Title: Importance of Technological Forecasting in New Product Decisions

Course:
Year: 1990
Author(s): R. Bhatia and B. Pathak

Report No: P90019

Abstract: This paper highlights the importance of technological forecasting and sets the framework for further research in establishing a relationship between new product decisions and technological forecasting for the computer/semiconductor industry. It concludes with a section on incorporating technological forecasting into new product decisions and the expected outcomes

Importance of Technological Forecasting in New Product Decisions

Bhatia, R., Panthak, B.

EMP-P9019

IMPORTANCE OF TECHNOLOGICAL FORECASTING IN NEW PRODUCT DECISIONS

Rohit Bhatia
Bimal Pathak

Portland State University
EMGT 506
Summer 1990

Seems highly superficial. "Different strategies exist. They involve differing amounts of risk. Forecasting is important." WE ALL KNOW THIS! So what have you contributed? Learned? Analyzed? Is there anything original??? Thoughtful?

But not all superficial. You state that you have "... set forth a framework..." This is true.

I. INTRODUCTION

Much has been written about the importance of new products to companies. There is an abundance of literature on the topic of new product selection itself. The development of new products is vital to the success and growth of an organization. Despite the abundance of research on new product selection and its importance to organizations, several studies have reported new product failure rates of ninety percent or more. It is ironic that research and development can be used to make new products, yet it fails to predict the success of new products in the marketplace.

Most of the new product development research literature has focussed on consumer and packaged goods. The issues that arise in selection of new products in this product segment are quite different than those in a high technology industry. In the consumer market, it is feasible to conduct test marketing, sampling new products acceptance and measuring consumer preferences. With such data, one can to some extent use various analytical methods and make a reasonable forecast of market penetration and potential of a new product under consideration. On the other hand, an organization in the high technology industry is already operating at the leading edge of technology. Therefore, such an organization, when it decides to develop new products, they become tomorrow's new technology. When Intel in the 1970's designed its first microprocessor, it created a new technology for the 1980's and beyond. But the decision to make the microprocessor was not driven by market forces. Intel had no way of forecasting how its product would be received in the market because it could not test market or sample customer response. Since the product was so new and beyond the then current level

of technology, even Intel did not anticipate many of the applications for the microprocessor and thus making it difficult to accurately forecast total market size. The decision to produce such devices was based on the forecasted need for more computing power to handle large amounts of data in the coming Information Age.

This paper will attempt to highlight the importance of technological forecasting and set the frame work for further research in establishing a relationship between new product decisions and technological forecasting for the computer/semiconductor industry. In this environment, new products are highly susceptible to obsolescence in a very short period of time. Considering that design to manufacturing cycle can take anywhere from one to five years, it is essential that products are designed such that they are state of the art when they are introduced to the market. This highlights the moot point that good technological forecasting is absolutely necessary to survive in this highly competitive environment. The rapid rate of technological change and the time lag between design and manufacturing has made technological forecasting a very important variable in the new product selection equation. The main focus of the paper will be on the importance of technological forecasting as it relates to new product strategies in high technology environments. The next section will be an brief overview of commonly used technological forecasting methods. The paper will conclude with a section on incorporating technological forecasting into new product decisions and its payoff.

II. TECHNOLOGICAL FORECASTING

Technological forecasting is the prediction of changes in the technical parameters, attributes, capabilities or needs of an area of technology as a function of time. Since it inherently deals with events in the future, there is a degree of uncertainty associated with it. This uncertainty can translate into a variety of risks such as financial cost, opportunity costs, and resource scarcity for other projects. Despite the risk associated with technological forecasting, it is essential for an organization to look into the future in order to develop new markets, products and technology to keep its competitive advantages. Technological forecasting is primarily based on three premises. First, the technological events and capabilities such as speed of microprocessors, number of transistors packed on a silicon chip and geometries feasible on silicon seem to advance at a astonishingly yet orderly manner over time. For example, in the early 1970's silicon chips with a few thousand transistors were being designed but today the level of integration has approached over a million transistors on a silicon die. The second premise is that technology responds to needs, to opportunities and to allocated resources. The recent activities in medical research for cure of cancer and AIDS can be directly attributed to the level of increased funding. The third rationale behind technological forecasting is that new technology can be anticipated by understanding the process of technological innovation, that is by understanding innovative processes it allows one to predict new applications and new products required to exploit the state of the art in technology.

