Concurrent Engineering in the Context of FRP Boats

Fluid and Structure Interactions Research Group

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1. Background

- The margin between a profitable and non-profitable design and build are small.
- Foreign companies have a larger percentage of the yacht market than British companies.
- This requires that UK companies become more innovative in design and try to use new materials and structures and production technologies in order to generate new, market-leading designs that are cost effective to manufacture.

T52 Fast Super-yacht made by Sealine

• It has been estimated that design costs only 5% but that as much as 70% of the cost of a manufactured part is decided at this stage.

•Boat designs, therefore, should take into account important factors like production and manufacture.

•Rapid and timely production of new designs can open up sales opportunities in other areas.

2. Aims

The strategic aim of this project is to develop a concurrent engineering system, consisting of a number of tools and a design environment, for use in the field of leisure boat design.

3. Methodology

Concurrent engineering

Concurrency will be produced in three main ways. The first is to produce a concurrent engineering environment consisting of a design environment, a grid computing network for British boatbuilding and finally an independent materials and product database. These will be linked to concurrent tools examples of which are the structural optimisation tool and the design history tool.

- Optimisation tool

One of the tools being developed is a structural optimisation tool taking concept design data to give an accurate initial structural model optimising production and structures. This tool will aid concurrency through automated transfer of information from other areas of design in this instance aiding the design for production process.

- Design Histories

Design histories are an important area for evolutionary design companies. The searching through of these processes can take many hours and it can be reliant on experiences “Design Gurus”. The automated searching of previous designs to give advice to designers about past successes should aid problem solving and strengthen the weighting system used in genetic algorithms.

- Materials and parts database

The ability to search and integrate new materials will involve the use of databases of currently available parts and materials. It will be important that these databases are filled with up to date and reliable data which has been independently sourced.

Current Tools	Techniques to be used
Structural Tools	Genetic Algorithms, Pareto Functions and Direct Optimisation Methods
Design Histories	Neural Networks, Fuzzy Logic and XML Schema
Concurrent Engineering Hub	Internet Based Excel Hub Embedded in SharePoint

Current tools to being developed and techniques to be used

4. Structural Optimisation

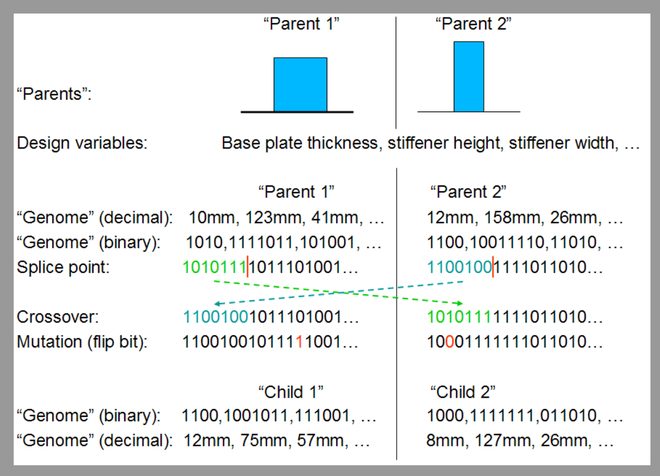
Optimisation

•Genetic algorithms used for optimisation.

•Mulitobjective optimisation used between structures and production

•Direct methods (Hill-climb) used for decreased computational time and increased accuracy

•Embedded algorithm for plate and structures



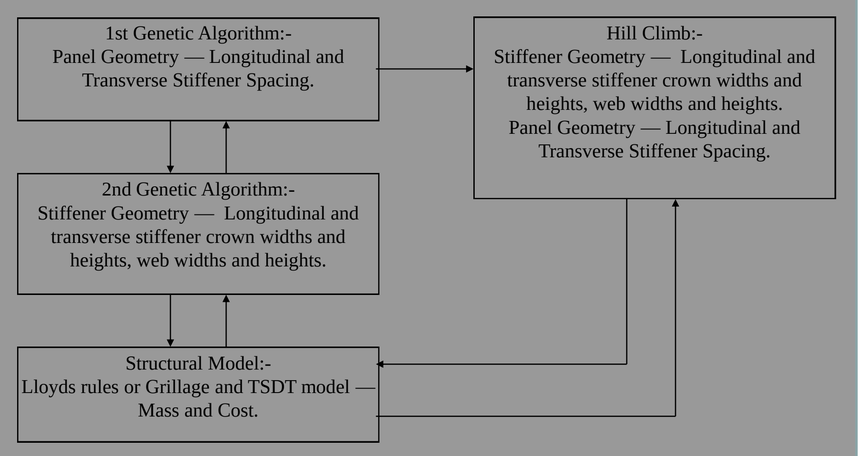
Top hat stiffener optimisation

Structures

•Navier grillage analysis (Topology) and Third Order Shear Deformation Theory (TSDT) (Plate) used for structural analysis.

