Technology Intelligence and Technology Scouting

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EXECUTIVE SUMMARY

Technology intelligence is rapidly becoming a widely recognized and important subset of the broader process of competitive intelligence. This article describes what the author views as the differentiating characteristics of business intelligence, competitive intelligence, and technology intelligence, and how external technology scouting—seeking new ideas in science and technology for further development—is filling a major and integrated role. © 1996 John Wiley & Sons, Inc.

Business intelligence is the comprehensive universe of analyzed, insightful information used for business advantage, spanning a broad spectrum from environmental, regulatory, and industry trends, to political, societal, and economic issues that can affect business success (Fig. 1). A more specific, and extremely important, component of business intelligence is competitive intelligence, which focuses on known and potential competitors. In addition, competitive intelligence also drives business decisions by generating insights about customer and supplier business changes, and market trends that can quickly affect revenues and profits. Some examples of actions resulting from competitive intelligence are shifts in strategies and tactics, partnerships with suppliers or customers, and establishment of distribution advantages.

Superior technology is often a source of considerable competitive advantage, making intelligence about competitive technologies essential. For example, understanding a competitor's product quality, environmental concerns, or process flexibility to produce a variety of performance grades can lead to opportunities for creating advantages in the marketplace. However, technology intelligence reaches beyond topics directly related to competitors, to include early identification and understanding of breakthroughs in science, technology trends, and changes in the technology bases of suppliers and customers. Actions that respond to these developments can often create sustainable long-term competitive advantage.

Signals of New Technology

New technology might require years to develop, so effective technology intelligence frequently focuses on very early indicators of change to optimize response options. However, these early signals of technology changes are

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often very weak and difficult to relate to potential consequences, such as product launches, that may occur many years later (Fig. 2).

The first signals often emerge in scientific and technical discussions, "gray literature," or statements that resources are being directed toward certain areas of science or technology. These signals might be weak, but gathering, assessing, and communicating this information are crucial objectives of external technology scouting programs that uncover and anticipate precommercial developments. For instance, Small Business Innovation Research grants are often awarded to one- or two-person companies with not much more than an idea. We can monitor those ideas related to our businesses and join the development as partners when progress occurs.

Later signals include scientific publications, which might occur one to two years after the research is completed. This delay is rapidly decreasing due to instant electronic communication of technical results, and effective technology intelligence now requires thorough integration with electronic sources of technical information. The Internet is now a key source of new research interests and programs at universities. We recently visited a foreign university to discuss potential collaborations, armed with the current research interests of 150 professors that we downloaded from the World Wide Web. This information made our visit far more effective.

Valuable scientific reports are often followed by rumors or announcements of R&D alliances, joint ventures, or partnerships. Later, patents will begin to issue; these patents can easily represent work performed three to four years earlier, and are clearly not timely indicators for identifying and addressing technology changes.

Next, process development efforts on the new technology might be rumored. Finally, near the end of the development cycle, the strongest signals occur, perhaps involving a product announcement, competitive product sales, and loss of business.

