Value Driven Design

UTC for Computational Engineering
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What is Value Driven Design?
The importance of cost is now well established in the transport industry, in particular within the commercial aerospace companies such as Rolls-Royce plc. Their technology and performance of the products are extremely sophisticated, therefore the competitive factor between the aerospace companies is increasingly based on cost. Customers are demanding lower cost products without sacrificing their requirements. An alternative interpretation of Value Driven Design is to view cost not only from the perspective of the client but also the design engineer. The overall system cost is affected by all phases of the design cycle. This highlights the significant of treating cost as an independent design parameter that can be controlled during the development cycle. Traditionally, cost tends to be considered late in the design cycle, which could lead to high cost if the designs were to change. There is now a shift to establish and understand cost drivers throughout the design phase, particularly when design and manufacturing options are considered.

Aim and Objectives
This research aims to support the concept of “Designing Future Generation Gas Turbines” to not only meet Performance Targets but also to meet Cost Targets. A viable route to influence Rolls-Royce plc design and manufacturing engineers to become aware of areas that directly drive the choice of design solutions and manufacturing processes. This approach is achieved through two case studies that build on the idea of integrating the cost parameter at early stages of design. The outcome of this research will be a delivery of tools, techniques and knowledge to support design decision making. This forms part of the Cost-Modelling Strategy being developed in the Research and Technology Cost Engineering team at Rolls-Royce plc.

Novel Component Cost Modelling
One of the case studies being examined is to build cost models for novel components. The models will allow engineers and designers to understand the cost drivers in developing the component. The cost model is constructed using various cost factors, which includes recurring costs, i.e. operating costs. The software selected for this study is Vanguard Studio, which has been well established as a costing tool at the University of Southampton and has been integrated into Rolls-Royce plc. The European project BREAD (Validation of Radial

Data Mining for Cost Estimation
An alternative approach to estimate costs using data mining method. Existing design and cost data of various engines and their components are entered into a large database, which is then explored with techniques used in data mining, relationship between design attributes can be established to estimate the cost of a new engine design. A powerful data mining tool is STATISTICA Data Miner by Statsoft. The tool offers a user-friendly interface (Fig. 4) and has a comprehensive selection of data mining procedures and graphical functions to aid analysis (Fig. 5).

Future Work
The models in the Novel Component Cost Modelling case study will be refined as more design and manufacturing process information becomes available, as well as the system factory model. The issue of uncertainty of data will be addressed as well as design complexity. The integration of the data model into Vanguard Studio will also be tested and implemented. Further research will be applied to the Data Mining case study to test pilot ideas for an engine cost estimation tool. The methods and techniques used in data mining can be adopted by a third case study that considers Whole Engine System Design and integrating a cost parameter into a design tool, e.g. to allow preliminary design optimisation to decide the impact of varying design parameters on cost.

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Fig. 1 Example of Optimised Engine Configuration

Fig. 2 Vanguard Studio: Data Mining Tool Interface

Fig. 3 Example of Surface Model and its Data Structure

Fig. 4 Vanguard Studio: Data Miner Interface

Fig. 5 Vanguard Studio: Data Miner Interface

Fig. 6 Vanguard Studio: Data Miner Interface