An Integrated Hub Facility for Manufacture, Installation, and Operations & Maintenance for Floating Offshore Wind

Hub Facility Scheme

To contribute to the industry wide challenge of lowering the costs of offshore wind, the Hub Facility will act as a manufacture, construction, deployment, and operations & maintenance base for future floating offshore wind farm developments throughout the UK. This will include the integrated manufacture of floating offshore wind turbine components and realisation of a new installation strategy that removes the need for expensive heavy lift installation vessels and dependence on adequate weather windows.

The aim of this project is to determine the feasibility of the Hub Facility scheme by developing an optimal layout and system design to capture the integration of the supply chain and improve financial value through a new installation strategy for floating offshore wind turbines.

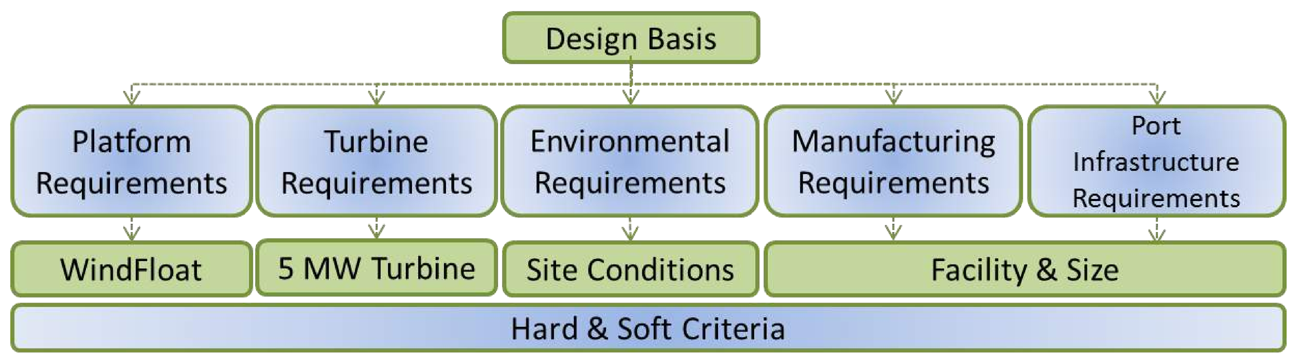
Objectives

To realise the overall aim of the scheme the following set of objectives have been highlighted:

I. Identify a suitable UK site location;
II. Develop a system architecture including integration of the supply chain and realisation of a new installation strategy for floating offshore wind turbines;
III. Optimise layout and system design to minimise system inefficiencies and maximise financial value;
IV. Demonstrate economic feasibility;
V. Justify commercial, environmental and social impacts.

