



## **“The Importance of True Scale Capability Demonstration to Ensure Product Integrity”**

### **Complexity drives Simplicity**

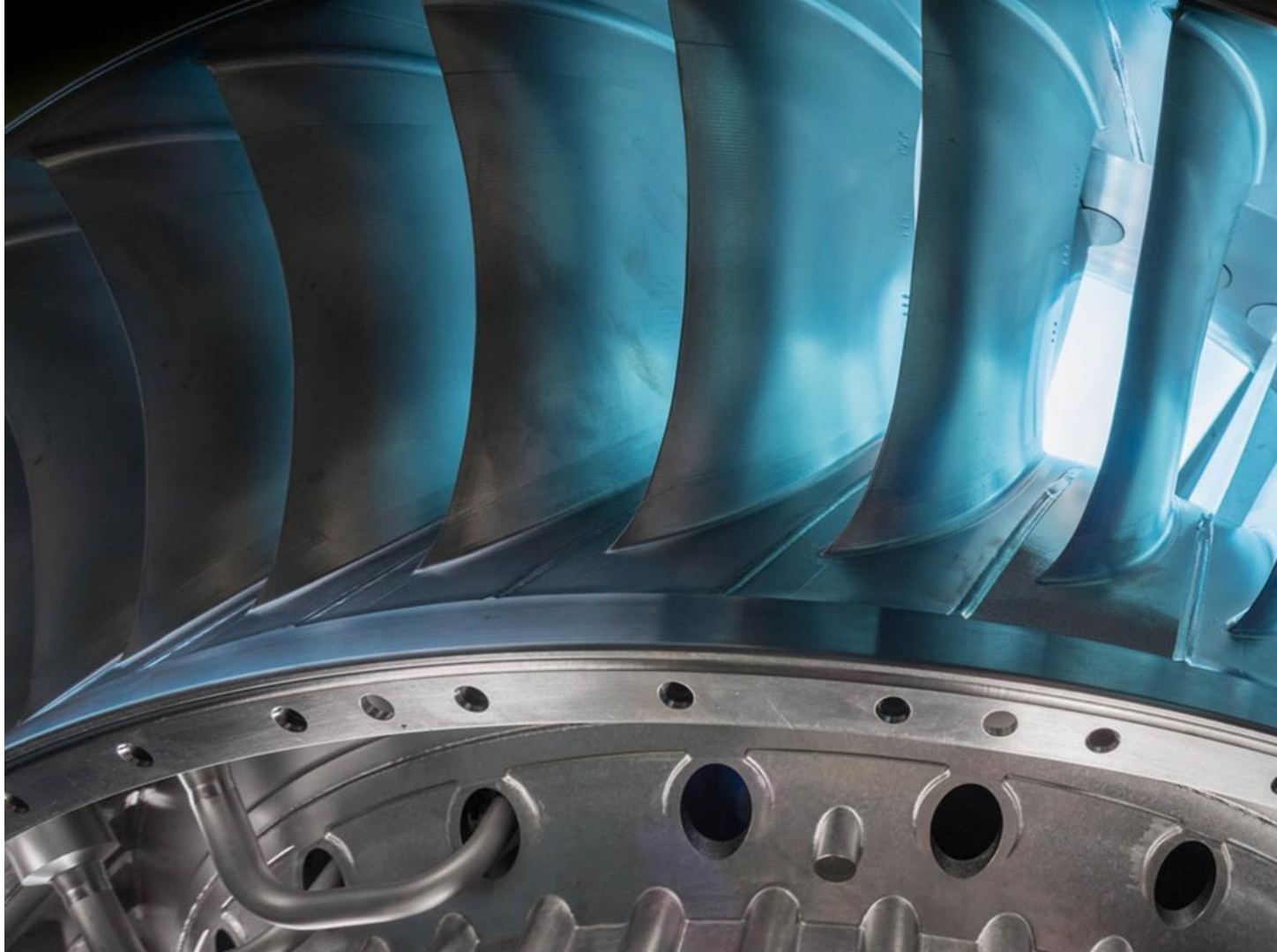
Neil Mantle, Head of Additive Manufacturing

