Who's on Watch?

By M.P. Manahan, W.B. Ashton, and G.S. Stacey

Technology is considered by many to be the primary basis for successful long-term competitiveness in manufacturing today. It is not surprising, then, that the pace of change in the technological fields is accelerating and that one's competitors are constantly searching for ways to utilize technology for improved or lower priced products. Just keeping up with what is happening is a daunting task; databases, conferences, symposia, and journals produce an overload of data. Watching technology effectively and efficiently is becoming a critical challenge for US manufacturers.

Observing a technological change is not sufficient to create success and long-term viability, of course. It is at least as important to use the information that is obtained from watching. Internalizing the results of watching—taking measures to ensure that a technology concept or idea is moved in the direction of use in a product, production process, or support function—is very difficult. Viable candidate ideas must be identified and screened, the best must be pushed forward, and key people must be invested in and motivated to use the ideas in the company's interest.

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It is by no means easy to deal with the problems inherent in technology watching. Many companies that can cover their own skill areas very well with in-house staff do not have broad enough coverage to monitor technical ideas outside their expertise. A major problem may be posed by technical solutions that involve the combination of several technologies,

Technology is a key to global competitiveness. How do US manufacturers select the right new technologies to pursue, and whose job is it to scan the technology horizon?

some of which the company is not monitoring, to produce a brand new technology.

Another difficulty involves the individuals who have the "gatekeeper" assignment within a company. They are usually highly valued, highly productive individuals who keep busy solving the company's day-to-day problems. Watching technology may be in their job description, but their reports on developments in the technical field are often prepared in a hurry in response to deadlines. This last-minute sort of approach can suppress one of the most useful aspects of the watching process: the creative connection between a new technical development and its potential application.

A third difficulty that organizations face is how to integrate the new technical ideas into the mainstream of the business thrust. Frequently, the merit of an idea that emerges from

the watching process is recognized, but its relationship to future business success is not. When no one but the person who had the idea is interested in it, it dies. New ideas are highly vulnerable and must be nurtured until they are strong enough to stand the heavy scrutiny that they will undergo before major commitments of money and other resources are made. The more obvious it is that the idea can be integrated into the company's normal business and technical plans, the more likely that it will receive the attention required for development and growth.

Another difficulty is caused by the rapid growth and expansion of commercially available databases; the dissemination of technical information in magazines, journals, newspapers, books, and other publications; and the blossoming of conferences and symposia on all types of technical developments. There are usually much more data in a technical area than can effectively be processed and analyzed. This problem is compounded by the fact that most businesses operate in a world market. In international watching, language and cultural differences can be a significant barrier. There is a premium on an effective screening process and the use of an analytic approach to the literature rather than simply reporting the information.

In the US, an idea or concept typically passes along a path within an organization and is assaulted by attempts to block or destroy it, as well as by various actions designed to support and nurture it. Most ideas are screened out along this path. The screening process itself can operate so as to permit only conventional,

