NIELS J. REIMERS
Manager, Technology Licensing

STANFORD UNIVERSITY
STANFORD, CALIFORNIA 94305
415 • 321-2300 Ext. 3567

MITCHELL E. DANIELS
ASSISTANT TO THE GENERAL MANAGER
DIRECTOR OF LICENSING

THE DOW CHEMICAL COMPANY
1200 MADISON AVENUE Box 68511
INDIANAPOLIS, IND. 46225 46268

LIFE SCIENCES DIVISION
PHONE: (317) 638-2521
CABLE: DOWPHARM

212 986-6622

ROBERT J. SANDERS, JR.
COUNSEL, PATENT PROGRAMS

RESEARCH CORPORATION
405 LEXINGTON AVENUE
NEW YORK 10017

RONALD H. CHADWICK

SENIOR VICE PRESIDENT
KNOLL PHARMACEUTICAL COMPANY
WHIPPANY, N.J. 07981
(201) 887-8300

University Station, Box 3367
University Of Idaho
Moscow, Idaho 83843
PHONE: (208) 885-6245

R. BRUCE HIGGINS
SECRETARY - TREASURER
1. speech
2.
Idaho Research Foundation, Inc.

NIELS J. REIMERS
Manager, Technology Licensing
Speech
STANFORD UNIVERSITY
STANFORD, CALIFORNIA 94305
415 • 321-2300 Ext. 3567

OFFICE 531-1467 / 1-1468 AREA CODE 419
RESIDENCE 885-1656
Send Niels Memos
sp

HUGH ADAM KIRK
PATENT LAWYER

1. Speech
2 Task Force Report
4210 WEST CENTRAL AVENUE
TOLEDO, OHIO 43606

SEARLE

Searle Laboratories
Division of G.D. Searle & Co.
Box 5110
Chicago, Illinois 60680
Telephone (312) 463-2111

Task Force Recommend
speech

Arthur J. Lemke
Product Proposal Monitor

University Of Idaho

Dr. Jessica Tuchman
Subcommittee on the Environment
Interior and Insular Affairs Comm.
Room 1522 Longworth Bldg.
Washington, D. C. 20515

Dr. Leon Jacobs
Associate Director for
Collaborative Research
Room 103, Bldg. 1.
NIH, Bethesda, Md.

Director
National Institutes of Health
Room 124, Bldg. 1
NIH, Bethesda, Md.

Dr. Carl M. Leventhal
Deputy Director for Science
National Institutes of Health
Room 122, Bldg. 1
NIH, Bethesda, Md.

Dr. Ian Mitchell
Acting Director
Office of Special Health Projects
Office of Assistant Secretary
for Health, DHEW
Room 17-A-43, Parklawn Bldg.
5600 Fishers Lane
Rockville, Md. 20852

Dr. Dorland J. Davis
Director, National Institute of
Allergy and Infectious Diseases
Bdg. 31, Rm. 7a-52
National Institutes of Health
Bethesda, Md. 20014

Dr. G. Donald Whedon
Director, National Institute of
Arthritis, Metabolism, and
Digestive Disease
Bldg. 31, Rm. 9A-52

Dr. Frank J. Rauscher, Jr.
Director, National Cancer Institute
Bldg. 31, Rm. 11-A-52
National Institutes of Health
Bethesda, Md. 20014

Dr. Seymour J. Kreshover
Director, National Institute
of Dental Research
Bldg. 30, Rm. 132
National Institutes of Health
Bethesda, Md. 20015

Dr. Carl Kupfer
Director, National Eye Institute
Bldg. 31, Rm. 6A-03B
National Institutes of Health
Bethesda, Md. 20014

B. Tower, M.D.
Dr. ~~Edward F. MacNichol, Jr.~~
Act'g Director, National Institute of
Neurological Diseases and Stroke
Bldg. 31, Rm. 8a-52A
National Institutes of Health
Bethesda, Md. 20014

Dr. Theodore Cooper
Director, National Heart and
Lung Institute
Bldg. 31, Rm. 5A-51
National Institutes of Health
Bethesda, Md. 20014

Dr. DeWitt Stetten, Jr.
Director, National Institute of
General Medical Sciences
Bldg. 31, Rm. 4A-52
National Institutes of Health
Bethesda, Md. 20015

Charles C. Edwards, M. D.
Assistant Secretary for Health
Room 5077, North DHEW
Department of Health, Education,
and Welfare
Washington, D. C. 20201

Mr. St. John Barrett
Deputy General Counsel
Room 5466, North DHEW
Department of Health, Education,
and Welfare
Washington, D. C. 20201

John B. Rhinelander, General Counsel
Office of the Secretary
Room 5228, North DHEW
Department of Health, Education,
and Welfare
Washington, D. C. 20201

Mr. Manuel B. Hiller
Assistant General Counsel, OS
Room 5362, North DHEW
Department of Health, Education,
and Welfare
Washington, D. C. 20201

Dr. Albert [illegible]

Bethesda, Md. 20014

1975

Technology Utilization: Incentives and Solar Energy

A technology delivery system is used to explain the role of incentives in stimulating public use of solar energy.

Arthur A. Ezra

In recent years, the federal government has been increasing its investment in research and development for clearly perceived public needs, with the approval and, in some cases, the urging of the Congress. Unfortunately, the existence of a public need does not necessarily correspond to a public market and, without being able to perceive a potential market, industry cannot begin to put the results of federally financed R & D to work in the form of new products, processes, and services for the public. What is even more unfortunate is that many a time, even in the presence of both a clearly perceived market and a public need, industry alone cannot put the R & D results to use for the benefit of the public. The solar heating and cooling of buildings is a good example of this situation, and is used for illustrative purposes in this article.

During the past 30 years, the R & D activities funded by the federal government were mostly for its own use, and were selected according to the needs of the various missions it had to accomplish. These R & D results were put to use by the government simply paying for the applications. For example, defense oriented R & D results were put to use through defense procurements. There was little conscious effort on the part of the Department of Defense to foster civilian applications of R & D results that were generated for its own use. Similarly, the results of R & D that were federally funded for the National Aeronautics and Space Administration (NASA) were promptly put to use for NASA's own applications through procurement. However, the application of NASA's R & D results to civilian purposes was a different situation altogether. While required by basic NASA legislation, such application did not take place naturally to any great extent (*1*). Because it was recognized that deliberate effort would be required to bring about civilian application of this R & D, the Technology Utilization Division was established as a part of NASA (*2*).

During the 1970's and 1980's, increasing amounts of federal R & D funds are expected to be spent for civilian needs in such agencies as the Department of Transportation, the Environmental Protection Agency, the Law Enforcement Assistance Administration, and the National Science Foundation. These federal agencies do not provide the primary market for the application of the R & D results in the way that the Department of Defense does, however. Although federal grants are made available to states and local governments to help pay for pollution control systems and transportation systems, for example, it is the federal grantees who decide whether to spend the funds on new or conventional technology. In some instances, the would-be purchasers of applications of federal R & D results have been unable to find a manufacturer or supplier willing to use the desired new technology.

Thus it is evident that federal research administrators must attempt to stimulate the application of federally funded, civilian oriented, R & D results without relying entirely on federal procurement for the applications. Some administrators may see this as a trivial task to be relegated to the "free workings of the marketplace" and, when confronted with situations in which there is ample technical knowledge but an unfilled gap between a public need and a public market, they will seek refuge in funding studies of "imperfections" in the free workings of the marketplace. Others may see this as an impossible task without federal procurement of some sort. However, the civilian oriented federal research budgets are large enough (about $7 billion for fiscal year 1975) for it to be worth exploring the alternatives.

Definition of Terms

Everything said here is in the context of federally funded R & D, no matter who the performers of R & D are. Technology utilization in this article refers to the application of R & D results for which they were intended. This is in contrast to technology transfer, which refers to the application of new technology to purposes other than those for which it was originally intended (*3*). For example, the application of defense R & D results to water pollution control would be considered as technology transfer in the context of this article, but the application of water pollution R & D results to water pollution control would be considered as technology utilization.

Technology transfer, as defined above, has problems of its own which I will not discuss here (*4*). What I will discuss is technology utilization by industry, when the R & D has been directed toward civilian use but paid for by the federal government.

The author is program director in the engineering division, National Science Foundation, Washington, D.C. 20550.

The Technology Delivery System

It takes a number of different types of institutions, interacting with each other, to introduce a new technology in the form of a new product, process, or service, into the marketplace, be it a federal marketplace or a civilian one. For example, universities may be involved because they provide the education required for utilization of the new technology; industrial and commercial institutions participate because they manufacture and sell the products based on the new technology; even lending institutions play an important role in making funds available for the manufacture or civilian purchase of applications of the new technology.

The notion of a technology delivery system (TDS) was employed by the National Academy of Engineering (5) to represent the complex processes by which knowledge in natural and social sciences is deliberately applied to achieve desired outputs of consumer amenities having social values.

Each technology has its own delivery system consisting of a number of interacting components, and each component consists of a set of institutions that perform a common function. Looked at from this point of view, one component of a TDS could consist of a set of research-performing institutions such as universities, nonprofit research institutes, and small R & D companies. Another component could be a set of institutions that manufacture products. A third component could be a set of institutions that distribute the product. A fourth component could be a set of lending institutions that make operating funds available to other components in the TDS.