November 2019



## The Rolls-Royce early Additive Exemplar

- Trent XWB-97  
Development Front  
Bearing Housing
- 2015 - The largest  
Aero Engine load  
bearing structure to  
fly made from  
additive  
components





**Trent XWB-97 Engine Development  
Programme – Ground Running and  
Flying Test Bed**

**2010 - 2015**

**Our Pioneering Spirit continues ...**

**2018 -**



## A sneak preview into the complex

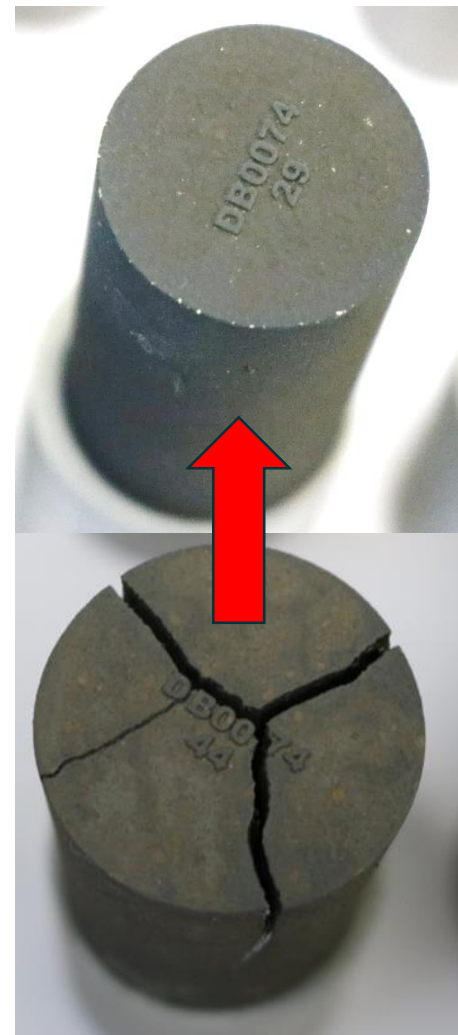
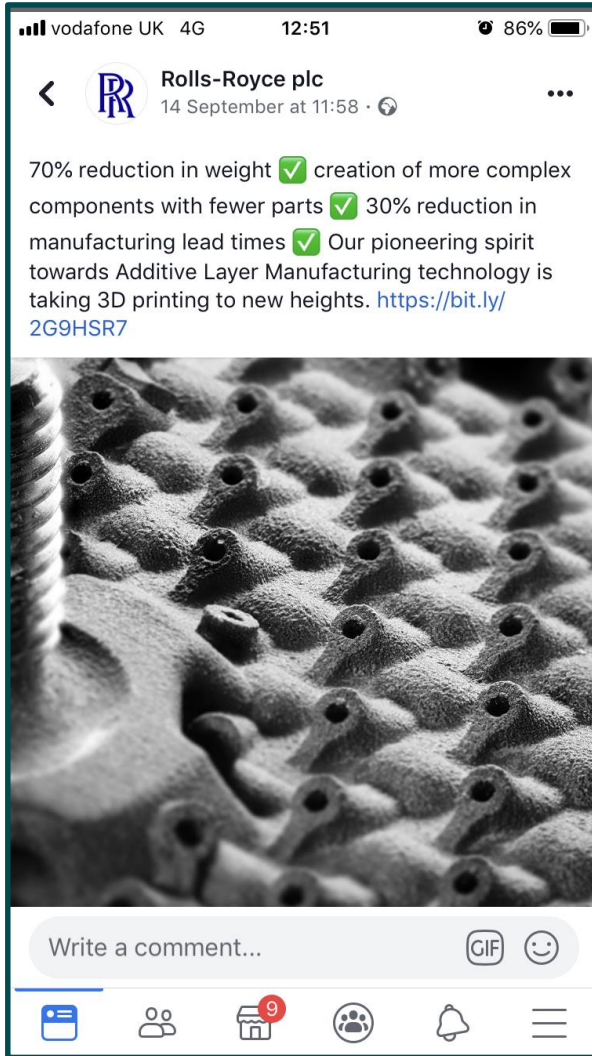
Social Media – Sept 2019