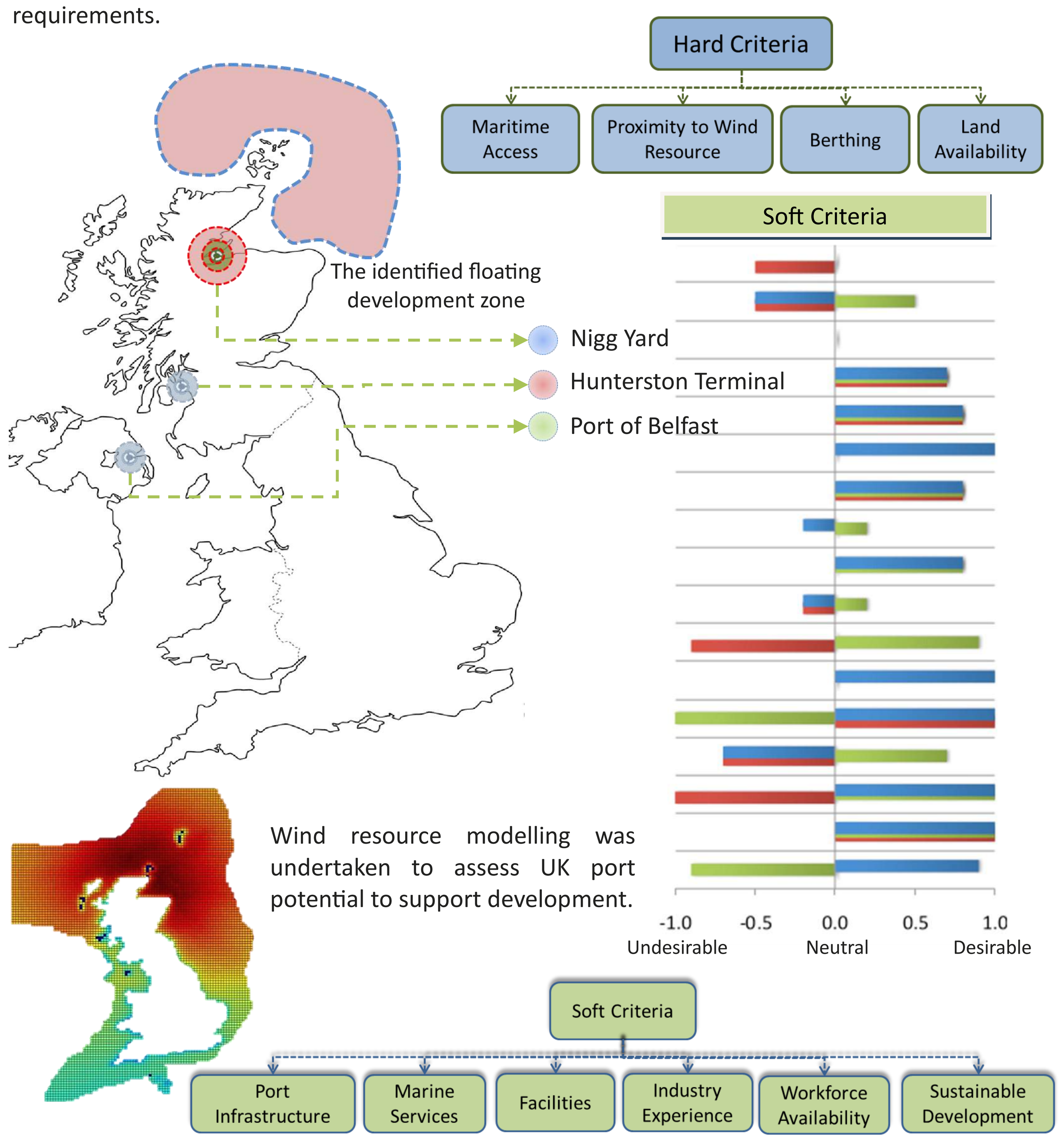
Design Basis

The Design Basis established five key requirements relative to the project aims and objectives.



Site Selection

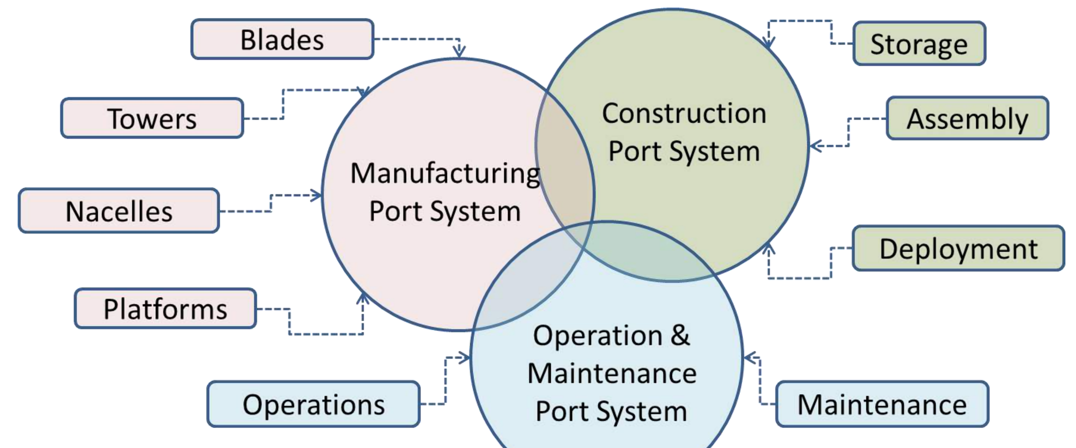
The Design Basis sets a number of criteria which were used to identify the optimal port location. Some criteria are must have 'hard' requirements, while others represent desirable 'soft' requirements.

