Corning’s R&D / Innovation Approach

October 17, 2011
American Institute of Chemical Engineers

Joseph A. Miller, Ph.D.
Executive Vice President
Chief Technology Officer
Corning Incorporated
Who We Are

- Founded: 1851
- R&D Lab Established: 1908
- Headquarters: Corning, NY
- Employees: ~26,000 globally
- Sales: ~$6.6 billion
- Sales (incl. pro rata JV sales): ~$11 billion
- RD&E @ 9% of sales $670 million

- Corning’s global operations:
  ~ 65% of revenues from outside North America
  More than 50% of our employees are outside the United States
# Market Segments

<table>
<thead>
<tr>
<th>Display Technologies</th>
<th>Telecom</th>
<th>Environmental Technologies</th>
<th>Life Sciences</th>
<th>Specialty Materials</th>
<th>Other Products &amp; Services</th>
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<tbody>
<tr>
<td>LCD Glass Substrates</td>
<td>Optical Fiber &amp; Cable</td>
<td>Emissions Control Products</td>
<td>Cell Culture &amp; Bioprocess</td>
<td>Advanced Optics &amp; Materials</td>
<td>Display Futures</td>
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<tr>
<td>LTPS-LCD Glass Substrates</td>
<td>Hardware &amp; Equipment</td>
<td>Automotive</td>
<td>General Laboratory Products</td>
<td>Display Optics &amp; Components</td>
<td>New Business Development</td>
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<td>Diesel</td>
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<td>Semiconductor Optics &amp; Components</td>
<td>Drug Discovery Technology</td>
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<td>Stationary</td>
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<td>Aerospace</td>
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<td>Astronomy</td>
<td>– Dow Corning Corp.</td>
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<td>Optical Metrology</td>
<td>– Samsung Corning Precision Glass Company, Ltd</td>
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<td>Ophthalmic</td>
<td>– Eurokera, S.N.C</td>
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<td>Telecom Components</td>
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Corning is building from a rich technology history

- Formal R&D Lab Established: 1908
- 100 Years of Organized R&D: 2008
- R&D + MT&E Technical Workforce: 1975
- Centralized RD&E - % in Corning, NY: 90%
- RD&E @ ~9% of sales (~$8B in 2011): $692M
Economic Disruptions
Evolution of Strategy
Look where we started 9 years ago
Where have we come from?

- **We were in a bad place in 2002**
  - Revenues of $3B
  - NPAT loss of $400M
  - Negative cash flow of $700M
  - Cash of $2B
  - Debt of $4B
Corporate Strategy Framework has proven to be resilient yet adaptable to change…as has been the Technology Strategy.

**We Need To Grow**

Grow Through Global Innovation

**We Also Need Stability**

Provide Stability and Balance

Synergy

**We Must Preserve Trust**

Live the Values

**Growth through Innovation:**
Strong capabilities directed at new opportunities

**Innovation Value:**
A talented, collaborative, inclusive culture

**Financial Stability:**
Affordable RD&E investments balanced across innovation activities
Technology strategy has changed over 10 years as the world and Corning has changed

• Rebuilding from the crash
  • 2002
    – Cut RD&E spend by 50%
    – Streamlined global R&D
    – Centralized RD&E at SP
    – Major shift: Telecom to Glass/Ceramic materials

• Returning to growth by focusing on our “core”
  • 2005
    – Built strength in core capabilities
    – Focused on on-going business
    – Created a NBD capability

• Diversifying growth by exploiting adjacent markets
  • 2008
    – Weathered recession
    – Built new capabilities
    – Launched flat glass adjacencies
    – Delivered key technologies to existing businesses

• Accelerating growth by taking advantage of our capabilities
  • 2011
    – Growing diversity in where we play
    – Shorter product lifecycles
    – Continue to deliver against our base
    – Executing at lower cost
    – Bringing the power of our technology to customers

• 2014

Revenue
$ Billions

3.2

4.6

6.0

8.0

10.2

– Growing diversity in where we play
– Shorter product lifecycles
– Continue to deliver against our base
– Executing at lower cost
– Bringing the power of our technology to customers

CORNING Science & Technology
Corning Internal
Where have we come from?
We’ve delivered outstanding financial performance

