Innovation and Entrepreneurship

The Academic-Industrial Complex:
A Clash of Two Cultures?

Successful innovation and entrepreneurship requires: 1) a constant flow of discoveries from research laboratories and 2) financial resources to commercialize these discoveries. Since the early 1950s, the US government has provided significant levels of funding to prime the discovery pump (Figure 1). Today, as a result of this investment, the research pipeline is jammed with discoveries in various stages of development. However, the emergence of these discoveries into commercial products is a painfully slow process.

In 1999, the leadership of the Dental Manufacturers of America, Inc, (DMA) met with representatives of the National Institute of Dental and Craniofacial Research (NIDCR) to discuss the possible causes of this phenomenon and to develop a program to accelerate the flow rate of discoveries from the pipeline. The Entrepreneurial Venture Fair—a showcase to representatives of the dental industry for inventions ready to become products—was born from that meeting. It was a collaborative venture between the DMA, the NIDCR, and the Friends of the NIDCR.

Three consecutive fairs were held in Chicago in 2000, 2001, and 2002. Fifty-two inventions were displayed for representatives of the dental industry during these 3 events. Of these, 2 were commercialized and became products. While the success rate for the fair concept continues to be a subject of debate, it is generally agreed that the federal government, through the NIDCR, has fulfilled the first requirement for successful innovation and entrepreneurship by providing a constant flow of discoveries from research laboratories.

Edward F. Rossomando, DDS, PhD, MS
Professor and Director
Center for Research and Education in Technology Evaluation
University of Connecticut
School of Dental Medicine
Farmington, Connecticut
erossoma@nso2.uchc.edu

The problem seems to be fulfilling the second requirement—providing financial resources to commercialize these discoveries, a responsibility that does not constitute part of the mission of the NIDCR. There may be several reasons for this lack of financial support. One may be related to risk, either real or perceived on the part of dental companies. Another reason may be the nature of the discoveries and the type of products they will generate. Most, if not all, of the post-1990 discoveries have roots in the genomic revolution of the last 50 years. As a result of the rapid rate with which these discoveries emerged and entered the product pipeline, the decision makers within dental companies must possess, or acquire, the background necessary to envision the potential products from these discoveries. Finally, dentists must be prepared to incorporate these new products and new services in their practices. One way to deal with both these issues would be for dental companies to align themselves with dental schools to form an academic-industrial complex much like the military-industrial complex of the early 1960s.

The Military-Industrial Complex

In a 1961 farewell speech, President Dwight Eisenhower noted the development of what he referred to as the military-industrial complex. His concern was the impact such an entity might have on public policy.[1] At the time, Eisenhower's comments carried a negative connotation—it was his way of warning the American people of the emergence of a possibly sinister and conspiratorial cabal between the military and industry.

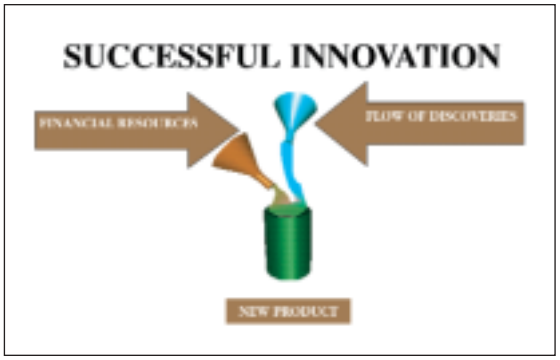

Figure 2—Adequate funding is essential to the discovery of new products.

Assuming what Eisenhower saw in his crystal ball became reality, and a military-industrial complex materialized, it might be appropriate to ask if this complex did indeed have a negative impact on US foreign policy. It is certainly true that since 1961 the United States has engaged in many military operations worldwide. While they ranged in scale from Vietnam to Granada, and most recently Iraq, it is not clear that the effect on our economy has been totally negative. Some might even argue that the needs of the military are responsible for some of today's most successful industries. For example, the telecommunications industry relies on satellites and satellite technologies originally developed for the military. Similarly, the Internet was originally designed for the military for communication in times of war.

The Academic-Industrial Complex

For some reason the alignment of most activities with industry is perceived as making a deal with the devil. Today, and for the last several years, there is a movement in academia to enhance ties with industry. Once again, some see danger in the emergence of an academic-industrial complex (AIC). Moreover, the threat of the formation of such a complex raises the question: What might be the consequence of the formation of such a complex not only on our citizens but also on the academic community?

However, an academic-industrial complex already exists in the United States (Figure 2). In 1944, just before the close of World War II, President Franklin D. Roosevelt asked Vannevar Bush, director of the Office of Scientific Affairs, to develop a plan for the role of science during peacetime. The Bush report, titled "Science, The Endless Frontier"[2] set forth a number of views about research, including the difference between basic and applied research and, of particular relevance to this article, the relationship between research and the economic growth of our nation. His often quoted dictum reads as follows: "A nation which depends upon others for its new basic scientific knowledge will be slow in its industrial progress and weak in its competitive position in world trade."[2]

This article argues that considering the biotechnology revolution, the high costs and risks of getting biotechnology discoveries to the market, and the high cost of clinical trials, the academic sector should partner with industry to share risks, costs, and, of course, benefits. Otherwise the oral health of the American people will suffer.