Before a new technology can reach the marketplace in the form of a new product, process, or service, all of the components of the appropriate TDS have to be ready to accept it. Part of the problem of stimulating technology utilization is to bring about this diffusion of readiness. When a TDS does not exist, the federal government may have to deliberately create one. One way of doing this is to set up a field agent system, as was done by the U.S. Department of Agriculture in the 1930's (6) to deliver R & D results into the hands of the farmers. Another approach is for the federal government to pay private companies to manufacture the product for a limited amount of time, in the belief that with this initial federal procurement a TDS will form itself. This seems to be the underlying theory behind federal technology demonstration projects such as that in the Solar Heating and Cooling Demonstration Act (7).

Defense Technology Delivery System and the Marketplace

Figure 1 illustrates the concept of a TDS in which the federal government provides the market for the application of R & D results. Under the stimulus of federal procurement, new technology is readily transferred from the R & D performers to the R & D users within that system. With the help of Armed Service procurement regulations or federal procurement regulations, a company which is a component of the system can acquire a working knowledge of the R & D results produced by others for the government, the costs being allowable as overhead charges to all the other federal R & D contracts the company has. The lending institutions provide the finances necessary for the functioning of the component while it awaits payments of its bills by the federal government.

The federal market can also lead indirectly to the creation of a civilian market for a new technology, when civilian needs are close to federal needs. For example, some well-known aircraft that are used by commercial airlines are adaptations of military aircraft.

Because of its capabilities in the most advanced technologies, it is not unusual for other federal agencies to choose the defense TDS to introduce a new technology to civilian applications, even though the federal government will not be the end user. This can cause some difficulties, because components of the defense TDS may not do business in the civilian marketplace. For example, a federal agency recently funded an aerospace company to develop a lightweight, efficient, two-way transceiver for use by police forces. Since the aerospace company was not in the consumer electronics business, it did not choose to commit its own resources to manufacturing and selling the transceiver to civilian police forces after completion of the R & D project. It sold the technology to a small private company formed for the purpose of making and selling these transceivers. The small company was underfinanced; it failed to make even its first payment to the aerospace company and went out of existence. In another example, the same agency developed a lightweight bulletproof jacket for police use by using the services of a nonprofit R & D corporation that did not traditionally manufacture or sell uniforms to civil police departments. The agency is continuing to fund the nonprofit corporation as a prime contractor to fabricate the jackets and distribute free samples to selected police departments. Regular clothing manufacturers are now being used as subcontractors.

It might be possible to avoid such potentially dead-ended situations if the federal government funded R & D performers that were components of both

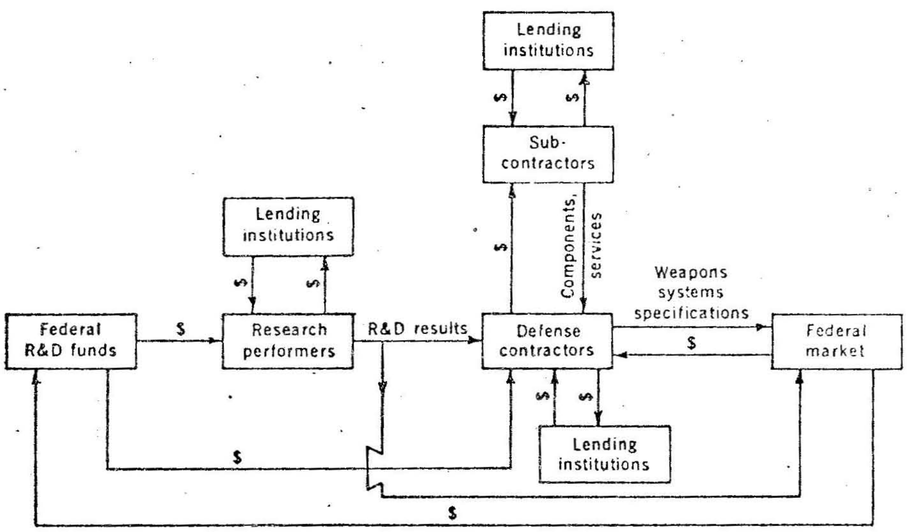


Fig. 1. A simplified diagram of the TDS for defense. It includes at least the following nonfederal institutional components: research performers, such as universities, nonprofit research institutes, and small R & D companies; defense contractors (who may also be research performers) and their suppliers; and financial institutions.

ne defense and conventional delivery systems—that is, R & D performers that sold their products to both the federal and nonfederal markets.

Incentives for Technology Delivery Systems

Even when the federal government ensures that the R & D performer is a component of the appropriate TDS, the other components of the TDS may not necessarily be willing to play their part in bringing the new technology to the uncertain civilian marketplace in the form of new products, processes, and services. A number of different incentives may have to be used to achieve technology utilization because the incentive that stimulates one component of the TDS may well have no effect whatsoever on another component.

Many different incentives to stimulate the utilization of civilian oriented technology intended for the nonfederal market are currently being used by the different mission oriented federal agencies which fund civilian oriented R & D. Some of the incentives that may be applied to components of the TDS for the solar heating and cooling of homes are shown in Table 1. Some incentives cost more than others and some are more effective than others, but no systematic set of performance data has been compiled for the federal incentives currently in use. For this reason, the Experimental R & D Incentives Office in the Research Applications Directorate at the National Science Foundation funded a project in fiscal year 1974 for the purpose of collecting the performance data for these incentives from the appropriate federal agencies.

In the following sections I briefly review some of the incentives for technology utilization that are now being used by various federal agencies.

Procurement, Demonstration Projects, and Information Dissemination

Initial federal procurement of limited extent. The intent here is to get the product based on the new technology into production by private companies, in the hope that they will start selling the product to the public after termination of federal procurement. For this incentive to work, the product should not require much adaptation for the civilian marketplace, and there has to be a public desire to buy this product. The Law Enforcement Assistance Administration is one agency that uses this approach.

Federally funded demonstration projects. This is a popular and frequently used incentive for stimulating utilization of civilian oriented R & D results. An example is the recent "Operation Breakthrough" organized by the Department of Housing and Urban Development. The Bureau of Mines has used this incentive in the past and it is part of the ongoing activities of the Office of Coal Research. The purpose of such projects is to provide empirical data on production cost, performance, reliability, and public acceptance. If the private company carrying out the demonstration project is capable of subsequently manufacturing and selling the new product, process, or service to the public, the chances are much higher for technology utilization in the civilian marketplace. If the demonstration project does not stimulate all the components of the appropriate TDS, the new technology may see no further application after the demonstration. If the demonstration project is carried out by a component of the wrong TDS (for example, one that delivers only to the federal marketplace), then subsequent utilization in the civilian marketplace may not take place at all.

Table 1. A summary of the incentives for technology utilization now being used by different federal agencies, which may be applied to six of the components of the TDS for the solar heating and cooling of homes.

Private housing market (homeowners)
Information dissemination
Demonstration projects
Loan guarantees and loan insurance
Construction grants

Home builders and developers
Information dissemination
Demonstration projects
Limited federal procurement
Federally funded market research and testing
Federal cost sharing
Federal construction grants

Equipment manufacturers
Information dissemination
Exclusive licensing of federal patents
Demonstration projects
Limited federal procurement
Federal testing of new products
Federally funded market research and testing
Federal cost sharing
No-cost leasing of demonstration plants for manufacture

Lending institutions
Information dissemination
Loan guarantees and loan insurance

Local government codes and regulations
Information dissemination
Federal specifications

Architect engineering companies
Information dissemination
Demonstration projects
Limited federal procurement

Information dissemination. This is a necessary (but not sufficient) step to get the R & D performer to the potential user. The National Technical Information Service (NTIS) of the Department of Commerce has the responsibility for storage and retrieval of the final reports of federally funded R & D. Not only do the federal agencies funding R & D have to make sure that the NTIS gets their reports, but most of them also actively engage in their own information dissemination activities. For example, the Environmental Protection Agency, the Law Enforcement Assistance Administration, the Department of Transportation, and the Department of Agriculture have their own technology utilization divisions that publish and distribute documents and organize public workshops, short courses for industry, and cooperative R & D programs between the performers of research and the potential users of the results.

The information that is disseminated by the R & D performers must be converted into a working knowledge of the subject by the potential user, before technology utilization can begin to occur. This requires a substantial amount of time and money. An organization that wants to develop working knowledge of a new technology, starting with documentary information of the R & D results, must pay for the time that it takes its employees to read, understand, assimilate, and even test the new information. Unless it independently tests the new information there is reason to doubt whether it has actually acquired a working knowledge of the technology: a multitude of essential empirical facts may be missing from the documents because the R & D performers considered them too mundane or obvious (or even too subtle) to include them in the documentation. This is recognized by a company that licenses a patent. The licensing agreement usually calls for the technical services of the inventor, along with permission to use the patent.