NEW TECHNOLOGIES

IN
NEWER TECHNOLOGIES

MANUFACTURING MANAGER
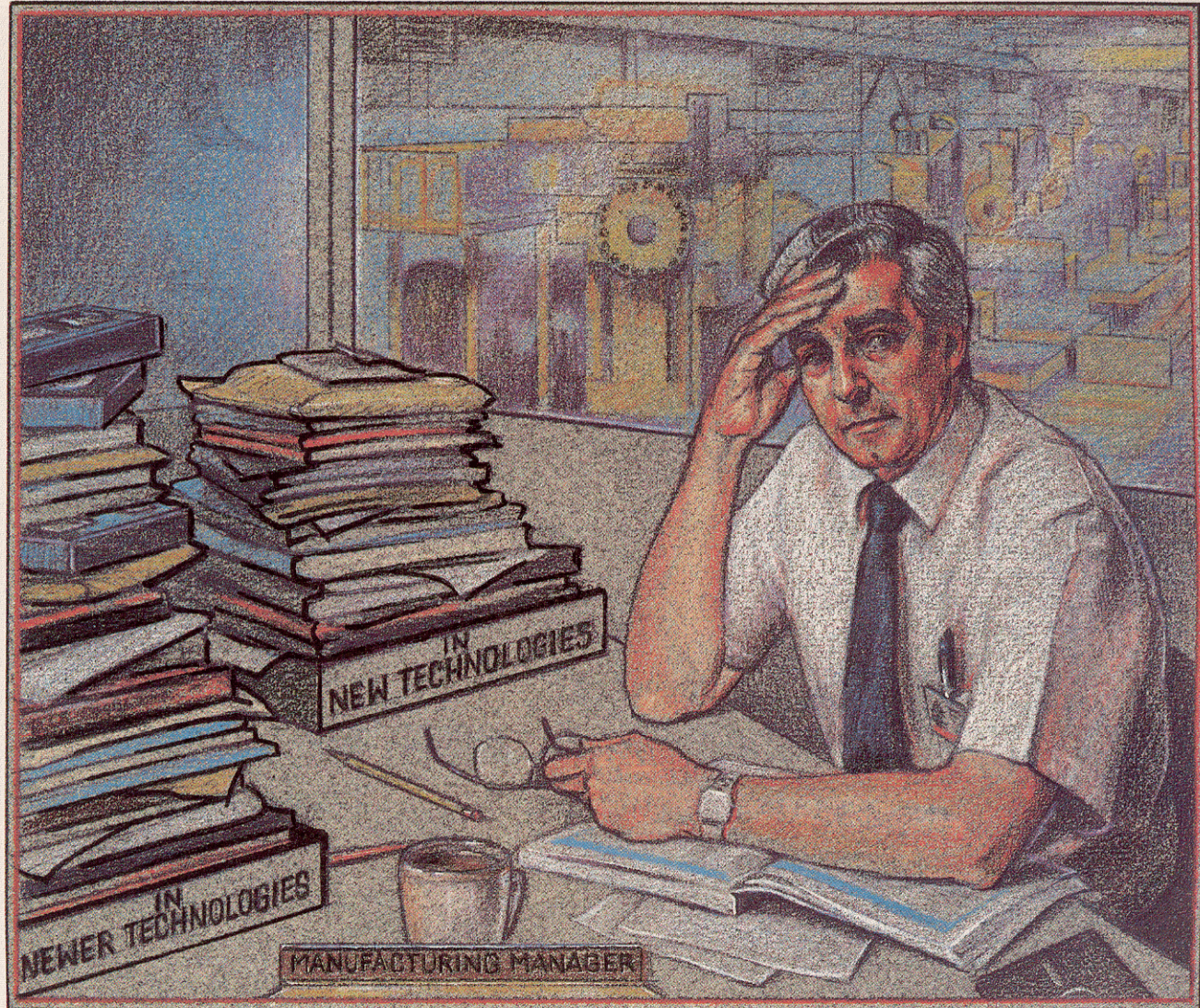
Mary Rochelle

incremental improvements to progress, while revolutionary ideas are squashed.

The larger the company, the more people and departments "handle" an idea before it is used or acted upon. In some cases, the Not Invented Here (NIH) syndrome is rampant in this process. Each time an idea is put forward that represents competition for an existing approach or method, a great deal of effort is devoted to showing that it cannot possibly succeed. Approaches to overcome this problem range from advancing the champion of the idea along with the idea to setting up internal (or external) innovation cells charged with competing with the existing technologies.

Technology monitoring systems in place today tend to be either highly intuitive, or formal. Generally, there is little satisfaction with either type. Both depend on key people, or

gatekeepers, who are technically well-informed and capable of and interested in identifying applications of the new technologies. In this framework, knowledge of technological changes is acquired only in areas in which the company has expertise. New or peripheral "threat" or "opportunity" technologies are not well covered.

Intuition-based systems appear inexpensive but do not ensure coverage of all technologies, and action in response to change is not promoted because there is no formal system for communication of change. Formal systems have been more successful in achieving breadth of coverage, but they are often unsuccessful in conveying an idea or concept for application of a technology through the organizational pathway to action.

If most current systems are not acceptable, how should technology be monitored? There is no one prescription to follow, of course, since

companies' needs vary dramatically. The best approach is to know the key elements of the watching and internalizing functions, and then to tailor those ideas to suit one's own agenda. These key elements include the following:

1. Audit Technology. To understand what to monitor, it is necessary to know where the company is at present. The fundamental technologies of its production processes and products should be identified, listed, and described. The company's position vis-a-vis the state of the art and its competitors' positions should also be described.

2. Identify watching needs. Identification of needs and development of a commitment to watching is the first step. Resources commensurate with the value of monitoring should be committed and these questions addressed:
- Why monitor?
- Who should monitor?

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- What should be monitored?
- How should monitoring take place?
- When should monitoring take place?
- What are the results that should be expected?
- How should the results be used?
- What is the value of monitoring?

3. Choose technologies to monitor. A list of technologies should be prepared based on the results of a technology audit. This list—a technology scan—will probably be quite long and unstructured. Using prioritization methods, criteria should be established and items grouped and evaluated. From this evaluation comes a list of important technologies to monitor. Criteria might include the following:

- Current level of importance in products and processes
- Pace of change expected
- Opportunities presented
- Threats posed
- Competitors' positions
- International competition
- Probability of technological breakthrough in a given time period
- Amount of time required for commercialization
- Cost of commercialization.

In addition, decisions regarding who should monitor should be made at this juncture. The choice of internal staff and/or consultants should be made based on the following types of criteria:

- Knowledge/expertise of staff
- Availability to monitor
- Interest in monitoring
- Ability to maintain effort over time
- Creativity
- Cost
- Need for absolute secrecy.

