



Designed for *Life*: Building for *Wales*
Cynllun *Oes*: Adeiladu Ar Gyfer *Cymru*



POST PROJECT EVALUTATION

Llanfrechfa - The
Grange University
Hospital

NHS WALES SHARED
SERVICES PARTNERSHIP

February 2022



**GIG
CYMRU
NHS
WALES**

Bwrdd Iechyd Prifysgol
Aneurin Bevan
University Health Board



**GIG
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Gwasanaethau Ystadau Arbenigol
Shared Services
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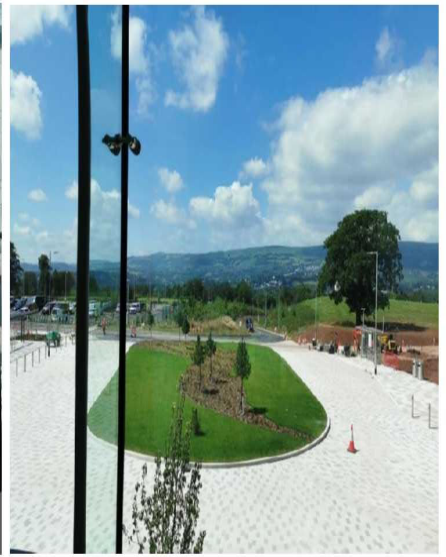
APPROVALS

This document requires the following approvals.

Name	Title
Steve Woodward	Director - McBains

Signed:Dated: 10 February 2022

For and on behalf of McBains Limited



CONTENTS

ITEM	DESCRIPTION	PAGE
1.0	EXECUTIVE SUMMARY	4
2.0	METHODOLOGY	8
3.0	PROJECT DETAILS	10
4.0	BEST PRACTICE AND LESSONS LEARNED	14
5.0	TESTIMONIALS.....	25

Schedule of Appendices

Appendix A - Questionnaire Proforma

Appendix B - Completed Questionnaires



1.0 EXECUTIVE SUMMARY

McBains (MCB) has been appointed by NHS Wales Shared Services Partnership to undertake the Post Project Evaluation for the new SCCC at Llanfrechfa, now called The Grange University Hospital.

The Grange University Hospital is a new 560 bed hospital built on a 60-acre site, and will provide emergency and urgent care, while bringing together services provided at the Royal Gwent Hospital in Newport and Nevill Hall Hospital in Abergavenny. The Grange University Hospital serves over 600,000 people integrating 40 specialist services and includes a helipad, 13 operating theatres, a Cat 3 laboratory, two MRI suites (one as a shell), two CT suites and an education block.



The Grange Hospital was subject to a standard business case approval process by Welsh Government, namely Strategic Outline Case, Outline Business Case and Full Business Case.

The approved budget for the Grange Hospital was £350m

The design and construction was undertaken utilising the Designed for Life Building for Wales 1 framework with the key project delivery team members as follows:

- Client: Aneurin Bevan University Health Board
- Funder: Welsh Government
- Architect: BDP
- MEP Design: Aecom
- Civil and Structural Design: WSP
- Project and Cost Managers: Gleeds
- NEC Supervisor: Arup
- Supply Chain Partner: Laing O'Rourke

The Grange Hospital was successfully completed and handed over in November 2020 within budget and ahead of programme achieving the following:

- Delivered 4 months ahead of programme
- 23% reduction in baseline programme due to use of DfMA
- GMP agreed £5.778m below approved FBC
- BREEAM Excellent achieved
- 74% of salaries and wages paid to people living in Wales with 72 staff living in Wales retained, 16 of whom were previously unemployed
- 10 non-accredited training opportunities completed and 20 non-accredited training weeks
- Saving of 237,000 person hours on labour due to DfMA



A summary of best practice and lessons learned by all parties on this project are:

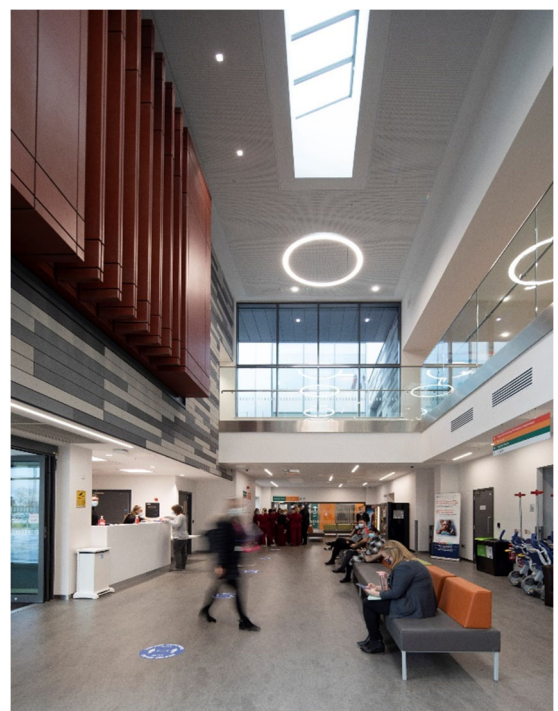
Best Practice	Lessons Learned
Centre of Excellence	
Development of robust baseline information before entering into contract resolved many issues prior to commencement of works on site and reduced the level of post contract change	Early involvement of Radiology equipment provider to work with the design team and Supply Chain Partner to deliver a coordinated solution
DfMA integrated supply chain involvement in the design process to advise on buildability and coordination between disciplines	Speed of decision making for some elements could be improved; this was partly due to change in staff. It was noted that the Health Board were excellent
Agreed stakeholder engagement strategy identifying all stakeholders with decision makers, stipulated workshops, dates and decisions outputs required	Improved repetitiveness of design would have improved programme further, particularly in relation to the back of house areas and elements of plant room
Development of a derogation schedule as the design progressed to capture any deviations from the HTM's and HBN's to facilitate early agreement and sign-off	A designated IT team should be identified and involved in the project from inception to capture innovation, cyber security, latest views on systems and resolve buildability/installation issues to generate a fully integrated solution
Accurate development and agreement of C sheets to inform the design	
Great support from the Health Board and NHS Shared Services	
Collaboration and Communication	
The development of the Project Execution Plan (PEP) by all key stakeholders at the start of the project was vital	Importance of The PEP to outline a clear structure on how the project should be delivered, clear definition of roles and responsibilities, and a clear definition of deliverables and key milestones to meet the delivery programme
Agreement of the baseline position in relation to design, programme, cost and deliverables	Ensure all stakeholders are involved throughout. Clinicians are particularly busy and need advance warning of their input and clarity on what is being signed off at each stage
Clear communications strategy established with identified personnel, and inclusion of all required parties to be kept informed correctly throughout the project	Decision making in some instances was slower than anticipated. Involvement of the correct decision takers and a strategy for resolution subject to slow responses should be identified, recognizing this is a complex procedure with high-volume involvement of many different teams
Stakeholder engagement strategy agreed with all interested groups, identifying engagement approach, identified inputs, required outputs, programme dates and protocols for sign off	
Establishing of robust project protocols and governance procedures	
Clearly recorded and reported change and project updates shared across all team members on a monthly basis underpinned the collaborative approach	
Clear communications strategy identifying methods of communication with all key stakeholders, staff and interested parties	