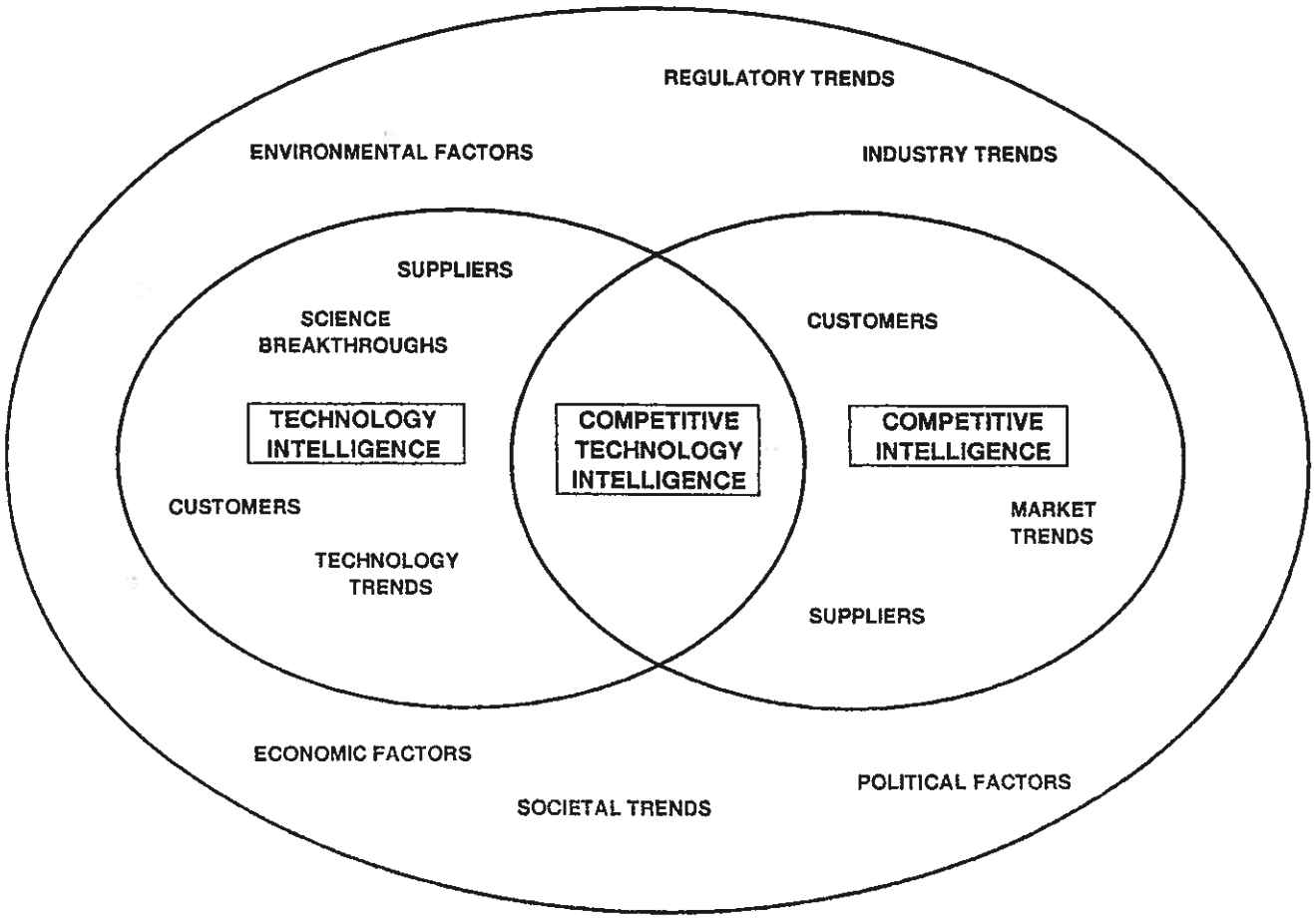

Figure 1.

Business intelligence.

