COMMANDERS DIGEST

VOL. 15, NO. 18/MAY 2, 1974

‘. . . We must combine the genius of invention with the skills of entrepreneurship, management, marketing and finance.’

By **Richard Nixon**
President of the United States

"As we face the new challenges of the 1970's we can draw upon a great reservoir of scientific and technicalogical information and skill—the result of the enormous investments which both the Federal Government and private enterprise made in research and development in recent years. In addition, this Nation's historic commitment to scientific excellence, its determination to take the lead in exploring the unknown, have given us a great tradition, a rich legacy on which to draw. Now it is for us to extend that tradition by applying that legacy in new situations.

"In pursuing this goal, it is important to remember several things. In the first place, we must always be aware that the mere act of scientific discovery alone is not enough. Even the most important breakthrough will have little impact on our lives unless it is put to use—and putting an idea to use is a far more complex process than has often been appreciated. To accomplish this transformation, we must combine the genius of invention with the skills of entrepreneurship, management, marketing and finance.

"Secondly, we must see that the environment for technological innovation is a favorable one. In some cases, excessive regulation, inadequate incentives and other barriers to innovation have worked to discourage and even to impede the entrepreneurial spirit. We need to do a better job of determining the extent to which such conditions exist, their underlying causes, and the best ways of dealing with them.

"Thirdly, we must realize that the mere development of a new idea does not necessarily mean that it can or should be put into immediate use. In some cases, laws or regulations may inhibit its implementation. In other cases, the costs of the process may not be worth the benefits it produces. The introduction of some new technologies may produce undesirable side effects. Patterns of living and human behavior must also be taken into account. By realistically appreciating the limits of technological innovation, we will be in a better position fully to marshall its amazing strengths.

A fourth consideration concerns the need for scientific and technological manpower. Creative, inventive, dedicated scientists and engineers will surely be in demand in the years ahead; young people who believe they would find satisfaction in such careers should not hesitate to undertake them. I am convinced they will find ample opportunity to serve their communities and their country in important and exciting ways.

"The fifth basic point I would make concerning our overall approach to science and technology in the 1970's concerns the importance of maintaining that spirit of curiosity and adventure which has always driven us to explore the unknown. This means that we must continue to give an important place to basic research and to exploratory experiments which provide the new ideas on which our edifice of technological accomplishment rests. Basic research in both the public and private sectors today is essential to our continuing progress tomorrow. All departments and agencies of the Federal Government will continue to support basic research which can help provide a broader range of future development options.

"Finally, we must appreciate that the progress we seek requires a new partnership in science and technology—one which brings together the Federal Government, private enterprise, State and local governments, and our universities and research centers in a coordinated, cooperative effort to serve the national interest. Each member of that partnership must play the role it can play best; each must respect and reinforce the unique capacities of the other members. Only if this happens, only if our new partnership thrives, can we be sure that our scientific and technological resources will be used as effectively as possible in meeting our priority national needs.

"With a new sense of purpose and a new sense of partnership, we can make the 1970s a great new era for American science and technology."

TECHNOLOGY TRANSFER —

DoD-Civilian development with direct military application

The authority for the DoD laboratories' consortium program is a policy memorandum, issued on June 21, 1972 from the Deputy Secretary of Defense to the Secretaries of the Military Departments and the Director of Defense Research and Engineering (DDR&E), encouraging the Military Services to participate in technology transfer to nondefense work. The guidelines were:

- The nondefense work must not impede the Service or laboratory.
- The work is to be compatible with the technological capabilities of the laboratory.
- The full cost of each project is to be supported by the transfer of funds through formal written agreements.
- Work may be performed in support of Federal, State, and local government organizations.
- Work may be performed for the private industrial sector only on an exception basis.

Jointly-sponsored cooperative developments, are permitted when there is also a direct application to a military requirement.

The level of effort that may be applied to civilian problems was not specified in the policy memorandum, and the further development and implementation of the policy was left to the perogative of each Military Service.

