Technology Transfer and Academic Libraries

Vladimir T. Borovansky

Arizona State University
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VLADIMIR T. BOROVANSKY
Noble Science & Engineering Library, Arizona State University, Tempe, Arizona 85287, USA

1. Introduction

Over the past several years in the USA a lot of attention has paid to the issues of productivity and industrial competitiveness. After the Sputnik shock of 1957 and the oil shock of 1973–74 we are in the midst of the competitiveness shock of the 1980s.

The reasons for this shock are many and varied. It is not only the cheaper labour in some countries that has made them more competitive on the world markets, but their work-forces have also achieved higher productivity. American productivity has grown at very low rates between 1978 and 1984: on an average only 0.7% annually. In 1985 it was only 0.2%. Major industrial countries except Canada have achieved 2.5–4% productivity.

Another comparison frequently mentioned is the number of patents granted to foreign companies and individuals. In 1985 almost 43% of US patents went to foreigners; in 1986 it was already 45%. Japan is the leading country for non-US patent recipients, followed by West Germany. Innovation is still the only way to economic prosperity and a future as a highly industrialized nation. Japan is also ahead of the USA in quality of production, and recent surveys show that Japanese students out-perform US students in mathematics and science. The same is true about several major industrial countries of Europe. If the USA continues on this path, its manufacturing industries will eventually disappear.

2. Under-utilized knowledge

One factor in the Japanese success in becoming a technological leader in many areas is the attention paid to, and the exploitation of, the available knowledge base. 'If any single factor explains Japan's success, it is the group-directed quest for knowledge,' writes Ezra Vogel in his book Japan as number one.

Ernest Breton in his seminal article 'Reinventing the wheel: the failure to utilize existing technology' quotes Arthur R. Thompson, director of Manufacturing Engineering for TRW, who warns that the USA could become a banana republic if it does not preserve its manufacturing industries. He further notes that the evolution of new technology should be substantially derived from scientific knowledge and less from trial-and-error input.
Breton writes that the flawed technology and constant re-inventing of the wheel is the cause of the USA’s falling further behind in world-wide competition. He cites the Three Mile Island accident and automobile recalls as examples of faulty engineering. Most of the blame is placed on ignoring the valuable dynamic knowledge base that is available through computerized data banks and other information resources.

NSF studies support this assumption, i.e. that engineers collect most of their advanced technical information in discussions with vendors, salesmen, consultants, and other engineers. Formal reading is related to the material that is found mainly in the vicinity of the engineer’s own desk (reference books, trade journals, and reports). And Thomas Allen of MIT added: ‘Engineers seem for the most part to be ignorant concerning the rise of bibliographic tools and to discount the potential of technical libraries for locating information.’ People and organizations are important sources of information, although this does not guarantee that when an engineer questions his office colleague that he gets correct information.

We librarians have our share of blame for this situation as well. As a discussion in the pages of *Library Journal* (October 86, February 87), attests, we do not do a very good job publicizing our services, in particular our expertise that would assist in retraining engineers to become knowledge engineers. The problem seems to be that we publish to ourselves and even the databases advertise mostly to the library and information profession.

And last but not least, the Mooers principle works also against the extensive usage of libraries and information centres: ‘An information retrieval system will tend not to be used whenever it is more painful and troublesome for a customer to have information that not to have it.’ It is therefore necessary to market better our products and services. And as another colleague pointed out: ‘Information must often be publicized repeatedly or through diverse channels before it will enter the stream of communications which will lead to its ultimate user; and from the point of view of the consumer of information, it is frequently necessary to be exposed to the information repeatedly before it will make an impact.’

We must also give more attention to other barriers to information access that Herbert White mentioned recently in one of his ‘White Papers’ in the *Library Journal*. As we all know from our experience, sometimes what clients need is not necessarily what they ask for. This is a particularly touchy problem in academic libraries. As Herbert White further writes, ‘... professors are allowed to continue pretending that they really have mechanisms for learning about new publications of importance to them. ... Part of the users’ unwillingness to admit an information need stems from the very real fear that “better” information systems will bring them more information, when their real hope is for less but more germane information.’ Reference librarians need to use all their diplomatic skills to convince certain scholars that they can do better if they confide in them with their information needs.
3. Role of academic libraries

To correct these shortcomings we librarians have to take the leadership role and confront them head on. We need to leave the walls of our institutions and share the market-place with other professions. We need to advertise our services and resources, and we need to reach the engineers and technologists in the industry. We need to publish in their publications and persuade them that it is to their advantage to exploit the available knowledge base, as Sharon Dean in her letter to Library Journal urges.

