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Redefining the Federal Government's Role in Technology Transfer

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Besides encouraging private use of government-owned patents and stimulating technological entrepreneurship, government should restrict itself to being a technological librarian.

Government efforts to increase private use of technology developed at taxpayer expense have been badly misconceived. The Federal approach to technology transfer has not only failed, but actually serves as a barrier to more widespread adoption of taxpayer financed technology.

To see why this is so — and to identify some remedies — let us begin by recalling that national concern with technology transfer increased during the 1960s because the United States was spending a greater share of national income on programs with large R&D components. Technology transfer refers to the use of technical knowledge in an area other than the one for which R&D was undertaken (14), and it usually requires adaptation and modification of the technology to be transferred (2, 7, 9). Government R&D expenditures were becoming increasingly concentrated in military, space, and nuclear fields. Political concern with these trends served as an impetus to examine their impact on the national economy, the educational system, the structure of organized innovation, and the importance of specific agency missions which required R&D spending.

This process of national self-examination involved broad segments of the nation in political positioning over the appropriate distribution of Federal expenditures. The resulting academic and professional literature on technology transfer can be interpreted in part as one plank of a political platform that has been constructed over the years by an amorphous coalition of scientists, engineers, technicians, educators, and entrepreneurs. In the continuing battle for share of natioal resources, especially as reflected in Federal budgets, the supporters of technological programs find themselves selling inherently long-term programs in what is often a budgetary framework with year-to-year horizons. The advocates of programs with longer-term payoffs are often at a disadvantage because competitors for resources may be able to point to more immediate and concrete results from expenditures in their areas. It is not surprising, then, that the concept of technology transfer should be embraced as a handy adjunct to mission-related goals by those desiring to convince politicians of the merits of a particular technological undertaking.

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Two Undesirable Consequences

Political focus on potential benefits of technology transfer has had two undesirable consequences. The first is a widespread acceptance of the notion that as a result of historical R&D expenditures there is an available "reservoir of technology" with significant economic value. The second is that a governmental role has been created to actively promote utilization of technology in this "reservoir."

A 1967 U.S. Senate subcommittee report stated that "The Federal Government 'controls' . . . a large reservoir of technology ranging from research results, to practical techniques and devices to patents . . . Federal control of $99 billion worth of technology over 10 years suggests Federal responsibility to get the most good out of this resource" (14).

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More recently the Committee on Technology Transfer and Utilization of the National Academy of Engineering reported to the National Science Foundation that "With a few exceptions, the vast technology developed by federally-funded programs since World War II has not resulted in widespread 'spin-offs' of secondary or additional applications ...One major recommendation, accordingly, calls for shifting the focus of federal concern from simply telling commercial users and local governments about promising technologies to actually transforming technical information into ultimate uses that fulfill public or private economic and social needs" (7).

This recommendation is doubly ironic in that the National Academy of Engineering not only highlights evidence pointing to the tenuousness of the assumption that previous federal R&D expenditures are likely to have widespread secondary applications, but they even go so far as to stress the necessity of testing this assumption!

Not all analysts have been willing to dismiss the need for examining this basic postulate of technology transfer. Richard Nelson of the Rand Corporation not only questions the future economic worth of much mission-related historical R&D expenditures, but suggests these expenditures are more indicative of the extent to which other avenues of technological innovation have had to be foregone (8).

Solo and Rogers provide an explanation for why even the largest and most technologically oriented firms avoid transfers of technology: "The out-transfer of superior technology is costly and difficult, particularly when components are embedded in the operations and in the cognitions of operating personnel in large and complex organizations, and will not ordinarily occur spontaneously" (9). This argument is especially instructive because it concerns the behavior of large defense contractors with respect to supposedly valuable government-funded technology that the contractors *themselves* developed.

Notwithstanding its many critics, U.S. Government policy on technology transfer depends on the validity of the notion that there exists a federally controlled reservoir of technology with significant economic value that is available for use by interested parties.

Federal Control

For many years the Federal Government has purchased a significant proportion of all R&D effort in this country. The major portion of these expenditures have been mission-related, although significant amounts have been expended on purely scientific work. The Federal Government has acquired legal rights to processes, equipment, and ideas, many of which pertain to novel technological developments. In the case of a patent, it is clear that the Federal Government can control its use. If this is the type of Federal control that relates to the reservoir of technology resource, then unfortunately the evidence is overwhelming that potential users assign very little economic worth to the rights that are available. Billions of dollars of R&D expenditures have resulted in thousands of patents, but the extent of secondary usage has been minimal and the economic impact very small (1, 5, 8, 9, 15).

