autumn we are hoping six or seven of our urological and colorectal surgeons will be fully trained to conduct robot-assisted procedures. Initially we envisage the robot being used mainly for urological procedures like prostatectomy, and colorectal operations such as bowel re-section, but in future plan to use it also for some gynaecological procedures and, in the fullness of time, for cardiac and cardiothoracic work too.”

Marion Washer explained, when I asked her whether the robot’s addition would boost throughput, that an operation such
We have an excellent new theatre facility, coupled with a well-designed and spacious new five-bedded recovery area as a prostatectomy would take a similar time – perhaps 3-4 hours – using the robot, as via a conventional laparoscopic approach, and perhaps initially, the procedures may take a little longer. However, the real benefits, she said, would be reduced risk, and a shorter length of hospital stay.

Of the add-on costs of “ramping up” use of the robot over time, she said: “The main cost will be the consumables. While the actual staff and clinical cost per procedure will be similar to that of conventional laparoscopic surgery, the instruments used with the da Vinci system are semi-disposable, and are designed to offer a life of around 10 operations each. Some can cost up to £2,000 apiece.”

The Trust will no doubt, therefore, be keen to get its money’s worth from the da Vinci robot, but, Intuitive Surgical says, “based on independent studies around the globe representing multiple surgical specialities”, the surgical robots do offer “significant advantages to surgeons and patients alike”. In future, Marion Washer said, the Trust will be aiming not only to “ramp up” the number of operations undertaken using robot-assisted laparoscopic techniques for patients from the hospital’s own catchment area, but equally from further afield.

Private sector opportunities

Trust chief executive David Loughton said when the first robotically-assisted procedure was undertaken at New Cross in March, prior to the theatres coming fully on stream, that, while the “normal rate” for laparoscopic procedures at the hospital was “around five cases a week”, the Trust would be aiming, over time, to undertake at least three da Vinci procedures a day, a number, potentially, on private, as well as NHS, patients.

With magnified 3D vision, which the CEO explained allowed clinicians to “see anatomy in a way they simply would not see” using conventional laparoscopic instruments and cameras, and “greatly improved dexterity” (the da Vinci EndoWrist Manipulation instruments can be rotated by the robotic arms through 360°, with “far greater precision than is possible with the human hand”), the da Vinci surgical robot offers significant potential practical advantages for skilled surgeons willing to adapt to new techniques.

Nevertheless, while Marion Washer described the transition from conventional laparoscopic procedures to using the robot as “far much less of a step change” than that of a surgeon accustomed to open surgery moving to conventional laparoscopic operating procedures, sound pre-surgical training for any clinician set to use the da Vinci device is clearly essential.

Surgeon Peter Cooke explained that he and his theatre team underwent an intensive three-month training programme and a “dress rehearsal with a surgical dummy” before undertaking their first procedure, which he said made performing the surgery “an incredibly seamless transition”. The training programme included online learning, being mentored and undertaking a procedure in Paris, and receiving ongoing support from both Intuitive Surgical and a “mentor”, Jim Adshead, consultant urologist at the Lister Hospital in Stevenage. He was able to view and advise Peter Cooke during procedures using the second (training) robotic console provided with the robot.

On stream early

The Trust had, in fact, originally been due to perform its first robot-assisted surgery in late May, but so effective was the training, and so intense the interest from patients, that it decided to push ahead with the first operation earlier than planned.

“In future,” said Peter Cooke, “we could, for instance, using the robot, be able to create a patient’s bladder using part of the bowel, remove and reconstruct part of a kidney, and even work on a beating heart through a closed chest. The da Vinci system is also known already for its success in treating endometriosis and performing hysterectomies”.

While the smaller of the two new MTX-built theatres at the New Cross Hospital will be used for a wide range of general surgery, including “conventional” laparoscopic, the second, larger theatre will undertake regular robot-assisted procedures, an area of work for which Marion Washer and her team anticipate there will be both increasing patient demand, and growing interest from a variety of surgical disciplines.

She said of this exciting, and much-needed, new facility: “I have been involved in a number of other theatre developments while in my role here and, thanks to the excellent co-operation between the Trust project team, including the estates and facilities department; MTX: AM Griffiths, and all the sub-contractors, this is the best project I have worked on to date.

“We have an excellent new theatre facility, coupled with a well-designed and spacious new five-bedded recovery area, while the addition of the surgical robot should not only benefit many patients though a more comfortable, and less traumatic, operating and recovery process, but will also provide the Trust’s surgeons with an ever wider range of opportunities to use robot-assisted laparoscopic procedures to patients’ benefit.

“We know that, elsewhere, da Vinci robots are also being successfully used for surgery including ENT and cardiothoracic procedures, and the surgical team here are naturally extremely excited about the potential to extend the robot’s use considerably as more of them become skilled in using it.”

Key project participants

- First phase civil engineering and groundwork/first floor plant room construction: AM Griffiths.
- New twin-theatre suite and recovery bay design and build, plus plant room fit-out and commissioning: MTX Contracts.
- Quantity surveyors: Holbrook Brookes.
- Structural engineers: Wardell Armstrong.
- Mechanical and electrical services engineers: DSSR.
- CDM consultants: HSQ.