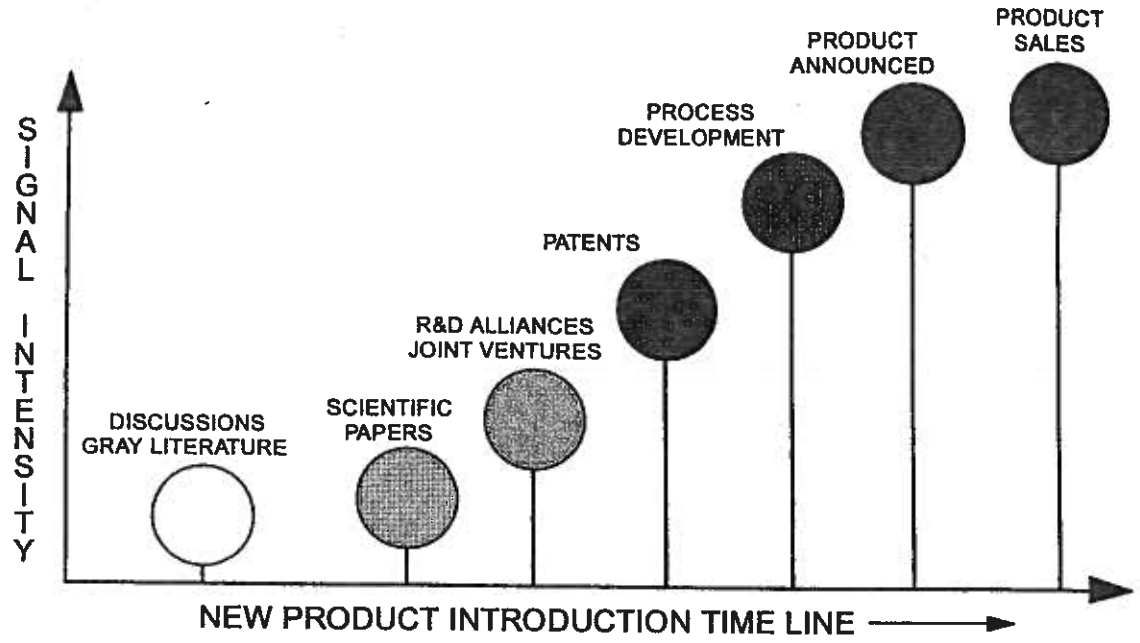

Figure 2.

Technology signals.

Technology Development Stages and Intelligence

The strength and timing of the technology signals correlate with the well-accepted S-shaped path of product development (Fig. 3). The earliest stage of new technology development is often a long period of knowledge-building and exploration of options that may appear to progress minimally toward the ultimate commercial goal. Technology search often focuses on the weak signals emerging from this stage of development.

The inflection point at the end of this early stage of development offers one of the best occasions for accessing technology. By this point, the inventor has invested significant time finding all of the options that did not work. Frequently, university or small company inventors run out of money at this stage, or lack the necessary engineering resources or scale-up capabilities to pursue the innovation. This is an excellent time to acquire technology or to partner with the inventor for further development.

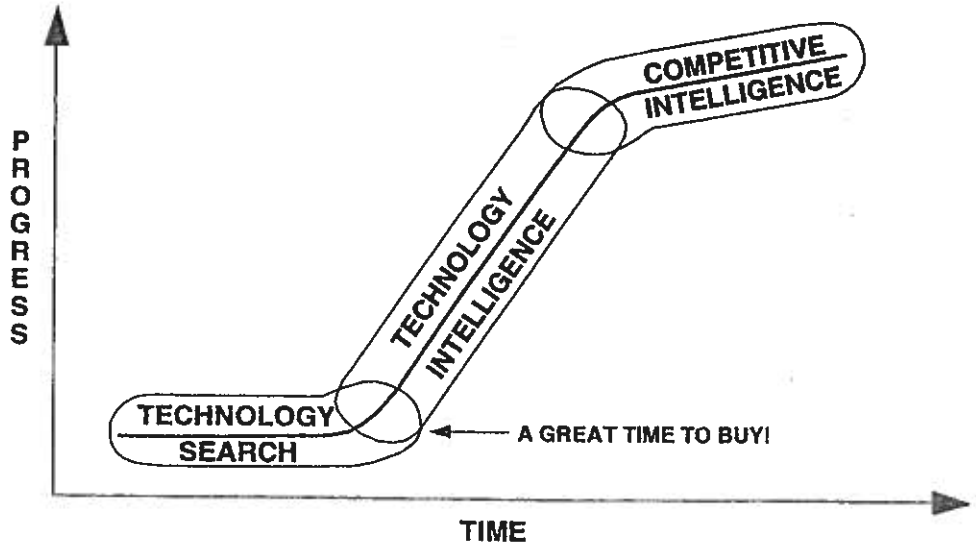

Figure 3.

Intelligence phases.

For example, we are now pursuing a partnership with a small firm that originally contacted us to be a supplier of gas separation technology for their process. They had developed a system around similar technology to ours and already had customers for their product. However, they did not have the resources or skills to build a semi-works scale test facility and we may now form a relationship that includes engineering, scale-up, and marketing.

As resources are applied to technology development, a great deal of progress occurs very quickly. This development stage is the major focus of technology intelligence. The inflection point at the end of this stage likely represents a product launch or technology implementation.

The latter stage of development is clearly in the arena of competitive intelligence. The technology has been commercialized and a real competitor is in place.

Broader business intelligence information also deals with external factors such as industrial and societal trends, environmental and regulatory issues, and economic and political factors. These factors are important to monitor throughout all development stages, and insights about these issues must be integrated into all intelligence phases.

THE OBJECTIVES OF TECHNOLOGY SCOUTING ARE GEARED TOWARD OPPORTUNITY GENERATION RATHER THAN PROBLEM SOLVING.

