

# **Titanium Strategic Review**

## **Outline of findings**

**Martin Marples**  
**Senior technologist**

- UK Capabilities
- Specific Research and Development needs
- New and Innovative Technologies
- Competitive Materials
- New Market Opportunities
- Recommendations

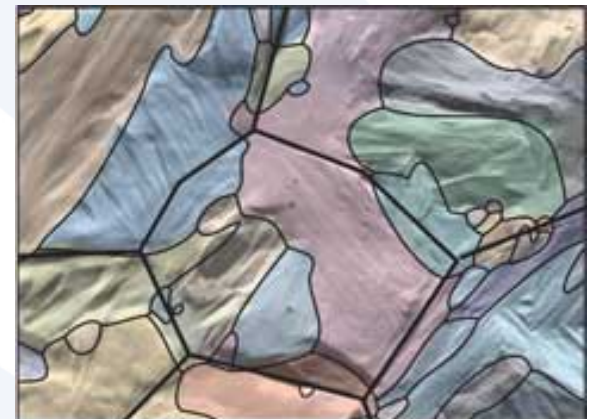
# UK Capabilities

- Primary Reduction
- Remelting & Ingot Casting
- Conversion
- Forming
- Fabrication
- Surface Engineering
- OEM



- Industry Needs Driven by Cost Reduction
  - Additive Manufacturing (not subtractive)
- Alloy Performance Appropriate for Application
- Surface Engineering
- Modelling and Simulation
  - Process
  - Performance

- **Process**
  - Casting, Forming, Machining, Welding, Powder Route
- **Microstructural Development**
  - Phase, texture, grain size, distribution
- **Performance**
  - Corrosion, Structural Integrity
- **Life Cycle Cost Analysis**



- Validation of Modelling
- Near Net Shape Methods
  - Powder Production, Consolidation and Processing
  - Thin Wall and Precision Casting
- High Speed / High Precision Machining
- Design Codes for Structural / Semi-Structural
  - Construction, Corrosion Resistant Service

- Powder Processes
  - HIP, CIP, MIM, Shaped Metal Deposition
  - Plasma Spark Sintering
  - Powder Forging



- Coating Technologies
  - Wear and Thermal Resistance
- Low Heat Input Joining Processes
- Processing of Shape Memory Alloys





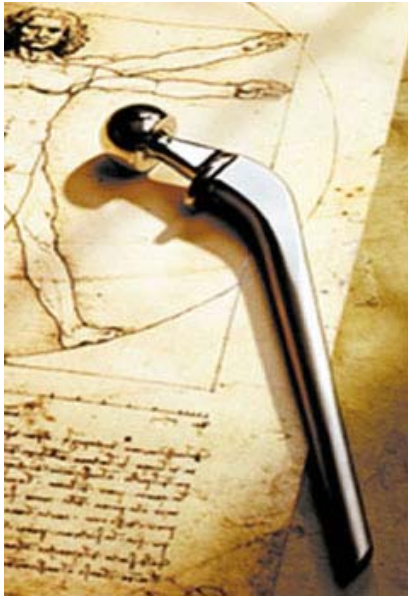
- **Based on Selection for Performance**
  - Not typically for “Fashionable” reasons
  - Corrosion Resistance
  - Mechanical Performance & Light Weighting

# Corrosion Resistant Service

Stainless Steels

Nickel Based Alloys

Cobalt Alloys (Stellites)



NiCrMo alloys (Prosthetics)

Zirconium Alloys (emerging)

Epoxy polymers (to elevated, not high, temperatures)

- Mechanical Performance / Light Weighting
  - In Some Aerospace Applications Ti is Not Considered Replaceable
- Decisions Based on \$ per Kilo and Availability
  - Aluminium
  - Magnesium
  - Ultra High Strength Steel
  - Polymer Matrix Composites
    - Aramid Fibre
    - Carbon Fibre



- Most Opportunities are Increases in Current Market

- Increasing “Dilettante” Use



## Aerospace

- Increased Proportion of Ti Used in Civilian and Military Aircraft
- Increased Aircraft Numbers and Flight Miles



## Defence

- New Defence Projects



## Corrosion Resistance for Sea Water Applications

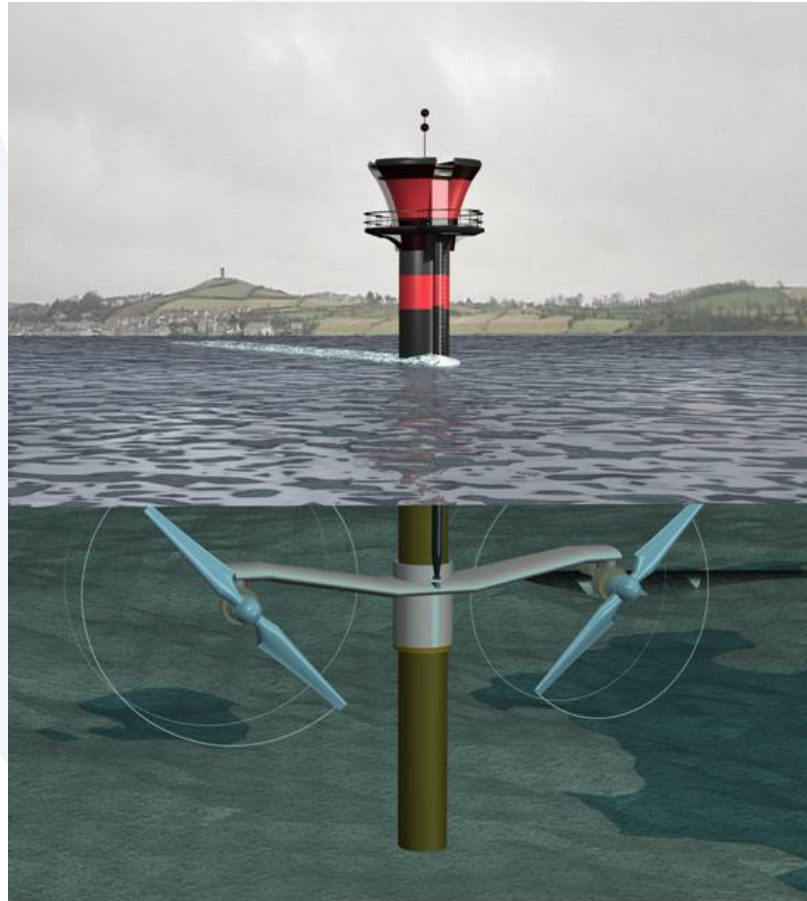


Image Courtesy of Marine Current Turbines Ltd



- Research needs to be focused on the industry needs highlighted
- Increased scope of design cases and guides
- Investment is required to address capacity gaps

- Improved Communication between:
  - Knowledge base
  - Knowledge base and industry
  - Supply chain
  - Funding Agencies (DTI, EPSRC, RDA, etc)