The Navy has issued an implementing instruction calling for an active program within the Navy and requiring the designation of a person as a contact for technology transfer in the various laboratories and components of the Navy under the Navy Materiel Command. The instruction also calls for an annual report of progress.

The Army and the Air Force have not yet issued detailed implementing instructions following the DoD policy statement but are continuing to respond to specific requests for technical assistance or technology initiated by a user.

In a Government Accounting Office (GAO) study, issued December 29, 1972, it was recommended that DoD initiate a more active technology transfer program. The DoD consortium was heralded as the beginning of such an effort.

Electronic visual testing, developed by the Military Services, is now being applied by a San Diego, California, clinic.

The consortium experiment began almost two years before the issuance of the DoD policy memorandum, and even before that a few laboratories experimented with ideas for the active transfer of technology to the civilian sector.

The unique characteristics of the DoD environment distinguishes DoD from the other high technology agencies such as the National Aeronautics and Space Administration (NASA), the Atomic Energy Commission (AEC), and the National Bureau of Standards (NBS). These agencies have mission requirements for promoting the utilization of their R & D outputs in the civilian sector. Within DoD, which lacks this requirement, has emerged a consortium of R & D laboratories and centers, but with representatives from other Federal agencies as participants. Even though the transfer of technology to the civilian sector is not in the DoD mission, DoD has become a respected colleague in a growing concept of a Federal laboratory consortium for accomplishing the transfer of Federal R & D outputs. Some characteristics which make it difficult to transfer technology in the DoD environment are:

- There is no DoD mission requirement for the transfer of technology or promotion of research utilization in the civilian sector.
- There are essentially no tangible incentives for a laboratory or R & D center director to participate in civilian technology transfer.
- No DoD funding is authorized for the marketing and adaptive engineering functions that are known to be essential for technology transfer.

Lacking the positive incentives above, what motivated the persons in the DoD consortium? There is a simple answer—DoD laboratory directors, and the scientists and engineers who work in these laboratories are citizens with an awareness of the urgent national problems in the environment, the economy, the energy crunch, transportation deficiencies, health and safety, law enforcement and crime prevention, etc. They are also keenly aware that R & D dollars don't go as far as they once did. Therefore, when the idea of getting more mileage out of their scarce R & D dollars by cooperative developments and secondary applications of military technology to civilian needs is presented to them, the response is usually enthusiastic.

The following are recent examples of technology transfer and cooperation by the Department of Defense which have resulted in positive contributions to the civilian section of the American society:

The Naval Weapon Center instrumented an aircraft to determine the pollution sources and cause of decreasing visibility on aircraft test ranges which were adversely affecting the mission of the station. The State of California has negotiated an agreement and is providing a three-dimensional mapping of aerosol concentrations in the area near the naval center.

A portable hand-held electrocardiographic (EKG) detector de-

A U.S. Army twin-turbine test vehicle under development at Fort Belvoir, Virginia. The vehicle is powered by two 15-kw turbine generators and a bank of nickel-cadmium batteries.

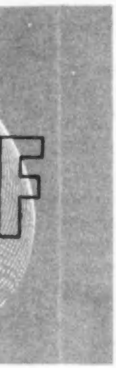
veloped by the Navy which, even when used by untrained personnel, is capable of detecting and indicating faint electrocardiographic activity. In use, two stainless steel tips are placed in contact with the skin on the precordium. Electrical signals arising from heart action are processed by a network of filter, trigger, and logic circuits enclosed within the instrument, the result of which is a bright flash of a light-emitting diode for each beat of the heart.

Lt. Col. Burton H. Kaplan, chief of the cardiovascular branch of the Army's Aeromedical Research Laboratory, Fort Rucker, Alabama, is responsible for the development of the most significant first aid advance since closed-chest massage. It is a new, inflatable "body boot" used to fight shock—the result of arterial-circulation shutdown—in trauma victims. If widely use it might save 10 percent of 117,000 Americans who die of injuries annually.

