R&D – a vital strategic focus area

Kimmo Vesamäki, VP, Research & Development
Kimmo Vesamäki

- **VP, Research & Development**
- Joined FLSmidth 14 April 2008
- Previous positions:
  - VP, Research & Development (Cement), FLSmidth A/S (2008)
  - VP, Product Management & Engineering, Construction – Contractor Solutions, Metso Minerals, Finland (2007)
  - Different positions within Metso Minerals (based both in Finland and USA): Engineering, sales support, product management and R&D with progressing responsibility (1994)
  - Production Control Engineer, Valmet Avicomp Inc., Finland (1993)
Overview

- Knowledge
- Development
- Innovation
- Summary
Key questions addressed

- **What is R&D focus on?**
  - Addressing main trends and industry needs
  - Developing world leading technology
  - Providing new attractive value propositions

- **How is FLSmidth’s multi faceted R&D approach?**
  - Research
  - Product development
  - External partner collaboration

- **What results have been and will be reached?**
  - New process knowhow & products
  - New & growing business
  - Patents
"It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change"

— Charles Darwin
Cement product introductions in last 15 years
Minerals product introductions in last 15 years

- XCEL™ Rotation Cell (1997)
- FT Series mills (1998)
- MILLMAX pumps (1999)
- Gyratory Crushers (2000)
- gMAX® cyclone (2001)
- gMAX® Inlet (2002)
- Top Service Gyratory (2005)
- NCF Preheater (2007)
- SlurryMax pumps (2008)
- Green liquor Clarisc (2009)
- CI200®/5 Drive
R&D investments continue strong

R&D investments (DKKm)

<table>
<thead>
<tr>
<th>Year</th>
<th>R&amp;D Investments</th>
</tr>
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<tbody>
<tr>
<td>2004</td>
<td>145</td>
</tr>
<tr>
<td>2005</td>
<td>143</td>
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<tr>
<td>2006</td>
<td>169</td>
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<tr>
<td>2007</td>
<td>210</td>
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<tr>
<td>2008</td>
<td>268</td>
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R&D as pct. of revenue

- 2004: 0.2
- 2005: 0.2
- 2006: 0.2
- 2007: 0.2
- 2008: 0.2
- 2009B: 0.2
R&D – Two main functions

- **Research (25%)**
  - To generate new knowledge (incl. new technologies, improved processes) based on a sound platform of science and engineering and to prepare ideas for using the new knowledge
  - Results in know-how and concepts, not products

- **Product Development (75%)**
  - To apply the new knowledge in technically progressive and value creating practical solutions
  - Builds on know-how and concepts and results in release to market of new products and processes
Product development
– Simulation tools (global support)

Innovative edge;

CAE (computed aided engineering) tools used in R&D to speed-up development processes and secure state-of-the-art results

FEA – Finite Element Analysis
CFD – Computational Fluid Dynamics
DEM – Discrete Element Modeling
Global R&D activities

- Valby, Denmark
- Mariager, Denmark
- Bethlehem, PA, USA
- Salt Lake City, UT, USA
- Chennai, India
- Product companies around the world
R&D Centre Dania in Denmark

- The world's largest experimental facility for cement production technology, incl.
  - Physical laboratory
  - Chemical laboratory
  - Pilot testing facility
  - Large pilot plants
  - Small test stands
- Used also by Automation, Airtech and Minerals activities
- In Chennai, India established supporting R&D Centre
Development and Testing Centers in USA

- **Dawson Metallurgical Laboratories** (Salt Lake City, UT, USA)
  - Metallurgical analysis
  - Minerals beneficiation
  - Hydrometallurgy
  - Consultation services
  - Flotation, leaching, separation
  - Ore variability, flowsheet development

- **Whitehall Test Center** (Whitehall, PA, USA)
  - Pyro processing
  - Crushing / Milling
  - Emissions

- **DOE Laboratory** (Salt Lake City, UT, USA)
  - Flotation
  - Sedimentation
  - Filtration
Research & patents