Thus a company has to make a considerable investment in order to achieve a working knowledge of R & D results, even if it gets the documents containing the results at no cost. When it gets the information through licensing a patent, its investment of time and money is generally protected by the terms of the patent. When a company obtains federally funded R & D results, which are available to anyone for the asking, there is no such protection for the investment it has to make to convert this information into a working knowledge of the technology, nor for the substantially larger investment it has to make to convert this working knowledge into a new product, process, or service.

There are two well-recognized ways in which a company can avoid paying for converting federally funded R & D results into a working knowledge of a technology. One obvious way is for the company to get a government contract that will enable it to do the specific R & D in which it may have a future commercial interest. Another way is to obtain contracts to do R & D in general for the federal government. Both the Armed Services procurement regulations and the federal procurement regulations recognize the fact that it costs a company money to assimilate the results of R & D performed by another. Provided that the company's costs of doing this are normal and reasonable, they are allowable overhead costs which may be distributed over all the federal R & D contracts the company has. In contrast, a company that does not do R & D for the federal government must use its own resources to pay for the cost of converting federally funded R & D results into a working knowledge of the technology they describe.

The concept of federally funded field agents to bring the results of R & D to the potential user has a long distinguished history. The Department of Agriculture began using this approach before the era of mass communications (*6*). The PENN-TAP (technology assistance program) program in the State of Pennsylvania has been a successful effort of a similar nature directed toward industry in the state. However, to achieve the success of the Department of Agriculture's field agent program, a federal research administrator must contemplate a budget for the field agent system roughly equal in magnitude to his agency's R & D budget (*8*). This is difficult to accept, since it implies either a substantial increase in the budget for technology utilization, or a drastic decrease in the R & D budget with an accompanying diversion of funds from R & D to technology utilization efforts. What is needed, perhaps, is a low-cost modern equivalent of the field agent system.

Construction Grants and Federal Patents and Licenses

Construction grants. Federal grants are normally available only to universities and nonprofit organizations. Under special circumstances grants to private companies may be made, usually in conjunction with cost sharing by the company and the performance of a public service. For example, grants may be made by the Environmental Protection Agency to a private company for a water pollution control installation, provided it is the first of its kind so that the company is, in effect, carrying out a public demonstration of its technical feasibility. In this case it would be the combination of the grant and the federal water pollution control regulation that was the incentive to the utilization of R & D results on water pollution control, rather than the grant per se.

Federal patents and licenses to users. The federal government takes out patents largely as a defensive measure, to avoid paying royalties on patents resulting from R & D that it has paid for although the patents might have been applied for by others. Another reason is to make the patents available for use by the public on a nonexclusive license. Nonexclusive licenses for federal patents have been put to successful commercial use, but only after considerable federal investment has been made to remove practically all of the technical and economic risks. Examples are the patent on potato flakes by the Department of Agriculture and the patent on a fertilizer by the Tennessee Valley Authority (*9*). In the absence of such extensive federal investments in development, industry is reluctant to invest heavily in commercializing a federal patent on the basis of a nonexclusive license only. There has been a growing recognition of this fact and of the need to protect this investment in some way that will encourage private industry to make commercial use of federal patents. Only NASA at present has the statutory authority to grant exclusive licenses as an incentive to the commercial use of patents. An attempt to give exclusive licensing authority to the heads of other federal government agencies by a General Services Administration (GSA) patent policy has been struck down by a recent court ruling. The other provision in this GSA patent policy, that would give title to a patent to a research performer under certain circumstances even though the research was paid for by the federal government, is under challenge in the courts.

At present, federal policy on the ownership and licensing of patents is a weak incentive to the commercial utilization of federally funded R & D results, particularly since the only federal agency with statutory authority to give exclusive licenses on federal patents (that is, NASA) will not enforce the exclusivity against patent infringers.

Federal Cost Sharing and Leasing

Federal cost sharing with industry. This incentive to technology utilization is popular with federal research administrators for a variety of reasons and is being used by such agencies as the Maritime Administration and the Office of Coal Research, among others. Cost sharing by industry is regarded as a demonstration of industrial interest in a federally funded R & D program, and is therefore very useful in justifying a requested budget. Federal cost sharing is also a useful way of responding to pressures from industry and the general public. As an incentive to technology utilization, it is believed to raise the level of technical and economic risk that will be acceptable to a company that is trying to decide whether or not to exploit R & D results.

Cost sharing of a federal R & D contract can be a useful indicator of the intentions of industry regarding technology utilization. A company that accepts only a small proportion of the costs of the R & D, say about 5 percent, is unlikely to feel a great commitment to the subsequent exploitation of the R & D results, whereas a company accepting a high proportion of the costs, say about 80 percent, is certainly interested in using the results. However, situations in which very high proportions of the costs are borne by a company raise the legitimate question of whether that company was planning to go ahead on its own anyway without federal support, which could therefore be better used elsewhere. Thus one can deduce that between the two extremes there is a range of values indicating that a company is seriously interested in utilizing R & D results but is unlikely to proceed with the research on its own without the incentive of federal cost sharing. An attempt is being made by the Office of Experimental R & D

... Applications Directorate of the National Science Foundation, to find this critical range of cost sharing ratios through a retrospective study of the recent history of cost sharing R & D programs between the federal government and industry.

The same reasoning can be applied to cost sharing of pilot or demonstration projects, except that the costs for these projects are much higher than the costs for R & D alone. Here, the critical range of cost sharing ratios may well be different from that in R & D projects. It is also possible that this critical range will differ from one industry to another.

No-cost leasing of federal demonstration plants. When the capital investment required for a full-scale industrial plant is very high, the technical and economic uncertainties are great, and there is a pressing national need that must be met, the federal government may construct and lease such plants at no cost, for industry to operate. This is a very powerful incentive to the utilization of research results under conditions of great technological and economic uncertainty, and enormously facilitates subsequent investment by industry. This approach was used by the government during World War II, for example, when it constructed plants for the manufacture of synthetic rubber and penicillin.

Leasing of public sites. This lowers the economic risk to the technical innovator who wishes to use the results of R & D. Public lands are leased by the Department of the Interior, for example, to encourage the construction of experimental oil shale extraction plants and the construction of geothermal power plants.

Federal Testing, Performance Specifications, and Regulations

Government testing for new products and processes. Some federal laboratories, such as those in the National Bureau of Standards, test new products (for example, building industry products) and make the results of the tests available to industry and the public. This can be an incentive to the civilian acceptance of new products based on federally funded R & D.

Publication of government specifications. The publication of performance specifications can be an incentive to the utilization of a new technology, particularly if the specifications include the results of federally funded R & D. This approach, which is used extensively by the Department of Defense, exerts its strongest influence when it is coupled to a federal procurement. It can also indirectly affect the acceptance of a new technology in the civilian marketplace. For example, the existence of a federal government performance specification can influence a new technology's adoption into local ordinances, codes, or regulations. Such specifications can be especially important to the many state or local governments that have neither the extensive laboratory facilities that the federal government has, nor comparable resources for acceptance testing.

Federal regulations. Federal regulations, if they are based on the results of federally funded R & D, can be extremely powerful incentives to technology utilization. If they are not based on the results of R & D, then they can be harmful by specifying what may be technically impossible or unnecessarily demanding. In the latter case there may be extensive defensive litigation by industry instead of willing compliance. This has been observed by the Environmental Protection Agency in the area of water pollution control, and by the Department of Transportation in its efforts to regulate automobile exhaust emission and automobile safety.

Federally funded market research and testing. The demonstration of the existence and viability of a commercial market can be a powerful stimulus to private industry's converting the results of federally funded R & D into new products, processes, and services for the public. The Department of Agriculture used this approach to introduce potato flakes to the commercial market, and the Tennessee Valley Authority used it to bring about the commercial manufacture and sale of a new type of fertilizer (*9*).

This incentive has not been used as much as it could have been by the federal government to stimulate technology utilization for civilian purposes.

Loan Guarantees and Loan Insurance

These incentives have been widely used by the federal government to stimulate the availability of loans to the public for a variety of purposes. Through the Federal Housing Administration, these incentives have made loans available for the purchase of homes. The Small Business Administration has used them to encourage lending institutions to provide loans for small businesses.

In principle, these incentives are intended to raise the levels of risk that will be acceptable to the lending institutions. In practice, however, there is reason to doubt whether this is ever achieved. The primary decision on whether a particular loan should be made is the responsibility of the lending institution: after this decision has been made the federal agencies' guarantee or insure part of the loan. Since only part of the loan is covered, the lending institutions are thereby encouraged to exercise their normal prudence.

The case for using such incentives for stimulating investment in technological innovation was made by the economist Kenneth Arrow (*10*) who concluded that for optimal allocation (of resources) to invention it would be necessary for the government or some other agency not governed by profit and loss criteria to finance research and inventions.

There is a growing belief that the federal incentives of loan guarantees or loan insurance should be used to stimulate investment in the high risk area of technological innovation. Two recently enacted laws (*11, 12*) are intended to provide federal loan guarantees in the areas of solar energy and geothermal energy, respectively. Since the normal sources of investment in technological innovation claim that their decisions are made solely on the merits of a particular case, it is possible that federal loan guarantees or loan insurance may not be as successful a stimulus in the high risk area of investment in technological innovation as it has been for housing. Investment in the utilization of the results of federally funded R & D also lacks the protection of private patent ownership or (with the exception of NASA) the limited protection of an exclusive license. "Seed money" investment in technological innovation is usually made in return for equity, in the expectation that the high return on equity will compensate for the high inherent risk of technological innovation.