Programme	
Early jointly agreed detailed programme aligned with deliverables with 'buy-in' from the project team, construction partner and Health Board	Delivery, installation, and commissioning of large equipment requires careful planning with the project team, construction partner and Health Board involved in determining the most appropriate strategy. This should be identified early in the programme and the parameters agreed prior to entering into contract so the key principles are agreed with the detail progressed sufficiently in advance of equipment procurement (to help inform design), commissioning and handover with clear lines of responsibility
Accurate monthly reporting on programme, activities, and Activity Schedule	Wayfinding strategy to be agreed early to facilitate an integrated solution as regards design and construction activities. Early agreement of the wayfinding strategy also assists the commissioning and handover process to capture Health Board and construction interfaces
Realisation of the benefits of DfMA in relation to increased programme predictability, programme certainty and overall reduced programme of delivery on site	Information Technology is often considered independently as a 'bolt-on' and kept apart from the main construction activities. IT is an important and complex component of the project, which requires early and open discussions between the Health Board and construction partner to optimise outcomes. The IT strategy should be established, shared and discussed between all parties early in the project lifecycle as it should inform elements of the design and importantly installations on site
Collaborative working to honestly, openly, and efficiently resolve the installation of radiology equipment, improving the overall programme by overlapping and utilising the clinical commissioning programme	
Agreement of phased handover to meet departmental clinical requirements and facilitate early use of the hospital, which was particularly key with the demands of Covid-19	
Site Management	
All site staff held the appropriate CSCS cards and with issued with photo ID, which was displayed at all times	No specific lessons learned from LOR's site management; the KPIs showed that this was exemplary, and they were completely inclusive, open, honest, and communicative throughout construction. The best practice approach identified above should be adopted on future projects.
Site deliveries were well planned and managed aligned with the programme and accurately recorded	
Site inductions completed for all staff and visitors, correct PPE worn at all times, and toolbox talks were completed regularly	
Staff access, and movement was monitored and aligned to construction delivery and activity	
Waste Management was well managed with a clear site waste management plan set in place and Waste Management KPIs were established and audited	

Handover and Commissioning	
Detailed training schedule established with all training recorded for future use	The appointed NEC supervisors were not in post until January 2018 during the foundation works, so witnessing arrangements with AHUHB were not formalized until after their appointment. The project would have benefitted from earlier involvement to establish processes prior to start on site
Establishing of a clear aftercare strategy	The project would have benefitted from the involvement of the NEC supervisors during the design process in order to proactively iron out any installation issues during the design stage. This is particularly relevant to the MEP services
Soft Landings workshops were held with a broad attendance to capture and clearly establish the strategic approach, responsibilities, contacts, and interfaces	
Approved Engineers and Authorised Persons were scheduled into the programme and early notification for attendance and sign-off provided so align with the programme	
Supervisors involved in all site works to drive quality	

The evidence demonstrates The Grange University Hospital is a highly successful collaborative project; a challenging scheme delivered within budget, ahead of programme and to a high quality. The evaluation has confirmed the key objectives have been achieved; a state-of-the-art 560 bed acute hospital on a 60-acre site, and will provide emergency and urgent care, while bringing together services provided at the Royal Gwent Hospital in Newport and Nevill Hall Hospital in Abergavenny. The Grange University Hospital provides a fit for purpose, modern hospital, which serves over 600,000 people integrating 40 specialist services and includes a helipad, 13 operating theatres, a Cat 3 laboratory, two MRI suites (one as a shell), two CT suites and an education block, suitable for the provision of 21st century care.

This Design & Construction Post Project Evaluation has been carried out with the involvement of the whole delivery team in a proactive and a blame free culture. Thanks are extended to all involved



2.0 DESIGN & CONSTRUCTION POST PROJECT EVALUATION METHODOLOGY

Context

The requirement for undertaking a Design and Construction Post-Project Evaluation is a constituent part of delivering the NHS Capital Programme within Wales; this was highlighted within the Welsh Government circular WHC (2018) 043: NHS Wales Infrastructure Investment Guide published October 2018. Framework Members can view this guidance on the Welsh Government website.

