MATERIALS CHALLENGES FOR THE AEROSPACE SECTOR

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Introduction

ADS trade organisation

The premier trade organisation advancing UK Aviation, Defence, Security and Space Industries globally

- **Serves over 900 UK based member companies (2300 with regional partners)**

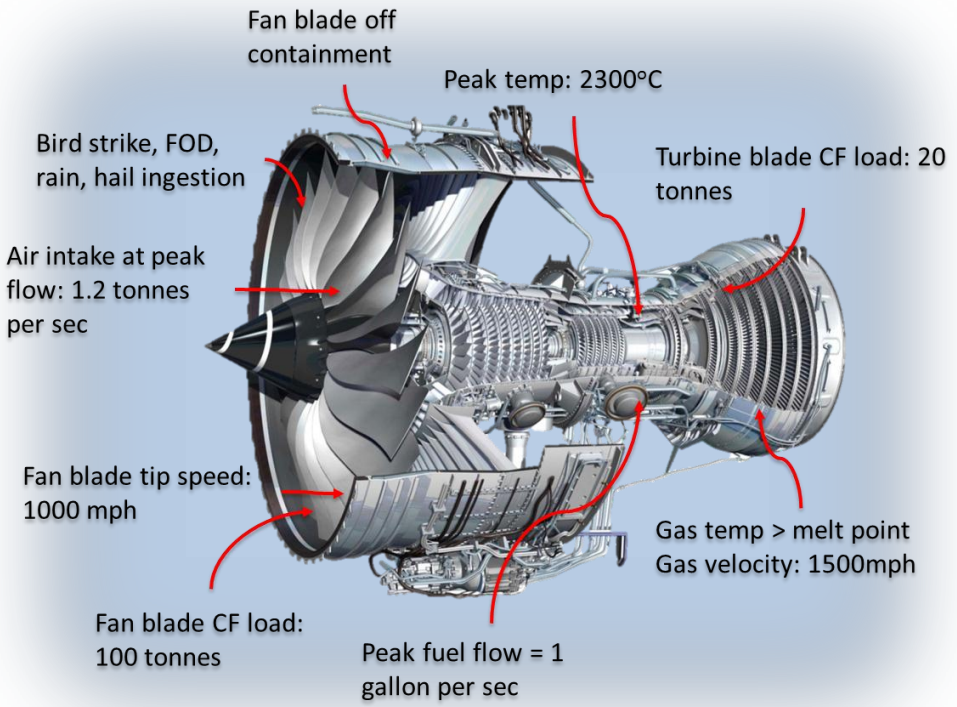
  - Manufacturers
  - Suppliers
  - Service companies
  - Operators

  - Small start ups
  - SME
  - Large global organisations

- **Represents the industry in all issues that affect ADS industry sectors, from environment and sustainability to supporting innovation and growth for SMEs**

Material Challenges for Aerospace

Operational environment of aerospace products



- Very arduous design requirements
  - Safety is paramount
  - Product life cycle is very long
  - Weight = Cost
- Operational environment is also extremely severe
- This results in a very limited range of material options for a given level of performance
- Understanding material supply risks is therefore a very important element of long term material planning

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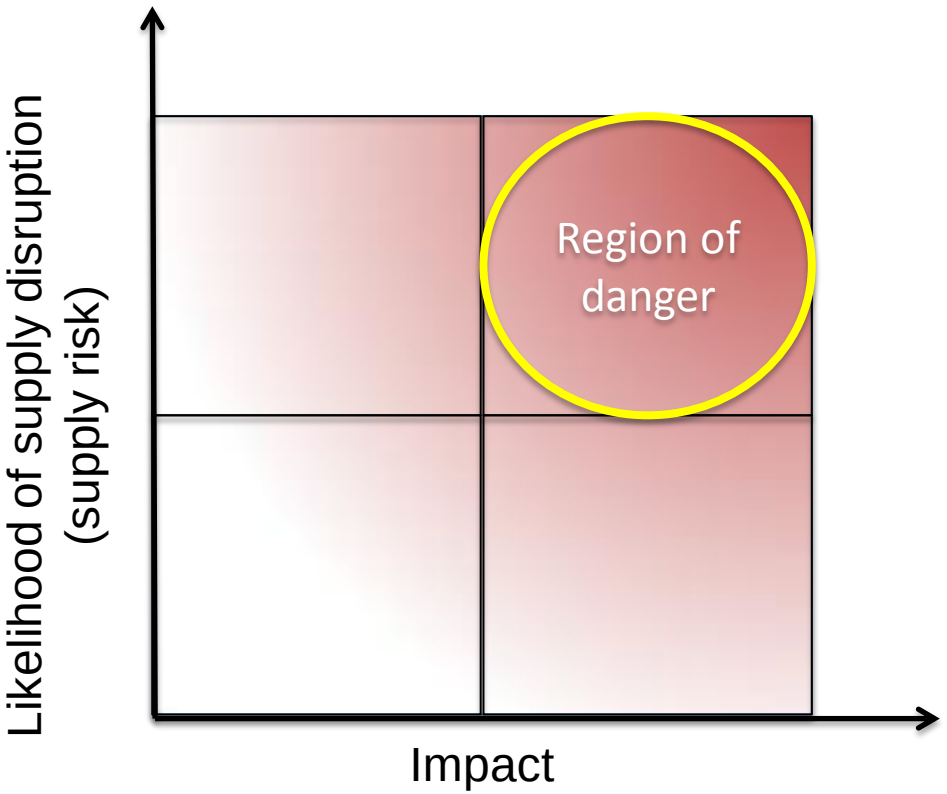
Material criticality