Recent Air Force examples of technology transfer include:

A modular airborne firefighting system for use by the Forest Service.

An infrared multispectoral reconnaissance sensor which was used in a joint program between the U.S. Geological Survey and the New York Department of Environmental Conservation for sensing thermal discharges in upper New York State.



The application of Air Force high speed analog-to-digital data conversion techniques by the Mayo Foundation for a three-dimensional, high resolution display of the cardiovascular system in situ.

Eighty-two Air Force educational programs, from their work on programmed and computer-assisted instruction, have been accepted for use in the civilian community. One of these is the Air Force technology for simulation in flying training which is being utilized by commercial airlines.

A mobile radiographic weld inspection detects potential and costly leaks in military pipelines.

Medical techniques and tools developed by the Air Force are readily adaptable for civilian use.

Electron beam microprobe analysis, developed by the Air Force, is now used for advanced biological tissue examination and diagnosis in civilian medical facilities.

In Air Force experimental flights, including space, sensors monitor all body functions. This technique has revolutionized operating-room procedures through development of constant observation and warning systems. It has become so well developed that a doctor can now check a patient at home by means of a telephone.

Air Force components paved the way for the development of heart and kidney machines.

In addition, super-cooled surgery is an outgrowth of cryogenics associated with missiles.

Scientists at the Naval Research Laboratory's (NRL) cyclotron facility have solved a number of problems associated with adequate production of ^{129}Cesium, a radioisotope being evaluated as a diagnostic agent in certain heart defects.

With the support of the National Heart and Lung Institute (NHLI), Myocardial Infarction Branch, the Cardiac Research Laboratory and the Radioisotope Laboratory of the University of Cincinnati College of Medicine are now conducting heart studies on canine-test subjects using ^{129}Cesium produced by the NRL-prescribed technique.

The ^{129}Cesium is injected into the bloodstream of a test subject, is traced through the normal heart muscle, and leaves an absence of take-up in a myocardial infarct (the area of the heart muscle which is dying because of lack of blood supply).

Cincinnati Medical College heart specialists say test results have enabled them to establish a dose which gives a high quality heart image. They say they can identify the presence, location and size of an experimentally induced infarct, and also can follow the course of an acute infarct in the subject by repeated scans over 24 hours following a single intraveous injection of ^{129}Cesium.

In a letter of appreciation to NRL, Dr. Robert J. Adolph, Director of the Cincinnati Medical College Cardiac Research Laboratory, said, "The practical application of this diagnostic technique to man is most promising, and the potential rewards in patient care are staggering."

A new five kilowatt diesel engine-driven generator (left) can operate 5,000 hours between major overhauls. This is equivalent to 200,000 miles on an automobile powerplant.

In a recent report by the Council of State Governments on the "Intergovernmental Uses of Federal R & D Centers and Laboratories" based on a study by William D. Carey, vice president of Arthur D. Little, Inc., the logic of the DoD program was succinctly stated:

"To argue that it is all right for the DoD laboratories to engage in mission-connected basic and applied research, but that it is wrong to go to the expense of diffusing that knowledge, appears to mangle the intent and purpose of a straightforward provision of public law."