In the case of control over other types of technological achievements, it is not clear that the Federal Government is in any way whatsoever able to influence the use, much less preside over disposal of benefits. Of the billions of dollars of R&D expenditures that occur in any year, some must be allocated to problem definition, some to information searching, some to developing alternative solutions, some to testing solutions and modifying approaches, and some to implementing solutions. As scientists, engineers, technicians, and managers work through these activities, they develop and refine ways of doing things and they create useful techniques, Such processes may fairly be said to represent contributions to the technological capability of a company, industry, or even the country, and a good part of R&D dollars can be demonstrated to have paid for these activities. It may be the case that the Federal Government could exert control over organization-and-skills technology that exists in companies or laboratories, if, for example, it were desired to redirect their primary missions in wartime or the event of a national emergency. It is ludicrous, however, to maintain that this means the Federal Government has under its control organization-and-skills technology that can be utilized or transferred into secondary applications.

Reservoir of Technology

The reservoir of technology concept is misleading *as a way to describe what is available for the purposes of technology transfer.*

The attribution of significant economic value to the supposed reservoir of technology amounts to equating mission related sunk costs with transferable technology. The "Federal control of $99 billion worth of technology" cited previously was for the ten fiscal years ending in FY 1967. The magnitude of these numbers has increased considerably — for the ten years beginning in FY 1973 and including estimated expenditures through FY 1982, obligations for Federally funded R&D will total over $260 billion, since 1953 the total is almost $470 billion (10).

The reservoir of technology phrasing analogizes between expenditure of R&D funds and outlays made for any investment. The reservoir idea is often expressed as "taxpayer investment in R&D developments" or as a means whereby society can "increase returns on R&D assets."

To evaluate the investment aspect of the reservoir concept, it is instructive to consider some basic

accounting ideas. Assets can be looked at as things that are used up during the ongoing activities of a business. An investment can be looked at as an outlay of resources made today in expectation of future return. Two tools of accounting, a balance sheet (balancing assets with liabilities and equity at a point in time) and a profit and loss statement (stating revenue and expenditures over a period of time) can be used to relate investments and assets. Assets resulting from investments would normally be entered at cost on a balance sheet. These assets are used up over time in the generation of revenues. An investment may be evaluated by comparing profits or losses resulting from its operation with the asset base that the operation required.

Clearly government expenditures for R&D activities can be interpreted in this framework as investment outlays for expected future return (e.g., as an investment in national defense for future security). Usually, however, R&D expenditures are tied to more specific mission goals (e.g., development of a particular spy-satellite as a defense related investment). In the process of carrying out an R&D mission, wages are paid, equipment is bought, facilities are used, and mission results are achieved. An obvious way to evaluate the investment is to compare mission results with original goals. Where R&D expenditures are concerned, however, it is often implied that mission evaluators can legitimately add a plus to mission results in the form of potential benefit from technology transfer. The summation of all such program pluses could perhaps then be termed a reservoir of technology.

This is essentially a sensible argument, and it has a very close parallel in the case of ordinary accounting for business transactions. The parallel is to the concept of goodwill. Illustration of this idea can be given in a situation where a business is to be sold. Say a company has been operating successfully over a period of years and it has built up a good reputation for quality, has excellent management, and has good relations with customers, suppliers, and the community. If the company is sold, the owner may be able to charge a price significantly in excess of the value of physical and monetary assets of the firm. The reason the owner could get such a price is that the buyer would recognize that there is a synergistic relationship between the organization and its assets — this is what determines the going concern value of the company. In accounting, goodwill is the difference between the asset value of a firm and its going concern value. The value of much new technology is also attributable to the synergy of human and physical assets. It makes as little sense to say that this type of technology can be spun-off as it would to say a business could sell-off a portion of its goodwill. The value in each case results from synergy — when interactive components are broken into bits and pieces their worth decreases dramatically.

Much of the technology that has been paid for with U.S. taxpayer dollars is inaccessible or unavailable for secondary use because it resides in people and organizations that developed it.

Technology represented by government-owned patents is readily accessible, but much of this technology is economically unusable — the Federal Government's reluctance to issue exclusive licenses means private companies are unable to protect development investments in potentially attractive new technologies (13).

