Responding to R & D Challenges
in a Changing Industry

Dr Tom Farley
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Innoval Technology Ltd
Presentation Overview

- Innoval Technology - Overview
- Industry Changes - Impact on R&D and Technical Expertise
- Technical Challenges
- Responding to The Challenges
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Innoval Technology – Our Background

- Innoval Technology is an independent company providing a unique resource of expertise to the downstream aluminium industry
  - Formed in 2003 as a result of closure of one of Alcan’s Global Technical Centres

- We are a group of 26 aluminium experts – our strength is the breadth of our aluminium knowledge
  - Rolling and extrusion process expertise
  - Metallurgy product expertise
  - Surfaces expertise

- Our engineers have an abundance of product and process experience
  - Most have been supporting the industry for over 20 years
  - Many have held Senior Management positions in global aluminium companies.
Innoval Technology – What We Do

- Product development to improve customer satisfaction
  - become a preferred supplier
  - increase or protect market share

- Process improvement to reduce operating costs
  - increase asset utilisation
  - reduce energy consumption

- Strategic Support
  - Technical Due Diligence on existing plants
  - Pre-Feasibility Studies and Greenfield plant design
  - Plant investment and upgrade support

14th World Aluminium Conference 10-12 May 2009, Dubai
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Global Growth Rates (Pre-Downturn)

Lower Growth Rate Regions:
Where higher costs
- Focus on cost reduction and process efficiency
  - Accelerated by recession
- Increased focus on specialised and value-added products

Higher Growth Rate Regions:
Generally lower costs
- New capacity
- Striving for world-class performance and quality

Source: CIA World Factbook 2009
Merger, Acquisition, Divestments and Closures - Example

- Alusuisse to Innoval (merger)
- Innoval to Alcan
- Alcan to Novelis (Acquisition)
- Novelis to Aditya Birla / Hindalco
- Alcan to Rio Tinto (Acquisition)
- Rio Tinto to Alcan
- Alcan to Packaging?
- Rio Tinto Alcan to Eng. Products?

Closure of major corporate Centres at Banbury (UK) & Novelis Neuhausen (Switzerland)

R & D Impact

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Example: Rolling Plant Closures in United Kingdom

Global Pool of Experienced Aluminium Consultants

Specialist Lithographic
Specialist Aerospace

Aluminium Rolling Plant
Closure
Impact of Changes on R&D and Technical Expertise

- Loss of experienced staff with world-class product and process knowledge from a mature western industry
  - BUT R&D still required for critical industry challenges

- Creation of a pool of independent aluminium industry consultants
  - Growth of R&D outsourcing model

- New industry in emerging regions needs R&D
  - Benefit from Knowledge Transfer to achieve world class product standards
  - Will develop own in-house R&D
    - Requires good source of local engineering graduates
    - … this will take time
  - Need access to expertise to design new plants and support investments
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### Key Aluminium Industry Challenges

#### Drivers
- More exacting customer requirements and specifications
- Cost reduction
- Competition from other materials (substitution)
- Increasing focus on sustainability

#### Examples
- Achieving world class quality (gauge, flatness, texture, surface, mech properties, etc.)
- Increased Asset Utilisation (recovery, productivity)
- Reduced Energy Consumption (smelting and rolling)
- Aerospace – retain market share
- Automotive – reduce Aluminium costs
- Packaging – retain market share
- Increase use of recycled aluminium
- Reduced process energy and water consumption (smelting and rolling)
- Reduced process emissions (CO$_2$ from smelting)
- Reduced landfill
Jaguar XK, 2006
(All Aluminium Construction)
Automotive

- The history of the use of aluminium sheet and extrusions in automotive structures goes back many decades.

- Favourable strength-to-weight ratio vs steel has long been recognized:
  - associated reduction in weight and CO₂ emissions.

- One of the major drawbacks to greater substitution of steel with aluminium is the greater cost of aluminium compared with steel.

- As a consequence much R&D is focused on reducing the cost differential:
  - One option is to increase use of recycled Aluminum.
  - ~75% of ~800 million tonnes of Aluminium produced since 1880 is stored in use:
    - The challenge is to utilise this source.
The Impact of Weight Reduction on Automotive CO₂ Emissions

![Graph showing the relationship between curb weight and CO₂ emissions for various car models. The graph is color-coded by fuel type: Petrol, Diesel, and Petrol Hybrid. Examples include Prius, Focus, and Audi 1.2 TDi.](image-url)
Audi A2 1.2 TDi AlV (80g/km)

- First 4 door “3 litre per km” car (2.99 litres/km)
  - 80 g/km CO₂
- Axle mounting frame, control arms and spring struts, brake calipers on the front disc brakes and the brake drums at the rear are aluminium
- Lightweight forged aluminium wheels
- Weighs 825 kg (135 kg lighter than 1.4 TDi)
- The three cylinder aluminium 1.2 litre TDi engines is one of the lightest passenger-car diesel engines at 100 kg
- Produced at 20 cars/day (~29,000 produced)
Automotive Example – A New Manufacturing Technology

- Benefits of Cladding Aluminium
  - Functional surface layer
  - Strength or low cost core (e.g. recycled)
  - No need to compromise properties

- Recent new technology – Novelis Fusion™
Automotive Example – A New Enabling Technology

- Development of improved joining technologies
  - aimed at reducing the cost of aluminium intensive automotive structures

- Resistance spot welding (RSW) of aluminium
  - Competes with cost of joining steel
  - Suitable for high-volume robotic manufacturing
  - Improved recycling (no rivets)

- Technology breakthrough – Electrode Buffing
Airbus A380
Aerospace

- Material usage changes in 10 years (Boeing 777 vs 787)

![Material usage changes diagram](chart.png)

Significant drop

Significant rise
The new generation of wide body passenger aircraft from Boeing and Airbus will be 20% more fuel efficient than today’s similar sized aircraft.