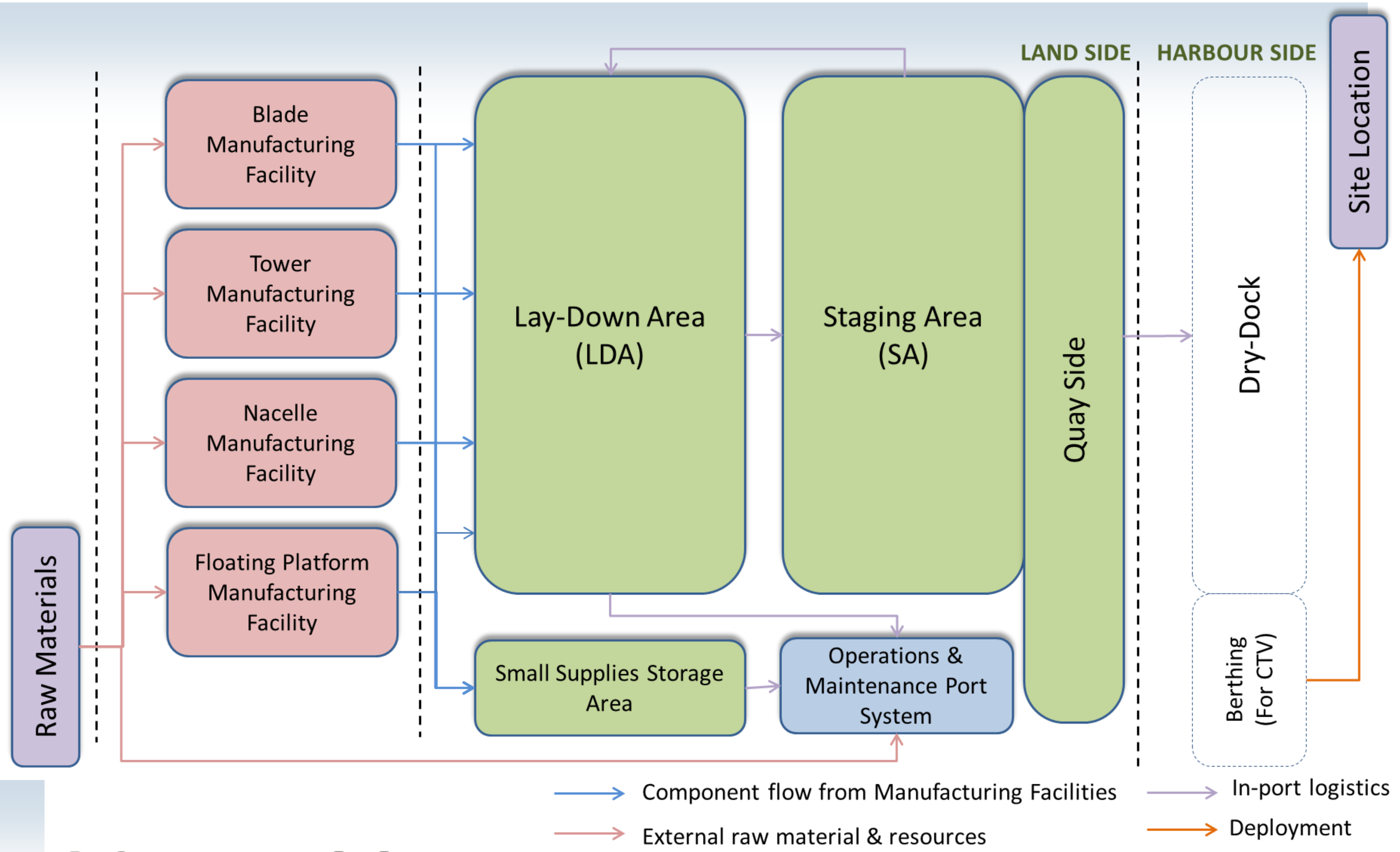


The port best suited to the above criteria has been identified as Nigg Yard, Scotland.