Because of the well-founded reasons for and against the merits of federal loan guarantees or insurance as incentives for stimulating investment in technological innovation (and by inference, in technology utilization) a small-scale experimental verification would be extremely useful. The Experimental R & D Incentives Office of the National Science Foundation is now examining the merits of this approach.

Solar Heating and the Cooling of Homes

Using the concepts of a TDS, let use consider the role of incentives in stimulating public utilization of solar energy in the heating and cooling of homes. Most of the R & D in this area is federally funded and present plans do not call for the federal government to be the major market for the application of the R & D results.

Figure 2 shows the system for technology delivery to the market for privately owned homes, and shows the interactions among the different components of the TDS. For illustrative purposes only a few components are shown, so that the diagram hardly does justice to the enormity of the housing industry, its complex structure, and its fragmentation. Many other components, such as public utility companies, may belong in the system but are omitted for convenience (*13*).

Now let us consider the superposition of a federally funded R & D effort meant for solar energy on this TDS. It is illustrated in Fig. 3 by the addition of a component called "R & D performers for solar energy." For the R & D results to find their way from these performers to application in the private home market, it is necessary to bring about the interactions shown in Fig. 3. In order to stimulate these interactions it will be necessary to apply incentives to the appropriate components. Examples of incentives that the federal government may apply are illustrated in Fig. 4. Some of these incentives have very recently been incorporated into new laws, others are already being used by several federal agencies. The Solar Heating and Cooling Demonstration Act (*7*) is intended to stimulate acceptance by the private housing market. The loan guarantee provision of the Housing and Development Act of 1974 (*11*) was meant to encourage lending institutions to accept the additional cost of a solar heating and cooling system as part of the mortgage on a home. For local housing codes to accept solar heating and cooling systems, a model federal specification may be necessary. These examples are by no means exhaustive and additional incentives may have to be applied to the TDS to achieve the objective of widespread solar heating and cooling of homes. A recently passed law authorizes research on incentives to assure rapid utilization of solar energy for commercial and other purposes (*7*).

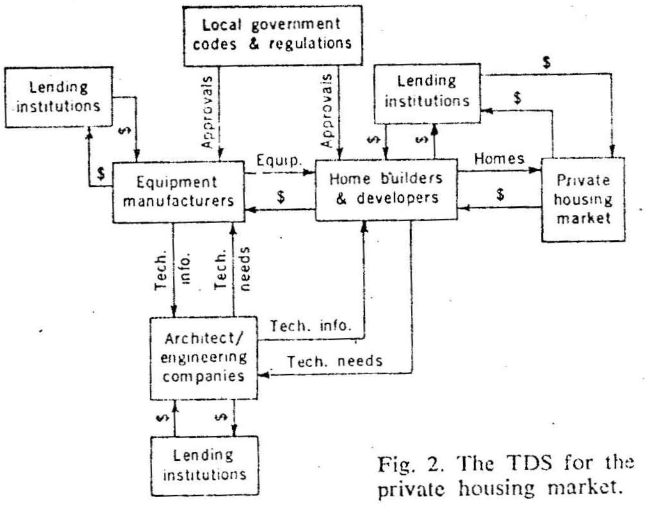


Fig. 2. The TDS for the private housing market.

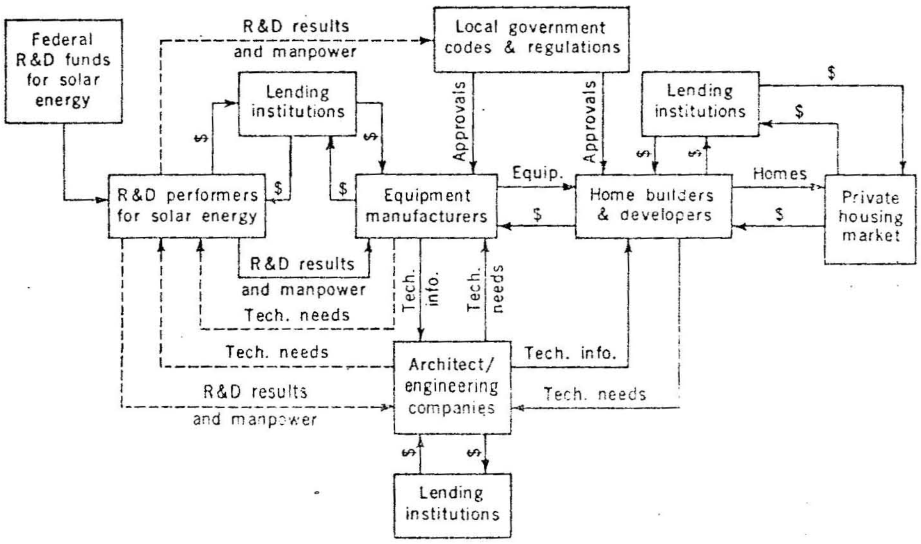


Fig. 3. The TDS for the private housing market showing the required interactions between the solar energy R & D performers and the other components. Broken lines indicate the linkages to be established or strengthened.

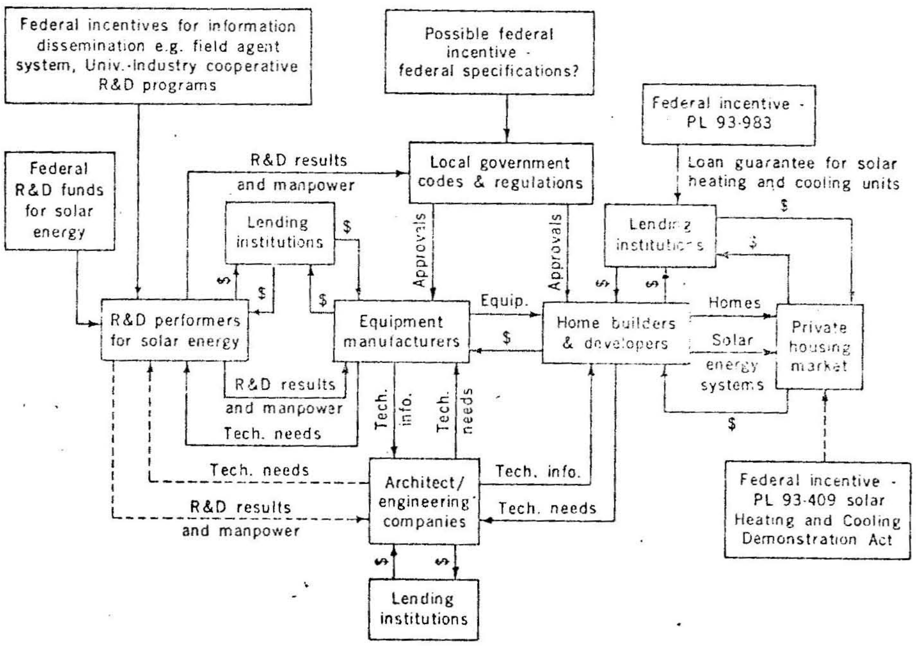


Fig. 4. The TDS for the private housing market showing examples of incentives for immediate use or consideration. Broken lines indicate linkages to be established or strengthened.

Summary

If the federal government is not going to be the major market for the application of federally funded R & D results, then the responsibility for bringing about technology utilization cannot be borne alone by the federal agency funding the R & D. That this problem is now being recognized is shown by the number of bills that were introduced in Congress in 1974, culminating in the Solar Heating and Cooling Act of 1974 (*7*).

An examination of the incentives for technology utilization in the conceptual framework of TDS (as shown in Fig. 4) reveals the following:

1) Incentives must be applied to each component of the TDS.

2) Different components in the TDS require different incentives.

3) Although information exists concerning a wide variety of incentives that are currently being used by various federal agencies to stimulate technology utilization, most of this information is in the form of raw data compiled by the respective agencies and a substantial effort will be required to collect, compile, and evaluate them.

4) All the components of a TDS must be activated if technology utilization is to occur on a self-sustaining basis. This makes perimental verification of a partic[illegible]r incentive on a particular compon[illegible] difficult.

5) A federal ag[illegible]y concerned with technology utilizati[illegible]n can and should assume the responsibility for identifying all the components of the required TDS, devising incentives for each component and testing them to ensure their effectiveness. Where a TDS does not exist, the federal agency may have to assume the responsibility of creating one. The scope of this effort in many cases may transcend the present authority of the agency, and congressional action may be required to remedy this shortcoming.

