Accelerate Radical Innovation—Now!

More rapid and effective radical innovation processes must be systematically implemented by technology-intensive organizations—now! This was the principal conclusion of the 1st Conference on "Accelerating the Radical Innovation Process," held in May in Charleston, South Carolina.

The conference, sponsored by Engineering Conferences International, was attended by over 50 academic and industrial practitioners of technological innovation from the United States, Europe and Asia (including Iraq).

Attendees represented universities (RPI, Stevens Institute, Toledo, Cincinnati, Bowling Green, Vanderbilt, Portland State, Georgia Tech, Tokyo University, Japan Advanced Institute of Science and Technology, National University of Singapore, Zhejiang University, Technical University of Berlin, TU Hamburg, TU Delft, ETH Zurich, Leeds); large diversified companies (BMW, DuPont, Eaton, ExxonMobil, Mitsubishi Chemical); specialty companies (Micropyretics Heaters International); nanotech companies (Applied Sciences, Frontier Carbon, Hybrid Plastics); government organizations (Argonne and Sandia National Labs, NEDO/Japan, ARCI/India); venture capital (New Venture Partners); and consultants (Pridco Management, Strategic Innovations International, Michael Gallis & Associates, and Popeo Strategic Advisors).

Starting from the premise that 20th century innovation practices associated with either incremental or radical research advances in a vertically-integrated or "closed innovation" environment (*1*) are inadequate for the fast pace of 21st century global competition, attendees set their goal to explore both theories and practical approaches to identify, develop and commercialize radical new technologies with 10× improvement in innovation effectiveness.

Against the backdrop of conference presentation and poster session papers, the participants undertook collective brainstorming of the "Grand Challenges" for accelerated radical innovation, and for development of a Vision and Mission for an ongoing international community of disciplined research and practice that would enhance education and political and societal understanding of the impact of accelerated radical innovation.

Why a Grand Challenge Exercise?

As large swaths of the manufacturing sector—and now an increasing proportion of the service sector—in the U.S., Europe and Japan shift to lower-wage regions, innovation is one of the few avenues of leadership left to advanced economies. These societies' best shot at maintaining unassailable leadership lies in breakthrough technologies and radical innovation, where their highly educated and mobile workforces, dynamic capitalist economies, and advanced information infrastructures confer distinct advantages.

Thus, the key questions addressed in the brainstorming sessions dealt with what new processes, tools, organizational arrangements, innovation methodologies, and information resources are needed to support a breakthrough paradigm seeking 10× reduction in time, cost and risk for successful radical

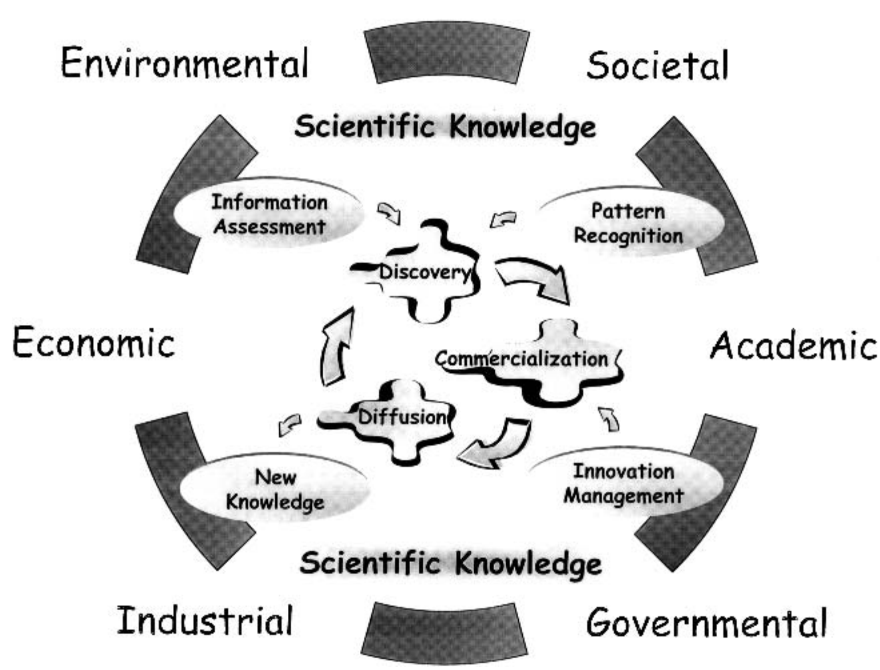

Figure 1.—This conceptual "adaptive and self-renewing radical innovation system framework" is intended to utilize scientific knowledge and computer science and telecommunication tools (assessment, recognition, management and new knowledge generation) to dramatically improve the effectiveness of existing processes for discovery, commercialization and diffusion, and to accelerate the global radical innovation process.

innovations. These questions included:

- What is the current state-of-the-art relative to the envisioned radical innovation economy?
- What are the prerequisite conditions, critical issues and hurdles to create and nurture a 21st century economy based on accelerated radical innovation?