- 8% from improved engine systems (RR / GE)
- 12% from the use of advanced materials

Boeing 787 ‘Dreamliner’

- ~50% of the primary structure, including fuselage and wing manufactured from carbon fibre-reinforced plastic (CFRP).
- For the fuselage structure alone this will replace ~1,500 aluminium sheets and 40,000 – 50,000 fasteners.

Airbus 380

- Retains the ‘aluminium aircraft’ with approximately 61% of the A380 structure made from aluminium alloys.
Aerospace – Challenges

- Aluminium must be competitive with other advanced materials
  - Carbon Fibre Reinforced Plastics (CFRP)
  - Glass Fibre Reinforced Plastics (GFRP)
  - Titanium

- Development of next generation of Al-Li alloys

- Alcoa are leading development of new Aluminium-GLARE composite material that is nearly immune to fatigue (CentrAl)
  - Increases range of applications of GLARE to include wing structures
Example: More Exacting Customer Requirements and Specification

Coca-Cola’s First All Aluminium Can, 1967 (weight 21g)

Coca-Cola Aluminium Can, 2009 (weight 12g)
Can Body Stock - Thickness Reduction and Tighter Control

- Extremely tight specification for aluminium sheet thickness
  - Correct thickness tolerance can only be achieved with state of the art thickness control systems ...
  - ... AND the know-how to get the most from these systems
  - Unlikely to be achieved at start-up

- Failure to meet specification will lead to can plant jams and can strength issues

Profile (crown) ~0.5%

Speed ~ 110 km/hr
Coil length ~10,000 m

Strip width ~ 1.8 m

Al strip

250 +/- 5 microns
Can Body Stock – The Challenge of “Earing”

- “Earing”
  - Anisotropic mechanical properties caused by crystallographic texture

- Sheet with “earing” that is out of specification will
  - Risk jamming and stoppage of the can plant line
  - Result in volume of can being too small

- Western companies have “earing” under control

- It remains a challenge for new industry in emerging regions

![Can after re-draw and wall ironing with severe earing]
Sustainability Challenges

Examples of Alcoa Targets (2020 framework)

- Increasing the use of recycled Aluminium
  50% recycled Al content in fabricated products by 2020

- Reducing energy consumption
  Reduce energy intensity by 10% by 2010 (vs 2000)

- Reducing process water consumption
  60% reduction in process water by 2009 (vs 2000)

- Reducing emissions incl. greenhouse gases
  25% reduction in greenhouse gas emissions by 2010 (vs 1990)

- Reducing landfill waste
  75% reduction in landfill waste by 2010 (vs 2000)
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Responding to the Challenges

The aluminium industry must continue to combat the threat from other competitive materials and maintain aluminium’s sustainable credentials
- develop new and improved alloys for specific applications
- develop new and improved process technologies

The aluminium industry has driven new product development and developed new markets
- Automotive, Aerospace, Packaging, etc.
- the emerging industry must join this challenge
- the pool of expertise can be used to help with these challenges

Best results can be obtained through development strategic partnerships
- with suppliers and customers
  - Technology suppliers
- a global response between manufacturers – to combat common threats
Responding to the Challenges

- Different regions need different types of R&D
  - established western industry needs support to reduce costs and in new product innovation
  - emerging regions need support in achieving world-class product and process performance
  - both need R&D to maximise returns

- The Aluminium Industry in emerging regions needs to have an effective technology resource in place
  - highly trained and experienced workforce capable of producing high-tech products and processes efficiently
    - Source of good graduates
    - Focussed University departments
  - a dynamic R&D programme – responding to the challenges

- BUT in-house R&D is expensive
  - Perhaps up to 0.8% of Sales
Responding to the Challenges - The Outsource R&D Model

- Utilise the pool of independent expertise that now exists

- Specialist independent R&D companies have extensive industry expertise and the broad range of skills needed and can supplement in-house capability

- Innoval’s approach …
  
  - We work as part of your in-house team to supplement your capabilities
  
  - Our cost can be switched “on” and “off”
  
  - IP developed is owned by the client
  
  - We adopt the same model for any specialised services that we need and pass on that cost saving to our client
Summary

- Aluminium Industry Changes
  - Growth of aluminium in emerging regions
  - Cost reduction within mature western industry
  - Acquisitions, mergers, divestments and closures
  - Reducing Western R&D but creating a pool of independent expertise

- R&D Challenges are driven by
  - More exacting customer requirements and specifications
  - Cost reduction
  - Competition from other materials
  - Increasing focus on sustainability

- Responding to the Challenges
  - Need to develop R&D capability in emerging regions to build on past achievements and to create knowledge
  - Need to work jointly on threats to the aluminium industry
  - An Outsourced Model of R&D can help to support the industry
Thank you for your attention ...
Innoval Technology Ltd
An independent technology supplier to the Aluminium industry