Making the Connection Industry Perspective

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The Dow Chemical Company
Global External Technology

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The Dow Chemical Company

Dow is a diversified chemical company that harnesses the power of innovation, science and technology to constantly improve what is essential to human progress.

- Founded in 1897 by Herbert H. Dow
- Serving customers in 175 countries around the globe
- Annual sales of $49 billion
- Employing over 43,000 people

Offering a broad range of innovative chemical, plastic and agricultural products and services in 10 essential markets:

- Food
- Building Maintenance and Construction
- Transportation
- Furniture and Furnishings
- Paper and Publishing
- Home Care and Improvement
- Personal and Household Care
- Health and Medicine
- Water Purification
- Electronics & Entertainment

Dow's Global External Technology Group

- A Capability that functions as an expertise center and a service center to:
  - Identify external science and technology options from around the globe (know the right people/open doors for Dow)
  - Facilitate cooperative relationships and projects with universities, research institutes, government laboratories, consortia…… (incl. support for contract proposal preparation, negotiate agreements, provide project management guidance)
  - Facilitate establishment and maintenance of government-sponsored projects

Open Innovation & External Technology

"Most innovations fail … companies that don't innovate die."

Open Innovation Principles:

- Not all smart people work for us
- We don't have to originate research to profit from it
- External R&D can create significant value
- Internal R&D is needed to claim some of that value
- If we make the best use of internal and external ideas we win

H. W. Chesbrough, "Open Innovation", Harvard Business School Press, Boston, 2003.

The ET Umbrella - What's Included?

FUNDS OUT PROGRAMS

- University/Institute Research
  - Unrestricted grants
  - Research agreements
- Government Lab Research (CRADAs, etc.)
- Research Consortium Memberships

FUNDS IN PROGRAMS

- Government Contract & Government Sponsored Research
  - EU Framework programs
  - DoD & DoE contracts
  - NIST ATP Program
  - et al

Motivation and potential benefits

- Obtain market opportunity insights from external focus
- Fill science, technology, facility, and capability gaps
- Increase activity/cost ratio (options to do more faster or reduce cost)
  - Collaboration leverage
  - Government support
  - Reduced cost of external labor
- External validation and market adoption as early as possible
- Drive projects and business growth as fast as possible
- Reduce risk
- Create network to world science and technology leaders
- Enhance external recognition of Dow science and technology acumen