My message from  
Singapore Oct 2018

“Complex Alloys  
Complex Challenges”

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## Additive Applications exist across the business

A world class full scale  
demonstration  
capability drives  
understanding from an  
early stage

From principle demos  
to flying components -  
Zero Defects defines  
our approach





## Keeping us safe

We operate and expect a stringent Zero Harm regime across our additive network

# ZERO HARM





## What does it take to industrialise Additive Manufacturing?

Investment in our people and capability infrastructure

Developing deep fundamental component, process and industrialisation knowledge

Committing to be an;

- Intelligent User
- Intelligent Customer
- Using Intelligent Suppliers





## **Great Opportunities**

**We review a new application  
or opportunity every week**

## **Industrialised Intent**

**Artefacts look shiny & bright  
Evidence enables flight**

## **Driving Intelligence & Ensuring Integrity**

**Learning by doing  
Leading by example**

## Why bother with true scale demonstration?

True industrialisation readiness for additive manufacturing remains challenging

Boring Predictability  
(N. Mantle, 2013)  
remains a distant thought for many ...



## Technology is scaling

Multi lasers are becoming the norm ... m/cs and components are getting bigger



## Robustness & Reliability

Over 7500 layers & 25 parts per build ... in excess of one week melt duration



## Calibration & Traceability

Each hole, each laser/E-Beam, each suite of Key Process Variables to be understood & controlled



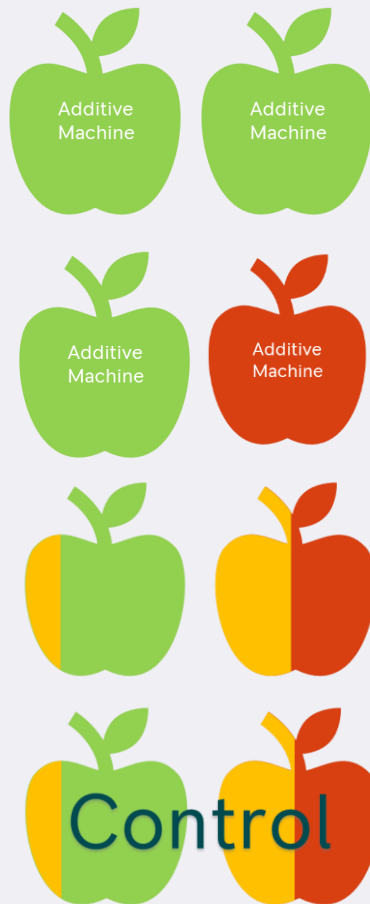
**Why bother with  
true scale  
demonstration?**