- **Research focused on our customers future needs**
  - CO$_2$, Fuels and Energy Efficiency
  - Environment and Emissions
  - Comminution
  - Mineral liberation technologies
  - Separation technologies
  - Materials and wear processes

- **2008 was record year in FLSmidth’s patent history**
  - Patent protection filed for 39 new inventions
  - Strong focus and determination on remaining an industry leading technology company
  - Protect technologies
Innovation is the process of creating and delivering new customer value in the marketplace.
Development areas within Cement process

1. Vertical Roller Mills (VRM)
   - raw mills
   - cement mills
2. Cooler
3. Alternative fuels initiatives
4. Roller press
5. Emissions
Open Innovation

“IPR” Membrane to allow proactive innovation

- Secure IPR rights
- Early, often, and in detail
New Cement Production Technology - 50m DKK program

- 5 year research program started in spring 2008
- In co-operation with the Department of Chemical Engineering at the Technical University of Denmark (DTU) and financially supported by the Danish National Advanced Technology Foundation
- Planned total of 8 PhD projects
- Target of researching more environmentally friendly cement manufacturing processes, where the main focus areas are:
  - Reduction of energy consumption
  - Improved emission control
Top Casing for Clinker Cooler

- Prefabricated to save time
- Accessible from outside
- Modular designed panels
- New flexible design
Top Casing for Clinker Cooler

Benefits for customer

- Estimated 40% reduction in time needed for erection
- Replace panels instead of repair inside
  - No curing time after erection
- Better quality
  - Manufacturing of modules at workshop conditions
- Higher safety during installation and maintenance

Benefits for FLSmidth

- Specialized external partners used for development
- From idea to a saleable product just in 7 months
  - Time to market is critical success factor
- Secured IPR protection of new application
- New concept has attractive potential at other applications
Development areas within Minerals process

1. Crushing
2. Mobile conveying
3. Grinding – HPGR, Mills
4. Flotation
5. Filtration/Thickener
6. Environmental
   (Mine tailings, Water recovery)
Research and Development – 300m³ SuperCell™

- Design worlds largest Flotation cell, with **improved recovery**, power consumption, efficiency, reduced wear part consumption
  - Modeled using most modern CFD tools
  - Models verified through lab scale pilot units (water and slurry)
  - Further validation via large pilot scale units
  - Improvements identified, and incorporated into new design
Research and Development – 300m³ SuperCell™

- **Full Scale Testing of New Design at Rio Tinto’s Kennecott Concentrator in Salt Lake City, Utah (USA)**
  - Expertise from FLSmidth companies
    - Dorr-Oliver Eimco
    - CEntry
    - Krebs
    - Dawson Metallurgical Labs
    - FLSmidth Automation
  - 110 days from agreement to start-up!

- **Proven Value for Customers**
  - Larger sizes for reduced CAPEX
  - Better recovery for improved OPEX
  - More energy efficient
  - 26 sold to date
Möller - Example of a Product Company R&D

- Market in ash handling has expanded
  - Innovative solutions required

- Development of new ESP Ash Removal systems

**Target**
- Reduced investment costs
- Extend Möller's lead against competition
- Highest possible performance and reliability

**Technical Highlights**
- Reduced number of pressure vessels
- Low cost solution for the rear fields

**Results**
Over 60 mDKK in sales since Oct 2008
Synergies between Cement & Minerals RD activities

- Sharing of knowledge from similar technologies
  - For instance: Emissions, Comminution, Separation

- Open access to all existing R&D Centers/Laboratories

- Cross functional R&D efforts in selected projects

- Alternative fuels

- Sharing of specialist functions
Summary

- **FLSmidth R&D focuses on**
  - Addressing main trends and industry needs
  - Developing world leading technology
  - Providing new attractive value propositions

- **A multi faceted approach is used**
  - Research
  - Product development
  - External partner collaboration

- **Results**
  - New process knowhow & products
  - New & growing business
  - Patents
Questions