Key Factors Behind Radical Innovation

The conferees concluded that radical innovation and its importance need to be defined before it can be accelerated. While acknowledging that radical versus incremental innovation is a relative term, varying by industry, organizational culture and stage in societal development, the group nevertheless identified a self-consistent set of key factors that encourage and promote non-incremental change, and particularly major (discontinuous, disruptive) changes. These factors include technological performance, application, products, processes, markets, users, organizational behavior, speed, and societal acceptance. They will result in drastic transforming capabilities for new technology systems that lead to profitable enterprises.

The presentations and discussions reviewed significant learnings from case studies of technologies and organizational behavior associated with radical innovation over the past 15 years. From this vantage point, the conferees developed a consensus that there is a crucial need to create an "adaptive and self-renewing system" for accelerating radical innovation. Such a system can rapidly recognize and interpret new and emerging scientific knowledge patterns and utilize them to create profitable radical innovations that systematically address the economic, environmental and societal influences and impacts of academic-industrial-government-driven technology development.

Figure 1, page 2, summarizes the conclusions in a conceptual framework that can serve as a basis for research and validation of improved theories and practices for accelerated radical innovation.

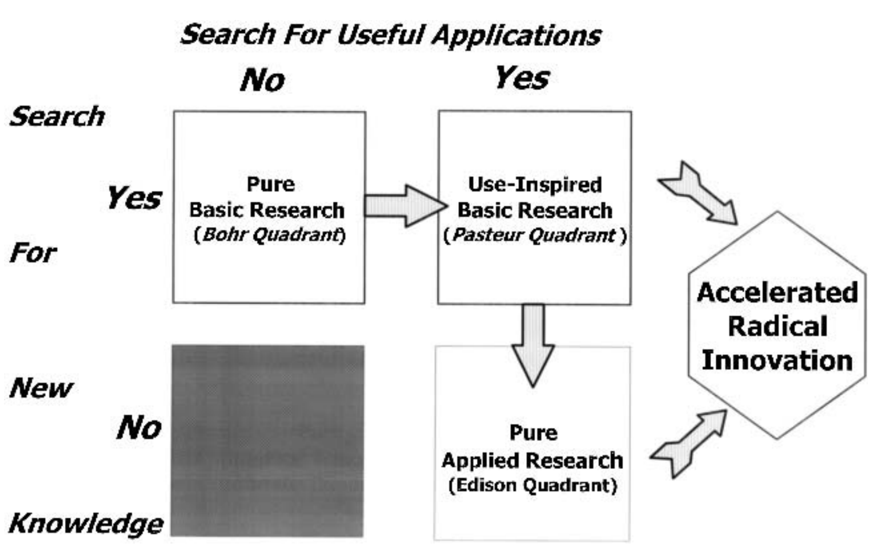

Figure 2.—By following the conceptual approach and logic path embodied in this "dynamic quadrant model for managing research," innovators can apply the information-enhanced mechanisms for accelerated radical innovation of Figure 1 to convert pure basic research, first, to use-inspired basic research, then to pure applied research, and finally to successful commercialization.

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"Constant reinvention is the central necessity at GE."—*CEO Jeff Immelt quoted in* Business 2.0, *July 2004.*

Issues and Hurdles

Conferees agreed that successful management of accelerated radical innovation requires treating the process as a *system,* as illustrated by Figure 1. To reach this goal will require an innovative mindset, both organizationally and individually, reflecting a clear vision, fully understood concepts and value propositions, resources, an environment with an appropriate balance between risk-taking and discipline, and constancy of purpose.

Disciplined but not overly formalistic handling of innovation processes will prove more effective and successful than ad hoc processes. In most situations, better informed innovation managers will produce better results than purely intuitive managers. Timely R&D and market intelligence are required for accurate understanding and scenario analysis of development options, but in the final analysis innovation will only be as effective as the insight and will of the technical and business decision-makers.