A variety of techniques have been developed for technological forecasting. Most of these techniques can be categorized into two groups which are exploratory methods and

normative methods. Exploratory methods are based on currently available knowledge base or expertise in an organization. This knowledge base could include market research data, prior experiences or competitors information. This knowledge can then be utilized to assess future trends which form a basis for the technological forecast. One of the exploratory methods is based on intuition. The intuitive method can take the form of experts forecasts, brainstorming sessions, scenario development and the well known Delphi technique. Another approach under exploratory methods could include historical analogies as well as growth curves which are based on the fact that growth patterns follow S-shaped curves. Thus, growth curves can help predict when an organization needs to move forward to a new technology or product. In contrast to these subjective techniques, there are also methods such as gaming, simulation, input-output analysis and cross-impact analysis which have a more mathematical foundation derived from the operations research area. However, these methods are still based on knowledge that is currently available, as opposed to the normative methods which attempt to establish a direction (norm) based on a desired future state of technology. Normative techniques are goal oriented versus the exploratory techniques which are trend driven. The most commonly used normative methods are relevance trees, morphological analysis and mission flow diagrams. Any one of the above described methods, normative or exploratory, by itself is not the ultimate tool in forecasting but a combination of these ideas can be used effectively to achieve more accurate forecasts of the future. There exists an abundance of literature on each of these techniques and hence they are not described in detail here, however the basic concepts relating these methods will be applied later in new product strategies for high technology companies.

A new product in this context is defined as a new application for a current product line or which can either enhance existing market share or capture future market share by using the organization's current technology base. The focus of our discussion will be the computer/semiconductor industry where a leading edge company needs to determine what products to develop to meet current and future application needs. The decision regarding new products in such an environment is further complicated by the rapid rate of technology growth, making technological forecasting an important parameter in these decision models. We will begin with a brief description of the nature of the industry of interest and the challenges involved in product innovation in such an environment.

III. PRODUCT INNOVATION IN SEMICONDUCTOR COMPANIES

In the late 1960's and early 1970's many small entrepreneurial computer companies were established in the US. These companies were driven by new technology and product innovation was a key to their successful growth. The explosion of such entrepreneurial companies created flurries of new products such as mass storage devices (hard disks), local area networks, modems, word processors, and a whole set of other software tools for higher productivity. The rate of technological change in this industry also dictated a continuous stream of products designed to keep pace with the technology. Product life cycles were considerably shorter because newer products contribute dramatically to the obsolescence of the older products. This implied that a company could not sustain itself by maintaining status quo but must continually bring out new and better products. Another point to note is that as the older products matured, the manufacturing yield would increase thus reducing the cost of

the product. This fact was leveraged by Japanese companies in the 1980's to increase their US market share. The cost reduction impacted the profit margin on these products and it was not feasible to maintain business solely on these products. For example, the first personal computer from IBM in the early 1980's had retail price of about $4,000. But today, just a decade later, a comparable machine would retail for about $400. Similar examples can also be cited in video recorders, television sets and other electronic consumer goods. Yes, the profit margins have dramatically been reduced over the years but the industry has been successful in creating newer products with better quality and more features which can be sold at a premium. This can be observed by looking at the personal computer market again. Today, one can purchase a 80486 based personal computer for $4000 which boasts performance of ten to twenty times that of the original personal computer. That is, for the same price (actually lower price in real terms) the performance of today's microprocessors is dramatically higher than the first generation products making the older products obsolete. This emphasizes that not only does a company need new products but that these new products must also be significantly better than the older generation products. It is this requirement of rapid innovation which dictates that technological forecasting is vital in new product decisions.