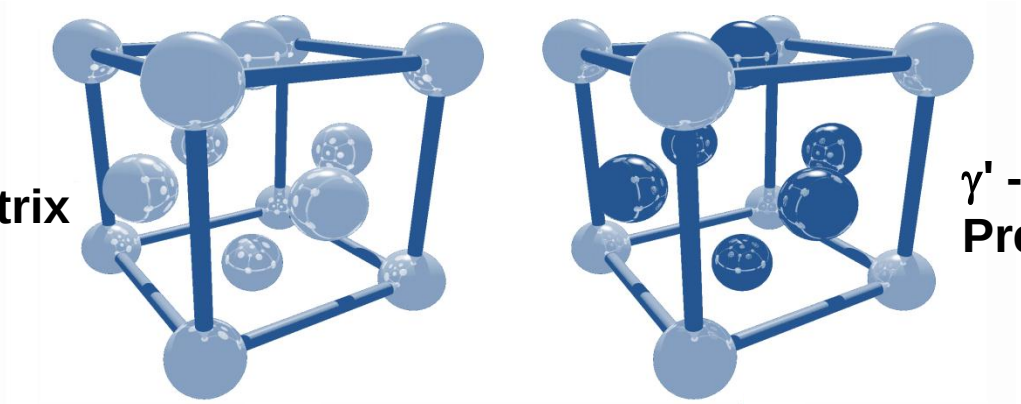
- Material supply risk is based on two elements of criticality
  - Likelihood of a supply disruption
  - Impact on the business
- Assessment of business impact is well establish, but likelihood is a multifaceted problem made up of:
  - Physical factors
  - Market factors
  - Political factors
- There are therefore many things that can have a significant affect on the supply of materials



Material Challenges for Aerospace

Example 1 – Turbine blade alloys

- The microstructure of nickel base, single crystal, superalloys is made up of a high volume fraction of intermetallic γ' particles uniformly distributed in a ductile metallic γ matrix



- The ordered crystal structure of the γ′ phase is inherently more resistant to deformation than the random distribution of elements in the disordered γ lattice.

- To enhance the mechanical properties, nickel base superalloys are heavily alloyed to strengthen the γ phase and optimise the γ' volume fraction to make deformation as difficult as possible

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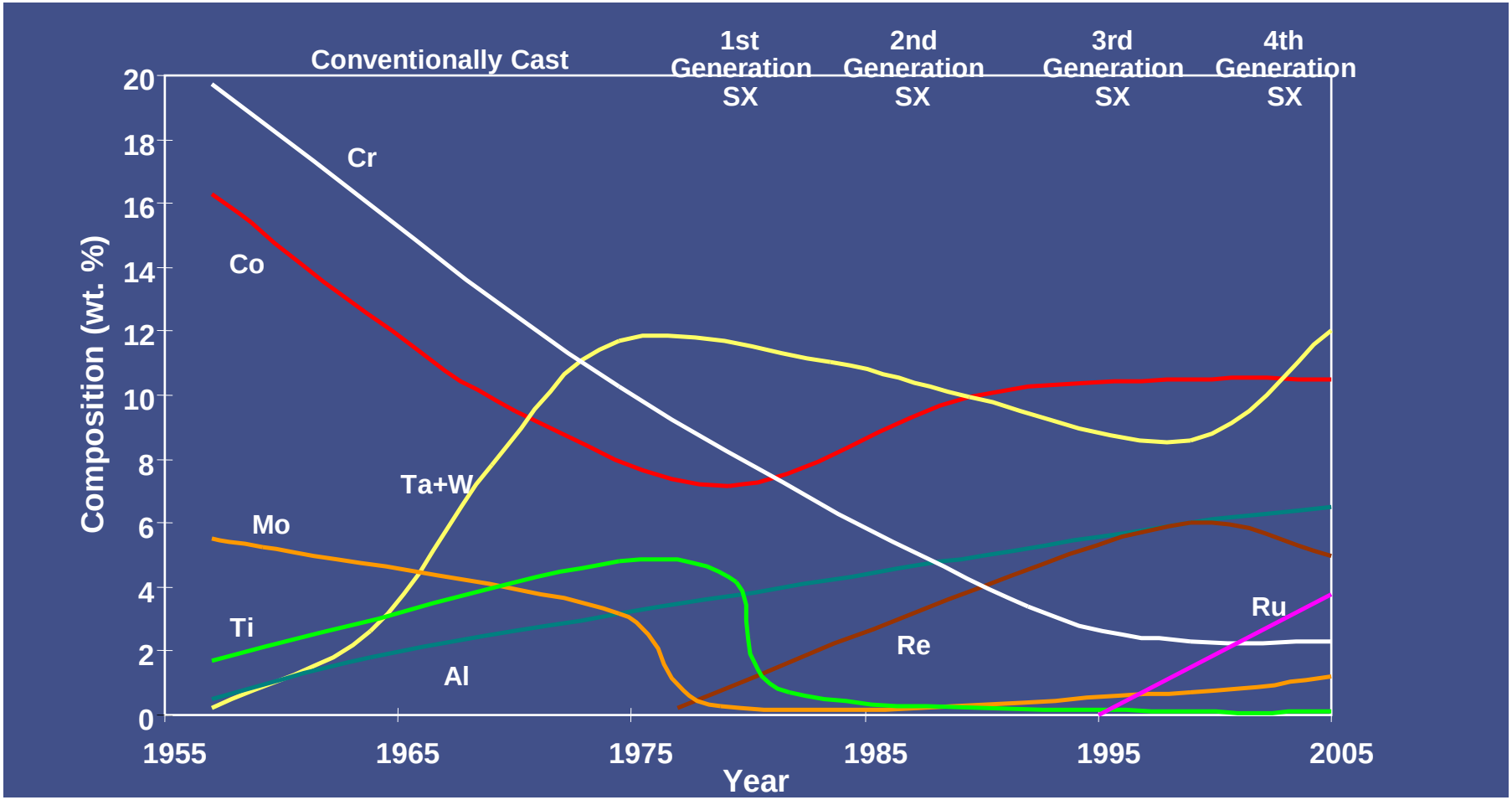
Example 1 – Turbine blade alloys