References and Notes

1. J. G. Welles and R. H. Waterman, Jr., *Harv. Bus. Rev.* **42** (4), 106 (1964).
2. There are a number of excellent papers giving accounts of NASA's experiences in fostering civilian applications of NASA-generated technology. For example, see J. P. Kottonstette and J. J. Rusnik, *Res. Manage.* **16**, 24 (July 1973); J. G. Welles, "Contributions to technology and their transfer: a NASA experience," paper presented at the NATO Advanced Study Institute on Technology Transfer, Paris-Evry, France, 24 June to 6 July 1973; M. D. Robbins, *Mission Oriented R & D and the Advancement of Technology: The Impact of NASA Contributions: Final Report* (Univ. of Denver Research Institute, Denver, Colo., May 1972), vols. 1 and 2.
3. Technology transfer is sometimes used to describe information dissemination, but this is only a part of the technology transfer process.
4. These problems have been discussed extensively at [illegible] posium on Technology Transfer, sponsored by the Division of Industrial and Engineering Chemistry of the American Chemical Society, held at the Carnegie Institution, Washington, D.C., 13 to 15 June 1972; NATO Advanced Study Institute on Technology Transfer, Paris-Evry, France, 24 June to 6 July 1973.
5. E. Wenk, Jr., chairman, "Priorities for research applicable to national needs" (Committee on Public Engineering Policy, National Academy of Engineering, Washington, D.C., 1973), p. 2.
6. The Smith-Lever Law, The Agricultural Extended Work Act, 8 May 1914 (Chapter 79, 38 Stat. 372 Title 7, USC, Sections 341–348) authorized universities to use field agents to disseminate the results of agricultural research.
7. The Solar Heating and Cooling Demonstration Act of 1974, PL 93-409.
8. "*Agriculture—Environmental and Consumer Protection Appropriations,*" *Hearings Before a Subcommittee of the Committee on Appropriations*, House of Representatives, 93rd Congress, 2nd Session (Government Printing Office, Washington, D.C., 1974), p. 231.
9. Harbridge House Inc., "Government Patent Policy Study," Final Report for the Federal Council for Science and Technology, Committee of Government Patent Policy (Harbridge House, Inc., Boston, Mass., 1964), vol. I, pp. 1–21.
10. K. J. Arrow, in *Rate and Direction of Inventive Activity* (Princeton Univ. Press, Princeton, N.J., 1962), p. 623.
11. The Housing and Community Development Act of 1974, PL 93-383.
12. The Geothermal Energy Research, Development, and Demonstration Act of 1974—PL 93-410. It provides a budget of $50 million for guaranteeing loans for the development of geothermal energy sources.
13. Many innovations have been introduced, disseminated, and applied over the past 100 years without any aid from federal agencies, although the Federal Housing Administration's home loans helped to create a larger potential market in the past few decades for these innovations, and the National Bureau of Standards' activities in testing new building industry products provided an additional incentive to the use of new products.

The Limitation of Human Population: A Natural History

The demographic transition of modern times is a return to a pattern familiar to our hunting ancestors.

Don E. Dumond

In demographic circles it has been commonly asserted that the long-term evolution of man was possible only because his high natural fertility permitted him to overcome the effects of an exceptionally heavy premodern mortality—mortality amounting to a loss before the age of reproduction of as much as 50 percent of all individuals born (*1–3*).

A corollary of this same viewpoint is the conclusion that the direction and degree of change in human population size has been governed in preindustrial eras solely by mortality. It is this preconception that has been largely responsible for "transition theory," which holds that the so-called demographic transition of modern times is the result of a new response toward reduction of growth induced by the rising standards of living and health that have followed upon the industrial and medical revolutions (*4*).

Recent years have seen attempts to modify these opinions, however, on the part of historical demographers [for example (*5–7*)], anthropologists [for example (*8–12*)], and others (*13*), who base their views upon various data from their respective disciplines. Unfortunately, discussion of the question is hampered on the one hand by the difficulty of constructing adequate demographic arguments from evidence of populations long dead (*14, 15*), and on the other by the fact that acceptable studies of hunter-gatherers or non-industrial agricultural peoples are limited by the scarcity of such peoples still available for study whose lives have

The author is professor of anthropology and head of the Department of Anthropology at the University of Oregon, Eugene 97403.

...unds to eligible former stu- closed, but the company ployment clai...

WASH. STAR
NOV. 8, 1975

Ralph Nader

'The Bigger, the Better?'

For over 100 years the slogan, "the bigger, the better" has guided the business community.

Even today, few executives would question the validity of such a slogan. Banks with assets exceeding $30 billion, oil companies with sales over $30 billion annually and insurance companies with millions of policyholders are believed to be big because they are better for consumers and the country.

ARE THEY? Let's look at the bigness issues a little more closely:

1. Smaller companies can do a better job for the consumer than the giants are doing in the same industry. This is true, for example, in the pricing of life insurance or servicing by truck companies. Small businesses, whose owners know they can win under fair competition, are unable to fight the political and predatory market practices of their opposing goliaths.

2. Companies can become so large that government cannot allow them to fail. While small business is perfectly free to go bankrupt, big business can go to Washington — for a bailout. Apart from the more sensational welfare case of the Penn Central, big corporations are in Washington all the time asking for handouts on the grounds that if they don't get them they will go broke and damage the economy.

3. Giant corporations very often mean giant monopolies or giant monopolistic practices, which fleece consumers out of billions of dollars, as detailed by the Senate anti-monopoly subcommittee over the years. Frequently big business forces small business to go along with their anti-monopoly violations.

4. BIG corporations, historically without much of an innovative record, just as historically have lunched off lone inventors or small firms. A Department of Commerce study in the mid-'60s showed that individuals were the source of most inventions that helped build the economy, not the fabled corporate laboratories.

In 1964, Donald Frey, vice president of Ford Motor Co., noted that auto suppliers, not the big auto companies, were the prime source of innovation.

5. Big corporations gravitate toward massive technologies because it is more profitable for them and more expensive for consumers. Recently, big technology is more likely to induce tax concessions or government subsidies.

In the quest for energy adequacy, why develop the abundant agricultural wastes and residues or other solar energies when there are more complex, expensive and government supported technologies like nuclear power around?

6. BIG COMPANIES can resist more strenuously the displacement of their existing technology by a more abundant form of new technology that is cheaper for the consumer. AT&T has preferred underseas cables at the expense of satellites; the three television networks long opposed cable TV development with its dozens of channels.

7. Big companies can control government and abuse significant political power more easily. Du Pont in Delaware, Union Camp in Savannah, Ga., and U.S. Steel in Gary, Ind., are only a few of the company states or company towns where bigness becomes virtual government. It is hard to think of small business overthrowing South American countries.

8. Conglomerate companies can afford to ignore one consumer sector if they can profitably shift to other consumer sectors, compared to firms rooted entirely in a smaller community. In such a case, only small business can fill the gap.

9. Large corporations encourage widespread community rootlessness by requiring constant moving of families between branch offices or plants.

10. Big companies are more likely to be inefficient than smaller-scale alternatives. Prof. Joe Bain has shown how, in several major industries, it is plant size, not company size, that determines efficiencies. The steel industry is a case study of that point. One giant publisher recently contracted for a series of books to a tiny publisher because it was cheaper than doing it in-house.

THE WHOLE question of efficiency needs a fresh review in other contexts as well, such as the side effects, maintenance costs, or injuries to consumers.

There need not be a reverse dogmatism in favor of all small enterprises to justify a critical examination of business bigness in our economy. Or to justify asking what such bigness is doing to our society's preferred values of individual initiative, responsibility and freedom from the giant organizations' conforming pressures.

nesses, whose owners know inventions that helped build Delaware, Union Camp in

...ands to eligible former stu- closed, but the company ployment ...

WASH. STAR Nov. 8, 1975

Ralph Nader

'The Bigger, the Better?'

For over 100 years the slogan, "the bigger, the better" has guided the business community.

Even today, few executives would question the validity of such a slogan. Banks with assets exceeding $30 billion, oil companies with sales over $30 billion annually and insurance companies with millions of policyholders are believed to be big because they are better for consumers and the country.

ARE THEY? Let's look at the bigness issues a little more closely:

1. Smaller companies can do a better job for the consumer than the giants are doing in the same industry. This is true, for example, in the pricing of life insurance or servicing by truck companies. Small businesses, whose owners know they can win under fair competition, are unable to fight the political and predatory market practices of their opposing goliaths.

2. Companies can become so large that government cannot allow them to fail. While small business is perfectly free to go bankrupt, big business can go to Washington — for a bailout. Apart from the more sensational welfare case of the Penn Central, big corporations are in Washington all the time asking for handouts on the grounds that if they don't get them they will go broke and damage the economy.

3. Giant corporations very often mean giant monopolies or giant monopolistic practices, which fleece consumers out of billions of dollars, as detailed by the Senate anti-monopoly subcommittee over the years. Frequently big business forces small business to go along with their anti-monopoly violations.

4. BIG corporations, historically without much of an innovative record, just as historically have lunched off lone inventors or small firms. A Department of Commerce study in the mid-'60s showed that individuals were the source of most inventions that helped build the economy, not the fabled corporate laboratories.

In 1964, Donald Frey, vice president of Ford Motor Co., noted that auto suppliers, not the big auto companies, were the prime source of innovation.

5. Big corporations gravitate toward massive technologies because it is more profitable for them and more expensive for consumers. Recently, big technology is more likely to induce tax concessions or government subsidies.

In the quest for energy adequacy, why develop the abundant agricultural wastes and residues or other solar energies when there are more complex, expensive and government supported technologies like nuclear power around?