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenues</th>
<th>NPAT</th>
<th>FCF</th>
<th>Cash</th>
<th>Debt</th>
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<tbody>
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<td>2002</td>
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<td>$2.1B</td>
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<td>$2.8B</td>
<td>$6.4B</td>
<td>$2.3B</td>
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<tr>
<td>2009</td>
<td>$2.1B</td>
<td>$3.3B</td>
<td>$2.8B</td>
<td>$6.4B</td>
<td>$2.3B</td>
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<tr>
<td>2010</td>
<td>$3.3B</td>
<td>$6.6B</td>
<td>$2.8B</td>
<td>$6.4B</td>
<td>$2.3B</td>
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</tbody>
</table>

NPAT Ex Specials ($M)

- 2002: ($392)
- 2003: $138
- 2009: $2.1B
- 2010: $3.3B

Revenues 2002 2010
NPAT ($400M) $3.3B
FCF ($700M) $2.8B
Cash $2B $6.4B
Debt $4B $2.3B
Response to 2001
Created a robust set of capabilities, processes and presence

Differentiated set of capabilities in materials science and process technology

Innovation Recipe and Keystone Components

- Deep understanding of a specific technology
- Identification of customers, markets, and processes
- Innovation Processes
- Multi-R&D Focus
- Regional competence
- Differentiation: Low cost, high value development

Broad and Deep Core Competencies

- Materials Science
- Optical Physics
- Ceramic Science
- Chemical Engineering
- Chemistry
- Electrical Engineering
- Electronics
- Process Technology
- Research

Glass, Optical Physics Process Technology

Disciplined innovation processes

Corporate Innovation Governance (CTC + GEC)

- Created New Corporate Innovation Governance
- Reinforced Five Stage Innovation Process

Five Stage Innovation Process

1. Ideation:
   - Corporate Technology Council
   - Growth Execution Council
2. Execution:
   - Created the Need for Portfolio
   - Reinforced the Future Portfolio
   - CTO + Research & MD Leaders
   - CTO + CTO Staff
3. Roadmaps → Portfolio → Execution

State-of-Art facilities

Sullivan Park, Corning, NY

- Europe
- Silicon Valley
- Asia

Technology footholds in global innovation markets

- Palo Alto, California
- Fontainebleau, France
- New Delhi, India
- Shanghai, China
- St. Petersburg, Russia
- Shizuoka, Japan
- Taipei, Taiwan

Centralized RD&E Offers Proximity to Integrate Technologies Quickly
...and developed a collaborative innovation culture

**Collaborative Culture, Strong Technical Talent, Experienced Leadership**

- Focus on knowledge sharing, idea generation, and global teamwork
- Attract and retain the best talent in Materials Science and Engineering: Attrition Rate = 1%
- >500 years technology innovation experience in top 2 levels of CTO’s organization

**Patent Board ranks Corning as #1 innovator in the Industrial Materials Segment**

<table>
<thead>
<tr>
<th>Industrial Materials Scorecard</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Scorecard Companies</td>
<td>113</td>
<td>109</td>
</tr>
</tbody>
</table>

**Corning Inc Y-o-Y Rank Change**

- Patents Granted Rank: 1 1
- Technology Strength Rank: 1 1
- Science Strength Rank: 1 1

**Solid stable of leading customers, partners and collaborators**

**Coveted University Relationships**

- Verizon
- AT&T
- Volkswagen
- Pfizer
- Deutsche Telekom
- Sony
- Honda
- AstraZeneca
- Samsung
- Apple
- Saint-Gobain
- Dow Corning
- Johns Hopkins University
- Uppsala Universitet
- Rutgers University
- Imperial College London
- MIT
- University of Southern California
- China Academy of Sciences
- Clarkson University
Our Innovation Recipe and technical competencies have served us well

### Innovation Recipe

**Innovation Recipe Yields Keystone Components**

- Deep understanding of a specific technology
- Identification of customers’ difficult systems problems

**Demanding Requirements**

- Material
- Process

**Unique Keystone Component**

A component that is a system enabler

**Differentiated by:**

- Uniqueness
- Intellectual Property
- Specialized Capital Investment

### Broad and Deep Core Competencies

**Core Capabilities**

- Inorganic Materials and Processes
- Characterization Sciences
- Organic Materials and Processes
- Systems Engineering
- Biochemical Sciences
- Modeling and Simulation
- Optical Physics
- Network Integration and Connectivity Research
- Thin Films and Surface Sciences
- Semiconductor Materials and Processes
Innovation Portfolio Governance Process