Consequently Design and Construction Evaluations are to be facilitated by NWSSP Specialist Estate Services and are to be undertaken during Stage 5: Operational Commissioning and Project Closure; the outputs of an evaluation should focus upon the performance of the project delivery from start of Stage 2: Outline Business Case development to Stage 5: Operational Commissioning and Project Closure (N.B. Stages as defined in the Designed for Life: Building for Wales process maps and Schedules of Services). In this instance McBains has been asked to complete the Post Project Evaluation on behalf of NWSSP Specialist Estate Services ensuring full involvement and integration at all stages.



Accordingly, NWSSP Specialist Estate Services issued guidance in the form of ‘Guidance Note: Procedure for Design and Construction Post-Project Evaluation - August 2021’.

Why carry out a Design & Construction PPE?

Post-Project Evaluation is a fundamental tool in achieving Best Value for Money and through lessons learned can improve future project performance and decision making by key stakeholders.

Post Project Evaluation can be an aid to:

- Improved design, organisation, implementation and strategic management of projects;
- Promote organisational learning to improve current and future performance;
- Avoid repeating costly mistakes;
- Improve decision-making and resource allocation (e.g., by adopting more effective project management arrangements);
- Improve accountability by demonstrating to internal and external parties that resources have been used efficiently and effectively; and
- Demonstrate acceptable outcomes and/or management action thus making it easier to obtain extra resources to develop healthcare services.

How has this PPE been carried out?

In accordance with the 'Guidance', this evaluation has been undertaken in an impartial, objective and blame free culture, which has involved the Health Board and all other key stakeholders of the Project Delivery Team. A specially structured suite of Pro-forma & questionnaire was issued to all (refer to Appendix A) to evoke memoirs of issues both good and not so good that occurred during the project journey. A workshop was then held with a select number of attendees representing Client, Supervisor, Project Manager, Cost Advisor and Supply Chain Partner, to further investigate the main themes and issues noted within the questionnaires to fully understand and highlight lessons learned. The draft report was then circulated to all respondents for review to enable input into the final edited version, for sign off by the Health Board prior to publishing.

In the interest of continuous learning and to benefit future project design, planning, development, and management; this Design and Construction Post-Project Evaluation will be shared with Welsh Government, all NHS bodies, Framework Members, and the Service Post Project Evaluation Team Members.

The Service Post-Project Evaluation, completed in accordance with the Benefits Realisation timeframe, will be initiated by the Health Board (normally during Stage 6: Completion). The Welsh Government Integrated Assurance Hub will provide support in developing and undertaking the Service evaluation.



3.0 PROJECT DETAILS

The Grange University Hospital is a new 560 bed hospital built on a 60-acre site, and will provide emergency and urgent care, while bringing together services provided at the Royal Gwent Hospital in Newport and Nevill Hall Hospital in Abergavenny. The Grange University Hospital serves over 600,000 people integrating 40 specialist services and includes a helipad, 13 operating theatres, a Cat 3 laboratory, two MRI suites (one as a shell), two CT suites and an education block.

An FBC Addendum was submitted by Aneurin Bevan University Hospitals Board to the Welsh Government on 14th October 2015, with approval granted in October 2016. Market testing concluded at the end of September 2017 to commence construction enabling works in October 2017.

During the business case approval process a detailed review of modern methods of construction was undertaken with the appointed construction partner, Laing O'Rourke (LOR). MMC is a broad term covering a wide range of offsite manufacturing and onsite techniques, which are used as an alternative to traditional building methods of construction. Design for Manufacture and Assembly (DfMA) is Laing O'Rourke's (LOR) response to MMC and incorporates a number of offsite technologies to drive efficiencies in construction. This addresses some of the targets cited by Egan in his 1998 report 'Rethinking Construction' with focus on improved productivity, reduction in cost, reduction in construction time, predictability of programme and cost, reduction in defects and reduced accidents. Utilising a DfMA approach facilitated improvements on the construction programme with over 23% programme saving, and clearly improved level of predictability of programme, which has added benefits of equipment orders, commissioning and handover, employment and staff retention, training, and correct sequencing of work.



Project Delivery Team and Headline Information

Client	Aneurin Bevan University Health Board
Funder	Welsh Government
Architect	BDP
Mechanical, Electrical and Public Health Design	Aecom
Civil and Structural Design	WSP
Project Managers	Gleeds
Cost Advisors	Gleeds
NEC Supervisor	Arup
Construction Partner	Laing O'Rourke
MEP Supply Chain Partner	Crown House - in-house Laing O'Rourke Subsidiary
Frame, façade and pod Manufacture	Explore - in-house Laing O'Rourke Subsidiary
Piling and Superstructure	Expanded - in-house Laing O'Rourke Subsidiary
Commencement on site	October 2017
Completion on site	November 2020
The Covid-19 Pandemic created on site challenges, which were overcome	
Post completion works were requested after the formal completion date	

Whole Life Costs

There is a reduced maintenance of the DfMA products for the lifecycle of the facility due to production in a controlled factory environment and reduced incidence of on-site modifications, therefore, maintaining a greater integrity of the original design.

The greater robustness of factory components results in a reduction in planned preventative maintenance and reactive maintenance for the DfMA components.



Risk

The one team in-house integrated self-delivery model offered through DfMA for key packages, means that LOR have more control over their own destiny. Reducing reliance on third party

subcontractors reduces the risk of claims, insolvency, misunderstanding and interface issues. As a result, the level of predictability of both cost and programme are improved and the interfaces between packages are improved as they have worked together previously and have an inherent understanding of each other's scopes, demarcation, handover procedures and are under the directive of a single point of responsibility.



Due to inherent understanding and belief in the integrity of subsidiary companies, there is a reduced level of duplication of preliminaries as the quality of personnel and reduction in overlap of resource results in more funds being expended on the facility and less on time related staff costs.