Several presentations and discussions highlighted the difficulties (e.g., "Valley of Death" and "Darwinian Sea") faced by companies endeavoring to commercialize results from basic research. It was concluded that the Vision for accelerated radical innovation requires development and validation of a systematic strategy to address this issue.

One possible approach, which arose from presentations assessing Donald Stokes' framework for basic and applied research in his monograph, "Pasteur's Quadrant" (*2*), is to apply the accelerated radical innovation system framework of Figure 1 to overcome these difficulties. This approach is represented conceptually in Figure 2, where the arrows signify mechanisms for acceleration of Pure Basic Research to Use-Inspired Basic Research and then acceleration of the latter to Pure Applied Research. The objective is to realize 10× improvement in radical innovation effectiveness compared to existing industrial experience.

Industrial Experience

Taken collectively, the presentations from the industrial participants confirmed that time for innovation is a key issue, with top management dedication typically diminishing as prospects for commercialization move from the near term (less than 5 years), to the medium term (5–15 years), to the long term (more than 15 years). The group supported the proposals that were made for systematic, collaborative exploration and validation of key approaches for improvement.

But the meeting addressed more than theory:

- Three small nanotechnology firms (Applied Sciences, Hybrid Plastics and Frontier Carbon) demonstrated progress in applying technical and business principles for radical innovation in the near term.
- Eaton Corporation, Mitsubishi Chemical and Micropyretics Heaters International demonstrated workable strategies and plans at the corporate and division level for near-to-medium term focus and renewal of radical innovation.
- BMW revealed the success of a radical market innovation approach to commercialize the company brand name in subsidiary consumer products.
- ExxonMobil demonstrated the success of an integrated management and technology strategy for achieving significant technological breakthroughs, by relying on focus and constancy of purpose across all levels of the organization.
- DuPont described its success story of radical innovation in the 19th and 20th centuries, and likened the current explosive growth in the biotech, nanotech and infotech areas to Tsunami waves of technology sweeping the world in the 21st century. This analysis provides support for long-term viability of the paradigm for accelerated radical innovation resulting from the conference brainstorming sessions.

Next Steps

Reflecting a collective enthusiasm of attendees that the conference "exceeded all expectations," the co-chairs plan to make available in Fall 2004 a detailed Conference Summary and Conclusions of the Grand Challenges brainstorming sessions. They are also acting to make the proposed community of theory and practice of radical innovation a reality.

Plans are underway to hold a Workshop on Accelerated Radical Innovation in March 2005 at The University of Toledo, with the goal to further explore and improve the paradigm for joint research and validation of computer science and telecommunication tools in a climate of university-industry collaboration, with participation from the United States, Europe and Asia. Longer-range plans to hold future conferences on a biannual basis, and to sponsor additional workshops and special courses are also being formulated.

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1. Henry Chesbrough. "Managing Open Innovation." *Research-Technology Management*, Jan.–Feb. 2004, pp. 23–26.

2. Donald E. Stokes. "Pasteur's Quadrant: Basic Science and Technological Innovation." Brookings Institution Press, Washington, D.C., 1997.

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Corporate Strategy

Microsoft Teams Up For EU R&D

Microsoft Corp. is pursuing a different path with its new applied R&D center in Aachen, Germany. The U.S. industry icon, known for its go-it-alone, highly competitive spirit, aims to collaborate with other European scientists and engineers in industry and academia.

The European Microsoft Innovation Center (EMIC), which officially opened earlier this year, is the first of a kind in Microsoft's portfolio of R&D activities worldwide, according to Jean-Philippe Courtois, the company's chief executive for Europe, the Middle East and Africa (EMEA). Even if the initial staff is relatively small—20 researchers—Courtois calls the center "unique" for Microsoft because of its focus on collaboration with European companies, universities and research institutions.

"This is very new for Microsoft," Courtois said. "We've never been involved in these sorts of collaborative projects, inside or outside Europe."

Each research project, according to EMIC director Pierre-Yves Saintoyant, involves between 6 and 12 companies and universities. The key advantage: While EMIC allows third parties to benefit from Microsoft's technology expertise, the center also helps the software giant learn from and develop stronger relationships with technology partners in Europe.

The new center joins three other R&D centers operated by Microsoft in Europe. The center in Cambridge, England, which was launched five years ago, is focused on fundamental research; it employs around 80 researchers. The center in Vedbaek, Denmark, is devoted to business software development; formerly part of Navision A/S, which Microsoft acquired in 2002, it employs nearly 700 software engineers. The smaller Dublin, Ireland, development center is devoted to product localization.