In academia, we need not only to instruct the students how best to use the libraries, we need to reach the faculty and try to improve or change their information gathering habits and assist in sharpening their library skills. We also need to improve our information systems to supply the users not with more information, but with less and more relevant information.

An integral part of this process is an effective document delivery system. As Nina Matheson writes in her landmark article in the Journal of Medical Education, we are in Stage 1 of the evolution of the information-handling environment, i.e. a modern resource library stage which acquires, houses, organizes, and makes available resources to support and advance the mission of the university. The information process is not completed until the user receives the desired document. To the user only the delivery of the document matters; he/she does not care whether we own it or not.

The American Council of Learned Societies study reported by Epp and Segal in College and Research Libraries News, February 1987 revealed also some disturbing findings. For example, in some fields half the faculty did not know whether orientation/instruction is provided at their institution and about the same number of people did not know about the computerized literature searching available through the library.

In a recent rather cursory survey of teaching engineering students information resources in the USA conducted by this author, it was found that only 12 schools out of 68 offer a formal course, although 56 schools offer presentations, special lectures, and online demonstrations.

Arizona State University is one of the schools offering a formal course. In addition to this course, engineering subject specialists give special lectures and presentations to classes, and more professors are incorporating ‘library assignments’ in their classes. Overall, on account of the online public access catalogue and the librarians’ contacts, we have more library-literate engineering graduates. But the situation is still far from ideal.

In order to improve our knowledge of ASU faculty curricular research and professional subject interests, a ‘Faculty Profile’ database has been developed. Through this database, reference librarians / subject specialists in the Noble Science & Engineering Library learn about the teaching and research needs of their departmental faculty. The system is described by Borovansky and Machovec in the December 1985 issue of Information Technology and Libraries. This tool provides information not only about the research con-
ducted at ASU but also about the consulting expertise of our faculty. This increased awareness of the institution's activities makes the libraries more responsive to the users' needs.

Most user studies conducted have concentrated on users and have ignored the much larger group of non-users of information resources. This problem is even more serious in industry. As mentioned before, the academic user, faculty or student, is usually more library oriented, although the situation is far from perfect. In the corporate world most engineers are still not reached by the information services. The lack of adequate information support is more frequently found among the smaller companies, although we know of several large corporations whose engineers and scientists get barely the basic information support. And yet there are people who are expecting better library services. However, there are more of those who are not even aware what these services could do for their productivity.

In the USA over the past several years the partnership between industry and academia has been strongly promoted. Co-operative educational and research efforts between the College of Engineering & Applied Sciences at ASU and industry with the support of the state government were instrumental in establishing the Excellence in Engineering Programme. Similar programmes now exist in several other states. The association between academia and business has a very positive effect on the academic side — having more research-oriented faculty, increase in sponsored research, construction of new facilities, gifts of equipment and cash, stronger undergraduate and graduate programmes and therefore better opportunities for graduates. This makes the state more attractive as a technological growth centre.

It also has, of course, a very positive effect on the other side. Industry benefits from more and better educational opportunities for their employees as well as from the increase in number and quality of engineering graduates, from the co-operative research and access to the university resources.

Even though the planning for the new science and engineering library at ASU began long before the idea for the Engineering Excellence Programme was conceived, its completion and occupation in 1983 coincided perfectly with this major effort. An important decision was made before the move into the new facility by the University Librarian, to request an establishment of a patent depository library. Noble Science & Engineering Library is now one of the few PDLs on the North American continent that can offer the entire US patent collection to its users. This event was hailed by both academia and the local business community as one of the most critical achievements. Patents are an important primary information source, yet frequently neglected.