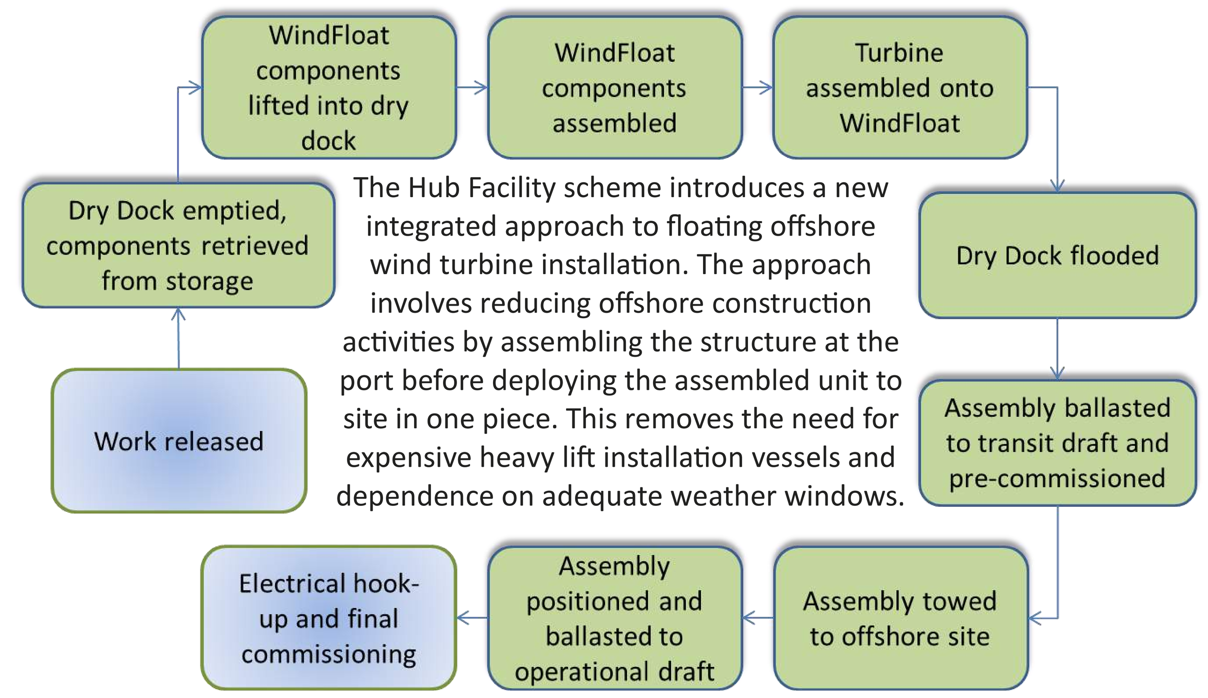
System Architecture

A system architecture (see right) was designed to develop Hub Facility systems, fully considering the processes, interactions and interfaces between manufacturing, construction, and operations & maintenance as shown below.





Installation Strategy



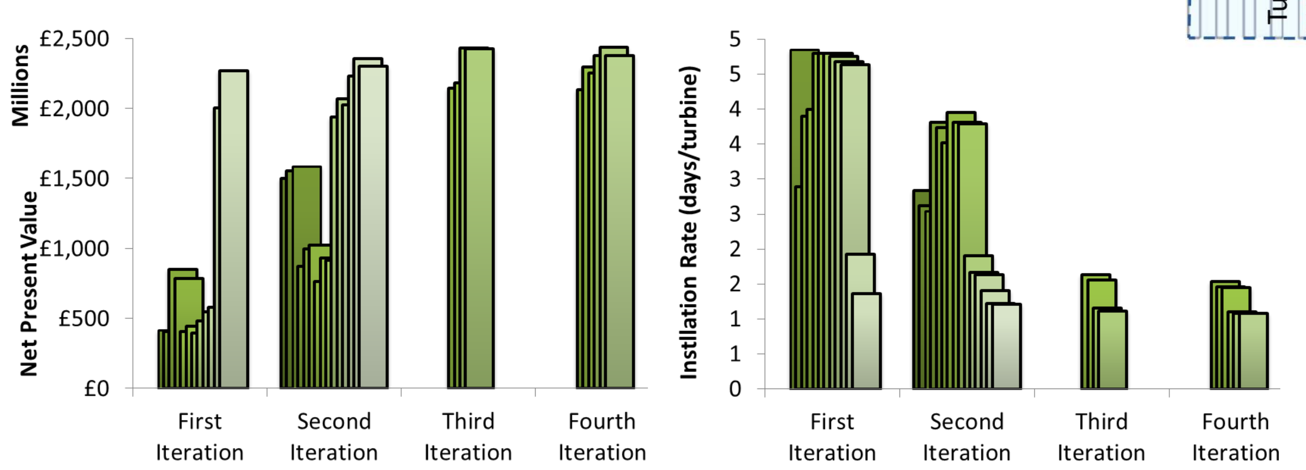
The Hub Facility scheme introduces a new integrated approach to floating offshore wind turbine installation. The approach involves reducing offshore construction activities by assembling the structure at the port before deploying the assembled unit to site in one piece. This removes the need for expensive heavy lift installation vessels and dependence on adequate weather windows.