**What did I think I  
specified?**

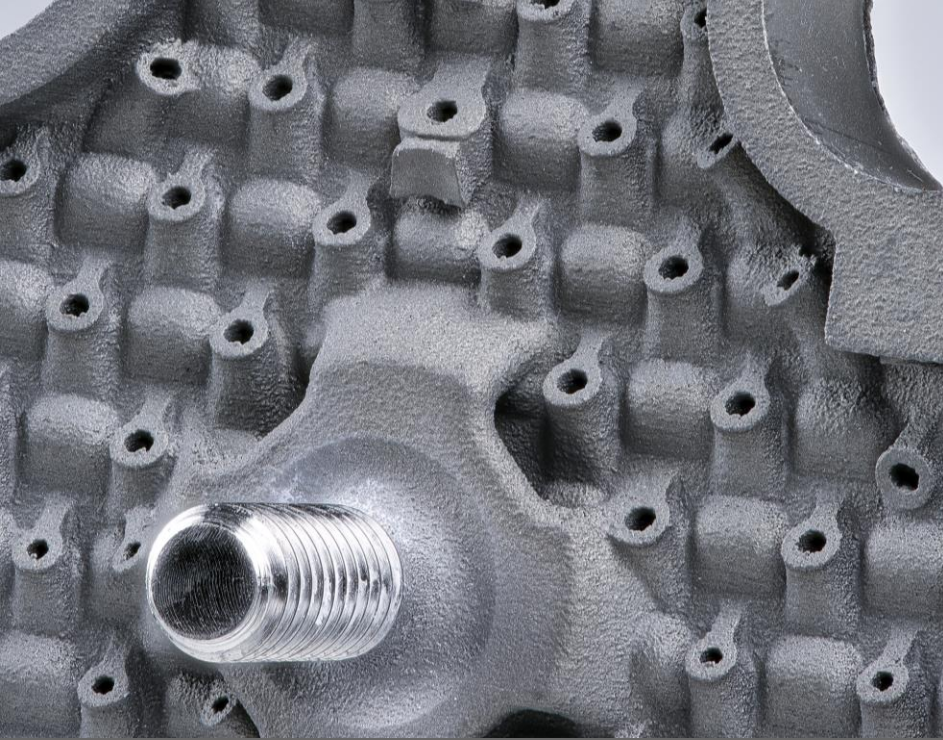
**Was it what was  
supplied ...**

**What have I  
actually received?**

**What is it that I  
need?**



**Understanding & Controlling Complexity drives Simplicity**



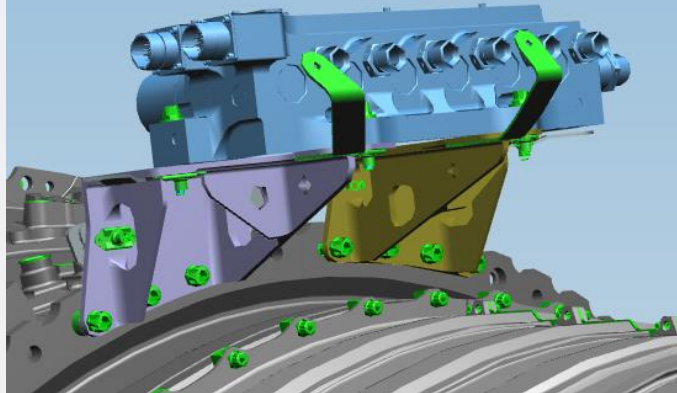
**Complexity Drives Value**



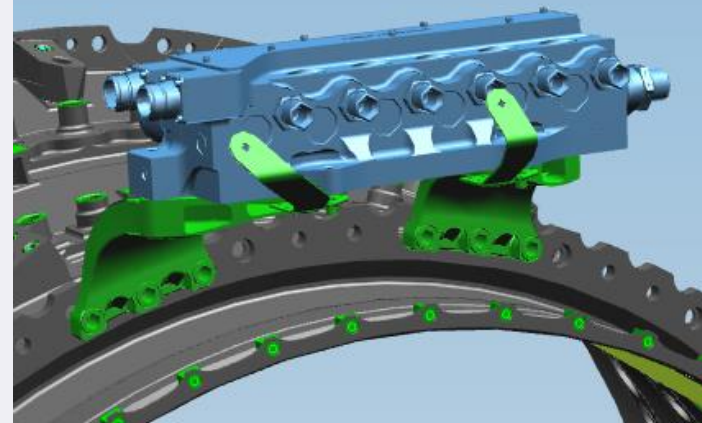
**... it also drives Simplicity**

## Understanding complexity drives simplicity

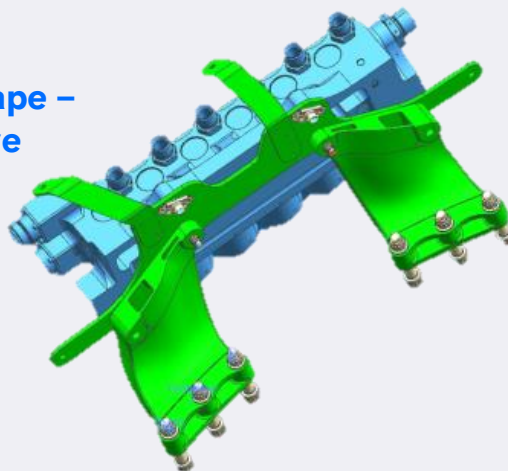
### A more conventional Approach



### An Additive Approach



**Specific optimised application, simple