Also before the opening of the new library, a new course in information resources in engineering made its debut in the Fall of 1982. The idea of a course for engineers dealing with the literature of their profession and the services available from the library had been discussed from time to time with no discernible results. During the 1979 ABET accreditation visit, one of the members of the accreditation team offered his support for this course and with
the blessing of the then new engineering dean we were able to offer it for the first time to our engineering students. A more detailed description appeared in the recent issue of the *International Journal of Applied Engineering Education.*

The objective of the course is to give the students a basic understanding of the organization of the literature of science and engineering, to give them a systematic view of the information process and introduce them to some of the major engineering reference sources. Also, the aim is to teach the students to identify and use information resources, including the computerized databases, making them aware of the need to use technical literature and giving them techniques and understanding for using it, and to instill in the students the habits of information gathering. The rapid growth of technical information makes it imperative for engineers to get acquainted with effective and efficient information retrieval techniques.

In one of the studies of information gathering habits of engineers, Rosenbloom and Wolek revealed that the need for information is sometimes recognized only after the information has been encountered. This 'post factum' discovery of a need for information only reinforces the importance of the awareness of information resources and services.

Today's students, the engineers and scientists of tomorrow, will be facing an increasing flow of information. They should be prepared to meet this challenge which will confront them in all fields: the rapid obsolescence of current knowledge as a result of accelerated technical progress.

4. Co-operation between academia and industry

'Technology transfer means different things to different people. . . . When we talk about the transfer of technology we usually mean transfer of knowledge. The knowledge can be stored and conveyed in many ways: The written word is knowledge; the spoken word is knowledge; computerized data banks are knowledge,' profess Mogavero and Shane in the first chapter of their book *What every engineer should know about technology transfer and innovation.* Information and knowledge are considered commodities. The competitive companies must rely on information in forms other than volumes on the library shelves. That is why the utilization of computerized databases is so critical. Because information frequently is also perishable (Bernal’s half-life of publication), urgency in handling is also very important.

Similarly, Larsen, Wigand, and Rogers describe the transfer of technology to industry from a university in their report to the National Science Foundation:

'Technology is diffused to industry in three ways. The first is through students who are hired by industry. A second way is through continuing education for industry's employees. These individuals are looking for specific information to apply to their particular job situation. The third type of technology transfer is through co-operative research.
From the perspective of the university researcher, most technology transfer involves the flow of technological information from the university to industry, while relatively little information comes from industry to the university, primarily because of problems with proprietary information. This view of the technology transfer process is consistent with the idea that the role of the university is to transfer knowledge to the private sector.

The current understanding of technology transfer includes research findings, information, and knowledge of technology. In this type of partnership, the library may sometimes be bypassed. The co-operation and the knowledge transfer takes place directly between the university researcher and the industrial partners. However, the library can become involved through the continuing educational process of industry's employees. Not only should they benefit from the co-operative activities, they can also benefit from an access to and a discovery of more sophisticated information and library services.

Academic librarians communicate frequently through informal networks with their colleagues in other libraries, including special libraries. They should encourage corporate librarians to support technological gatekeepers in their own companies and use them as 'representatives' in relating information about the potential of academic librarians for the improvement of their companies' competitiveness.

There are several other avenues available for marketing library and information services to industry. Several American university libraries offer a 'corporate information service' with a fee-based structure. These services advertise the capabilities of their parent libraries and thus contribute to the improvement of the knowledge transfer process.

Another channel of technology transfer is the so-called professional development programme that is an integral part of most US engineering schools. Through their continuing education efforts, short courses, and conferences the importance of the role of libraries can also be disseminated.

Last but not least, we should work with professional engineering societies to enhance their information-related activities. Some of them are already involved to a certain degree and much more ought to be done for their members. The efforts of the American Chemical Society could serve as an example.

It will depend on the libraries and librarians how well this important role will be carried out. We need to improve the ways of increasing engineers' awareness of library resources and services and improve the marketing of our 'products'. We need to improve the delivery of not only the bibliographic information but also of the documents. If we can show our clients that we are capable of delivering not more information, but rather more relevant information, we will effect technology transfer in a very positive way. I would like to close with a quote from an Australian librarian, Carmel Maguire, who concluded her paper on libraries and technology transfer with these words: 'Librarians should have a voice in the formal discourse in which science policy
generally and information technology policy in particular are made in their countries."  

The Author

Vladimir T. Borovansky, graduate of the Czocho-Slavic Academy of Commerce in Prague, in 1965 received a graduate degree in library science from Charles University, Prague. He has been at Arizona State University, Tempe, Arizona since 1968. During 1978–79 he worked at the University of Petroleum and Minerals, Dhahran, Saudi Arabia. Since 1983 he has been Head, Noble Science & Engineering Library at Arizona State University.

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