Lean Optimisation

Software models were built of both the construction process and cash flow forecast. Several construction improvements were identified through the use of *Lean* principles; demonstrating that improvements to both Net Present Value (NPV) and time to install were achievable. Some commercial improvements are not captured in the models and were not included in assessment (shown in grey).

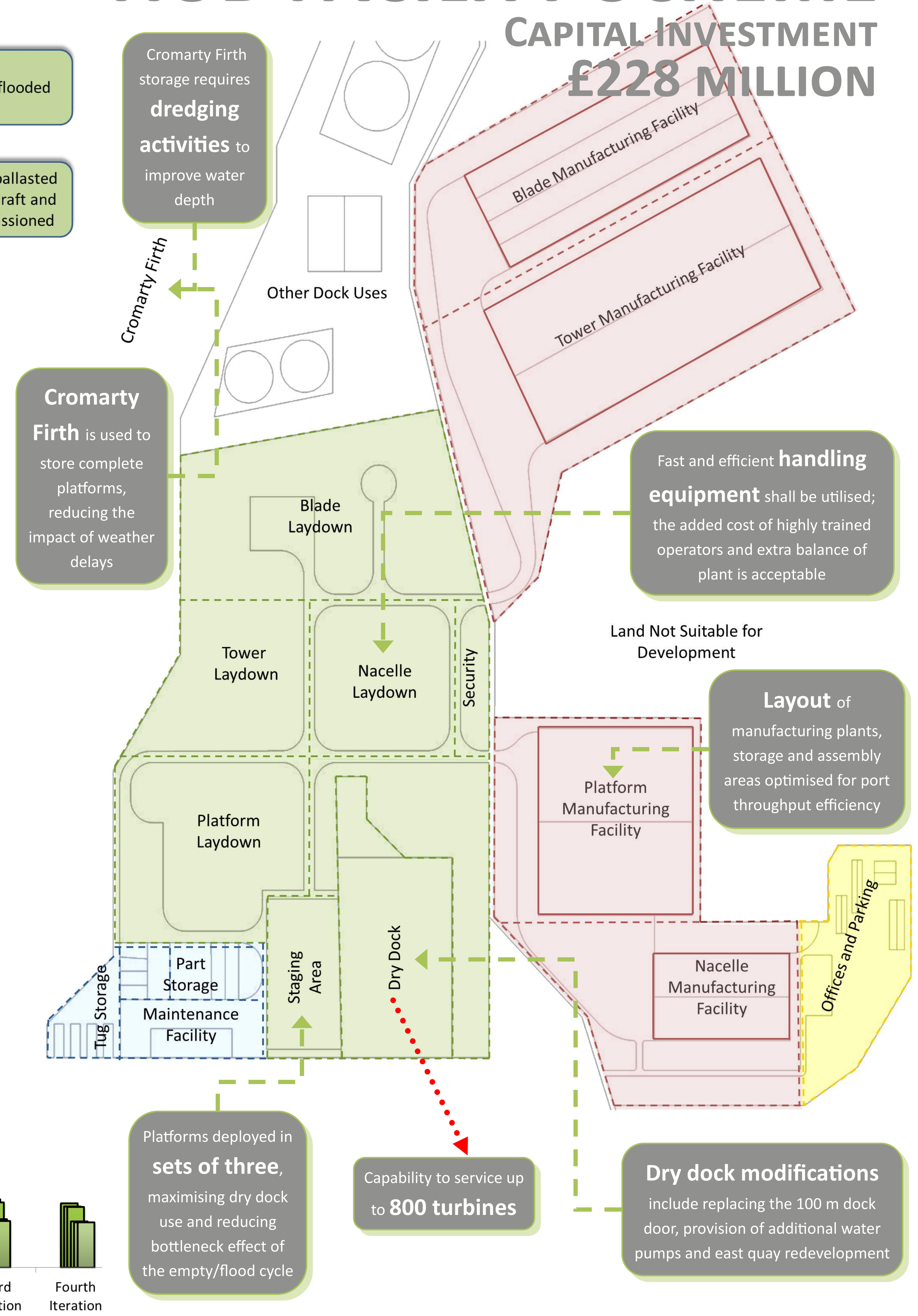
	Scenario	*Lean* Principle	Increased cost due to
0	Base Case	Benchmark	N/A (as detailed)
1	Speed up dry dock empty/flood rate	Reduce cycle time	Dry dock & quayside improvements
2	Speed up tow to site	Reduce cycle time	Faster and/or more vessels
3	Speed up onshore handling equipment	Reduce cycle time	Faster and/or more equipment
4	Multiple turbines in dry dock	Reduce NVA activities	Quayside improvements, more equipment/vessels
5	Multiple turbines in dry dock (incl. Storage)	Increase output flexibility	As above, plus dredging & rental
6	Multiple Manufacturers on site	Increase output value	Facility construction, land acquisition
7	Import/export activity	Increase output value	Quayside improvements
8	Build second dry dock	Increase output flexibility	Construction, quayside improvements, dredging