•World wide failure criteria are used to confine the results

•Comparison with FEA the next step.



Optimisation algorithm

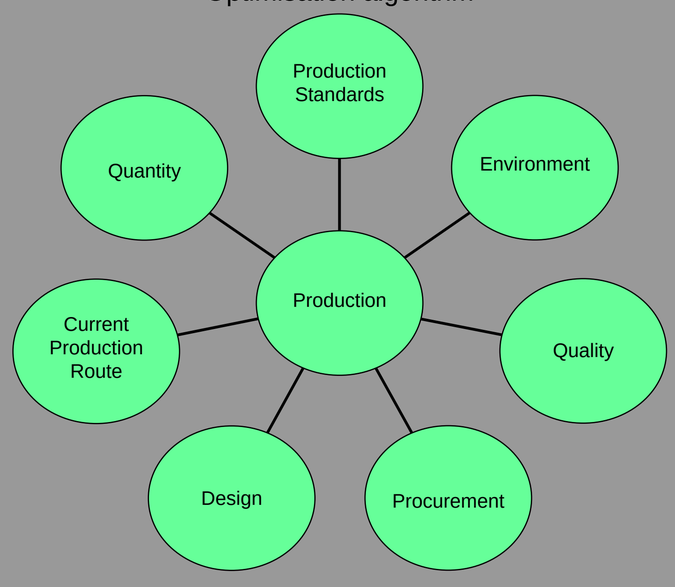
Cost

•Used to model production for the optimisation model.

•Detailed cost modelling offers the best option.

•Different production techniques compare current techniques with new possibilities

•Different layups and materials optimised for reduced cost



Production key areas

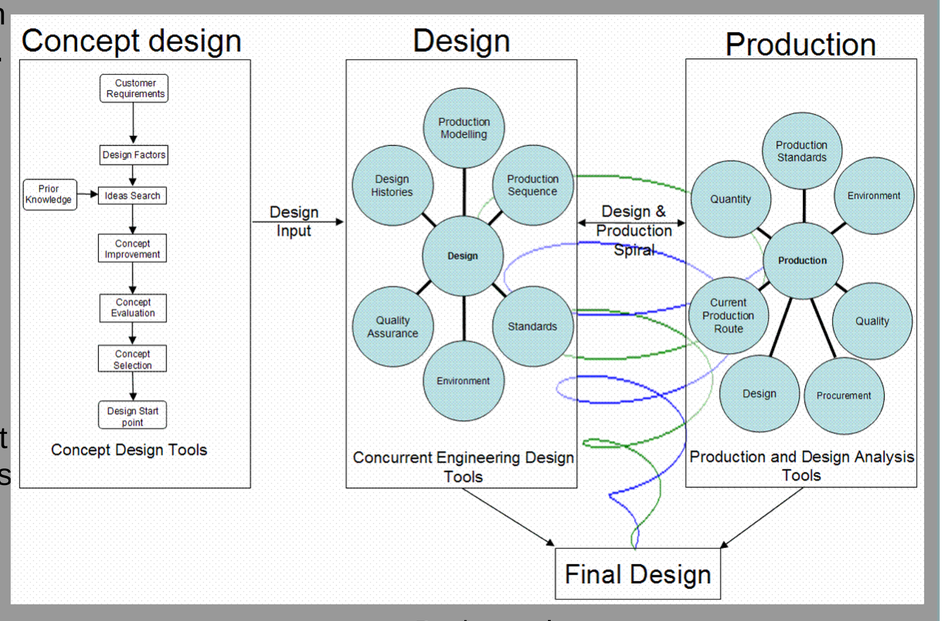
Concurrency

•Concurrency is an aid to design for X.

•.The transfer of information and data is key.

•Companies often work within a distributed information network.

•Concurrency must aid all of the stages of design through automated or communicative processes.



Design cycle

5. Collaboration

•The project is sponsored by EPSRC and the British Marine Federation who are coordinating the project with industry.

•The project will involve collaboration with a number of boat yards including Princess, Oyster, Green Marine and VT Halmatic