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The Process of Innovation

*Mary Jo Veverka**

How do leading companies succeed in achieving high returns on their technology investments despite growing financial constraints and traditional barriers to successful commercialization?

The topic of innovation always draws high interest. My own experience spans across fifteen years of looking at product development issues; five years in industry, and eleven years with Booz, Allen & Hamilton. Increasingly, my work in the last few years has been specific to dealing with issues of research and development (“R&D”) management.

I plan to discuss some of the findings and conclusions drawn from our work in helping clients deal with the issues of managing innovation through to successful commercialization. These findings are drawn from the broad-based industrial surveys we periodically take to better understand the issues and the companies’ responses to those issues, and from spending time with the leaders in the industry such as Dow and Merck to assess what they do so successfully.

Technology investments have exploded in the last decade. Globally-based R&D expenditures over several successive decades, 1965-1985 have increased. This spiraling trend has continued in the United States at almost twice the rate of inflation through the 1980s. The Japanese have now surpassed the United States in R&D spending as a percentage of gross national product (“GNP”). This first occurred in 1986, and they have continued to outpace U.S. and other countries’ spending. Other countries are increasing their R&D investments as well.

With more and more money at stake, it is no surprise that CEOs are concerned about how this money is being spent. In the pharmaceutical industry, which is one of the leading spenders, the increases in worldwide R&D demonstrate the challenges presented to these companies. All companies are increasing not only their absolute R&D expenditures, but their R&D expenditures as a percentage of sales. However, these greater expenditures have not yielded an increase in the number of new products being approved for the marketplace. Because of increased competition, the risks attendant on these investments are also increasing. Moreover, managing these investments — choosing the research focus, finding applications, taking a new technology to market — has become far more complex.

Companies recognize that they are increasingly betting their futures

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on new technology. New technologies are dissolving natural divisions of the value-added chain and eroding competitive positions based on these very divisions.

I am going to share the results of several surveys that we have taken to get a better sense of what issues leading companies are wrestling with as they manage innovation. The first survey was taken in the late 1960s to give us a basis for understanding the issues that management faces. The second survey was taken in 1981. Seven hundred companies participated in that survey. It represented their collective experience on introducing over 13,000 new products over a five-year time span. We will be planning another survey, probably next year, to update our perspective. Later I am going to discuss what we have seen happen in the 1980s, as companies have continued to wrestle with the issues related to innovation.

Briefly, the survey results in 1981 show that during the early 1980s, companies were counting on new products for growth. Over the five years prior to 1981 new products had generated about 25% of the sales growth. Companies were expecting that to increase by a third, to yield about 33% of their growth over the next five years. Similarly, the portion of the total company profits generated by new products was expected to increase by 40%. To accomplish this, companies expected to double the number of new products introduced. These expectations existed in all industries. Technology investments, in particular, have continued to grow in order to fuel this. I presume that if we look at the results from the next survey, we will see that these companies have not achieved their expectations with these increased technology investments.

Our analysis of the surveys identified several key new product practices and trends. An examination of the mix of new products introduced yielded several important findings. First, additions to existing product lines and improvements to existing products account for approximately 52% of all new product introductions. This conservative investment is necessary to manage the product life cycle and keep existing products viable. Another 30% are new product lines for the company and new products for the world. These often become the firm's most successful new products. Indeed, they accounted for approximately 60% of the new products that were viewed as most successful. Despite the obvious attractiveness of these categories, their variability of return is far greater. Truly innovative products involve far higher risks. Thus, managers are reluctant to put more investment into these areas.

Innovation risks are extremely high. For example, within the pharmaceutical industry very high attrition rates, lengthy development periods and escalating costs associated with new product development are well documented. Anywhere from 2000 to 15,000 leads go into the applied research stage. At the development stage, when clinical trials are undertaken, the fallout rate is about five out of six product ideas over a period of six to eight years. The cost for development of a successful new

product currently stands at about \$140 million, factoring in failures, and it is growing every year.

What are companies doing about this? The new product development process has been well-documented. Researching our own work in this area, I discovered that we first documented this process back in the 1950s. The early documentation showed a six-step process which included idea/concept generation, screening and evaluating, business analysis, development, testing and commercialization. Today companies still follow this process but lead it with a step which involves developing an explicit new product strategy. Seventy-seven percent of the companies surveyed in the early 1970s indicated that they were using this step. The addition of this step has changed the nature of the beginning of the process. The first three steps, new product strategy development, codification of the idea concept generation, and screening and evaluating that idea, have become a very closely linked set of steps in managing the innovative process for successful companies.

As a result, companies have shifted their resource allocation. Another way to look at this, given increasing R&D expenditures, is that companies have increased front-end expenditures at a far greater rate than expenditures later in the process. This appears to have improved product selection. R&D spent on successful new products has grown from about 30% historically to about 54% at the time of the second survey.

The more sophisticated new product process has had a profound effect on the number of ideas considered in developing one successful new product. In the 1968 survey, on average, across all industries, it took about fifty-eight new product ideas or concepts to yield one new product in the marketplace. By 1981, this had dropped quite dramatically to about seven ideas. This begins to show you the impact and power of the front-end strategy driving the whole new product development activity. Yet companies are not ranking their experience in terms of successful new products on the marketplace any better than in 1968. This suggests that there are other factors also at work here, not just managing the overall R&D innovation process.