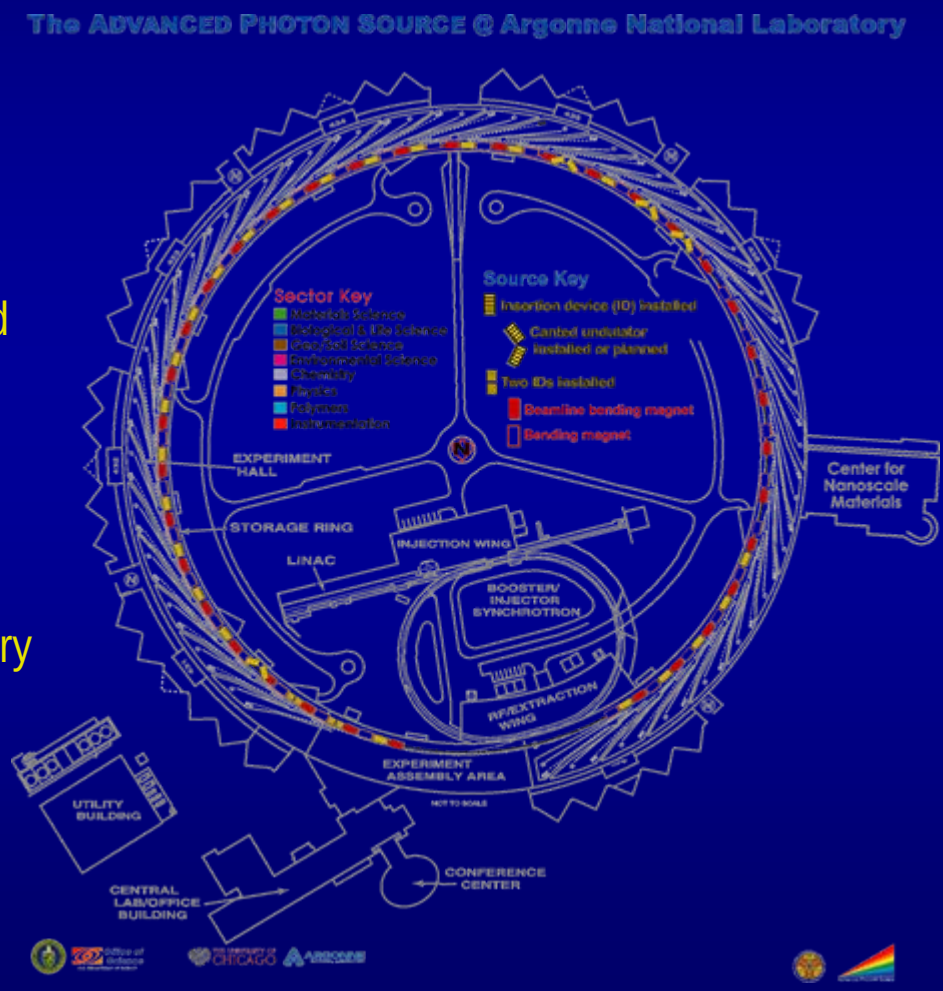
Profile of a Successful Partnership

- Provides “something” that cannot be achieved alone
- Based on mutual respect
- Each party understands and needs of the other
- Fully meets the needs of all parties
- Is flexible – changes as the needs change

Dow Synchrotron studies at National Lab Facilities

What is Synchrotron Radiation

- When electrons are constrained by a magnetic field to move in a curved path they will radiate light.
- Synchrotron light is produced by a large mostly circular device where the electrons have been accelerated close to the speed of light.
- The light is very intense, highly focused beams of ultraviolet and soft & hard x-rays.
- The light is emitted from “beam-lines” positioned at specific locations
- Synchrotron radiation has proven vital in the study of a wide variety of areas including,: chemical structure, catalysis, materials, and engineering.
- Size and cost makes commercial operation impractical - ALS @ Argonne National Laboratory
  - Construction cost: $467 million
  - Operating budget: ~$90 million per year
  - Staff: ~450
  - Outer diameter 390 meters (1,225 feet)



(Credit: Argonne National Laboratory)

History of Synchrotron Studies at Dow

- Over 20 years of experience
- Early work at Cornell High Energy Synchrotron Source (CHESS)
- Structure development during fracture and fatigue of polymers.
- These early studies proved the value of high energy sources for the study of the structure of materials.

www.lightsources.org

Studies of Craze Fibril Deformation During Fatigue in Polystyrene

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Synopsis

Small-angle scattering of synchrotron x-ray radiation has been used to study the effects of fatigue on craze fibril microstructure. The results obtained during unloading and reloading during a single cycle have been compared with those predicted by a model of sinusoidally bent fibrils. In addition the total displacement of the craze boundaries was found from the change in the invariant on unloading. The mean fibril diameter $\bar{D}$ was measured at the maximum tensile strain in each cycle. Over 250 cycles, $\bar{D}$ increased by at least a factor of 2 from an initial value of 6.5 nm, with most of this change happening in the first few cycles. The increase in $\bar{D}$ must occur by fibril coalescence, a mechanism that requires that the material in craze fibrils have considerable molecular mobility, even at room temperature, 70°C below the glass transition temperature.

Journal of Polymer Science: Part B: Polymer Physics, Vol. 25, 1765-1778 (1987)

National Lab Partnerships

- Allocation of beam time limited expansion in the synchrotron studies at Dow.
- In early 90's a decision was made to increase access by joining a Participating Research Team (PRT) at the National Synchrotron Light Source (NSLS) at Brookhaven National Lab
- It was also decided to participate in two additional facilities under construction at the time:
  - Advanced Light Source (ALS) at Lawrence Berkley National Lab (1993)
  - Advance Photon Source (APS) at Argonne National Lab (1995)
- User agreements have been in place for over 15 years