6. BIG COMPANIES can resist more strenuously the displacement of their existing technology by a more abundant form of new technology that is cheaper for the consumer. AT&T has preferred underseas cables at the expense of satellites; the three television networks long opposed cable TV development with its dozens of channels.

7. Big companies can control government and abuse significant political power more easily. Du Pont in Delaware, Union Camp in Savannah, Ga., and U.S. Steel in Gary, Ind., are only a few of the company states or company towns where bigness becomes virtual government. It is hard to think of small business overthrowing South American countries.

8. Conglomerate companies can afford to ignore one consumer sector if they can profitably shift to other consumer sectors, compared to firms rooted entirely in a smaller community. In such a case, only small business can fill the gap.

9. Large corporations encourage widespread community rootlessness by requiring constant moving of families between branch offices or plants.

10. Big companies are more likely to be inefficient than smaller-scale alternatives. Prof. Joe Bain has shown how, in several major industries, it is plant size, not company size, that determines efficiencies. The steel industry is a case study of that point. One giant publisher recently contracted for a series of books to a tiny publisher because it was cheaper than doing it in-house.

THE WHOLE question of efficiency needs a fresh review in other contexts as well, such as the side effects, maintenance costs, or injuries to consumers.

There need not be a reverse dogmatism in favor of all small enterprises to justify a critical examination of business bigness in our economy. Or to justify asking what such bigness is doing to our society's preferred values of individual initiative, responsibility and freedom from the giant organizations' conforming pressures.

nesses whose owners know inventions that helped build Delaware, Union Camp in

Wash. Star
Nov. 8, 1975

Ralph Nader

"The Bigger, the Better?"

For over 100 years the slogan, "the bigger, the better" has guided the business community.

Even today, few executives would question the validity of such a slogan. Banks with assets exceeding $30 billion, oil companies with sales over $30 billion annually and insurance companies with millions of policyholders are believed to be big because they are better for consumers and the country.

ARE THEY? Let's look at the bigness issues a little more closely:

1. Smaller companies can do a better job for the consumer than the giants are doing in the same industry. This is true, for example, in the pricing of life insurance or servicing by truck companies. Small businesses, whose owners know they can win under fair competition, are unable to fight the political and predatory market practices of their opposing goliaths.

2. Companies can become so large that government cannot allow them to fail. While small business is perfectly free to go bankrupt, big business can go to Washington — for a bailout. Apart from the more sensational welfare case of the Penn Central, big corporations are in Washington all the time asking for handouts on the grounds that if they don't get them they will go broke and damage the economy.

3. Giant corporations very often mean giant monopolies or giant monopolistic practices, which fleece consumers out of billions of dollars, as detailed by the Senate anti-monopoly subcommittee over the years. Frequently big business forces small business to go along with their anti-monopoly violations.

4. BIG corporations, historically without much of an innovative record, just as historically have lunched off lone inventors or small firms. A Department of Commerce study in the mid-'60s showed that individuals were the source of most inventions that helped build the economy, not the fabled corporate laboratories.

In 1964, Donald Frey, vice president of Ford Motor Co., noted that auto suppliers, not the big auto companies, were the prime source of innovation.

5. Big corporations gravitate toward massive technologies because it is more profitable for them and more expensive for consumers. Recently, big technology is more likely to induce tax concessions or government subsidies.

In the quest for energy adequacy, why develop the abundant agricultural wastes and residues or other solar energies when there are more complex, expensive and government supported technologies like nuclear power around?

6. BIG COMPANIES can resist more strenuously the displacement of their existing technology by a more abundant form of new technology that is cheaper for the consumer. AT&T has preferred underseas cables at the expense of satellites; the three television networks long opposed cable TV development with its dozens of channels.

7. Big companies can control government and abuse significant political power more easily. Du Pont in Delaware, Union Camp in Savannah, Ga., and U.S. Steel in Gary, Ind., are only a few of the company states or company towns where bigness becomes virtual government. It is hard to think of small business overthrowing South American countries.

8. Conglomerate companies can afford to ignore one consumer sector if they can profitably shift to other consumer sectors, compared to firms rooted entirely in a smaller community. In such a case, only small business can fill the gap.

9. Large corporations encourage widespread community rootlessness by requiring constant moving of families between branch offices or plants.

10. Big companies are more likely to be inefficient than smaller-scale alternatives. Prof. Joe Bain has shown how, in several major industries, it is plant size, not company size, that determines efficiencies. The steel industry is a case study of that point. One giant publisher recently contracted for a series of books to a tiny publisher because it was cheaper than doing it in-house.

THE WHOLE question of efficiency needs a fresh review in other contexts as well, such as the side effects, maintenance costs, or injuries to consumers.

There need not be a reverse dogmatism in favor of all small enterprises to justify a critical examination of business bigness in our economy. Or to justify asking what such bigness is doing to our society's preferred values of individual initiative, responsibility and freedom from the giant organizations' conforming pressures.

Judith
Wagner

National Academy
of Sciences

2101 Constitution
Av.

Wash. D.C.

20418

Copy of Evans Article
on Tech Transfer
Sent [illegible] memo 2/2

Triggering Technology Transfer

By Thomas P. Evans

Adapted from a paper presented at Dr. Dvorkovitz & Associates University/Industry Forum, Chicago, Illinois, February 3-7, 1975.

ABSTRACT

Technology transfer — the movement of new product and process ideas from seller (usually an inventor, a university or a research institute) to buyer (an industrial organization or company) — is a potentially important instrument of commerce which needs cultivation and encouragement. Many problems, some real and some imagined, prevent wide acceptance of the concept today.

The triggering of technology transfer requires buyer and seller attitudes which are more closely attuned to each other; mutual understanding of and respect for each other's problems can provide the necessary spark to initiate beneficial interchanges.

* * *

A display of its identifiable products usually gives an accurate image of any particular company; the products largely reflect the corporate philosophy, the personality of the marketing department and the manufacturing tools and skills available in its production plants. The products or processes which "fit the company" are the ones which find their way from conception stages through research and development and prototypes to production and marketing and general use.

Corporate organizations are formidable fortresses, and relatively little transfer of technology takes place between companies or to or from other outside institutions. When transfer does take place, it is usually in the form of a finished product to strengthen product lines or a proven process intended to reduce production costs or meet competition. Perhaps surprisingly, a corporation rarely seeks or accepts outside technology merely because it is the least expensive way to acquire certain new product/process concepts and research and development.

The movement of technical ideas and know-how from a conceiving organization (the seller) to a user organization (the buyer) is TECHNOLOGY TRANSFER . . . at any stage of research or development. While TECHNOLOGY TRANSFER is a rather unusual experience for the buyer, it is also often confusing, mystifying and uncommon for the seller and, more broadly, can have wide social and economic effects which extend to world trade and standards of living.

The case can clearly be made for acceleration of technology transfer, but the means by which the buyers and the sellers can be encouraged and emboldened are not obvious. The synergism of technology transfer which has actually taken place — where the transfer has brought product or process results which are substantially more valuable than would have been possible in the buyer's or seller's domain alone — suggests the prerequisite for success and an underlying triggering mechanism: somehow, in some way, the two parties in every successful technology transaction have developed an understanding and a sympathy and a respect, one for the other.

By first examining separately the attitudes, the hopes, the expectations, the frames of reference and the different environments of potential buyers and sellers of technology, it is possible to begin the process of fostering more and better transfer of technology, secure in the knowledge that the mutual respect and understanding which stem from such examination and which are vital to that process will provide the trigger for successful results.

The two parties to transfer: buyer and seller

The buyer of technology is usually a corporation. As such, he will likely have a split personality — that is, several different views of new technology will surface from within the same organization. The Board of Directors, as any one of its members will quickly tell you, is ALWAYS interested in new products and processes; unfortunately, no Board member has ever found one suitable for the company, for no proposed new product or process has yet met all of the model specifications of the Board:

- It must be a completely new product which no other company has.
- It must be protectable against imitation or substitution by competitors, in the U.S. and abroad, by strong patents and know-how. It must be absolutely exclusive.
- The product must be cheap to make, habit-forming for the buyer, non-durable (it must wear out).
- The product/process must be producible with no capital investment.
- Firm orders should be in hand before products are sold (no inventory).
- There must be no research or development risks, no marketing risks, etc.

A second view of acceptable new technology is held by the President: his outlook is usually somewhat more moderate than that of his Board, for he has the practical problem of getting results — demonstrating accomplishments. The President of a corporation which may be seeking new technology from outside his company is generally looking for products/processes not too different from those which his company already sells, or which "fit" well with his various departments (promise a minimum of upheaval everywhere) — so as to minimize the risks of time and money and prestige for the company. At least, he is not expecting that new technology can be injected into his company with ZERO risk!

The various departments within the corporation have their own slants on outside technology, and all of them are prejudiced against triggering any transfer. The Marketing Division has very definite ideas as to what products/processes may be salable (and with the least effort), what sort of appearance and color the product should have, what the customer wants, the type and intensity of advertising and promotions which it likes to run and which will surely be successful with a new product, and so forth. Such thinking leaves very little room for new technology from outside the company, for all of the thinking is geared to existing products and product lines.