EU Applied Research

One of the key reasons for launching the new German center, Courtois said, is to participate in applied research projects sponsored by the European Union (EU) and national governments in Europe. EMIC is already active in several

EU-sponsored projects involving web services for e-health and e-learning, security and privacy and network technologies.

The Cocoon project, for instance, aims to create networked communities within health-care systems with an eye toward improving risk-management opportunities. It has attracted a string of companies, including Telecom Italia SpA, Siemens Informatica SpA, and the European Dynamics Advanced Systems of Telecommunications, Informatics and Telematics SA.

The European Learning Grid Infrastructure (E–LeGI) project intends to develop software technologies for effective human learning, while the TrustCM project seeks to create a framework for trust, security and contract management in rapidly evolving virtual organizations that provide collaborative services or develop complex industrial products.

All these projects are part of the Integrated Projects and Networks of Excellence project, which is funded through the EU's 6th Framework for Research and Technological Development. The program runs from 2002 to 2006. Its budget, which was initially set at 17.5 billion euros ($20.3 billion), rose to 19 billion euros as a result of EU enlargement on May 1. The 7th Framework Programme is expected to span the period from 2006 to 2010. The EU has proposed a budget of 40 billion euros ($49 billion).

Integrated Projects involve a variety of individual steps that, depending on project scope, include R&D demonstrations, the exploitation and application of knowledge, exchange of personnel, and knowledge transfer. The projects aim to acquire new findings and establish specific results that can be integrated into products, technologies or services.

Networks of Excellence, on the other hand, aim to provide the long-term sustainable network of outstanding research facilities and divisions forming a virtual excellence center.

Unlike Integrated Projects, Networks of Excellence are not intended to achieve applicable results in the short term.

Typically, the EU funds between 30 and 50 percent of a Framework research project. But Courtois claims Microsoft's interest in EU-funded research programs isn't about money—Microsoft is investing 20 percent of sales, or nearly $7 billion, in R&D, a figure that is unmatched in the technology industry—but about "being part of a team" working on European research projects.

Microsoft's applied research falls into three areas in which Europe already has developed considerable expertise: web services, security and privacy technologies and wireless systems. In addition, the research focuses on three platforms: enterprise computing, embedded devices and extended home networking.

The primary goal of EMIC, according to Courtois, is to convert—in close collaboration with partners—innovative ideas into technologies that can be used by organizations, companies and individuals, typically within three to six years.

Driving Innovation in Germany

The center is currently in talks about collaborative research projects with the German Ministry of Research and Education and the Ministry of Economics and Labor, he said. It is already collaborating with the Aachen Technical University. "Alliances with global companies such as Microsoft are indispensable if we want to drive innovation in Germany," said Willi Berchtold, chairman of the German Association for Information Technology, Telecommunication and New Media.

Aachen won the bid for the Microsoft lab largely because of its renowned technical university, which is one of the leaders in Europe in the fields of IT and wireless communications, according to Peter Steinbruck, minister–president of the German state of North Rhine–Westphalia.

At the same time, Microsoft is funding several internal projects at EMIC focusing on areas such as XML (Extensible Markup Language) signatures and mobile Web services, according to Saintoyant. The research on mobile Web services involves several network operators and close collaboration with Microsoft product groups at its headquarters in the U.S., he said.

Coincidentally, Microsoft opened the curtain on its new research center in Germany one week after the European Commission, the EU's executive arm, released its 302-page document detailing the EU's antitrust decision against the U.S. software giant. The company has been taking a beating in Europe over the antitrust ruling. The opening of the innovation center, some observers believe, could provide it with some welcome respite.

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"Nanotech is in danger of becoming another Frankenfood controversy."—Julia Moore, senior advisor to the U.S. National Science Foundation, quoted in *Science,* June 18, 2004, p. 1,732.

See Modest Growth for R&D in 2005

"Steady, if modest growth" is again forecast for R&D spending in the coming calendar year by Schonfeld Associates.

The latest edition of the Riverwoods, Illinois consulting firm's annual *R&D Ratios & Budgets* again expects the pharmaceutical industry to continue to be the biggest R&D investor, with drug companies upping their budgets 7.2 percent to $69 billion (see Table, below).