In this environment, new product strategy can take various forms depending on an organization's objectives. One strategy might be to imitate successful competitors by making similar products after the competition has announced their products. This approach can be successful but if the targeted market is profitable, it tends to attract many other companies to follow a similar strategy. Also, there is a limited window of market opportunity in the sense that the imitator's products must be introduced soon after the original product comes

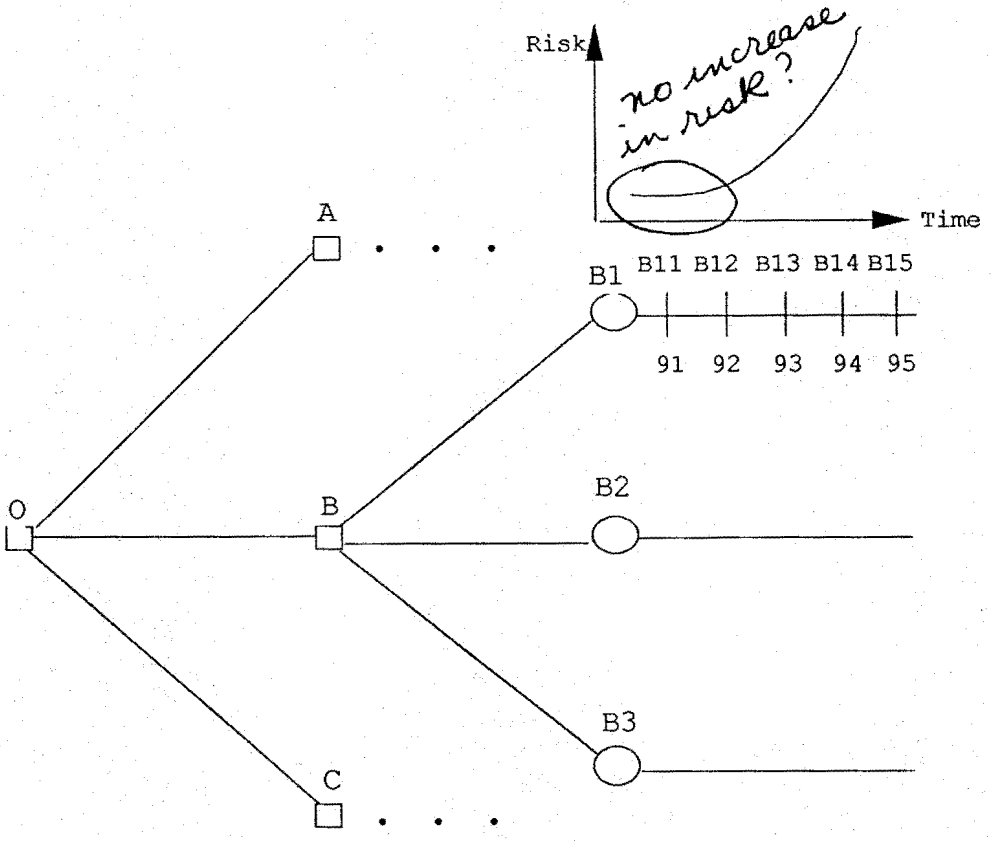
to the market. In the semiconductor industry, some of the recent arrivals in the US market such as Samsung and Daewoo of South Korea have followed exactly this approach to get a foothold in the US market. A slight variation of this strategy could include second sourcing and other royalty paying licensing agreements. Some of the US companies such as Cypress Semiconductor, LSI Logic and others have used such agreements to establish their business. Another strategy can be to make products that are similar to the competitor's products but offer some few enhancements. These fall in the category of me-too-with-a-twist product and rely on product differentiation to capture market share. The enhancements offered could be in terms of speed, cost and ease of use. The third strategy could be building upon the old products with new manufacturing technology and design enhancements. These are called next-generation products which are usually upward compatible with the current line of products. An example of this approach is Intel's 80X86 family of microprocessors and Motorola's 680X0 microprocessors. Yet, another strategy could be to produce one-of-a-kind product to create a new market segment. This is usually based on some proprietary technological advantage. The introduction of reduced instruction set processors (RISC) by Sun Microsystems in its SPARC microprocessor line in the 1980's was an innovative, one-of-a-kind product.

Of the four new product strategies for semiconductor companies described above, the first two can be categorized as conservative approaches in terms of risk which can be used to establish the foundation of a company. However, it is the third and fourth strategies, if used successfully, which can contribute to growth and expansion of a company beyond its initial foundation. Not surprisingly, these strategies also have more risk associated with them. It is

here that technological forecasting can reduce risk in new product decisions. It should be noted that each of these strategies has a different impact on the time-to-market of products. The imitation and enhanced imitation strategies will have the shortest time to market since the product is already well defined. Also the cost of development of such products is likely to be lower because the research and development efforts have already occurred. On the other hand, the current product extension and the one-of-a-kind product strategy will have a longer development cycle and also cost more to develop.