There is a reduced reliance on wet trades and as such reliance upon the weather. The only key weather-related risk with DfMA is wind downtime on use of cranes.

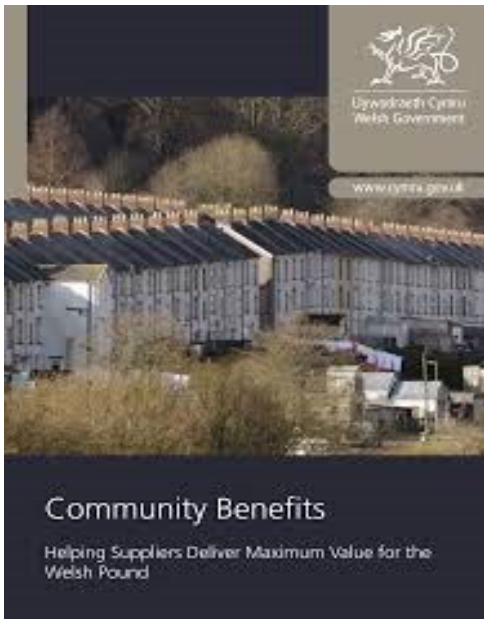
Overall, a more strategic, controlled and predictable approach to procurement and delivery of on-site works generates reduced risk position for the project.

Health and Safety

Health and Safety considerations are paramount in the delivery of major project and delivering The Grange via a DfMA solution provided benefits improves site safety in many ways. The primary benefits of a DfMA solution are due to the following criteria:

- Reduced labour on site
- Predictability of forecast labour
- Reduced trade package interfaces
- Reduction in waste
- More strategic and planned delivery approach
- Minimal high-risk activities due to off-site prefabrication

Community Benefits



A structured community benefits approach underpinned the delivery of The Grange, which encompassed Enterprise, Employment, Resources, Community, Education and Training. The value of the contract related to goods, services and overheads was stated as just over £59m with £44m (74%) spent with businesses based in Wales, of which 6% were Small and Medium Sized enterprises.

In relation to staff, 74% of salaries and wages were to people living in Wales and 72 staff living in Wales have been retained, 16 of whom were previously unemployed.



In addition, 10 non-accredited training opportunities were completed, and 20 non-accredited training weeks were provided during the period of this project.

Awards

Due to the success of The Grange delivering a high-quality healthcare facility to budget and ahead of programme, attention has been drawn to the methodology of construction in contributing to project success. It is notable that the project has also won two significant awards in recent months as follows:



- Constructing Excellence National Awards 2022 - Building Project of the Year - Finalist
- Constructing Excellence Wales Awards 2021 - Building Project of the Year - Winner
- Constructing Excellence National Awards 2021 - Offsite MMC - highly commended
- Constructing Excellence Wales Awards 2020 - Offsite MMC - Winner
- Constructing Excellence Wales Awards 2020 - Digital Construction - Winner
- Building Better Health Awards 2021 - Best Healthcare Development - Winner
- Building Better Health Awards 2021 - Best Modular/Mobile Healthcare Facility (offsite) - Winner
- CIOB Construction Manager of the Year 2021 - Finalist
- CIOB Client of the Year 2021 - Finalist

**ADEILADU
ARBENIGRWYDD
YNG NGHYMURU**



**CONSTRUCTING
EXCELLENCE
IN WALES**

4.0 BEST PRACTICE AND LESSONS LEARNED

4.1 Centre of Excellence

There were several key aspects to delivering a centre of excellence, split into 3 component parts, namely (a) clarity of objectives, (b) design integration and, (c) stakeholder engagement

The objectives for The Grange Hospital were clearly defined at the outset of the business case process, which were as follows:

- Therapeutic environment
- State of the Art solution
- Enhance research and education
- Predominantly single bedrooms
- Good clinical adjacencies to reduce staff, patient, and visitor travel times

During the design development process design workshops were arranged and attended by all key stakeholders including a wide range of Health Board staff, together with members of the Design Team and the Supply Chain Partner. Importantly the decision makers were involved in the design workshops facilitating agreement and closure of decisions efficiently. During these workshops a proposed schedule of accommodation was assembled and an ideal arrangement to suit the preferred adjacencies and flows of the new proposed building. This approach allowed the users to discover the opportunities and challenges associated with arranging complex clinical facilities.

Room Data Sheet sign off provided a superb baseline, so the level of coordinated design information generated at contract stage was excellent. A thorough review of the design was completed at this stage and all discrepancies clearly identified and listed.



The governance, process and procedures set in place from inception provided a robust framework to progress and agree the design and progress into construction. This included accurate recording of design and the use of Project Decision Notices. NHS shared Services were excellent in their support of the project. The process was well documented and clear throughout the project and decisions made by the internal project team were quick and efficient following the established good governance process.

The requirements of DfMA required a high level of design detail to be complete prior to progressing to site as the factory prefabrication requirements stipulated agreement of advanced design and specification. The involvement of the supply chain members in the design process also facilitated resolution of design queries early so construction detail was known, and coordination was well advanced. It is important to note that elements of the back of house solution (facades and roof) and some plant rooms adopted a traditional build approach and standardization of these elements through DfMA may have generated further quality and programme improvements.

Two key areas of interface were managed by the Supply Chain Partner, namely planning and statutory authorities. Both these require continued and regular contact over the full programme to ensure all the requisite design, licenses, data, and information are progressed and issued at the appropriate time. Having a dedicated resource within the Supply Chain Partner integral and centre to the progress of these key elements facilitated good progress. To enhance value for money, the risk allocation for planning and statutory authorities remained with the client, whilst the management and organisation resided with the Supply Chain Partner.