Corporate Technology Council
- Create-the-Next Wave Portfolio
- Evaluate early stage opportunities
- CTO + Research & NBD Leaders
- Meets monthly or as needed

Growth Execution Council
- Invest-in-the-Future Portfolio
- Sort, pace, execute growth programs
- CEO, CTO + CTO Staff
- Meets monthly or as needed

Technology with the Board
Effective Technology Delivery to Current Businesses from RD&E

<table>
<thead>
<tr>
<th>Display</th>
<th>Diesel</th>
<th>Auto</th>
<th>Telecom</th>
<th>Specialty</th>
<th>Life Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>• LCD Substrates</td>
<td>• Light Duty Diesel Filters</td>
<td>• Next Gen Substrates 600/2 400/3</td>
<td>• FTTx – Fiber, Cable, H&amp;E</td>
<td>• HPFS for KrF Sensor Products</td>
<td>• Epic® System Assays</td>
</tr>
<tr>
<td>• Poly-Silicon Substrates for LCD / OLEDs</td>
<td>• Heavy Duty Diesel</td>
<td>• Thin Wall / Ultra Thin Wall light-off</td>
<td>• ClearCurve - SM Ultra Low -loss Fiber</td>
<td>• Precision Optics</td>
<td>• Advanced Cell Growth Surfaces &amp; Vessels</td>
</tr>
<tr>
<td>• Thin/Slim Substrates</td>
<td>• Stationary Emissions Diesel</td>
<td>• Next Gen Substrates 600/2 400/3</td>
<td>• Pretium® EDGE - Data Center</td>
<td>• Gorilla™ Glass</td>
<td>• Life Science Products</td>
</tr>
</tbody>
</table>

~1 - 2 New Products Each Year for Each Business
Response to 2009
Added A Third Leg

Innovation Pipeline

- **New Businesses**: 5 - 10 years
- **Adjacencies**: 2 - 4 years
- **On-going Businesses**: 1 - 3 years

Synergy → Tension

Forced the new leg into the middle

Massive redeployment of resources
We needed to balance our portfolio using existing technology assets

- Specialty glass is our core materials and process capability
- We have substantial glass sheet forming process technology and manufacturing assets to support the Display Technologies business
- We redeployed some of those assets to address adjacent market segments in Consumer Electronics with thin, strong, damage-resistant glasses
- Here’s an illustration of the adjacency concept
Glass Composition
Fusion Process
Chemical Strength
Finishing
Value-added Features

Flat Glass Core Competency

Corning Retained Science & Technology

Illustrative

Fusion process invented in 1964

Started with focus on windshields for GM in 1970
2011 Strategic Frame

• Corporate technology strategy has three legs
  – Support the ongoing businesses near term
  – Build an adjacency opportunities portfolio medium term
  – Maintain exploratory activities and new business development longer term

• Make room for significant shift to adjacencies
  – Resource the fastest growing segment – glass
  – Restructure New Business Development
    • Prune the New Business Development project portfolio
    • Direct some of those resources to adjacencies
  – Maintain exploratory research to create a pipeline of opportunities
2011 Innovation Portfolio

Near Term (60%)

**Major Businesses**
- Display
- Diesel
- FTTx & Next-Gen Data Center

**Flat Glass Adjacencies**
- Gorilla® Glass
  - Handhelds/IT Covers
  - Touch Screens
  - TV Covers
- Thin-Film Photovoltaics

1-3 years

Medium Term (25%)

- Advanced Life Sciences
- Advanced Wire/Wireless Optical Communications
- Advanced Consumer Electronics and Industrial Applications
- Energy & Environmental

2-4 years

Long Term (15%)

- Organic Semiconductors
- Thermoelectrics
- Advanced Batteries
- CO₂ Sorption
- Ceramic Adjacencies
- Optical Adjacencies

5-10 years
Gorilla® Glass Applications
Touch Devices

• “Projected capacitive” touch devices are changing the game
  – Multi-touch
  – More complex applications and gestures
  – Better optical performance

• Touch device growth accelerating
  – Handheld 20% CAGR
  – Notebook/netbook 60% CAGR

• Potential for sensor integration on cover glass
Gorilla® Glass - The Slate Effect

- Glass will play a significant role in this space
  - Thinner LCD glass
  - Thinner Touch sensor glass
  - Thinner, yet stronger cover glass will be required