Information pertaining to Federally-funded technology is widely accessible and actively distributed by a number of U.S. Government agencies and some private companies. Information, however, usually comprises only a small portion of what is required to effect a transfer of technology, but it is always the case that obtaining and utilizing information is part of the technology transfer process (as it is of any problem solving process). Sometimes a transfer of information is misinterpreted as a transfer of technology. This is unfortunate because it makes technology transfer appear deceptively simple, and at the same time it serves to denigrate the contribution effective use of information can have on the transfer process.

Redefining Government's Role

The U.S. House of Representatives Subcommittee on Science, Research, and Technology held hearings in 1981 aimed at stopping planned budget cuts in Federal technology transfer programs (6). During these hearings, support for failed policies and advocacy of misconceived technology transfer premises were loudly reiterated. Senator Charles Mathias, (R-Md), for example, said that billions of dollars worth of scientific and technical knowledge would not result in benefit to the public unless Congress continued to fund technology transfer centers.

The most serious consequence of the Federal Government's misconceived technology transfer efforts is not their failure to achieve substantial increases in the transfer of technology. Rather, it is that acceptance of misconceived premises actually serve as *barriers* to technological innovation — the guise of a positive effort to stimulate technology transfer justifies policy-makers' inattention to areas with significant potential for augmenting technological innovation.

Redefinition of the Federal Government's role in technology transfer should focus on: (a) development of policy that will encourage private use of government-owned patents; (b) creation of a tax and regulatory environment that will stimulate technological entrepreneurship; and (c) restriction of governmental activity in technology transfer to that of technological librarian.

Patents Policy — Congress has for years ignored pleas from scientists, engineers, academicians and

corporate contractors to facilitate exclusive licensure for government-owned patents (1, 3, 7, 9, 13). Part of the reason for Congressional inaction is that Federal agencies gain nothing by giving up "their" ownership of patent rights, but these rights can be used to justify an agency role in technology transfer. Adopting the technology transfer stance allows an agency to point to its efforts encouraging utilization of technology while at the same time protecting the public's interest in potentially valuable patent rights. Politicians have been reluctant to liberalize patent policy because of the hope that the Government's technology transfer efforts may provide essentially the same results as exclusive licensure, but with a more equitable distribution of benefits to society.

Recently Congress has shown some interest in establishing a more reasonable patents policy. Legislation was introduced to the 1st session of the 97th Congress which would give contractors the option of retaining title to inventions created by Federally sponsored research and development, subject to certain limitations (11, 12). This is definitely a step in the right direction. However, the proposed legislation would also "establish a uniform Federal system for management, protection, and utilization of the results of federally sponsored scientific and technological research and development. . ." (11, p. 1). It is difficult to predict the effect of a new tier in the Federal bureaucracy (proposed under the Secretary of the U.S. Department of Commerce), but creation of an additional patent-rights interest group and the requirement that this group oversee a uniform Federal system for utilizing R&D from agencies with diverse missions means implementation of this act will be needlessly complex and politically difficult.

The key point, however, remains: technology transfer, as it has been and continues to be conceptualized by Federal agencies, simply does not make sense.

Technological Entrepreneurship — Tax and regulatory reforms have been identified by many researchers as crucial to the creation of a favorable environment for technological entrepreneurship (11). Recommendations usually include adjusting the application of the gamut of governmental regulations to reflect conditions of new and small businesses that distinguish them from larger counterparts — relevancy of regulations and proportionate resources to comply are major issues. Tax reform suggestions most often relate to accounting treatment of R&D expenditures, depreciation schedules for R&D equipment and facilities, and capital gains taxation for high risk technological investments. Federal misconception of technology transfer is consistent with the position that regulatory reform and tax breaks are unnecessary to stimulate technological entrepreneurship. This is because technology transfer will supposedly take place in ways such as those being pursued by technology transfer bureaucrats.

The overwhelming weight of evidence, however, suggests that the technological entrepreneur is the *sine qua non* for the vast majority of transfers of technology (4, 5, 9, 13). It is totally erroneous to assume that government employees, no matter how well-intentioned or how technically competent, can perform the entrepreneurial role necessary to accomplish transfers of technology.

Technological Librarian — An appropriate role for the Federal Government in the transfer of technology is that of assuring legitimate access to technical information that has been developed with taxpayer money. Conceptualization of this role as technological librarian is important because it emphasizes the task of providing economical access to information rather than that of providing publicity for selected technological achievements. An ancillary publicity role may be justified to encourage use of information because Government claims on R&D achievements reduce normal incentives for individuals or companies to promote usage by others of their work.

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