The Production Division is ever more inclined to resist any change whatsoever in its operation, unless it is to discontinue a few products and processes with which it has always had trouble. Engineering has scarcely recovered from its flurry of tooling and methodizing for the last "new product" (which, they will hasten to tell you, was a flop — even though it has just gone on the market), so THAT Division doesn't want to have anything to do with ANY new product — particularly one from outside the company — unless it is just like one now being produced.

The Research & Development Division of the potential buyer's organization is often the group with whom the seller of technology makes contact and expects to react. Examination of the motivations of and the management expectations for an industrial R&D operation, however, yields the same negative likelihood of of the triggering of technology transfer from any source external to the company. The rejection of "not invented here" (N.I.H.) is no less real because it stems from complex motivations, pride and corporate expectations rather than from simple pigheadedness. R&D might consider a new product/process idea from an external source IF the division could get corporate credit for a masterful job, and IF the risk to its prestige and its budgets were close to zero. Nobody wants to be responsible for a failure!

To summarize the characteristics of the would-be buyer of technology: he is many-headed — and each head has different reasons for saying NO. Basically, the buyer is seeking minimum exposure, minimum risk and maximum return. Perhaps to such a degree that he is overlooking tremendous opportunity.

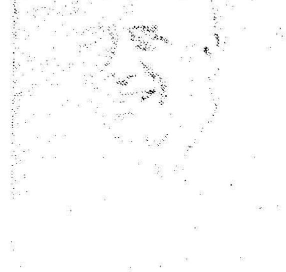
The technology seller may be too shortsighted, also. We shall proceed on the assumption that he has a good idea to transfer to a company which can use it; the seller nevertheless often vastly underestimates the difficulties and the costs in time and dollars to bring his technologically advanced product/process to the point where it can be marketed or otherwise usefully employed. Even with a working prototype and, perhaps, a product design concept for mass production, the seller is not likely to have any realistic feel for the agonizing laborious product development, evolution, marketing test stages, appearance models, engineering designs, production drawings, tooling arguments and agreements and procurements, quality control standards development, marketing program creation — and finally, production start up and sales introduction involved in just getting the seller's baby launched into a hostile world!

The technology seller with a good item for which he, himself, has no particular use (the usual case) and in which he does not intend to invest his own development, production and marketing dollars has definite feelings about the worth of his technology to others who may be in a position to use it. Since he doesn't recognize

(Continued on Page 20)

ABOUT THE AUTHOR:

Thomas P. Evans has been Director of Research at Michigan Technological University since 1967. He received his B.S. degree from Swarthmore College in 1942, then spent 3 years in the Navy during WWII. A two-year stint of study-teaching at Yale earned him an M. Eng. degree in 1948. Evans did nuclear plant design at Westinghouse Atomic Power Div. and at AMF, Inc., followed by broad military and industrial R&D supervision at AMF. For the 5-year period just prior to his move to Michigan Tech, he had been Vice President for Research and Development at W. A. Sheaffer Pen Co. He is a member of American Management Association, Society of Plastics Engineers, Institute of Electrical and Electronic Engineers, American Physical Society, American Defense Preparedness Association, American Forestry Association and Yale Science and Engineering Association. He belongs to Sigma Xi and Tau Beta Pi honorary scientific and engineering societies, and is a registered professional engineer.



to strengthen product lines or a proven process which "fit" well with his various departments has a good idea to transfer to a company which

Triggering Technology Transfer

(Continued from Page 3)

either the complexity of the job or the risks which the buyer assumes when he makes the decision to proceed with development of an item of new technology, the seller practically always has a highly-inflated idea as to the value of his technology to others. He drastically discounts the risks inherent in new product/process development and marketing — risks which are invariably financial and which often involve unavailable technical skills or undeveloped production methods as well.

The would-be seller of technology, then, can be satirically characterized as the owner of a sure-fire item which anyone in his right mind KNOWS will be successful, and which is worth a fortune because it can be produced for a nickel and sold for a dollar and can be put into production next week (after special new machines are purchased and installed by the Manufacturing Department of your company, of course!).

The transfer gap

If there were few differences between the thinking of buyers and sellers of technology, there would be little need for concern about triggering technology transfer. But the buyer is a very different animal from the seller; one is over-reluctant to take risks and the other is over-confident of the value of his technology. The width of the gap can be described in a series of contrasts between the thinking of buyer and seller:

1) The gap between IDEA and PROTOTYPE; the seller maintains that an idea is all that is necessary — that the buyer is a fool if he can't readily envision the benefits which will flow from the new technology which is represented by the concept he is expected to be eager to embrace. The buyer, on the other hand, is anxious to make the best possible investment of his funds and his manpower and facilities resources; he must minimize his risks, and therefore seeks only those ideas which have been translated into prototype products or pilot-plant processes. The seller generally cannot afford to develop his idea into one or more prototypes, and he likely does not have the expertise to do this in any event. Thus occurs a very wide gap between the two parties — one which must be bridged in some manner before transfer can be accomplished.

2) The simple communications gap between organizations: "Who to talk to" in a company or in a university is always a dilemma. When potential seller wishes to explore items of technology transfer with potential buyer, who gets together with whom? The seller is not going to get anywhere with the buyer's R&D Department, for N.I.H. will quickly squelch any idea-transfer conversations. Moreover, the resources-planning decisions of the buyer must all be made at a high corporate level, so it is practically essential that the seller communicate first with such decision makers. The buyer, for his part, may be dealing with an inventor, a consultant, a research laboratory, a university or another company; he must be able to recognize a seller-communicator who can speak authoritatively about the item or items of technology for sale, and who is going to follow through on inquiries and decisions. In most universities it is exceedingly difficult to find a seller-communicator who is willing to concede that he has the necessary authority and who is willing to use it! Transfer simply cannot occur until or unless "the right people" are in communication with each other.

3) The disparity between the buyer's concept of WORTH of new technology and the seller's opinion of its VALUE has been discussed; the gap is almost invariably a wide one. It probably causes as many transfer failures as the N.I.H. factor. Bridging this gap requires a great deal of patience and open-minded give and take on the part of each party to any negotiation, and, of course, is crucial to transfer. The basic secret for triggering technology transfer is mutual respect and understanding; that respect and understanding begins with the discussions between buyer and seller on WORTH vs. VALUE.

4) The would-be buyers and sellers of technology either never begin serious discussions about new items or abruptly interrupt such talks with great gnashing of teeth on both sides because buyers refuse to recognize that outside technology can be valuable to them. Often, the buyer could profit immeasurably from infusion of techniques, design concepts and products from outside the normal view of his business. The problem which makes technology transfer difficult is the well-known "N.I.H.," NOT INVENTED HERE; it affects, in varying degrees, practically every organization of every type — the unwillingness to admit that someone from outside the business might have some creative and ingenious ideas about the business which we had not thought of ourselves. Such idea-interjection attempts are inclined to be summarily rejected without rational consideration.

5) A gap common to most negotiations between buyers and sellers of new items is a biased interpretation of the RISK vs. RETURN axiom. Naturally, the buyer stresses the tremendous risk and the need for handsome return (to him), while the seller sees the new product risk of his new technology to be minimal. The seller seeks sub-

(Continued on Page 22)

tant to take risks and the other is over-confident
inclined to be summarily rejected without ra-

Triggering Technology Transfer

(Continued from Page 20)

stantial compensation (to him) for his low-risk idea which he believes will soon put the buyer at the top of the FORTUNE 500 list. Both parties need some education on the matter of new products — the cumulative investment curve as market introduction approaches (which would be an eye-opener for the seller, no doubt) and the history of companies which are too inflexible to change products and lines or are too conservative to risk resources on new technology which can drastically affect the nature of their products or services.

6) Most buyers of technology will find it difficult to believe that the sellers oftentimes have a peculiar, curious, problem. A university or a company or a federal agency may generate new technology as a regular thing, though as a by-product of its basic functions and/or outside of its normal interests and needs; such an organization is likely to have many individuals in its employ who are not convinced of the value and importance of selling its technology to those who can put it to use. In some instances the sale or licensing of new ideas is even discouraged by official policy. Until this attitude can be changed, there will be many, many items of new technology languishing in graduate theses, in professors' desks and heads and on university and government laboratory benches. Though the result is the same, a large number of companies have a somewhat different internal problem to resolve: do we want to sell some of our technology, and if so, how and to whom? Incredulous as it may sound, the first step in triggering technology transfer must frequently be one of convincing the owner of such technology that everyone's best interests may be served by transfer of his new, unutilized products/processes to those who can put them to good use!

To bridge the differences between buyer and seller, it is necessary to recognize that differences exist, then consciously seek to minimize them one-by-one. If a few of the highest hurdles can be cleared away, those remaining inevitably appear to be less formidable. As a start, the tremendous IDEA to PROTOTYPE barrier between buyer and seller can be tackled if each party will shift his position slightly; the seller could assume some of the development risk (and learn a bit about the buyer's problems at the same time) by investing time and energy and modest funds in designing and producing a prototype or two. Even though the seller's prototypes might not be most appropriate for the buyer's purposes, the evidence of seller's willingness to meet the buyer further down the road will have accomplished much.