The use of consultants is a direct, often cost-effective way to solve the problems associated with the use of tunnel-vision experts within the company. Like company experts, academics and private consultants keep abreast of new developments in a broad range of related disciplines as part of their normal activity. Moreover, their contacts and spheres of influence tend to be broader than those of company employees, who are busy and focused on more specific tasks.

4. Disseminate information. There are always some people in the company who are not familiar with

Intuitive-based Approach

Formal Approach
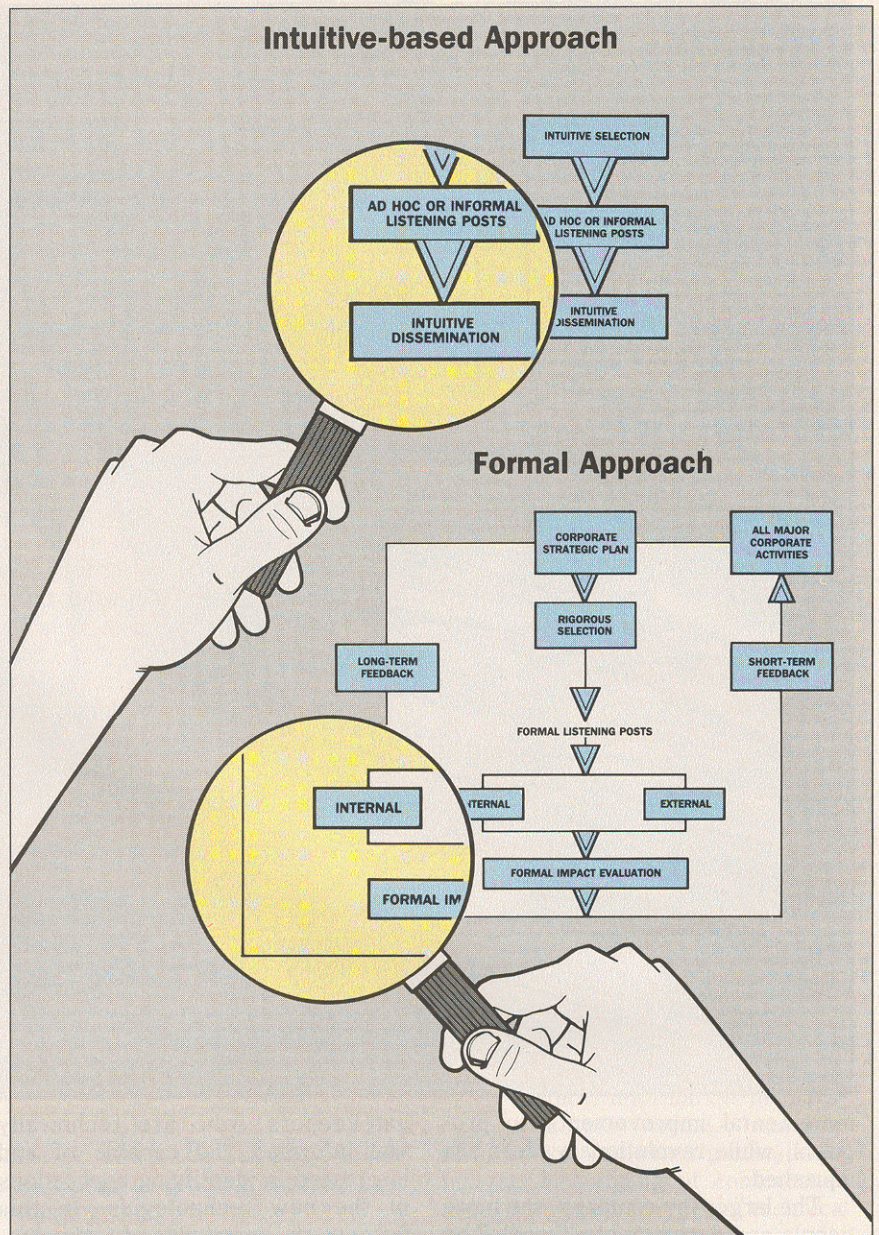
Intuition-based monitoring systems appear inexpensive, but they do not ensure coverage of all technologies. Formal systems are not successful in promoting an idea through corporate pathways to action.

the technologies central to its business. It is useful to produce a series of background or white papers for circulation among key executives, decision makers, and staff to describe the technologies and their importance for the company. It is also important to create a mechanism whereby information on recent developments is documented and sent to key people. This is often best accomplished by assigning staff to write one to two-paragraph briefs on the new technologies.

5. Develop baseline forecasts. A detailed perspective on the outlook for important technologies is vital to

knowing when threshold changes in the pattern of progress are taking place and breakthroughs can be expected. Depending on the importance of the technology, a variety of forecasting techniques can be used. Highly critical technologies warrant detailed analysis, while less important but relevant technologies can be analyzed in less detail.