The base case represented the first design option prior to optimisation. An iterative process was adopted to identify the optimum combination of construction improvements. An improvement of 485% and 353% in NPV and Installation Rate was achieved on the base case following four iterations.



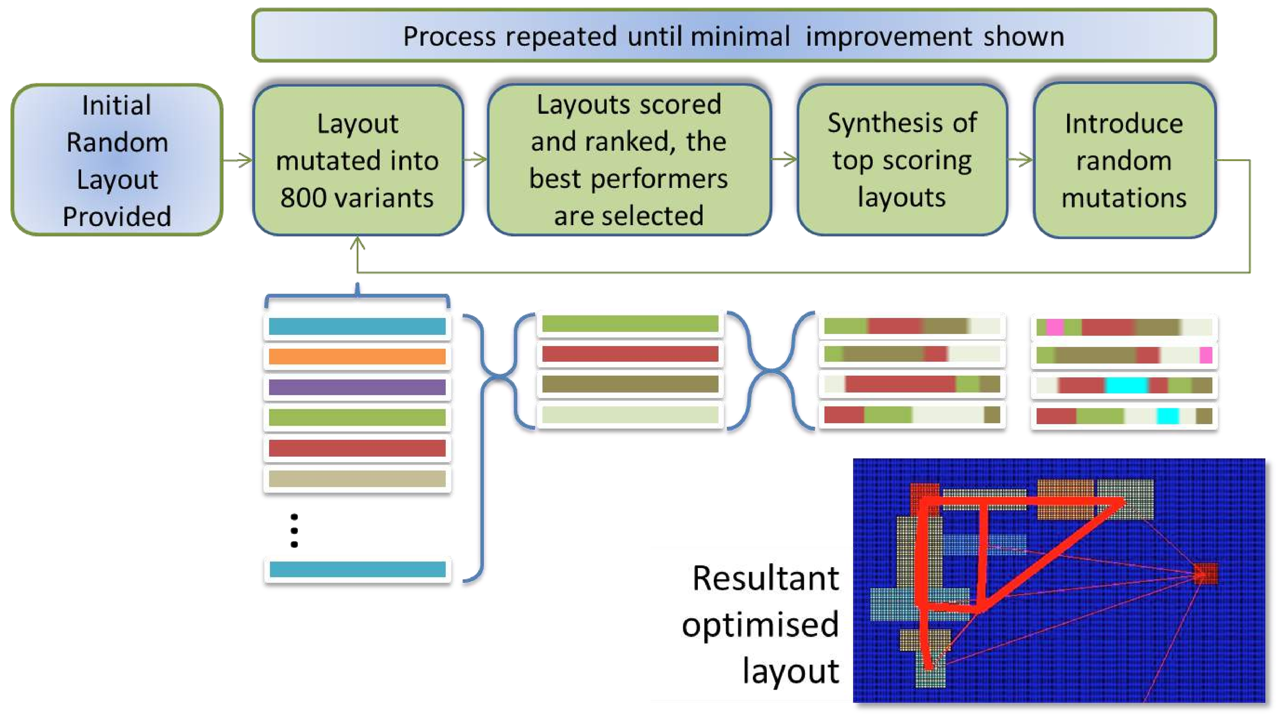
Nigg Yard: Hub Facility Scheme

Capital Investment £228 Million



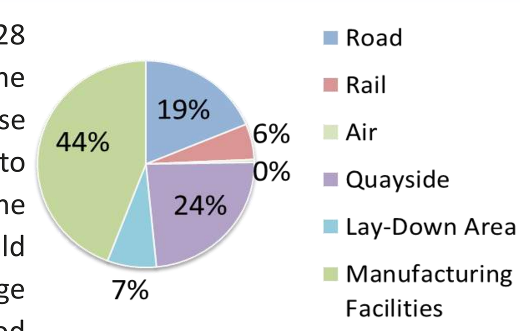
Layout Optimisation

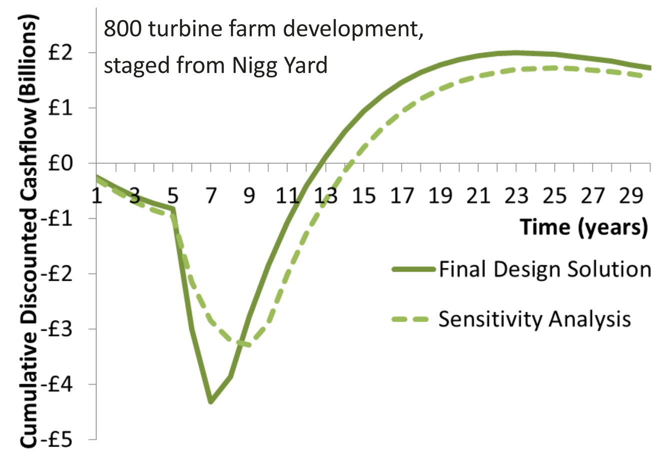
A Genetic Algorithm (GA) tool is used to optimise the site layout. Physical boundaries form GA constraints and layout 'fitness' was scored using cost of component movement between facilities.



Business Plan

The capital investment required for the scheme is £228 million for which a breakdown is provided. For a 100 turbine wind farm, development from Nigg Yard could realise savings of 13% and 37% in installation costs and time to install respectively, when compared to current practise. The savings made staging a 175 turbine floating wind farm would offset the costs of the scheme. A maximum capacity to stage 800 turbines indicates its feasibility, with a payback period less than 13 years.





The scheme is tested for sensitivity. Given a 100% increase in capital investment and time to install, costs will still be recovered for a 350 turbine farm and payback for a maximum capacity project occurs in the 14th year.

A Cluster Port Model facilitates integration and involvement of key supply chain stakeholders. Nigg Yard is well positioned to benefit from market growth as 30 GW of offshore wind energy is expected 'post Round 3'. The scheme is expected to provide up to 6000 jobs for the offshore wind industry.