Statutory changes due to fire such as fire-stopping and insulation were identified and incorporated into the design solution early to avoid any late changes minimizing impact on cost and programme. A fire team were appointed along with an inspection team to facilitate compliant progress of all fire elements.

Whilst there were certain items of design that required review and additional clarification such as the ventilation strategy, taps (due to sensitivity of water management relating to thermostatic controls, legionella and pseudomonas aeruginosa), alignment to the correct quality criteria including HBNs, HTMs and Building Regulations; a live derogations schedule captured where design differed.

The design solution of the radiology department and, in particular, the equipment created some challenges that required resolution late in the programme. This was due to two key factors, firstly the late engagement of the equipment provider and secondly the lack of proactivity shown by the equipment provider in working with the supply chain partner to resolve design interface issues between the equipment installation and the base build provision both architecturally and for the MEP systems. Integration of the equipment procurement, design development and installation should all be aligned throughout the project to improve cost, programme and predictability.



The integration of IT into the design could have been improved. Often IT teams work separately to the project team as they have wide ranging demands on their time and often are engaged later in the process. Early engagement of the IT specialists would have been beneficial to capture thoughts on cyber security, how the building should operate from an IT perspective, capturing the latest innovations and resolving design, infrastructure, and installation questions earlier in the project. The IT remains a challenge and maintenance of systems is more challenging due to the solution.

Best Practice

- Development of robust baseline information before entering into contract resolved many issues prior to commencement of works on site and reduced the level of post contract change;
- DfMA integrated supply chain involvement in the design process to advise on buildability and coordination between disciplines;
- Agreed stakeholder engagement strategy identifying all stakeholders with decision makers, stipulated workshops, dates and decisions outputs required;
- Development of a derogation schedule as the design progressed to capture any deviations from the HTM's and HBN's to facilitate early agreement and sign-off;

- Accurate development and agreement of Room Data Sheets to inform the design;
- Great support from the Health Board and NHS Shared Services.

Lessons Learned

- Early involvement of Radiology equipment provider to work with the design team and Supply Chain Partner to deliver a coordinated solution;
- Speed of decision making for some elements could be improved; this was partly due to change in staff. It was noted that the Health Board were excellent
- Improved repetitiveness of design would have improved programme further, particularly in relation to the back of house areas and elements of plant room;
- A designated IT team should be identified and involved in the project from inception to capture innovation, cyber security, latest views on systems and resolve buildability/installation issues to generate a fully integrated solution.

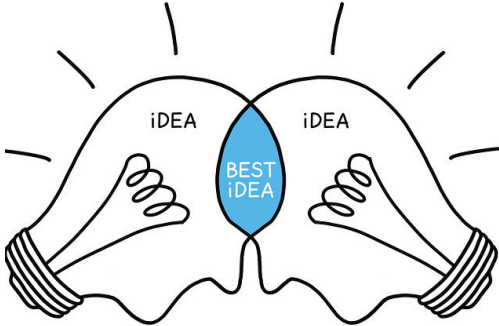


4.2 Collaboration and Communication

As the project was delivered through a framework and utilised a NEC3 suite of contracts it has benefited from a collaborative approach between all parties. Whilst the principles of ‘mutual trust and cooperation’ and collaboration are pivotal to the NEC3 contract, it is the project team, Health Board and construction partner responsible for delivering the project who set the culture of collaboration.

This was enshrined in the Project Execution Plan (PEP) developed by all key stakeholders at the start of the project which outlined a clear structure on how the project should be delivered, the strategy for communication, meeting structure, and a clear definition of roles and responsibilities.

Collaboration must be underpinned by robust project procedures to provide clarity to all parties and all times. The baseline ‘jointly agreed’ programme, agreed solution and clarity on deliverables all provided a good basis to collaborate. Additionally, robust reporting on a monthly basis with accurate recording of agreed changes shared amongst the team, assisted in providing clarity and working together.



Supplementing the reporting process, a clear governance procedure was established and agreed, which sat alongside the agreed programme and facilitated accurate management of project gateways and a smooth transition through the programme. All information was included in the PEP. This included a meeting structure including project board, progress meetings and estates meetings which were aligned and reported into each other. The Supply Chain Partner were represented at all meetings which helped to keep senior management up to date on progress and a fast-track mechanism for decision making as the need arose.

Regular reporting was provided to the Health Minister on all facets of the project including cost, programme, quality, and governance.

Balancing time, cost, quality, flexibility, and risk for a high-profile project presented some key challenges; these were proactively managed, and solutions reached for the best outcome of the project. It is important to note that team members had worked together previously. This was seen as a positive to the project as the relationships were good and it facilitated some open, honest discussions in sharing information, concerns, and issues between the project team, Health Board and construction partner.

All team members commented positively on collaboration and said there was a ‘one team’ ethos with project outcomes at the centre of everyone’s considerations. Team working is essential in the delivery of all projects to enhance overall project performance.

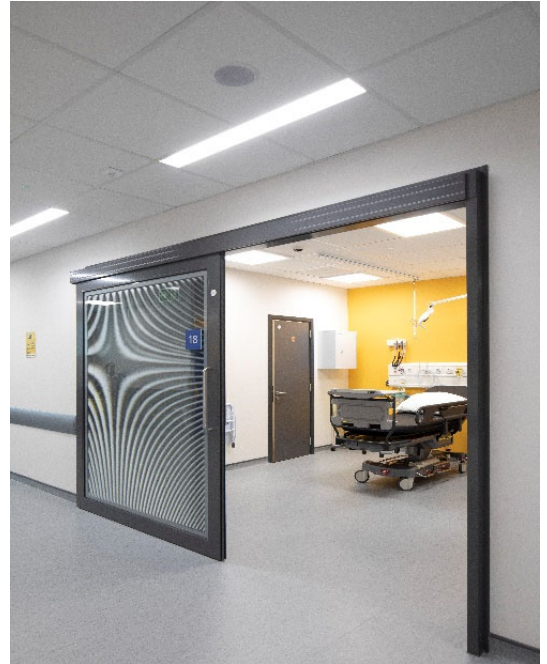
A clear communications strategy was established and was adhered to. The Supply Chain Partner regularly updated all key stakeholders, staff, and members of the public through Information boards, newsletters and on-line blogs. Close liaison with the Health Board communications manager was key to the frequency and level of detail being relayed to the wider community.