6. Acquire technology. Once an idea has been screened and selected for commercial development, the optimum acquisition path must be chosen. In a broad sense, there are two options available: develop the technology in house or buy it from the

outside via a merger, company buyout, technology transfer agreement, licensing agreement, or contract R&D. An overall strategy for technology acquisition is essential to the successful focusing of effort because it provides the framework within which more micro decisions can be made to address new issues or answer unexpected questions. A strategy will allow decision makers to decide quickly what to do and how to do it so that the path chosen is consistent with other decisions and actions that have been and will be taken.

US companies tend to organize the process of commercializing ideas using a linear model. At the end of each phase of development, the ideas are screened. As successful ideas pass from one screen to the next, the level of commitment of company resources generally increases. The decision criteria, the decision making methods, and the people involved in the decision making generally are proportional to the level of the investment.

In contrast, many Japanese companies move ideas to commercial success using a parallel model. Development phases overlap as much as possible. Often an entire team will move through phase after phase of development and, if the idea is successful, to a commercial product/process phase. This Japanese model does not require a hand-off, and it avoids many of the NIH pitfalls, but it puts more investment at risk than does the linear model.

While there are no specific formulas that ensure success of a technology watching and internalizing function, some general guidelines can be identified. Companies are finding that, to give adequate attention to technology strategy and management, it is essential to provide the person or group in charge with designated responsibility, funding, and a specific charter. Often a vice president of technology takes on these duties. (Alternatively, a special task force may be established. Sometimes this function is placed in the strategic planning area.) The appointee should be at a senior level, reporting to the president. This gives the activity the visibility and influence it needs. The other participants in the process should come from the business side, including the marketing and strategic

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planning areas.

Supported by a budget that covers the required work and analysis, the staff should help collect, organize, and analyze data. Generally, a committee is set up to promote the utilization of technology in production or in products. But unless this committee actually produces tangible results—a series of recommendations, for example—or is itself given a budget and staff, it is difficult to convince decision makers of a technology's importance.

Most serious attempts to introduce a broader perspective on technology require a commitment that is longer than the typical annual planning cycle for the organization. They should also be authorized from a level above division R&D budget. This is why the function is sometimes found in corporate planning. If the activities are placed in central R&D, technology acquisition recommendations tend to be made in the form of additional R&D, and other methods of acquisition (buying outside licenses, for instance) may not be considered.

For the future-thinking company, the unit responsible for technology strategy, planning, and management will probably have the following characteristics:

• It will be attached at a very high level in the company

• It will be relatively small in terms of funding, but will have review and sign-off responsibility for technology investment decisions

• It will have ongoing responsibility for developing and maintaining strategy and plans and informing senior management of major shifts and changes in the technological environment as it affects the company's business

• It will promote investments in technologies that will pay off beyond the normal, expected investment payback period.

In the future, better analytical tools will be developed; databases will be improved; and the linkages between databases, tools, and decision makers will be made more direct and immediate. Screening processes that avoid "throwing out the baby with the bath water" will be developed and applied, as will more efficient, effective methods to evaluate new technology ideas.

Further advancements and application of the findings regarding the creative process will increase the quantity and quality of new ideas and concepts. Linkages within companies between R&D departments (or more broadly, the company's technology acquisition activities) and marketing, sales, and production activities will result in more focused and efficient use of resources. This will also improve the processing of ideas and ensure support of fragile but potentially valuable concepts.

Who, finally, is on watch? No better watchers can be found than creative, interested, committed people who have the concept of the company's future embedded in their psyche and who think and operate with this future in mind. Databases can be bought, subscriptions to various services undertaken, and specific assignments made to externally hired gatekeepers. In the final analysis, however, the idea must be successfully guided through the internal jungle of the company. A moderately clever idea that is well accepted by people in the company is much more valuable than the "best" idea that is rejected.

In the end, it is *you* who are on watch.

BIBLIOGRAPHY

M.P. Manahan, "Technology Acquisition and Research Prioritization," *International Journal of Technology Management* (March 1989).

Office of Naval Research and National Science Foundation, "Monitoring Foreign Science and Technology for Enhanced International Competitiveness: Defining US Needs," *Proceedings of the Office of Naval Research and National Science Foundation Workshop*, Washington, DC, October 5–7, 1986.

G.S. Stacey and W.B. Ashton, "Integrating Business and Technology Planning in a Global Environment," 1988 International Conference on Strategic R&D Management, Tokyo, Japan, May 10, 1988.

G.S. Stacey et al., "Estimating the Value of Intangible Technological Assets," report to Farmitalia Carlo Erba Spa, Battelle-Geneva Research Centres, April 1988. ∎