At the same time, the buyer could assign the responsibility in his organization for the risk-taking of investment in new products/processes to a special group having the introduction of new products and new lines of products as its major responsibility and loyalty. Such assignment would immediately reconcile the buyer/seller gap caused by the infamous NOT INVENTED HERE syndrome and would also help to alleviate the WORTH vs. VALUE, RISK vs. RETURN and the communications problems which beset the potential transfer of technology from seller to buyer. A buyer who can uncouple his risk-taking on new technology from his marketing and production and R&D department has gone a long way toward meeting the seller on more mutually understandable terms.

If the seller would consider developing prototypes and the buyer would isolate an "outside investments in technology" person or group, two useful steps could be taken toward bridging the transfer gap. These steps can cock the trigger for technology transfer; they are two steps toward the prerequisite mutual respect and understanding between buyer and seller.

Advice to the buyer

It should be quite clear to all concerned that the triggering of technology transfer on a regular basis will require substantial changes in buyers' and sellers' attitudes — changes which are entirely feasible, but which may be hard to implement because habit and outlook are often difficult to alter. If only a part of the advice is heeded, the words of admonition will have been worthwhile.

From the sweet and bitter experiences of one who has been both a buyer and a seller of new technology, the words of advice which can help to trigger technology transfer for the buyer include the following suggestions:

a) Take a hard look at the absolute cost, the ongoing commitment and the cost effectiveness of your RESEARCH (not your DEVELOPMENT) operation. Try to estimate the research cost of each new product/process (if any) which has evolved from this operation. Do not include "warmed-over" products. Has your research operation produced new new products/processes at some sort of reasonable intervals and at an acceptable cost?

b) Turn on your imagination and your ingenuity! Open your eyes and ears to outside new product/process IDEAS and to new components which may become useful in new products. Don't wait for working models and prototypes before making assessments of the impact of new technology items on your business.

c) Develop a plan and a budget for risk-taking on new products/processes in your company. Establish some financial objectives and some numerical new product objectives. Don't be afraid to buy outside ideas when they sound promising.

d) Keep your R&D Department and your Production Department away from new outside technology item evaluations. Don't let your New Product Evaluation Committee near them, either — a sure way to develop instant resistance to anything from outside the company is to ask any of these groups to determine the suitability of outside technology for you! The NOT INVENTED HERE psychology is hard to overcome.

e) Assign the responsibility for looking at outside new product/process ideas to the President or to an imaginative Vice President — someone in the organization who knows the corporate philosophy and who can make decisions stick.

f) There are hundreds of people who, when confronted with any new idea, can explain why it won't (can't) work; try asking yourself and others around you HOW IT CAN BE MADE TO WORK.

g) Challenge yourself to imagine what you would do, and how, with a new product/process for which you have no use, but which should be of value to another industry. Put yourself in a seller's place.

h) If your company hasn't already done it (or hasn't done it well), try to decide objectively what your company is in business for (don't say "to make money" — if that were so, you could do much better by investing in AAA bonds, at much less risk).

Advice to the seller

If the buyer takes some of the advice which has been freely offered, he will have moved positively toward respect for and understanding of the seller and his way of thinking. To push the seller in the general direction of the buyer, with the expectation that the two will reach a common understanding and the transfer of technology will result, the following suggestions are offered:

a) DO try to make a working model of your product or test out your process on a small scale. The buyer usually won't have a very good imagination, and needs reassurance that your item of technology is practical.

b) Don't be coy with a prospective buyer — explain what you have. Don't withhold vital information or detail.

c) Recognize that a reputable company has far more to lose by stealing your idea than have you; if you have a good item of technology, have faith and trust in the integrity of well-known potential buyers. There are simple ways to protect your interests.

d) Try to estimate the cumulative cost to a buyer of product development, testing, market tests, production tooling, and so forth, necessary to bring your product to market. Ask the potential buyer for his figures, and use various references which are available for typical product development. Then multiply this cost by the accepted number of failures per successful new product introduction to obtain a quantitative index to the financial risk which the buyer will be assuming if he takes on your product/process.

e) Share the buyer's risk by investing whatever you can in proof of product/process performance and effectiveness and economy before you present your item for transfer to others. Your investment will be evidence of your own confidence in the technology you are selling.

f) Let potential buyers know what you have to offer — what it will do, what it replaces, why it is better — in simple, non-technical language. Leave the technical detail for in-depth explanations when requested.

g) Do not hesitate to seek foreign buyers when domestic companies will not listen to your technology item description; in many countries, imported technology is common and companies openly seek new ideas from abroad.

(Continued on Page 23)

DEPARTM T OF HEALTH, EDUCATION, AND W FARE

Associate Director for Communications, NIH

Patent Counsel, OS/OGC/BAL

Draft Report for Committee on Dissemination of Research Results

Reference your February 26, 1975, memorandum attaching subject report, and our March 3 conversation regarding that report. As advised, I believe the contents of the report to be basically factual, and therefore raises few uestions. However, I do have some difficulty with the organi ation of those facts and the emphasis placed on some with respect to others.

I understand you agree that the purpose of the Congressional in uiry was to determine the effectiveness of transferring technology from those generating it to those whoccould make best use of it, or at least determine the means u ed to document the flow of research funds into practical results. In light of this, I believe the report should be reorgani ed, taking into consideration the following broad concepts:

1. Grant research funding, in the main, results in new increments of knowledge which lead to better understanding of larger questions. These findings are the raw materials out of which, in time, through refinement, in combination with other findings, new means of treatment, diagnosis, or prevention will be developed. (This, of course, merely paraphrases the report as now drafted.)

2. Our system of communicating such new increments of knowledge is basically fu ctioning well, and is improving. (Under this broad statement all your present comments on how our publication system functions and how it is being improved would appear to be appropriate..)

3. NIH is not necessarily or ordinarily the party who will combine new increments of knowledge and develop them into new means of treatment, diagnosis, or prevention. It is, however, clear that in those areas where the Institutes have identified missions, such combination and development may be necessary in order to accomplish that mission. (I believe this point is missing in the report.)

FILE COPY

OFFICE	SURNAME	DATE	OFFICE	SURNAME	DATE	OFFICE	SURNAME	DATE

4. When useful results emerge, it becomes the responsibility of the NIH to determine whether further development is necessary to accomplish delivery to the public, and whether such development is possible within its mission. (Under this concept, a discussion of how the contract function, the Department's patent program, the Regional Medical-type program, and/or the report's suggestion of a possible development organization may be utilized to complete delivery to the public would appear to be appropriate.)

5. NIH plans to better track the results of the efforts to deliver under the mechanisms of Item 4, so that it might report to Congress. (This concept must be carefully worded to dispel the idea that NIH performance is proportional to the number of specific results that we are able to track to the marketplace or user.)

I believe the report presently places too much emphasis on 2. above and not enough on 4. It seems clear that Congress is aware of our existing means to communicate new increments of knowledge. It seems equally clear that they have a poor understanding of the difficulty and the means available to deliver results to the marketplace.

I would suggest that the emphasis of the report be on educating the Congress to the latter point. In this regard, you may wish to review the National Academy of Engineering Report on "Technology Transfer" which you will find in the materials sent a few days ago.

Norman J. Latker

bcc: Dr. Lowell T. Harmison w/repeat-DHEW
Mr. Carl A. Fretts-NIH/ODA/C
DHEW/OS/GCB NJLatker: as 3/4/75

FILE COPY

OFFICE	SURNAME	DATE	OFFICE	SURNAME	DATE	OFFICE	SURNAME	DATE

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH

TO : Norman Latker

DATE: February 26, 1975

PATENT BRANCH, OGC

FEB 28 1975

FROM : Associate Director for Communications

SUBJECT: Draft report for Committee on Dissemination of Research Results

Attached is draft which is to be reviewed by our Committee tomorrow. A number of editorial changes have already been made, but the sections we discussed this morning reflect our latest effort.

Would appreciate a call as soon as you have had opportunity to review.

Storm Whaley

Attachment

5. We plan to ~~report~~ track delivery + report results to [illegible]

met w/ NTIS Jacob,

1. MAR. 12 meeting w/ Lasker
2. call Akers

1. discrete parts are being disclosed through our communication system.
3. We ~~have~~ are not ~~means of~~ [illegible] ordinarily the party who will combine findings into useful results
2. Communication system of discrete parts is basically ok, and improving.
4. However, when useful results are identified we do the following to insure delivery to public.

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH

TO : Members
Committee on Dissemination of Research Results

DATE: February 24, 1975

FROM : Associate Director for Communications

SUBJECT: Committee Meeting - Thursday, February 27 10:30 A.M.
Building 1, Room 124

A meeting of the Committee on Dissemination of Research Results is called for 10:30 A.M. on Thursday, February 27 in room 124 of building 1.

With luck, this will be our final meeting.

Attached is a draft of Parts I, II and III of our Committee Report. Part IV, a summary report of current activities, will be ready for inspection Thursday.

Please go over the drafts with care and bring your "marked up" copy to our meeting.

You will note that the draft is now in the form of a final report from the Committee to the Director. He will submit it, along with his comments to the Senate Appropriation Committee.

Storm Whaley

Attachment