Pictures: www.lightsources.org

Today

- The synchrotron program is part of Dow's Analytical Labs, accelerating progress in materials, catalysis, electronics, and biological business areas.
- Advanced Photon Source (APS)
  - Extended X-ray Absorption Fine Structure Spectroscopy (EXAFS)
  - X-ray powder diffraction
  - X-ray scattering
  - X-ray micro-tomography
  - X-ray Absorption Near Edge Structure Spectroscopy (XANES)
- Advanced Light Source (ALS)
  - Near Edge X-ray Absorption Fine Structure Spectroscopy (NEXAFS)
  - Scanning Transmission X-ray Microscopy (STXM)
- National Synchrotron Light Source (NSLS)
  - Near Edge X-ray Absorption Fine Structure Spectroscopy (NEXAFS)
  - Soft X-rays

Drivers of a Successful Partnership

- Obtain Technology/market opportunity insights from external focus
- Fill science, technology, facility, and capability gaps
- Collaboration leverage
- External validation and market adoption as early as possible
- Drive projects and business growth as fast as possible
- Reduce risk
- Create network to world science and technology leaders
- Enhance external recognition of Dow science and technology through Joint publications

Meeting the long terms needs of the Company

"The operation was a success, but the patient died"

Technical Success is necessary but not sufficient !

Cambridge/MIT Study of Industry University Partnerships

- To identify the practices that support sustainable, productive, industry-university collaboration for industrial organizations
- To define the underlying rationales for collaboration and the metrics involved in project selection, management, and payoff

Outcome vs. Impact

Best Practices in University-Industry Collaboration
Project Supported by Cambridge-MIT Institute (CMI) Ned Calder, Ed Greitzer, Bill Lucas

Outcome

A tangible result of the project – Knowledge gained

- New idea or better understanding of a useful technology
- Solution to a problem, new method or other tangible result
- New intellectual property

Impact

A positive change in competitiveness or productivity – Knowledge applied

- New knowledge that influences a company strategy or decision
- Knowledge put to use to solve a problem
- Steps taken to obtain, protect and/or use intellectual property

The Merit of External Research

- The need to be profitable (i.e., competitive) drives R&D decisions
  - R&D spending is viewed as an investment in future success and profitability
    - » Seek to maximize the return on this investment
    - » Avoid making poor investment decisions
  - Generating, protecting, and commercializing IP from research is the basis of competitive advantage
- Companies want "reasonable control" of foreground IP resulting from research that they sponsor because without this they may
  - Be unable to use technology developed with their funding (bad research investment)
  - Have to pay licensing fees/royalties that make commercialization unattractive (bad business decision)
  - The technology is licensed to a competitor (worst nightmare – damages competitive position)
- "Reasonable control" will vary from project to project; depends on the sensitivity of the technology to the company

Research Projects … *across the spectrum*

Increasing Impact

Fundamental Research

- Deliverable- Knowledge only
  - IP not expected or not critical
  - Often correlates with "tacit knowledge"
- Sponsor contributions/investment - low
- Timing- less critical
- Agreement Size and Complexity- Low
  - Might use an unrestricted grants
  - Low degree of IP control

Commercial Research

- Deliverable-
  - IP often anticipated
  - Often correlates with "explicit knowledge"
- Sponsor contributions/investment - high
- Timing- critical
- Agreement Size and Complexity- High
  - High degree of IP control
  - May define licensing terms

The User Agreements is very important to the success of the collaboration

Maximizing Impact – Flexibility

Non-proprietary user agreement

- Patent and data rights covered under a class waiver
- Government has unlimited rights to data – Result typically published
- User may retain patent rights (march-in rights & preference for US manufacture apply)
- Costs covered under user fees

Proprietary user agreement

- Patent and data rights covered under a separate waiver
- Provisions for proprietary data – typically not published or disclosed
- User retains patent rights (march-in rights & preference for US manufacture apply)
- User pays based on full cost recovery

Other Issues affecting Impact

- Horizontal versus Vertical Consortium
  - Working with competition – hard to get competitive advantage
  - Working up & down the value chain can have impact
- CRADA - Does it meet the needs of the company?
  - At the beginning
  - At the end
- Government Labs contributions on cost shared research contracts
  - Incremental costs high
  - Limited control

THE END