shape – more costly subtractive manufacturing**



**Complex shape – minimised post processing (additive) and machining (subtractive)**

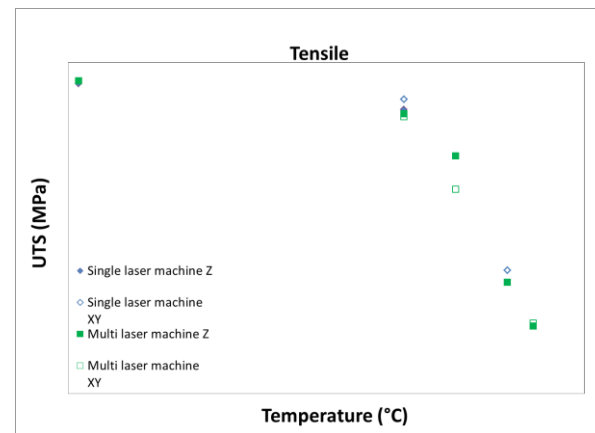
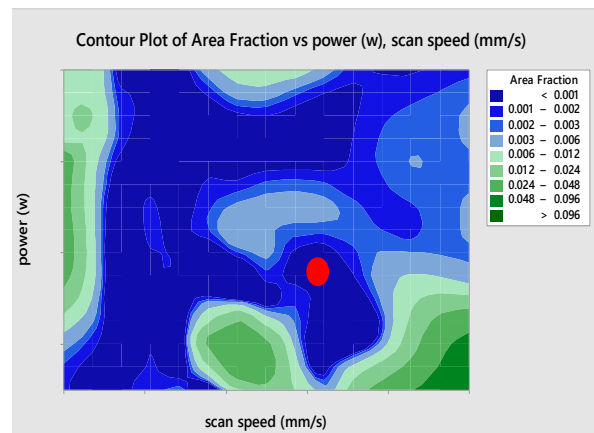
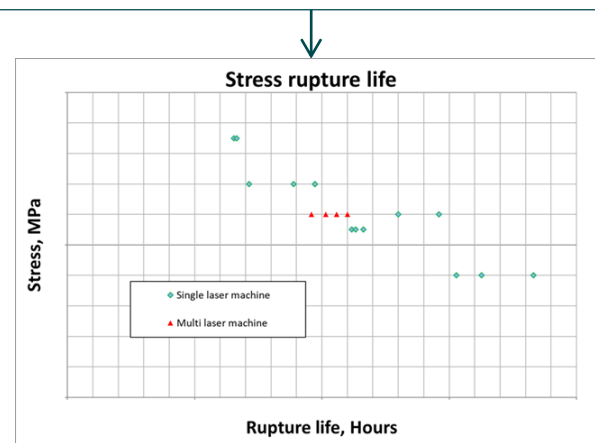
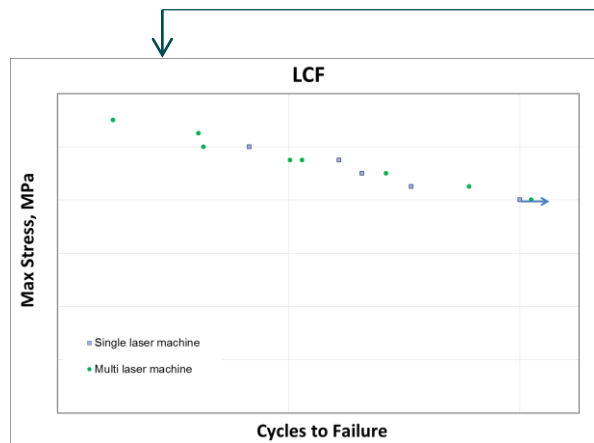
**Optimised for manufacturing with minimum support structures**

Understanding complexity drives simplicity

Options and capabilities for development are more agile and drive greater value ...

when you understand EQUIVALENCE

# MECHANICAL PROPERTIES (suppressed)





**Thank You & Questions**