A stakeholder engagement strategy was established, involving the correct decision takers, and included workshops, explanation of the design and clinical outcomes with input collated, tracked, and updated in three rounds to finalise and agree the solution. Clinical sign off was translated into the final design solution, which was agreed and signed off by the Health Board and project team. Optimising the clinical adjacencies and clinical pathways was integral to the process to maximise efficiency of staff, patient, and visitor flows through the hospital.

Best Practice

- The development of the Project Execution Plan (PEP) by all key stakeholders at the start of the project was vital;
- Agreement of the baseline position in relation to design, programme, cost and deliverables;
- Clear communications strategy established with identified personnel, and inclusion of all required parties to be kept informed correctly throughout the project.
- Stakeholder engagement strategy agreed with all interested groups, identifying engagement approach, identified inputs, required outputs, programme dates and protocols for sign off.
- Establishing of robust project protocols and governance procedures;
- Clearly recorded and reported change and project updates shared across all team members on a monthly basis underpinned the collaborative approach;
- Clear communications strategy identifying methods of communication with all key stakeholders, staff and interested parties.



Lessons Learned

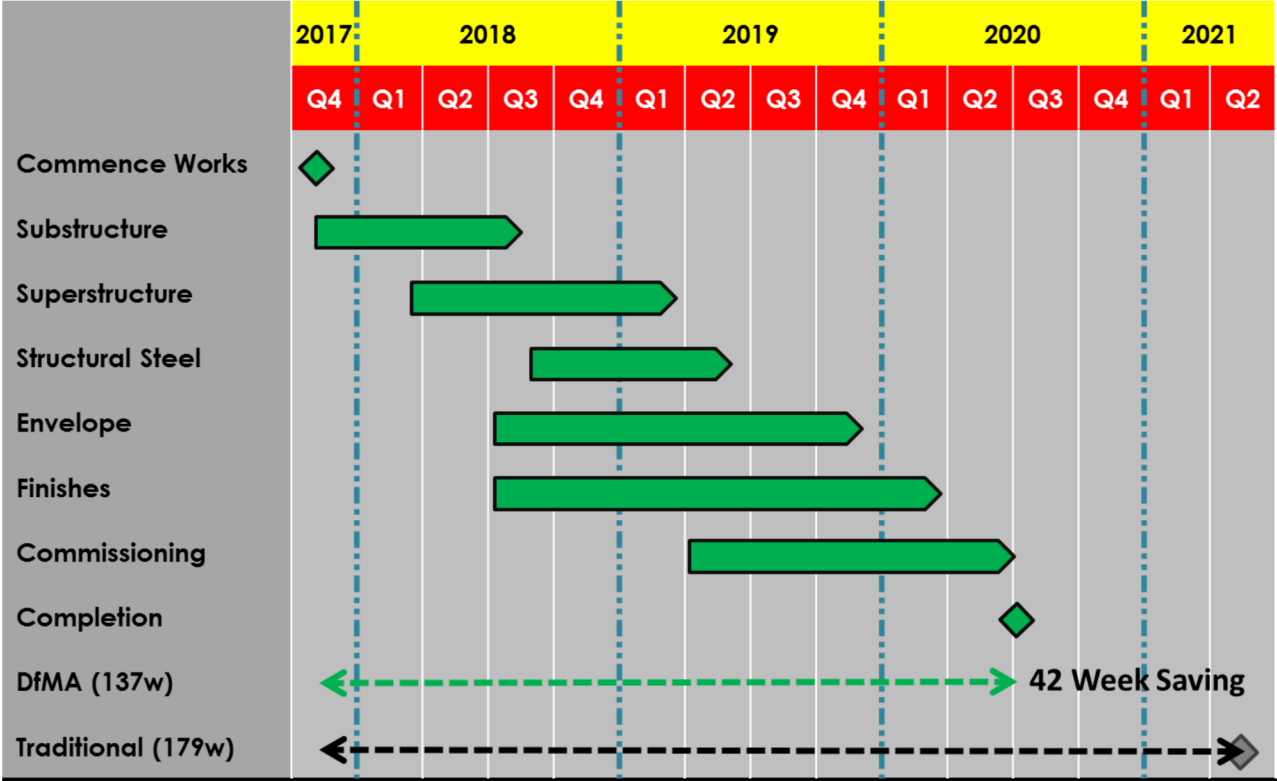
- Importance of The PEP to outline a clear structure on how the project should be delivered, clear definition of roles and responsibilities, and a clear definition of deliverables and key milestones to meet the delivery programme.
- Ensure all stakeholders are involved throughout. Clinicians are particularly busy and need advance warning of their input and clarity on what is being signed off at each stage.
- Decision making in some instances was slower than anticipated. Involvement of the correct decision takers and a strategy for resolution subject to slow responses should be identified, recognizing this is a complex procedure with high-volume involvement of many different teams.

4.3 Programme

A detailed programme was established and agreed by the whole project team to ensure buy in from inception to completion establishing the critical path and clearly stating period for clinical sign-off, design, market testing, construction activities, commissioning, and handover.