A simple example will illustrate the subtleties in technological forecasting which are relevant to new product decisions. A particular semiconductor company, X, with all of the characteristics discussed above, has to decide among three new product lines A, B and C. The example assumes that market research data has been gathered and narrowed the choices to A, B and C only. The parameters that will be used to forecast technology in this case will be cycle times (speed) and performance as measured by instructions executed per second. The cycles are measured in nanoseconds which relate to the clock frequency. A simplified version of this product selection problem is shown below.

In each of these categories, A, B and C, there may be sub-categories that can be pursued. For instance, the B product line may have three avenues to pursue. The sub-category B1, B2 and B3 may each be expanded along a time line using technological forecasting to assess the future potential of these products.



New Product Selection

In addition one can plot the technology assessment on the time line to guide the product strategy. The product type B11 as shown on the time line above year 1991 is expected to have a 50 nanosecond cycle time and 10 million instructions per second (MIPs) performance range. But by 1992, a similar product, labeled B12, is predicted to have a cycle time of 30 nanoseconds and performance of 15 MIPs. Similarly products in 1993, 1994 and 1995 will have higher performance characteristics. As a new product strategy, one could choose any one of these product subtypes. The products in the nearer future can be imitation products that have a shorter time-to-market and afford a lower development cost. As one moves to

products further into the future (to the right on the time line) the new product strategy will have to change to one-of-a-kind or next generation type of products. The latter strategies will need more investment now and have a longer time-to-market, however, if the product is a success the company will be a leader in the industry and can demand a premium for its product. As discussed above, the rapid change in technology and improvement in quality makes the long term projects more risky. The key contributor to the risk is the inability to accurately forecast technology development. However, for a given organization in a particular stage of development any one or several of these strategies are useful.

IV CONCLUSION

Obviously the authors of this paper believe that product innovation is one of the most important tasks in a high technology company. In the early stage of growth of a company, a conservative product strategy such as me-too and a me-too-with-a-twist product are essential to lay a foundation upon which the company can build. Once sufficient business has been generated by these products, the company can take on more ambitious projects. This will include next-generation products and one-of-a-kind products. There is a higher risk factor associated with these product strategies as explained above. This risk factor can be diversified or reduced by incorporating technological forecasting into new product decision models. Good technological forecasting can also help a firm in directing its product line toward markets that are expected to have higher growth rates than the firm's current market segments. Sun Microsystems correctly forecasted the tremendous growth in the workstation market in deciding to introduce its RISC processors. On the other hand Intel was slow to

recognize this market and only recently introduced a RISC processor. We hope that this paper has set forth a framework for more thorough and in-depth research in the area of new product selection and technological forecasting.

yes

BIBLIOGRAPHY

[1] Martino, J.P., *An Introduction to Technological Forecasting*, Gordon & Breach Science Publishers, 1972, New York, NY.

[2] Souder, W.E., *Managing New Product Innovations*, Lexington Books, 1987, Lexington,MA.

[3] Schnaars, S.P., *Megamistakes: Forecasting and the Myth of Rapid Technological Change*, The Free Press, 1989, New York, NY.

[4] Wind, Y, et al., *New-Product Forecasting*, Lexington Books, 1981, Lexington, MA.

[5] Shannon, R.E., *Engineering Management*, John Wiley & Sons, 1980, New York, NY.

[6] Knight, R.M., Product Innovation by Smaller, High-Technology Firms in Canada, *Journal of Product Innovation Management*, pp. 195-203, vol. 3, 1986.

[7] Kleinschmidt, E.J., Cooper, R.G., New Products: What separates winners from loosers?, *Journal of Product Innovation Management*, pp. 169-184, vol. 4, 1987.

[8] Albaum, G.S., Baker,K.G., Modelling new product screening decisions, *Journal of Product Innovation Management*, pp. 32-39, vol. 1, 1986.

[9] Moore, W.L.., New Product Development Practices of Industrial Marketers, *Journal of Product Innovation Management*, pp. 6-20, vol. 4, 1987.

[10] Gelsinger,P.P et al., Micro 2000: Workstation on a chip, *IEEE Spectrum*, pp. 43-47, vol. 26, no. 10, October 1989.