Stranger by Design

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Introduction

Rolls-Royce is a multinational organisation providing gas turbine engines for the defence, civil, marine and energy markets. All the components that Rolls-Royce design and manufacture are organised into a commodity structure where the supply chain has experience with each type of component. An example is the nozzle guide vane, which between engines may appear different but on the whole is fundamentally similar. This similarity has been exploited so that the Rolls-Royce supply chain is very familiar and confident with the design and manufacture of these complex components.

A 'strange' component is one that is unfamiliar for some reason, either due to its production volume, manufacturing method or design. Unfamiliarity can give rise to producibility issues. Within Rolls-Royce there is a supply chain unit that is dedicated to delivering what it terms 'strangers and aliens'. These are end-of-lifecycle components that fit into two categories: stranger by volume, and stranger by manufacturing method. The main focus of this research is to consider another aspect of unfamiliarity whereby components are strange due to their design.

Stranger by Design

The definition of a stranger by design component is a component that meets one of the following criteria.

a) The component falls outside, or uneasily inside, the existing commodity structure in Rolls-Royce. A commodity describes a group of components that have similar features, and a commodity set is a group of related commodities. For example, the commodity set 'fan blades' is made up of several commodities including 'honeycomb fan blades', 'composite fan blades', and 'solid fan blades'. In theory, all of the components that Rolls-Royce produce belong to a commodity, so generally a stranger by design challenge arises when a component does not fit properly into the commodity to which it belongs. Any feature of the component's design including its size, material, shape, tolerances, design rationale etc, could cause this.

b) The component has features that do not have established design rules. Within Rolls-Royce there are many documents that provide best practice methods for the design of features or the use of materials etc. If a component has to be designed outside of these standards then it could be considered stranger by design.

Considering the component life cycle, components can start as strange by design but over time, as more knowledge and experience is gained they become more familiar and less strange. An example is a blisk (bladed disc, **Fig.1**), which is a relatively new design that has progressed to having its own commodity set.

Fig.1 : A blisk (© Image: Rolls-Royce.com, 2007)

Producibility

Producibility is the measure of the ease of manufacturing, assembling and testing a component to specification in full production. It cannot be achieved without considering all activities in the product development lifecycle from initial concept, through prototyping, pre-production and full production. Good producibility can be achieved by having a robust design, a robust process and a capable and supportive supply chain. Rolls-Royce have successfully managed this through the use of supply chain unit commodity structures. However, when a design is strange due to unfamiliarity then producibility can suffer.

3-Bearing Swivel Module Case Study

An initial case study is concentrating on the casing of the 3-bearing swivel module (3BSM), **Fig.2**. This component forms part of the STOVL (short take off and vertical landing) variant of the Joint Strike Fighter. This casing can be considered stranger by design for a number of reasons.

The study will apply a Rolls-Royce design / make method called Build in Quality. This is a continuous improvement method that analyses a component's manufacturing process and identifies the potential causes of errors. The method involves 5 basic steps:

1. Understand the manufacturing process
2. Understand the key features and dimensions on the component
3. Bring the knowledge about the process and the component together in order to identify key problem areas
4. Create and troubleshoot the future state
5. Act on results to ensure that the future process is robust and the design is producible.

The application of this process to the 3BSM casing will prove its capacity to gain and maintain producibility on a stranger by design component.

Fig.2 : 3BSM (© Image: Rolls-Royce plc, 2006)

Current Work

- A detailed exploration of the current product design process within Rolls-Royce so that specific areas of it can be targeted for improvement.
- An internal and external study of the existing theoretical methods that aim to improve a component's producibility. The aim is to assess the range of methods that could be employed, how successful some of them have been in the Rolls-Royce environment and then use this knowledge as a base to create an effective solution.

Future Work

Future work will be aimed at:

- External and internal benchmarking in order to establish which techniques are most effective for improving producibility in other, similar, organisations and to see if this information could be read across.
- Final development, implementation and testing of a solution.

Acknowledgements:

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