The programme was reviewed, updated, and agreed on a monthly basis, as required under the NEC contract; the Activity Schedule was also updated and aligned to the programme each month. Periodically a more detailed review was completed and a full robust cashflow issued. This facilitated accurate reporting for the programme but also enabled forecasting for expenditure each month and to establish the position in relation to gain share anticipated for the project at completion.

The original duration of construction was established at 179 weeks with commencement in quarter 4 of 2017 and completion in quarter 2 of 2021. A DfMA programme was developed showing a programme duration of 137 weeks generating a forecast saving of 42 weeks, equating to a 23% improvement on the construction period. This is graphically represented by the LOR programme comparison provided below.



Adopting a DfMA solution, also improved the predictability of programme. Due to offsite manufacture, programme risk is reduced, and the level of programme certainty is significantly improved. The reason for the improved predictability is three-fold, firstly the construction of the components in a controlled environment is more predictable reducing the impact of site-specific challenges, secondly, the supply chain is controlled by LOR directly for these components and, as a consequence, third party risk is reduced, and thirdly accountability and responsibility resides within in-house organisations facilitating control and just-in-time deliveries.

Greater predictability of programme generated several benefits:

- The commencement of delivery of clinical services can be accurately predicted and as such communication with staff, patients and users is quicker, cheaper, and more efficient;

- Enhances the employment of high quality clinical and non-clinical staff including staff retention;
- Equipment delivery is more predictable generating procurement cost benefits, installation benefits and commissioning benefits;
- Avoidance of abortive visits for delivery, training, approval, witnessing, and commissioning;
- Reduced storage requirements on and offsite, and improved efficiency of logistics, reducing staff time and cost;
- Improved quality of the final solution and reduced occurrence of defects saving time at the end of the programme;
- Improved sequencing and predictability of installations improves quality of the final building as all works are delivered in the planned and correct sequence.

It is important to note that the construction programme included within the contract included one start date and one completion date. Due to the nature of collaboration within the team, this was seen as beneficial to the delivery of the contract. Under usual contractual relationships, this could have been problematic in completing the project, however, collaborative working facilitated phased handover and flexible working.



The most notable challenge was the Covid-19 pandemic, which created a new way of working from March 2020. How the building was completed particularly in relation to sequencing of works, room handover, and completion of departments was re-planned and agreed in an open collaborative way to generate the best outcomes for the Health Board whilst maintaining an efficient, safe, and deliverable overall programme.

The delivery and installation of the Radiology equipment was due to be completed by the Health Board at completion of the main project works. As the project progressed, the efficiency, and benefit, of including this within the contract works to be overseen by LOR, was identified. Originally, the Health Board held a 6-month programme for operational commissioning. LOR, the project team, and Health Board worked closely together to facilitate delivery, installation, and commissioning of the Radiology equipment during the commissioning programme to facilitate a smooth handover in a timely manner.

The wayfinding solution and impact on the handover and commissioning programme was identified and concluded late in the programme. Large projects such as The Grange, have a broader wayfinding strategy, which correctly is managed by the Health Board. The details of the strategy are important to share early in the construction programme to capture any impacts on construction activity.

The IT networking interface and resolution of IT issues took longer than anticipated. This element of the project was managed by the Health Board; this is not unusual and does require a high level of input from the Health Board IT team. We frequently see independent working of IT specialists and construction partners, which is partly due to the nature of works required but more importantly not having clarity of how the IT elements will influence the works being completed

on site. The project would have benefitted from an earlier strategy discussion on the IT installations and delivery requirements to inform the design, construction and programme.

Best Practice

- Early jointly agreed detailed programme aligned with deliverables with ‘buy-in’ from the project team, construction partner and Health Board.
- Accurate monthly reporting on programme, activities, and Activity Schedule
- Realisation of the benefits of DfMA in relation to increased programme predictability, programme certainty and overall reduced programme of delivery on site.
- Collaborative working to honestly, openly, and efficiently resolve the installation of radiology equipment, improving the overall programme by overlapping and utilising the clinical commissioning programme.
- Agreement of phased handover to meet departmental clinical requirements and facilitate early use of the hospital, which was particularly key with the demands of Covid-19.

Lessons Learned

- Delivery, installation, and commissioning of large equipment requires careful planning with the project team, construction partner and Health Board involved in determining the most appropriate strategy. This should be identified early in the programme and the parameters agreed prior to entering into contract so the key principles are agreed with the detail progressed sufficiently in advance of equipment procurement (to help inform design), commissioning and handover with clear lines of responsibility.
- Wayfinding strategy to be agreed early to facilitate an integrated solution as regards design and construction activities. Early agreement of the wayfinding strategy also assists the commissioning and handover process to capture Health Board and construction interfaces.
- Information Technology is often considered independently as a ‘bolt-on’ and kept apart from the main construction activities. IT is an important and complex component of the project, which requires early and open discussions between the Health Board and construction partner to optimise outcomes. The IT strategy should be established, shared and discussed between all parties early in the project lifecycle as it should inform elements of the design and importantly installations on site.

4.4 Site Management

Site Management processes established by LOR were exemplary, and the site was kept exceptionally clean at all times. Importantly the Health Board were included in the process and LOR provided regular accurate and honest reporting on site management and health and safety processes throughout the project with clear statements on preventative measures. Everyone was fully informed and updated with regular supply chain meetings held with health and safety being an essential agenda item.



Local labour was used during construction with community benefits recorded, including employment of apprentices, re-starts and some prisoners. The value of the contract related to goods, services and overheads was stated as just over £59m with £44m (74%) spent with businesses based in Wales, of which 6% were Small and Medium Sized enterprises. In relation to staff, 74% of salaries and wages were to people living in Wales and 72 staff living in Wales have been retained, 16 of whom were previously unemployed. In addition, 10 non-accredited training opportunities were completed, and 20 non-accredited training weeks were provided during the period of this project.