Intelligence Focus

The objectives of technology scouting are geared toward opportunity generation rather than problem solving (Table 1). New ideas in science and technology are sought for further development to fit into the company's businesses. The technologies are all precommercial, since there are no products or processes yet. The developers are potential, rather than actual, competitors. As the technology progresses into development, the signals are getting stronger and measurable advances are being made. The innovators are no longer looking for a feasible option, but have selected an option to develop into something that might be salable. After launch, the intelligence effort becomes more competitor focused and more oriented to problem solving than opportunity generation.

Types of Technology Information

The types of information acquired vary with each development stage (Table 1). In the technology scouting phase, information about technology developments might be received in discussions or presentations, as short abstracts, in statements of current interests and capabilities of researchers, or perhaps as initial hints about science breakthroughs or technology trends. The technology intelligence phase likely emphasizes information about customer and supplier technology trends, development strategies among competitors, and competitor strengths, partners, and bounds. In the competitive intelligence phase, specific information about costs, strengths and weaknesses of competitors, and their strategies and tactics might be at the forefront.

Benefits of Technology Intelligence

The benefits expected of intelligence efforts also vary with each development stage (Table 1). Technology search primarily saves time. Cost is relatively low in the earliest stage of technology development, but this period typically represents a long time with very little obvious progress—a difficult situation for most companies to endure. Successful technology scouting adds alternative options and new paths to achieve the same objectives that are already being pursued internally. For example, as we were beginning our effort to use the new developments of scanning tunneling and atomic force microscopy (STM/AFM), we uncovered a key thesis, the author of which was now representing one of the three vendors of equipment we were evaluating. Needless to say, our investigator's knowledge of the person's graduate work helped form a relationship very quickly and improved the information we received about the vendor's device.

False leads can be avoided by uncovering external attempts that failed. Significant time and effort can also be saved by accessing peripheral inventions; for example, development of a new reactor system need not include the ancillary inventions of customized pumps, sensors, controls, and materials of construction. In one case, we uncovered an analytical technique that saved a researcher two weeks in the lab—perhaps a minor improvement, but one of clear significance to his successful completion of his project.

As the technology development proceeds, the more focused technology intelligence effort will help to avoid the potential surprise of a competitive technology launch. Effective intelligence can reduce uncertainty during the high-expense period of technology development and scale-up. Perhaps hedging by developing parallel approaches will be appropriate. The technology intelligence effort also monitors technology trends that might obviate the development being pursued.

	Technology Search	Technology Intelligence	Competitive Intelligence
Technology development stage	Early Idea/concept/definition Feasibility/screening/assessment	Middle Development/analysis/problem-solving Testing/pilot/semicommercial	Late Commercial Full-scale
Intelligence focus	Opportunity generation Broad technology scanning Potential competitors Precommercial science and technology	Focused monitoring of technology progress Actual/potential competitors Technologies in development	Problem solving, answering questions, addressing issues Actual competitors Commercial products/processes/services
Types of information	Technology developments/abstracts/inventions/expertise Science breakthroughs/directions	Customer/supplier technologies Competitor development strategies/strengths/partners/bounds Technology trends	Costs Business strengths/weaknesses Strategies/tactics Market/industry trends
Intelligence benefits	Save time New options Avoiding false leads Reduced peripheral invention	Avoiding surprises Reduced risk Hedging Early trend identification	Effective pricing Product positioning Early warning of obsolescence

CI CAN PROVIDE EARLY INDICATORS OF TECHNOLOGY ABANDONMENT.

As the development nears commercialization, competitive intelligence can provide manufacturing costs for effective pricing, performance analyses of competitors' products for positioning, and early indicators of technology abandonment.

Intelligence Process

Overlapping all of the phases of technology, competitive, and business intelligence is a process for using analyzed and insightful information for business advantage (Fig. 4). Enormous volumes of incoming data constantly bombard us, but most of these inputs are, at best, very early predecessors of business impact. Filtering and organizing the data creates information that can be analyzed to develop insights. These insights transform the information into intelligence or knowledge. Of course, this knowledge will be fed back to improve the data gathering and sifting processes.

However, intelligence by itself provides no value in the marketplace; knowledge and intelligence must be structured into decisions about the business. I have discussed this topic with many and varied organizations and, without exception, the ineffectiveness of organizations in making decisions about issues was identified as the most significant cause of intelligence failures. Clearly, intelligence professionals must better structure and communicate insights to improve both the ease and the quality of decision making. Of course, these decisions still do not provide any business impact; only when the decisions are implemented can a company achieve the advantage sought from the beginning of the process.