Pfizer is expected to be the biggest spender with $16 billion, up 15 percent, followed by Johnson & Johnson, GlaxoSmithKline, Novartis, and Adventis, each projected to spend more than $4 billion. Schonfeld attributes much of the growth to new discoveries as well as attempts to protect expiring patents.

Biotech companies are forecast to spend $5.9 billion in 2005, 24 percent more. Electromedical apparatus makers, led by Medtronic, are expected to spend $2.4 billion, an 11.2 percent jump.

The auto companies will spend $45 billion, an increase of 5.6 percent. Three of the top five R&D spenders are auto companies.

Schonfeld sees major software companies spending $19.6 billion on R&D in 2005, an increase of 4 percent. Microsoft leads with a budget of $5.4 billion, up 6.1 percent. Oracle and SAP also will invest over $1 billion in 2005.

R&D budgets of semiconductor makers are expected to grow 4 percent to $20 billion. Intel will have the largest R&D budget, $4.6 billion, up 3.3 percent. While R&D budgets of a number of the industries that are major users of chips, such as Electronic Computers and Computer Communications Equipment will likely decrease, other related industries, such as Computer & Office Equipment and Computer Peripheral Equipment are expected to spend more on R&D.

Schonfeld's forecasts are drawn from a database of 3,000 public companies, relying on data compiled from Form 10K reports to the Securities and Exchange Commission and a proprietary econometric model. The model combines individual firms' historical R&D spending with the major R&D drivers, which include profits and sales.

NEWSBRIEFS

May 17—Intel is expanding its **Planetlab virtual laboratory** project (see "Intel's Open Collaborative Model of Industry-University Research," *RTM*, July-Aug., pp. 19–26) to include Indian Institute of Information Technology and Indian Institue of Technology.

June 15—Eighty of 100 global companies surveyed by The Conference Board have a central R&D unit and 40 have someone acting as "**chief innovation officer**." However, on average, only 55 percent of innovation originates from inside the companies.

June 28—U.S. **science and engineering graduate enrollments**, including post-docs, grew to record highs in fall 2002, National Science Foundation reports. However, foreign grad students dropped 7.9 percent overall and nearly 15 percent in computer sciences.

June 30—**R&D tax credit** for U.S. companies expired but several technology groups are urging Congress to renew it, IDG News reports.

20 Largest R&D Spending Industries in 2004 and 2005 (by SIC Group)

Industry	SIC No.	R&D Spending (Millions $) 2004 (*1*)	2005 (*2*)	R&D $ as % Sales	R&D $ as % Margin	Annual R&D % Growth (*3*)
Aircraft	3721	6236	6365	10.4	68.1	2.0
Chemicals and allied products	2800	6806	7375	4.7	10.1	8.6
CMP programming, data process	7370	11021	11588	6.9	18.5	4.8
Computer and office equipment	3570	9417	9632	4.6	17.1	2.3
Computer communication equip	3576	3938	3611	18.3	20.3	−8.0
Computer peripheral eq, NEC	3577	4574	4805	7.4	14.2	4.7
Conglomerate	9997	9627	9983	2.7	10.2	3.6
Electr. other elec eq, ex cmp	3600	8551	8740	7.4	21.6	2.6
Electronic computers	3571	4067	3439	4.0	15.9	−14.8
Household audio and video eq	3651	6770	7338	7.1	N/A	8.8
Motor vehicle part, accessory	3714	5988	6182	3.7	24.0	3.2
Motor vehicles and car bodies	3711	43227	45534	3.9	15.6	5.6
Petroleum refining	2911	5292	5599	0.3	1.7	5.4
Pharmaceutical preparations	2834	63034	69412	15.9	20.8	7.2
Phone comm ex radiotelephone	4813	22386	21981	2.6	4.8	−2.3
Prepackaged software	7372	18626	19594	15.4	20.5	4.0
Radio, TV broadcast, comm eq	3663	12812	13230	10.0	25.5	2.7
Radiotelephone communication	4812	8164	8659	2.6	4.4	6.2
Semiconductor, related device	3674	19212	20031	15.5	27.0	4.0
Tele and telegraph apparatus	3661	2352	2096	10.8	18.2	−32.4

Source: *R&D Ratios & Budgets,* June 2004 Edition, published by Schonfeld & Associates, Inc., Riverwoods, Illinois, www.saiBooks.com. (*1*) Estimate, (*2*) Forecast, (*3*) Annual growth rate is relative to 2003.