- Weight and area increase 5 to 7x on slates vs. handheld devices

- System designers faced with significant challenges

- Gorilla a perfect fit for reliability
Glass Adjacency Innovation Results

- Gorilla® Glass is exceeding growth expectations
- Growing awareness of glass as a new design element
- More than 40 major brands using Gorilla® Glass
- Next generation technology delivering significant improvements in both performance, capabilities and product possibilities
- With a potential to achieve close to $1B revenues in 2012
Strategic Response Delivered Strong Technology Performance

- Technology leader in each of our market segments
- More than 50% of revenues over last three years from new products
- Strong profitability
- Full pipeline of opportunities
- IP strength
Innovation
What I’ve Learned
Dynamics of Innovation – Observations

• Innovation is more than a process

• Innovation is an interconnected system
  – Imbedded in culture
  – Linked to strategy
  – Supported by process
  – Directed by leaders

• Talented people enabled to do their best - a critical success factor

• Must go beyond today and look to New Markets / New Businesses
Principles / Philosophy – My Top 10

• Strive for balance

• Pursue multiple avenues to maximize value from R&D investment

• Know “who you are” and what your “recipe” is

• Select early stage projects based on broad criteria together with a large dose of experience

• Mistakes happen – don’t try to eliminate them
Principles / Philosophy – My Top 10

• Great leaps are very risky

• Effective change is evolutionary …requiring continuous evaluation and feedback processes

• R&D must be aligned with business strategy but have enough independence to balance today’s needs with the opportunities of the future

• Business silos achieve focus and intensity - their long term preservation leads to a steady decline in technology enrichment, breadth and connection

• Don’t forget the social aspects – people have to work well together
Other Important Considerations - I

• The number of ideas for a robust pipeline >>> number than most believe are necessary

• Idea generation must be global with multiple sources and connections

• An unstaffed bench of ideas and opportunities promotes greater realism in assessment of current projects

• Multi-disciplinary teams of competent, motivated people beat individual genius every time … more productive, moderate risk, and compress cycles

• Sufficient rate of new business creation requires both linear and non-linear innovation pipeline flow

• Technology, marketing, manufacturing in it from the start

*You get the business where you got the business*
More Important Considerations - II

- Balance the deep scientific competencies with deep engineering competencies – both are needed for success
  - Great outcomes from meshing the engineering mindset with the scientific mindset

- Inject advanced engineering into the early stages of the innovation process to create and adapt more effective process invention
  - Process invention has been equally important as material invention for Corning’s innovations
  - Corning embedded the advanced engineering group in the R&D center and hired PhD engineers in multiple engineering disciplines

- Reduce the learning cycles on process engineering with pilot scale laboratory operations
  - Goal: Every major manufacturing process platform in the R&D lab
More Important Considerations - III

• Modeling and simulation … and materials and process characterization are critical enablers for materials and process engineering success
  – Yield better fundamental understanding at all levels of the innovation process, create strong IP positions, and often lead to significant cost reduction

• Faster clockspeed innovation opportunities require more technology presence at the customer interface
  – Reduce the learning cycles and requirements iterations
  – Application development, applications engineering and product/process engineering are prominent roles at the customer interface

• Gross margin (GM) performance is really the name of the game
  – GM% is what actually funds RD&E activities
  – Process engineering innovation plays a major role in improving GM% and extending profitable business life cycles
Talent … Talent … Talent

- RD&E people are different than the prevailing business culture
- Continuous infusion of new talent refreshes any organization, especially R&D
- Development of well balanced innovation leadership demands multiple experiences as early as possible
- Teams prevail
- Different talent is needed at different stages
- T-shaped people with depth and breadth
Successful Innovation
The Critical Role of Leadership

• Capabilities, processes, culture, and money are critical

• But it takes *individual will* to lead innovation
  – determination and resolve in the face of uncertainty and change
  – acceptance of failure and comfort with scientific risk

• *And individual skill*
  – the backgrounds of our top leaders must reflect
    • real skills in technology and science
    • understanding – and rich intuition -- of how and why technology creates business value
At the End of the Day..........

- Innovation is Easy to say, Hard to do
  - It is all about the “how”: culture, leadership, talent, and process … and patience … and money

- A balanced innovation investment
  - Grows the existing businesses
  - Creates new businesses

- Still plenty of opportunity for invention and innovation in glass, ceramics and other inorganic materials
  - Especially when integrated with other technologies