Prominent examples include steel, cars, and buggy whips, but we all have examples of watching the development of a new technology for years, and not taking action until it was fully commercial, severely affecting profits. We must overcome our decision biases by more clearly delivering objective insights.

WE HAVE ALL WATCHED THE DEVELOPMENT OF A NEW TECHNOLOGY AND NOT TAKEN ACTION UNTIL IT WAS FULLY COMMERCIAL, SEVERELY AFFECTING PROFITS.

Matrix of Intelligence Roles

The intelligence process essentially reflects learning and acting. Therefore, the acquisition and protection of know-how, or preferably "know-why," defines key intelligence roles. Let us assume that our company has critical know-how about a technology. At the same time, any of our competitors and potential competitors might or might not have equivalent know-how. This suggests a two-by-two matrix defining our capabilities versus those of our competitors. In addition, our current understanding of science might make an envisioned technology seem "impossible" or infeasible without a new-to-the world invention. These additional criteria expand the matrix to include the perception that new science or technology is needed (Fig. 5).

Technology intelligence and scouting play a particularly important role when a company does not have know-how about a technology, or when the technology is perceived to be new-to-the-world or not possible, and the actual and potential competitors think similarly. This situation suggests a process that seeks potential new competitors, that identifies new technology options, inventions, and science and technology trends, and that uncovers enabling and complementary technologies, or new fusions of technologies from different disciplines. The

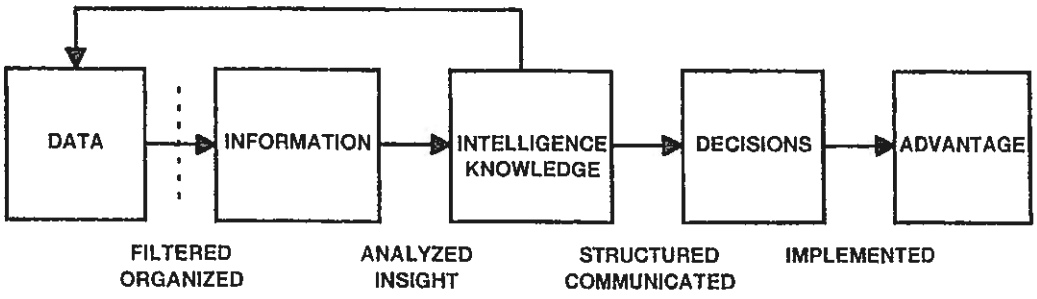

Figure 4.

Business intelligence process.

