GKN Aerospace – A Vision of the Future

Frank Bamford
Senior Vice President – Business Development and Strategy
Introduction and Agenda

➢ Introducing GKN
➢ Having a Vision
➢ What Drives Your Vision
➢ Technology to Attain Goals
➢ Summary and Questions
GKN PLC

HQ
London, UK

Sales $7.5 Billion
40,000 employees
in 30 countries

Automotive
- GKN Driveline Driveshafts
- GKN Sinter Metals
- GKN Off Highway
- $5.8BN

Mission: Deliver outstanding products and services to our customers and exceed performance of our competitors

Aerospace
- GKN Aerospace
- $1.7BN

GKN PLC

GKN AEROSPACE
A global, first-tier supplier of structures, components, assemblies and engineering services to aircraft and aero-engine manufacturers
What Is Your Vision of the Future?
Do is include your future ENVIRONMENT or LOCATION?
Does it include your future TECHNOLOGY?
Does it meet your future GOALS and OBJECTIVES?
The Environment Driving Your Vision
Market Environment

➢ No shortage of passengers – steady population growth

➢ Plenty of need for more commercial aircraft

➢ Commercial market is in boom
  ➢ Approx 8,000 aircraft forecast to 2015

Population increase slowed down

- Population more than 1.5 billion greater than in 2005
- The global distribution of population remains roughly constant
- Global population expected to stabilise at ~11 billion in 2020

- No shortage of potential travellers
- No real change in the focus of destinations
- Existing route structures develop

Aviation growth demand continues

- World traffic growth continues at ~5% per annum
- 2030 traffic is 350% of 2006 level
  - 18,000 more aircraft than in 2005 – doubling the world fleet
  - 2 billion more passengers
- Increased security issues
  - Passenger scanning
  - More airport congestion
  - More ATC congestion

Source: Rolls-Royce (Oct 2006)
Environmental Issues

- Advisory Council for Aeronautical Research in Europe (ACARE) has set targets, endorsed by all major aerospace companies, to be met by 2020:
  - Reduce fuel consumption and CO₂ emissions by 50 per cent
  - Reduce external noise by 50 per cent
  - To reduce the emission of nitrous oxides by 80 per cent
  - To make substantial progress to reduce the environmental impact of the manufacture, maintenance and disposal of aircraft and related products

- Targets not stringent enough – 30%
- But prepared to pay to make a better aircraft

Source: Rolls-Royce (Oct 2006)
Expanding Composite Usage

Aerospace Application – Expanding Composite Usage

Composites ratio in structural aircraft weight

<table>
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<th>AIRBUS</th>
<th>BOEING</th>
<th>Military</th>
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<td>2015</td>
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Airbus A380
550 Passengers
EIS 2008

Boeing B787
250 passengers
EIS 2010

Main composite parts
Growth in Composite Materials Usage

Airliner % composite by weight

- B737NG
- B767
- B747-400
- B777-200LR/300ER
- B787
- A330/340
- A320 Series
- A380
- A350XWB
Titanium Content by Weight
of Aircraft (% of Total)

Source: Boeing Fact Sheets, RAND Corporation
A Revolution in Aerostructures

% Structure Titanium

15% | 40%

% Structure Composite

50% | 37%

Total

65% | 77%

Combined Boeing 777 - 17%

Combined F18 E/F - 40%
Why???

➢ Weight, weight and weight
  ➢ Compared to aluminium structure Carbon and Titanium can save between 20% to 30%

➢ Life
  ➢ Carbon fibre components are relatively insensitive to fatigue damage and Titanium is less susceptible to corrosion

➢ Design Freedom
  ➢ Because CFRP is a moulded product extravagant high performance shapes are possible for the same cost as traditional solutions
Technology to Suit the Demands
Future Trends - Propulsion

- Lighter engines delivering the same power provide:
  - A lower weight propulsion system installation
  - Lighter wing attachments leading to a lighter wing
  - A more efficient aircraft
    - Less fuel burn and lower emissions
- Engines of the future will incorporate:
  - Lower speed, larger diameter fans and perhaps open rotors
  - Higher bypass ratios
  - Better fuel efficiencies
  - Lower CO₂, NOₓ and noise emissions than engines of today
GKN Propulsion Systems Technology

- Pushing the boundaries in composites design and production
  - VITAL – composite fan blade
  - Composites Fan Cases
  - Advanced Acoustics
General Electric GENX Composite Fan Case

- Contracted for the Boeing 787
- Uses Resin Film Infusion
- Automated lay-up

First Engine to Test

Second Engine to Test
Future Trends - Aerostructures

» Lightweight structures are an equally important part of the equation
» They will be self sensing for damage through life
» They will be highly automated in manufacture to compete on cost and drive up quality
» End of life disposal will become ever more important
GKN Integrated Wing Developments