Notably, an academic-athletic complex already exists. While scandal has at times touched individual athletes or universities, the alliance between the university and industry, usually the sports /entertainment industry, has been positive for both. For example, this association has fueled university growth from not only generated revenues (eg, from the marketing of television rights) but also the enhanced visibility of the university nationwide.

In a few cases, the involvement of academics with industry has resulted in problems that should not have occurred. Solutions still need to be found when addressing issues such as the following:

- Ethics
- Conflict of interest
- The freedom to publish vs protection of intellectual property.

Perhaps one of the most significant issues is the reluctance of university scientists doing basic research to consider research and development (R&D) an intellectual pursuit.

Benefits of an AIC to the University and Dental Schools

R&D is often considered a separate and distinct activity from basic research, the latter being a term introduced by Vannevar Bush and defined by him as an activity "performed without thought of practical ends."[2] He added, "Basic research is the pacemaker of technological progress."[2]

While it is difficult to argue against the pur-

Figure 2—Academia and industry already work together in the United States.

suit of knowledge for its own sake, it is not clear if US financial successes are solely a result of basic research. Some would argue that the capacity to bring these discoveries to the market is equally important if not more so. Clearly, each stage of the commercialization process requires investment and risk. The entire enterprise involves financial risk, and the level of risk at each stage of the process varies. For example, when success is measured by whether a discovery is commercialized, then risk is evaluated by the probability of attaining success. Of course, the probability of a discovery reaching commercial success is very low and therefore the financial risk involved high. For over a half-century, since the publication of the report by Bush, the policy of the US government has been that the American people should assume most if not all of this risk. Therefore, the federal government funds at least 95% of the basic research in the United States, and almost all of this research is conducted in academic settings and government laboratories.

Benefits of an AIC to the Dental Industry—Industry Funding R&D in Academia

Company growth requires continuous scanning of the discovery pipeline for opportunities to introduce innovative technologies (Figure 3). Dental companies make no exception. While large dental companies with sufficient funds are able to scan efficiently, small to medium dental companies with limited financial resources are unable to maintain an adequate scanning process with consequences to their corporate growth. These financially disadvantaged companies must rely on a variety of alternative sources—including trade journals, professional meetings, and serendipity—to identify product development opportunities.

The research activities of the last 20 years, however, have produced a potential reservoir of discoveries that will require additional research to bring them to market. Fortunately, the R&D phase of research is associated with less risk than the discovery phase. Consequently, the dental industry should financially support the much-needed R&D.

R&D has been defined most recently as the design and engineering of hardware, machines, and other tangible products.[3] In 2002, US industry provided almost 69% of the $265 billion total US R&D budget.[4] This means that only about 30% of the US R&D funding was derived from other sources, prevalently the federal government.

But while these values are representative of all industries, what about the R&D spending levels for the dental industry? Though specific numbers are not easily available, it is possible to make some estimates as follows: Based on corporate reports of some of the larger publicly traded dental companies, assume that 1% to 2% of total sales are representative of the investment by US dental companies in R&D. Considering the enrollment of companies in the major dental trade associations, also assume that there are approximately 800 US dental companies of a variety of sizes. However, for purposes of this exercise, we will assign an average of $50 million in sales per year for each of the 800 companies. These numbers suggest a total of $4 billion in total sales for most US dental companies, no doubt a minimal estimate. Finally, by applying the 1% to 2% of total sales to compute the US dental companies' investment in R&D, we arrive at about $40 million to $80 million.

The absolute value of this number is not important. However, in comparison with the approximately $350 million federal investment in dental research by the NIDCR, it is difficult to escape the following conclusion: The NIDCR is meeting its obligation in funding basic dental research in the United States, while the dental industry is not fulfilling its duty of funding the dental R&D effort.

Given the significant number of proven inventions and discoveries in the product pipeline, there is clearly ample opportunity for the dental industry to collaborate with academic institutions, especially dental school facul-

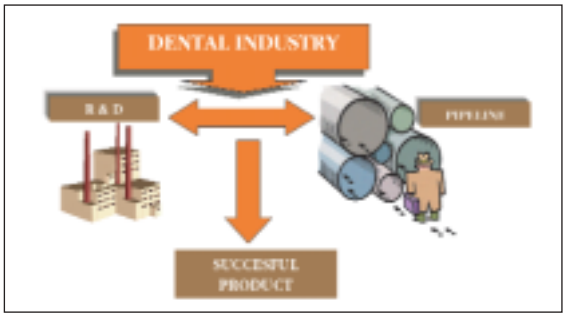

Figure 3—Successful product development requires companies to know what is in the discovery pipeline.

ties, for assistance in new product development and product commercialization. To do so is in the best interest of the academic community and the dental industry, and most importantly, it will lead to the improvement of the oral health of the American people.

Acknowledgement

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4. National Science Foundation, Division of Science Resources Statistics. *Academic Research and Development Expenditures: Fiscal Year 2000*. Arlington, VA; 2002.

Columnist's Note: *Thank you to those who contacted me about the article on credibility. From the comments it would appear that the importance of credibility, or its absence, in dentistry is as important as many other issues that confront our profession. It's gratifying to learn that many professionals are trying to deal with this issue. Comments are always welcome and it is my policy to respond to all submitted.*