

# THE STRATEGIC MANAGEMENT OF TECHNOLOGY : EMERGING GLOBAL TRENDS IN INDUSTRIAL INNOVATION

A Conference Report  
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On December 1, 1999, a group of academic and industry leaders gathered at an MIT-hosted conference to discuss professional insights on the issue of technology strategy and management. The Strategic Management of Technology: Emerging Trends in Industrial Innovation Conference was based on a research project conducted at the MIT Industrial Performance Center, and was sponsored by three MIT-based institutions: the Industrial Performance Center (IPC), the International Center for Research on the Management of Technology (ICRMOT), and the Industrial Liaison Program (ILP). MIT President Charles M. Vest welcomed the participants, noting in his opening comments that MIT's continued success as one of the world's leading research institutions hinges on its ability to pool resources with corporate sponsors. Said Dr. Vest, "These interactions bring real-world problems and issues into our research labs and classrooms, and keep us grounded and forward looking."

A highlight of the conference was a presentation of findings from an MIT global benchmarking survey that sought to identify practices that most strongly affect R&D performance. The benchmarking survey was conducted as part of the IPC's ongoing research on the Global Trends in Industrial Innovation. The survey, which updated a similar effort conducted in 1992, focused on 209 firms in North America, Europe, and Japan, whose annual R&D expenditures topped \$100 million. The findings were presented by the survey's principal investigator, Edward B. Roberts, the David Sarnoff Professor of the Management of Technology, and co-chair of the ICRMOT in the MIT Sloan School of Management.

The presentation of survey results was followed by a series of talks given by corporate leaders from companies including Aluminum Company of America, Eastman Kodak Company, General Electric, and ABB Asea Brown Boveri, Ltd.

## Integration of Business and Technology Strategies and Company Performance

According to Prof. Roberts, one of the survey's most significant findings is that measures of superior performance are highly correlated with a strong integration of business and technology strategies. "This is a fundamental and reassuring message," he said. "The more companies are able to link their overall technology and business strategies, the [better they perform]." Specifically, the performance measures evaluated include the overall corporate sales growth rate; sales from new and improved products and services; technology leadership; and perceived R&D timeliness in meeting new product delivery schedules. In all three of the geographic regions studied, the leadership that Roberts deemed vital to this integration appeared to be concentrated among a few key individuals, i.e. the chief executive officer and the senior corporate technology executive. Remarkably, neither the vice-president of marketing, nor the chief financial officer,

were found to be highly engaged in this effort.

Survey results also indicated that the level of technical training among CEOs was similar across all three regions (roughly 50% have technical backgrounds), and furthermore, that the technical expertise of American CEOs appeared to be inconsequential with regards to measures of overall performance. Roberts said this finding destroys an old myth—namely, that European and Japanese firms have a more technical orientation at the executive level, and that American firms have suffered in their long-term view due to their lack of technically-trained CEOs. Nevertheless, CEOs with a technical background were much more likely to get involved in technology strategy. This involvement led to a greater integration of technology and business objectives, which, in turn, were correlated with high performance.

## Reliance on External Sources of Technology

The merging of business and technology strategies is in many ways a recent trend, Roberts said. It wasn't long ago that companies could isolate their R&D efforts and produce good science without being constrained by the

problems of the marketplace. But this antiquated approach is proving inadequate for companies trying to adapt to the rapidly changing pace of technology today. To succeed in the current environment, companies need

to have their R&D programs much more closely aligned with marketplace demands. The pressure for rapid innovation is leading many companies to lean heavily on external sources of technology. This trend, which Roberts describes as the “most important change in technology management over the past decade,” was observed in 1992, and found to be accelerating today. In a sharp break from the past, many companies are obtaining new technology from rivals, customers and suppliers; creating alliances to share costs and risks; and investing capital in smaller companies in order to benefit from their own internal R&D programs. Whether this is bad or good is a tough question to answer, and varies from firm to firm. “It really depends on whether you are dependent on [the external technology source] or leveraged on it,” said Prof. Roberts. “But clearly, every company has become more exposed as these dependencies have grown over the years. We used to talk about R&D management. Now, technical management is very much about using someone else’s R&D to benefit you. That’s a very critical message.”

A similar point was emphasized later in the day by Lewis S. Edelheit, the Senior Vice President of Corpo-

rate Research and Development at General Electric. Edelheit said that a “revolution was redefining R&D at General Electric,” where scientists at the company’s Research and Development Center (one of the world’s largest and most diversified industrial laboratories) are now expected to lead or co-develop new business strategy and understand the business opportunities enabled by emerging technology. General Electric encourages its R&D staff to work without boundaries, he said, and “get good ideas from everywhere,”—namely, other departments, divisions, businesses, and countries.

One consequence of relying on external technology sources, added Richard K. Lester, the Director of the IPC and Professor of Nuclear Engineering at MIT, is that it also obligates corporate and technical managers to seek integration across multiple boundaries, as well as across internal business units. “Companies are finding that they can’t do it all in-house,” he said. “The demands of speed and time to market, as well as the complexity of the technologies they are involved in, push them to look outside the boundaries of the firm.”