Through integration of the supply chain, and implementation of an optimised installation strategy, it has been shown that the scheme can improve financial value and offer a feasible opportunity for investors.

Limitations & Future Work

The scheme is limited to a single floating platform design (WindFloat) that has implications upon port infrastructure. Only UK offshore wind development is considered. Assumptions are made regarding OEM strategic intent in considering the Port Cluster Model.

Recommendations within a SWOT framework account for three levels of project scope. First, to provide broader opportunities in fulfilling the project aim (A). Second, to identify further work regarding project objectives (B) and third to highlight recommendations specific to Nigg Yard (C).

Recommendation	Level/ SWOT	Reasoning
Detailed appraisal of Nigg Yard	(C) Threat	Critical design decisions rely upon Nigg Yard being a suitable and adequate location. Site survey and a full infrastructure study will identify any negative details of Nigg Yard.
Application to other Floating Platforms study	(B) Opp.	A fundamental design decision includes the floating method of WindFloat. Investigation of sensitivity to platform type would indicate design proposal flexibility.
Electrical infrastructure requirements	(B) Weak.	The requirements and implications of the electrical infrastructure for such a large wind development is not looked at in detail. The implications of a large energy source as proposed must be investigated.
Global application of the floating wind Hub Facility scheme	(A) Opp.	The project presents obvious opportunities for global development of offshore wind and specifically floating wind. Consideration of opportunities to perform a similar design activity elsewhere is suggested.

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