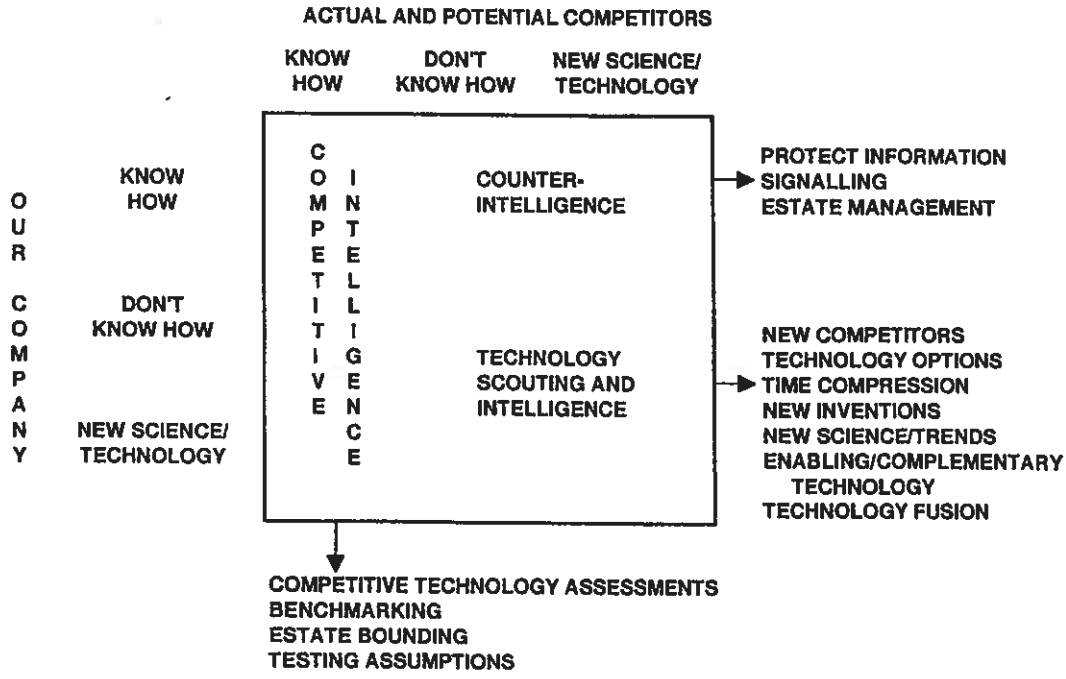

Figure 5.

Intelligence roles.

primary objective of the technology search process in this domain is to compress development time.

The belief that an invention or breakthrough is required can severely constrain technology opportunities, and effective technology scouting is important for stimulating alternative thinking. Perceptions that technologies are impossible or that breakthroughs are required are often later proven to be incorrect biases; an effective technology intelligence effort must challenge these paradigms. Here are just a few of the now ubiquitous technologies that were initially dismissed by the leaders of the very organizations that should have embraced them: telephones, radio, movies with sound, airplanes, computers, and personal computers.

Competitive business and technology intelligence programs are especially important when competitors have the necessary know-how, and our company either does or does not have equivalent know-how. This situation suggests intelligence outputs such as competitive technology assessments, trend analyses, benchmarking, estate bounding strategies (for example, a patent strategy that limits the range of use of a competitor's intellectual property), and testing of assumptions, clearly reflecting a greater orientation to analyses in this phase.

In the final part of the matrix, our company has know-how about a technology, but the competitors either do not have the know-how or believe that new science or technology is needed. This is the world of counterintelligence, with a focus on taking actions to protect information, controlling external signals, and managing the technology estate (that is, the intellectual assets of the organization). For example, we might protect some technologies by secrecy rather than patents, because infringement cannot be easily policed. In the chemical industry, this philosophy is often applied when making improvements to reactor or distillation column internals. Of course, the most well-known example is the Coca-Cola formula.

External Technology Scouting

External technology scouting programs fill important and integrated roles in the frameworks described above. At Air Products and Chemicals, Inc., we proactively search for new precommercial opportunities, innovations that are perhaps researched and ready for development, product extensions, technology improvements, and peripheral know-how, that our researchers and business developers can pursue. We concentrate on unusual sources of information, such as gray literature and human networks.

APTECH, the Air Products Technology Clearing House, is a technology search operation currently scou

ing for more than 10,000 specific interests of 1300 Air Products people worldwide. We search for technology using more than 140 regular sources, as many occasional sources, and thousands of network contacts.

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This effort has been remarkably successful. More than 500 unique technologies and over 1000 information items reach more than 400 Air Products people each year. Our internal customers respond that 75% of this information has not been seen elsewhere and that 94% of the information is valuable. Thirty percent of the responses are "hits," that is, a technology judged by the Air Products recipient to be both "not seen elsewhere" *and* a "good opportunity, will follow up." In other words, more than twice each week, we find a new technology opportunity important enough for our researchers and developers to spend *their* time pursuing. Many of these hits progress through confidentiality agreements, physical testing, and further development to be integrated into process and product technologies.

Summary

In this article, I have described the integration of technology scouting, technology intelligence, and competitive intelligence in the overall world of business intelligence. Although the primary focus changes with each stage of technology development, the intelligence phases form a continuum with vague boundaries and some degree of overlap. Each intelligence process has different features, different emphases, and different benefits, but all are required to do an exceptional and complete job of business intelligence.

About the Author

Merrill Brenner is Manager, Technology Outreach at Air Products and Chemicals, Inc., 7201 Hamilton Blvd., Allentown, Pennsylvania, 18195-1501; Tel: 610-481-5737. He is the founder and head of the company's external technology scouting operation. Prior to this, he held positions of increasing responsibility for R&D planning and analysis and process technology development and engineering. He received his B.S. and M.S. degrees in Chemical Engineering from Stanford University and the University of Michigan, respectively. He has been a SCIP member since February 1990.