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Example 1 – Turbine blade alloys

- Due to the high performance demands, we have little choice but to keep using these alloys in the short to medium term

- The potential supply risks necessitate a range of mitigative responses

  - **Short- medium term:** Secure supply, enhance resource efficiency, enhance reclamation
  - **Long term:** develop new alloys, develop new design methodologies

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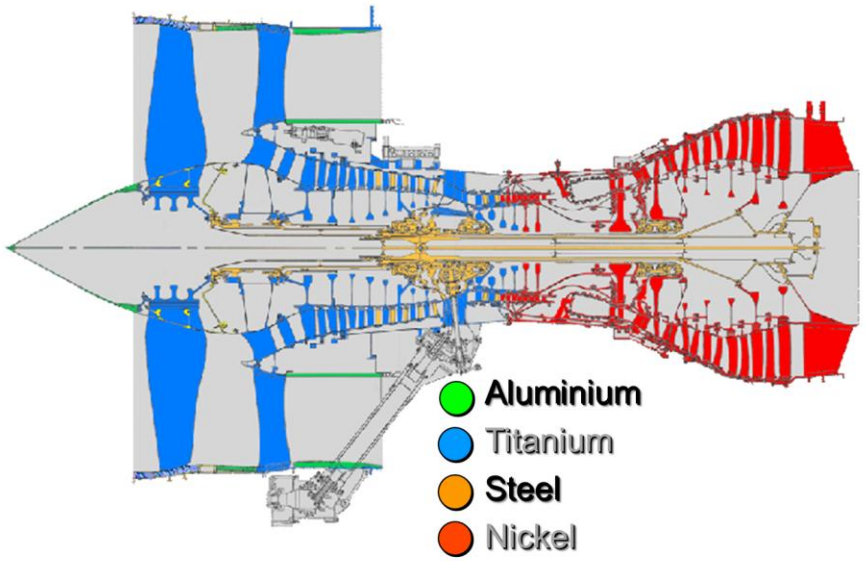
Example 2 – Corrosion protection

- Aircraft gas turbine engines are exposed to some highly corrosive contaminants
- Some parts of the engine require extra corrosion protection to maintain the high safety standards
- At present, the only process that meets the rigorous standards for aerospace is chrome coating, which requires hexavalent chrome



Material Challenges for Aerospace

Example 2 – Corrosion protection

- Hexavalent chrome is a genotoxic carcinogen and is on the REACH candidate list for authorisation (no sunset date yet – but there will be one soon)
- In this instance, the problem material is not embodied within the product, but is necessary to operate the process
- Due to the legislative restrictions placed on this material, our only option is to substitute the process or material
- The challenge is:
  - The industry won't 'daisy chain' to an equally toxic substance
  - The industry will not accept a lower level of performance
- The most viable solution is to find another way of getting the chrome on to the component surface

Material Challenges for Aerospace

Conclusions

- The aerospace industry has very stringent material requirements, which limits the options available when specifying solutions
- Understanding the factors that affect the long term supply of these materials is critical to defining the appropriate responses
- There are a range of material supply issues that are being managed by the industry. More will follow