There is common agreement on the R&D commercialization objectives. It is clearly important to foster innovation. Increasingly companies are putting greater emphasis on winning the race to market. There is much greater recognition today that getting to market early with innovation is a key element of competitive strategy and success in the marketplace. However, it is not only necessary to win that race, but also to position products successfully against competitors in a local market. Positioning products well requires marketplace input very early, in defining product features and how to proceed in the development process. It is also being aware of what the competition is doing and how they are proceeding. Ongoing competitive assessment increasingly needs to be done in a global context as competition globalizes, particularly in tech-

nology intensive industries. The emphasis on local markets cannot be lost however. Some companies are beginning to think about globalization in the context of a single product which can be commercialized worldwide. There remains an increasingly complex requirement to manage the innovation process to tailor products to local market needs. A fourth objective is one of minimizing the resources required to achieve the above goals.

In our work with clients over the last several years, we observed an added set of management issues. Technology continues to change. Today there is a much faster pace of change which needs to be factored in, both from a strategy as well as a planning and execution perspective. Many companies, as they have changed their strategies, have experienced uneven new product pipelines. That in turn drives companies to go outside of their organization to external sources of technology. We are seeing more and more licensing and acquisitions, specifically for purposes of sourcing technology. New sourcing strategies yield multiple funding opportunities which increase the complexity of the decision-making process, and cause greater competition for scarce development resources. Finally, as mentioned earlier, the global roll-out opportunities also add complexity, particularly with regard to the organizational aspect. Companies are struggling with ways to improve bringing together the various elements of the organization on a worldwide basis.

As we work with our clients in commercializing new technology, we find that internal attitudes are a major contributor to the progression of successful ideas. Typically, the approach to the technology assessment is very much a "can-do" approach. This is promoted by the technology champion who believes that technology can do anything and solves many problems. Then the technologists encounter the marketing organization which takes a very hard-nosed approach. One of the things that companies then wrestle with is how to balance the technology champion who truly believes in the value of the technology against the marketing skeptic. A more successful approach is to flip those attitudes; get the technologists to take a hard-nosed approach, to be realistic about the true value of the technology. How does it stack up against competition? How will it be valued in the marketplace? Then challenge marketing to make this work, to start small, find a success, and to move it to more successes in the marketplace. Those companies who really manage innovation successfully balance the realistic assessment of the technology and the value of the technology with the creativity of the marketing people who develop and position that product in the marketplace. The orientation of how you manage the process and think about the performance requirements begins to change.

Product strategies must be developed in the context of the product, the technology and the market life cycles. There are unique skills required at each stage of this cycle. For example, in the advanced materials area, one must look at the various dimensions of the customer's

ability to pay for innovation, the value that innovation provides to the customer and how the success requirements, from a technology and skill base, change over the life cycle. The success requirements change as the business evolves from the introduction of the material to processing refinements to much heavier reliance on application skills, and ultimately to process scale. A company must understand the skill requirements coupled with these customer and supplier economics. A breakdown at any stage of this process can slow or stall the development of the material.

A portfolio approach to project selection is also important and can provide a bridge between the critical issue of management control requirements and the inherent risks associated with R&D technology. Technology maturity and the specific technology emphasis required — research, development or business support — define the various components of a corporate portfolio of technology applications and activities. Companies need to look at their overall technology investments in the context of the overall portfolio, to manage risk, technology evolution and the allocation of these efforts.

There are several “Best Practices” for successful innovation and technology commercialization. First is the need to make a long-term commitment to support innovation in new product development. Second, companies need to implement company specific approaches, driven by corporate objectives and strategies with a well-defined new product strategy at the core. Companies have gone through various diversification stages. Now companies are focusing more on core businesses due to the realization that making a company specific approach, based on experience and unique technical skills, is very important to continuing to manage the innovation process successfully. Third, companies need to capitalize on accumulated experience to achieve and maintain competitive advantage in the marketplace. That includes experience from the total commercialization and marketing cycle, not just the accumulated experience from technology. Finally, companies must establish an environment conducive to achieving new product and corporate objectives in terms of management style, organizational design and the degree of top management support.

In our 1968 survey, organizational problems were the key obstacles to success in R&D management. By 1981 management practices and planning attitudes had surfaced as the major deterrence. Lack of attention to new products and emphasis on short-term problems are something that has not disappeared in the 1980s. Also, from a management practice standpoint, the need for more market research remains. We still see many of the organizational problems. In fact, through the 1980s the organizational problems have resurfaced. Today the combination of globalization, the increasing pace of change, the niche strategies necessary in the competitive environment and the resulting complexity have exacerbated the problems in the decision-making process.

That leaves a number of management imperatives for the future. Companies must aggressively pursue opportunities to accelerate product development by focusing on where the development cycle can be shortened. This requires making timely decisions, within a strategic context. It also requires an understanding of the trade-offs and the implications of those decisions. Companies need to allow the decisions to be made at the lowest appropriate level in the organization. New mechanisms will be needed for improving the decision-making process. It also requires a renewed effort to ensure that an effective organization will support the decision-making process and ensure expeditious implementation.

The future R&D organization must concentrate on continuous self-improvement (“CSI”), a critical building block of world-class performance. CSI is the ability of an organization to achieve continuously higher levels of performance through a steady stream of seemingly small, internally generated improvements in methods, tools and procedures. R&D leaders will energize and actualize their organizations for CSI through changes in process and culture.