- Automated manufacture of closed box type structures
- Demonstrator components now fully defined
- Staged manufacture now in progress, leading to a wing box demonstrator.
Next Generation Manufacturing

- Automated manufacture with integrated design tools
- Deposition of carbon pre-pregs at higher rate. 10 times a manual rate
- Advances in composite tooling, especially when combined with Out-of-autoclave self heated tools with embedded thermometers and local cure detection.
- Reduced cycle time, energy, and material

Higher Rate ATL
Smart Structures

- **Spraymat™** - plasma sprayed metal on composite materials
- Selected for Boeing 787 wing ice protection system
  - **Design drivers:**
    - Weight
    - Non-metallic structure
    - No engine bleed air
    - Field replaceable
  - **Design concept (composite heater mat structure behind a thin aluminum erosion shield, on the movable slats)**

*Image of Spar Bracket Assembly showing alternative mounting of the TWB to the Fixed Wing Forward Spar.*
Metallurgical Structures Technology

- State-of-the-art lightweight metals
  - Chemically milled titanium jet casings
  - Advanced honeycomb construction
  - Machined titanium and aluminium structures
  - Titanium Metal Matrix Applications
Why???

- Weight, weight and weight
- Life
- Cost of acquisition and operation

LESS WEIGHT = LESS FUEL = LESS EMISSIONS
Using Technology to Attain Goals and Fulfil Vision
GKN Aerospace

Market

Business Mix

Sector

Customer Base

AIRBUS
Sikorsky
Rolls-Royce
Boeing
Cessna
Honeywell
BAE Systems
Bombardier
Expect More
To Fulfill the vision requires TOP LINE GROWTH and SUSTAINED MARGIN:

Growth
- Technology to secure position
- Capture key programs
- Reposition in growth areas
  - Single Aisle
  - Aftermarket
- Expand Niche businesses
- Selective Acquisitions

Sustainability
- Portfolio Realignment
  - Commercial
  - Aftermarket
- Operational Improvement
  - GKN Lean Enterprise
- Exploit the business potential

$4.2B Sales by 2016
An Exciting Future
Based on New Technologies

Estimated total production values exceed $9bn and growing
• Firm orders options and just 1000 JSF delivers over $4bn

approx shipset values US$m
GKN Aerospace Today
GKN Leadership in Composites

➢ First application of RFI in commercial aircraft – A380

➢ World’s first large wing composite spars - A400M – automated lay up process

➢ GEnX filament wound composite fan case – a first for large commercial engines

➢ F35 (JSF) F135 engine fan inlet – first composite structural front end to a military engine – proprietary RTM process

➢ B787 first electronic wing ice protection product
GKN Aerospace Today
Northrop Grumman X-47B Participation

Around 80% of total structure GKN responsibility -

Design
- Wing and flight spoilers – composite / metal hybrid
- Body structure – metal

Build
- Complete Wing Assembly
- Spoiler Assembly
- Large portion of the body substructure
- 80% of the OML – composite skins, covers, and doors
Engine Products Potential for Integrated Modules

- Composite and Metal Fan Blades
- Composite and Metallic Fan Cases
- Engine Core Cases
- Fan & Compressor Blades
- Blisks
- Existing
- Acquired
- Turbine Exhaust Cases
Airbus A380 Programme

GP7000 Turbine Exhaust Case

GP 7000 Fan Blade Finishing

Composite Flap Track Beam

RTM Vertical Stabiliser Components

Full Composite Wing Trailing Edge Structure
Boeing 787 Programme

- Passenger cabin
- Windows
- Trent 1000 Rear Case and ICF
- Wing Ice Protection System
- GEnx Fan Composite Containment Case
- Floor System

Passenger cabin
Windows
Future Technology Opportunities

A350

Next Gen Single Aisle

Advanced UAV’s
Risk Reduction of New Technology

- Test, Design, then Apply, industry often designed then tested
- Advances in technology analysis and certification tools and processes
- Ever increasing complexity of risk analysis waterfalls
- Impact of technology risk as a fundamental of any business case
- Technology as risk reduction tool
Summary

- Setting YOUR vision is imperative to achievement
- Product integrity, safety and quality underpins everything we aspire to achieve
- In today's Aerospace industry technology and innovation is critical in securing your vision and goals
- Above all else meeting customers needs and satisfying shareholders demands remains a primary element of GKN’s Vision but…
- Reducing risk in every aspect of business goes hand in hand with this
Thank You