Finishing Trends & Technologies

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What Does Innovation Have to do With It?

In the past several columns, I have focused on new technology for the metal finishing industry. A significant part of the previous columns included the expanded role of intellectual property, particularly patents, as a key component in the exploitation of new technology for competitive advantage. To paraphrase what someone has said: "Invent a better mousetrap and the world will beat a path to your doorstep!" Unfortunately, this comment is wishful thinking.

According to the *American Heritage Dictionary*, an invention is a new device, method, or process contrived by the use of ingenuity or imagination. Of course, as we know from previous columns, it is generally wise to obtain patent protection for one's invention. An innovation is the act of "introducing" something new.

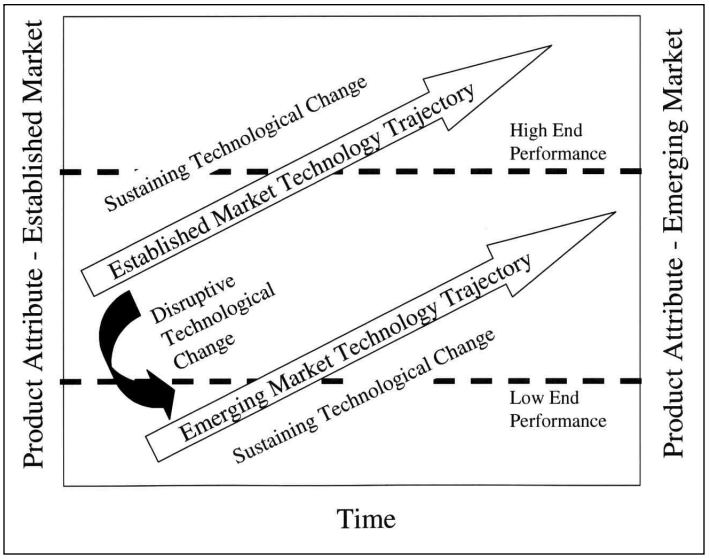
Note the seemingly subtle but very important difference between the definitions of invention and innovation. Further, note that less than one percent of patents generate revenues to cover the cost of obtaining the patent in the first place! To paraphrase H.T. Shapiro, President of Princeton University: "Being first in science (as well as invention) doesn't mean that someone else can't capture the associated economic and social dividends through better implementation."

I feel so strongly about this message that it is hanging in prominent view in our company lobby.

The U.S. has generally led the world in the number of patents issued, but it is questionable if the U.S. leads in innovation. Do companies with the most number of patents reap the economic benefits associated with innovation? Clearly, these questions are rhetorical and suggest a major problem in bringing an invention to the commercial market as an innovation.

The Innovator's Dilemma

An easy rationalization for failure of innovation based on bureaucratic, risk-averse, and/or complacent organizational cultures is the common mantra of technical people—blame it on the bean counters and business weenies. A very informative read regarding the influence of organizational culture on the "development" of a next generation minicomputer is found in Tracy Kidder's Pulitzer Prize book.[1] But the organizational malfunction argument is overly simplistic. There are many examples of excellent organizations that suddenly became "un-excellent."



Another rationale is that the radical breakthrough nature of innovations is too difficult for companies to manage. But there are many examples of significant innovations that are not, in fact, breakthrough. A prime example is the miniaturization of disk drives, which enabled the miniaturization of the computer.[2]

Considerable insight regarding the problem of innovation is found in a seminal work by Harvard Business School Professor Clayton Christensen.[3] The basic dilemma is the numerous examples of loss of market dominance by companies that: (1) employed good management practices, (2) listened to their customers, and (3) invested in new technologies. Prof. Christensen studied a "fruit fly" technology, computer disk drives, to gain insight into the innovator's dilemma. Recall from the column in the July issue that biologists study the forces of evolution by considering *Drosophila* because their generational time-scale is about two weeks. Similarly, in order to gain insight into the forces of innovation, the study of fast clock-speed technologies, such as disk drives, is dictated[4].

Sustaining Versus Disruptive Technological Change

Prof. Christensen considers technology trajectories to gain insight into the impact of technological change. A technology trajectory plots an aspect of product performance vs. time. In the case of the disk drive industry, a key product performance aspect would be capacity. The mainframe computer market continually demanded increasing disk capacity, and the dominant firms responded with

technological innovations to sustain the technology trajectory. Prof. Christensen terms these innovations as *sustaining technological change.* Many of these sustaining technological changes were, in fact, radical breakthrough innovations.

With time, inferior disk drives that offered (1) less capacity, (2) slower access time, and (3) higher cost per megabyte, were developed. Because these disk drives were also smaller and lighter, they enabled desktop and notebook computers. As Christensen asks: "Is a notebook computer better than a mainframe?"

This question has no absolute answer. The answer depends on whether you want the computer to be the data warehouse of a large company or to be able to carry the computer on the airplane with you. The notebook computer established a totally different product performance attribute—weight. This type of technological innovation is termed *disruptive technological change*. In fact, although disruptive, the innovation was not radical or breakthrough.