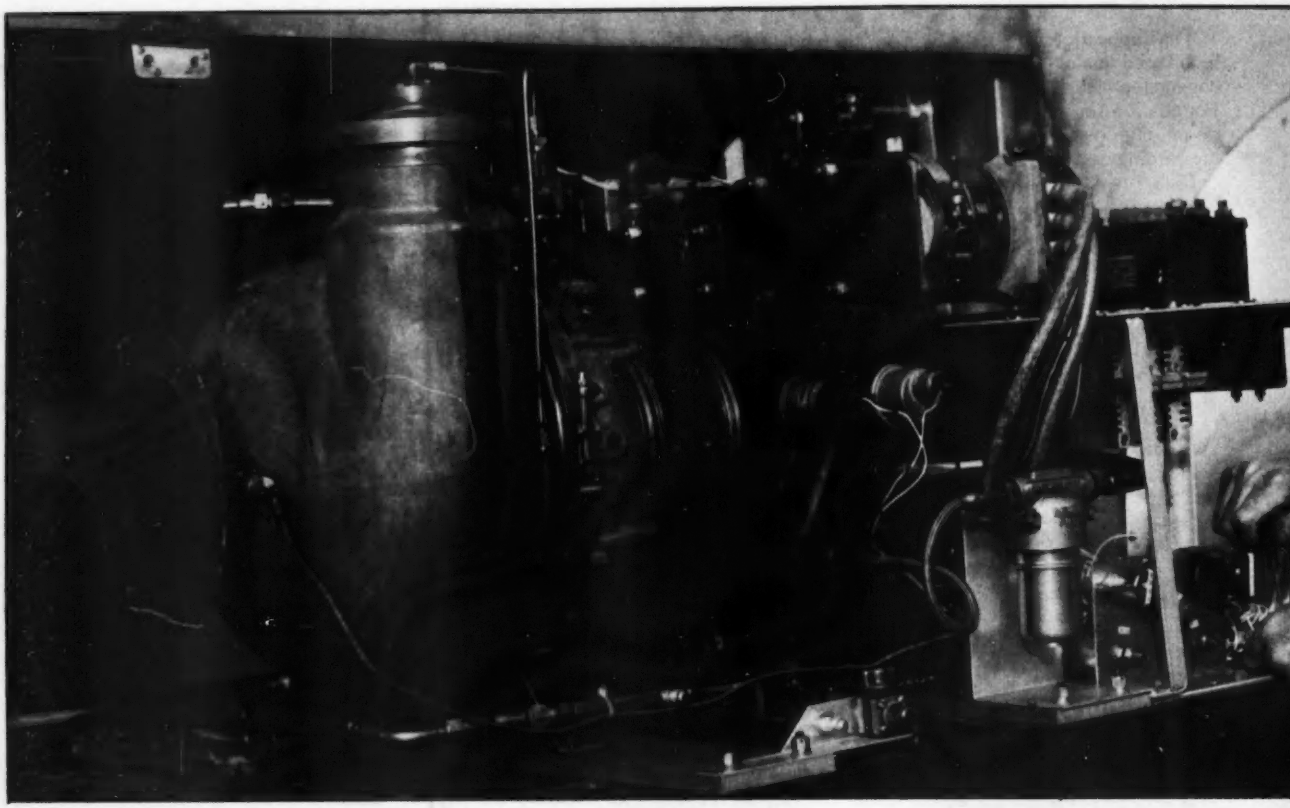
Observing that this belief was growing in the laboratories, a few DoD laboratories organized in a very informal way in July 1971 to tackle the challenge of a more active technology program. With encouragement from Ed Glass, assistant director for laboratory management in DDR&E, 11 laboratories were represented at a meeting held at the Naval Weapons Center, China Lake, California.

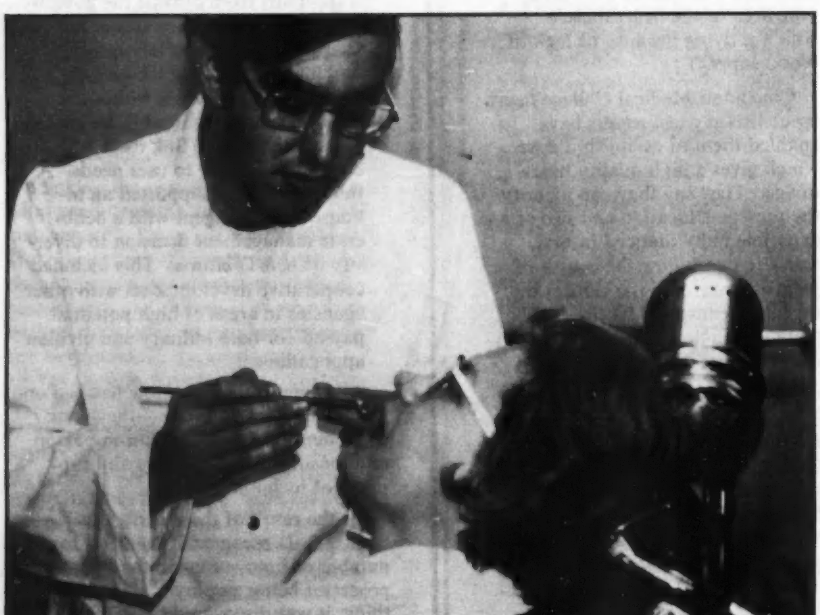
Some of the laboratory representatives attending reported on technology transfer activities that were underway prior to this meeting. Their efforts were increased as a result of the encouragement from this new cooperative effort among these laboratories. In these earlier activities three different approaches were tested:

> One of the laboratories employed a specialist from outside the government to help match its technology to user needs. Another laboratory employed a full-time technology transfer agent to work within the laboratory organization in technology assessment, and to link its R & D outputs externally to user needs. A third laboratory supported an in-house transfer agent with a deliberate management decision to diversify its R & D efforts. This included cooperative developments with other agencies in areas of high potential pay-off for both military and civilian applications.

All three of these approaches had one vital element in common—they were dependent largely on person-to-person relationships between users and suppliers of technology.

As the result of these early experiments, DoD recognized the need for a number of innovations in the transfer processes being employed. For one thing, it was discovered that DoD needed





a more open and direct access to the problem statements and program needs of the various Federal agencies. This required becoming involved with their program planning process—and this could not be accomplished effectively by a linking agent from outside the government.

DoD also discovered that it needed a central focal point for coordinating communications with its own agencies and with the Federal user agencies in Washington, D.C. And perhaps most importantly, DoD needed a linking mechanism with State and local governments.

In September 1971, a big step forward was taken in the solution of all three of these recognized needs, primarily due to the foresight of Dr. Frank Hersman of the National Science Foundation (NSF), Intergovernmental Science and Research Utilization (ISRU) Office. Dr. Hersman established a function in his office for providing liaison with the DoD and other Federal R & D laboratories and centers and between them and

An Army engineer, left, makes an adjustment on a turbine generator used to power heavy equipment, such as a rough terrain crane. Lower left, a dental technician prepares a patient for an application of experimental dental braces made of titanium-nickel alloy developed by the Services.

State and local governments. This function was also integrated into the overall efforts of the Research Applied to National Needs (RANN) program of the NSF. As a result, the Federal R & D laboratories today are a part of what NSF calls the RANN extension system for facilitating the use of the research "products" from NSF grants and contracts.

A program manager was detailed to ISRU in NSF from one of the DoD laboratories to manage this liaison function. DoD participants in the consortium began immediately to work closely with this person, and through this arrangement the consortium gained:

- A resident representative in the Washington area for liaison and coordination.
- A strategic base of operation through the NSF Intergovernmental Science and Research Utilization Office.
- A linking mechanism with State and local governments through the groundwork and communication networks which had been established through the ISRU program since 1967.

These additional person-to-person mechanisms were forged as the liaison program developed:

- DoD's "Washington representative" replaced the outside consultant in developing contacts in other Federal agencies.
- Under the authority of the Intergovernmental Personnel Act, DoD began to place a few DoD technical specialists in strategic positions in other Federal agencies such as the National Institute of Health, and Environmetal Protection Agency at both the headquarters and regional levels.

Over a period of 8-10 months the liaison activity with NSF developed into a coordination/management function which has helped to better systematize what had been a somewhat random process of communication, information exchange, and determining the needs of potential users.

DoD also became better able to offer alternative and better solutions to problems by obtaining multiple, quick responses to problems.