## Globalization and Technology

More often than not, “looking outside the boundaries of the firm” means looking outside national boundaries altogether. According to the recent survey, said Roberts, companies are conducting more and more R&D outside of their home-country every year. This trend is strongest among North American and European firms, which are both converging on their degree of R&D globalization, and spending roughly 30% of their R&D budgets abroad. The survey also identified a strong correlation between

the percentage of sales revenues generated from non-domestic operations, and the percentage of spending on non-domestic R&D. According to Prof. Roberts, this indicates a growing role for international R&D within corporate efforts to support and extend sales beachheads in other countries. Mirroring the trend—but at a very different level—were the Japanese firms, which limited their slowly rising expenditures on non-Japan based technology activities to roughly 7%.

## Emphasis on Reduced Time to Market

Survey results also indicated that many firms are focused heavily on reducing the time to market for new technologies. Roberts said this is critical because reduced time to market was shown to be associated with many positive benefits like increased revenue, and faster growth rates for new products. Some of the factors shown to have a positive influence on time to market included technology leadership; more short-term R&D spending and orientation; frequent collaboration with suppliers; and simultaneous engineering and product-development processes. However, the emphasis on speed also appears to push firms toward a disproportionate emphasis on near-term R&D investment at the expense of long-term strategies. This is, at least partially, explained by a steady shifting of resource controls down to business units which, as one might expect, are especially motivated by short-term successes. Backing this assumption are additional data showing that as control over R&D is shifted up to the corporate level, overall per-

formance declines. Furthermore, the survey found that the more money companies spend on short-term R&D, the better their score on several important measures of performance.

Remarkably, the survey found the inverse to be also true: the more money spent on long-term R&D, the poorer the perceptions of several indicators of corporate and long-term performance. “This negative finding is true for many measures and statistically significant for most of them,” said Prof. Roberts, who added that he found this conclusion foreboding. “At some point, you’ve got to pay the piper,” he said. Unfortunately, the survey was not designed to assess the long-term impacts of a heavy focus on short-term R&D, and data describing the potential affects are not currently available. Nevertheless, Roberts felt it a matter of common sense to assume that without sufficient planning for the future, the fruitful days of a firm’s quick success with a given technology were probably numbered

## Case Study Presentations

Following the presentation of survey results, Prof. Lester presented a discussion of conclusions from a series of case studies comparing different approaches to the strategic management of technology. Some of the specific industries he looked at included telecommunications equipment, financial services, pharmaceuticals, automobiles, and cellular telephony.

Prof. Lester noted that the environment for innovation in all these industry sectors is changing in three important ways: first, value chains are fragmenting and becoming more specialized. As a result, many of the fastest growing firms are achieving dominance by relying on a network of contract manufacturers instead of their own internal production. While this approach reduces costs and spreads the risk of market volatility, it also heightens vulnerability because everyone has access to the same manufacturing capacity. Second, Lester observed that global operations are becoming more tightly integrated, and that the pace of globalization is accelerating. Third, he cited the rise of technical entrepreneurship. Even though large corporations still account for the bulk of R&D and the diffusion of technical knowledge, the role of smaller firms appears to be increasing. The degree of innovation occurring in these smaller firms is one explanation for the dramatic leap in mergers and acquisitions occurring both in Europe and the United States.

These changes have important implications for technology managers, said Prof. Lester. For example, how should companies balance their focus on core capabilities with the search for new markets? Should productivity dominate over creativity? What are the boundaries of a company's competence? Addressing these issues has emerged as a significant challenge—one that further il-

lustrates the need to link corporate and technology strategies, he said. The most successful firms position themselves at the center of overlapping areas of technology, and allocate resources in ways that allow them to respond quickly to external developments, Lester added. Prof. Lester said that technology managers must strive towards integration—between functions and business units; between technological disciplines; across value chains, services, and products; as well as across national and industry boundaries. Furthermore, they should reconsider the dominant view of innovation as problem-solving. Many times, the standard approach to problem solving (i.e. defining client objectives, assembling resources, and solving the problem in its component parts) is unrealistic because objectives aren't always clear, and the individual components of the problem are not readily identifiable. In addition, clients themselves often do not even know what they want at the outset. Rather, their desires and perceptions of the final product are shaped over time, and evolve from conversations and processes of mutual discovery. Prof. Lester, therefore, recommended striking a balance between two managerial approaches: one that seeks to solve problems in an analytical, technical fashion; and one that strives for an interpretive client relationship that fosters conversation and communication, clarifies evolving visions, and helps to expand boundaries and possibilities. "Some people don't realize there's an alternative," he concluded. "Successful innovative organizations need both analytical and interpretive perspectives. Managers need to understand that interpretive processes are more in line with the way that innovation actually happens, and that these are actually core processes rather than overhead."