DfMA contributed to improving site management and safety in many ways. The first and most important factor in improving health and safety is the reduced number of workers on site during construction. The forecast labour saving between DfMA and traditional construction is 237,000 person hours (5,927 person weeks).



The prefabrication of components has the benefit of reducing the number of trade package interfaces during construction works on site. By combining several activities in controlled factory environments and bringing the completed component to site and fitting together simplifies the process and reduces the need for different contractors working together with labour on a busy construction site. The wider management and control of the site is improved with a reduced level of health and safety risk with a less congested site.

There is also a reduced level of waste generated, which not only has an environmental benefit but also means that waste is not generated on site, being moved around for removal and disposal. This improves general housekeeping on site and reduces the risk of trips, slips, and falls.

DfMA simplifies the working processes with fewer large components being handled, which facilitates a more strategic approach with better planning and organisation. It also results in a significant reduction in scaffolding, reducing the number of operatives erecting maintaining and removing scaffolding and working at height during construction.

Best Practice

- All site staff held the appropriate CSCS cards and with issued with photo ID, which was displayed at all times.
- Site deliveries were well planned and managed aligned with the programme and accurately recorded.
- Site inductions completed for all staff and visitors, correct PPE worn at all times, and tool-box talks were completed regularly.

- Staff access, and movement was monitored and aligned to construction delivery and activity.
- Waste Management was well managed with a clear site waste management plan set in place and Waste Management KPIs were established and audited. Key waste management benefits were:
 - (a) Recycling was employed where viable - excavated material used on adjacent land to avoid unnecessary landfill
 - (b) Supply chain waste was minimal due to DfMA
 - (c) DfMA reduced spillages significantly
 - (d) Temporary works and shuttering requirements reduced due to DfMA
 - (e) Bunding was put in place to prevent leeching of unwanted waste into local water

Lessons Learned

No specific lessons learned from LOR's site management; the KPIs showed that this was exemplary, and they were completely inclusive, open, honest, and communicative throughout construction. The best practice approach identified above should be adopted on future projects.

4.5 Handover and Commissioning

The commissioning programme was established early in the programme and pre-agreed. This process included the witnessing of systems, sign-off, collation of O&M manuals, testing, commissioning, balancing of systems, training, and integration of Health Board personnel.

Training was scheduled in advance and all requisite personnel notified. All training was conducted in person on site but also recorded, both to show to anyone unable to attend, and for future use.



The appointed NEC supervisors were pivotal in the process, working with LOR to establish witnessing, sign-offs, and commissioning programmes, as well as recording of snags or defects, which were managed and concluded prior to handover. In addition, identification of attendances for the Approved Engineers and Authorised Persons was clearly established and notified in advance to facilitate attendance for witnessing and sign-off at the appropriate time.

The process for soft landings was clearly established via the use of workshops with all parties attending including the architect and MEP designer to best capture responsibilities, contacts, and interfaces.

An aftercare strategy was clearly defined and shared with the Health Board and project team so any post completion rectification works or operational issues could be communicated and resolved efficiently with clarity on responsibility.

Best Practice

- Detailed training schedule established with all training recorded for future use
- Establishing of a clear aftercare strategy
- Soft Landings workshops were held with a broad attendance to capture and clearly establish the strategic approach, responsibilities, contacts, and interfaces.

- Approved Engineers and Authorised Persons were scheduled into the programme and early notification for attendance and sign-off provided so align with the programme
- Supervisors involved in all site works to drive quality

Lessons Learned

- The appointed NEC supervisors were not in post until January 2018 during the foundation works, so witnessing arrangements with AHUHB were not formalized until after their appointment. The project would have benefitted from earlier involvement to establish processes prior to start on site.
- The project would have benefitted from the involvement of the NEC supervisors during the design process in order to proactively iron out any installation issues during the design stage. This is particularly relevant to the MEP services.



5.0 TESTIMONIALS

Anthony Pitcher, Senior Fire Safety Advisor

“LOR’s systematic approach, level of scrutiny and attention to detail, first-class standard. Simple, extremely effective labelling system, partitions colour coded above ceiling indicating fire-rating properties. Ensuring future alterations don’t compromise fire strategy. We’re promoting this best practice across NHS Wales estate.”

Chris Brieger, Arup

“LOR delivered an outstanding project, Arup were fortunate to act as NEC Supervisor. Exemplary level of collaboration, run with enthusiasm and professionalism, testament to a project delivered ahead of schedule with zero defects.” “At every stage of the project, LOR consistently delivered a high quality product.”



Feedback from patients

“Spacious rooms.” “Excellent facilities.”

“Lovely environment.” “I noticed staff seemed so much more relaxed.” “I can't recommend the hospital and staff enough.”

Nicola Prygodzicz Executive Director ABUHB

“The GUH environment not only provides amazing modern facilities for patient care; but has opened so many opportunities to the Health Board in relation to the recruitment of staff wanting to come and work in this state of the art building.”

Dr Tim Rogerson, Consultant in Emergency Medicine

“It’s been good to be involved in design and see it come to life.” “We can deliver the standard of care we’ve always been proud of but now it’s in this amazing clinical space.”

“We were meant to open GUH around now (March 2021), but as a pandemic response we opened months early. Completely feels like home now, so proud of what the team has been able to deliver.”

“The view from GUH canteen is amazing and makes a real difference to your day.”

SCHEDULE OF APPENDICES

Appendix A - Questionnaire Proforma

Appendix B - Completed Questionnaires

Appendix A - Questionnaire Proforma

Appendix B - Completed Questionnaires