Generally, disruptive technologies are characterized as simpler, cheaper, lower-profit technologies, compared to sustaining technologies. Additionally, disruptive technologies address emerging markets, whereas sustaining technologies address established markets. Consequently, the business opportunities associated with disruptive technological change are often missed by market leading companies. Based on his research, Christensen defines a number of "principles" of disruptive innovation.

Customers & Investors Provide Resources

Another concept borrowed from the biological sciences—the *theory of resource dependence*—provides insight into the innovator's dilemma.[5] Simply put, resource dependence says that customers and investors (not managers) ultimately decide how companies spend money. Just as in life's battle for resources, companies with investments that do not satisfy their customers and their investors do not survive. Consequently, the best performing companies have adapted to their resource providers by evolving systems that kill ideas that cannot be sold to their customers, and cannot be justified to their investors.

Small Markets Don't Fuel Growth Needs Of Large Companies

As defined here, disruptive technological innovations allow new product attributes for not-yet-established markets. Further, considerable evidence indicates that early entrants to emerging markets have substantial first-mover competitive advantage over later entrants. Yet, as these same companies succeed and grow, it becomes prohibitively difficult for them to enter the next generation of small emerging markets. The problem is that in order to maintain share prices and create internal opportunities for employee growth, companies must continue to grow. However, for a $40 million company versus a $4 billion company to grow at 20 percent, it requires new revenues of $8 and $800 million, respectively. But new, emerging markets are seldom $800 million in size.

Non-Existent Markets Cannot Be Analyzed

The basic hallmarks of sound business management are: (1) solid market research, (2) good business planning, and (3) market plan implementation. Application of these practices to sustaining technological innovations has consistently yielded the desired results. The reason for the success regarding sustaining technological innovations is precisely that the markets are established and can be analyzed. In other words, the technology trajectories are established. Consequently, most executives have learned to manage innovation in the context of sustaining technological innovation where analysis and planning are feasible. In the case of disruptive technological innovations, the only seeming certainty is that the forecasts will be way off target! In evaluating the potential of disruptive technological change, well-managed companies demand market information when none exists, and they base judgments on financial projections where neither revenues nor cost can be quantified.

A Strategy for Circumventing The Innovator's Dilemma

So, a summary of this discussion would seem to be that, in order to become market-dominant and successful, companies establish management practices that lead to their ultimate failure in recognizing and exploiting emerging markets. This is the innovator's dilemma—how to stay focused as a market leader, and at the same time recognize and exploit new opportunities. Based on Prof. Christensen's research, several solutions to the innovator's dilemma are suggested.

To avoid the resource-dependence dilemma, companies should establish autonomous organizations to build new and independent businesses based on disruptive technological innovation. These organizations would have a cost structure to achieve profitability at the low margins associated with disruptive technological innovations. Furthermore, the size of the autonomous organization would be matched to the size of the target market. Finally, business planning would be replaced with scenario analysis where the objective is to continually learn and continually test assumptions. Effectively, these autonomous organizations must behave entrepreneurially. The basic definition of an entrepreneurial organization is one that identifies opportunities, and then assembles the resources to exploit the opportunity.[6]

But, as I see it, there is still a fundamental dilemma to the innovator's dilemma. How are these organizations "connected" yet "autonomous" from the parent company? If they are truly autonomous they should be allowed to fail with no guaranteed safety net for the employees to safely return to the parent company.

Approaches to the problem of innovation in the form of R&D organizations are generally fatally flawed. The central or corporate R&D lab, which accomplishes "autonomy," is too removed from the needs of the operating plants or divisions. Although the budget for corporate R&D comes from the divisions, the plants typically have only perfunctory input into the R&D direction. Although the "autonomy" of corporate R&D is established, the lack of response to the needs of the divisions evolves into "taxation without representation." Ultimately, most corporate R&D labs fail at delivering innovation to their companies and are the first to go during difficult times.

To address the corporate R&D dilemma, companies have established advanced manufacturing groups at their plants. These groups, while

chartered to address the long-term innovation needs of their companies, are part of the plant budget. But because they are "connected," when production problems occur the advanced manufacturing groups are called upon to solve the problem. This level of "connectedness" prohibits the advanced manufacturing group from addressing the longer-term innovation needs of the company.

There is, however, a possible solution to the fundamental dilemma associated with the innovator's dilemma. There is a new industry emerging consisting of small inventive/innovative companies associated with the federal government's Small Business Innovation Research (SBIR) program. These companies meet many of the criteria associated with Prof. Christensen's "solution" of autonomous, yet connected, organizations. Specifically SBIR companies are:

(1) Small—ranging from one to no more than 500 employees.
(2) Establishing the technical feasibility of high-risk, high-payoff technological innovations for new and emerging markets.
(3) Accustomed to surviving on low profit margins.
(4) Allowed to fail.
(5) Required to commercialize or innovate.

In summary, SBIR companies are part of a new innovation industry and provide an opportunity for strategic alliance with large, established companies to solve the fundamental dilemma associated with the innovator's dilemma.

In the next column, I'll discuss the SBIR program and provide models for utilizing SBIR companies as the autonomous organizations suggested by Prof. Christensen. *P&SF*

References

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