Maximum use was also made of existing institutional arrangements and communication networks. Some of the groups with whom DoD works in the all important problem-definition part of the transfer process are:

- **NASA**—Problem statements are made available to the DoD consortium and an opportunity is provided for the laboratories to respond.
- **Public Technology Incorporated (PTI)**—DoD has access to the problems defined and priority lists developed by PTI with the cities and the public interest groups. PTI is a nonprofit company formed to market R & D products and output to cities and local governments. It derives its funding from Federal, State, and local government organizations.
- **Four Cities Program**—A representative from the consortium sits in on the program reviews and quarterly meetings of the Four Cities Program—Anaheim, Pasadena, Fresno, and San Jose, California. This is a program sponsored by NSF wherein a scientist or engineer from an area-space company resides on a city manager's staff to help transfer technology to the needs of the city.
- **Federal Agencies**—By systematic review of the R & D program plans and needs of other Federal agencies, the technology transfer specialists in the DoD laboratories are able to focus more readily on problems amenable to solution by the technology available in the consortium laboratories.
- **State and Local Governments**—The various lists of urgent problems and priorities developed by States and cities, are available for review and analysis by the consortium laboratories, and cooperative partnerships between a number of States and DoD laboratories in those States have evolved.

The number of DoD laboratories participating in the consortium have increased from 11 to 30 since 1971. Their laboratories are located in 15 states and represent a large professional workforce of scientists and engineers with many diverse kinds of expertise and facilities. The number of active interagency projects is now over 100. These activities are paid for by the customer, not DoD.

Technology derived from military R & D has been applied successfully to a wide range of civilian problems in the following fields:

—Fire and safety
—Environment
—Health and medical

Micro-electronics research at the Naval Research Laboratory used in building satellites and other scientific instruments also benefits the civilian community in such areas as radio, television and communications equipment.

—Law enforcement
—Transportation
—Analysis and testing
—Instrumentation

Some specific examples are;

- Mine safety—Randon detection in mines.
- Transportation—Evaluation of passenger vehicle restraint systems.
  —Use of rocket test track for testing urban rapid transit way stations.
- Air safety—Adaption of Navy command and control to air traffic control.
- Medical instrumentation—Adapting visual studies related to human factors/weapons systems to visual testing in a new clinic in San Diego, California.
- Firefighting—Suppression of full-scale coal dust fires.
  —Explosive primacord to construct fire lanes.
  —The use of airborne infrared equipment to locate forest fires.
- Law enforcement—Development evaluation of protective clothing for police officers.
- Disaster control—Instrumentation for detecting buried corpses after the Rapid City, South Dakota, flood.
- Ice-thickness measurements—Adapting Navy aircraft instrumentation for ice-thickness measurements.
- Scientist in the sea program—Navy diving technology incorporated in the curriculum of university engineering institutions.
- A program is being developed for rehabilitation of paraphlegics by training them to become professional divers.
- Housing—Structural and environmental tests of HUD operational breakthrough housing units.
- Highway safety—Laser device for rapid measurement of highway surface roughness.
- Law enforcement—Tracking of drug smuggling operations in low flying aircraft.
- Cardiovascular assist device based on adaption of Navy equipment for screening divers.
- An instrument for early detection of cataracts by a simple self-screening test.
- Management systems—Adaption of DoD management system in use by the Navy to the EPA health effects program.
- The application of the Navy-developed program for maintenance management to the maintenance operations of a major university and a consolidated school district.

It is planned to place an increased emphasis on helping States and local governments during the coming year, and doing this in concert with the objectives and plans of the Committee on Federal Laboratories of the Federal Council of Science and Technology. DoD will be working closely with them in defining DoD's future role. The consortium also hopes to get involved in more major efforts, rather than a large number of smaller projects.

For example, the Federal agencies have a mandate to lead the way on the problems of pollution control and abatement and are spending large sums of money in research and control of their own pollution. Nearly all of this R & D on control and technology is directly applicable to the needs and requirements of cities, counties, and industry. There is a tremendous opportunity for cooperative efforts in the environmental area, and everyone can accomplish more with a lot less total cost to each participant.

COMMANDERS DIGEST

Vol. 15, No. 18, May 2, 1974

A publication of the Department of Defense to provide official and professional information to commanders and key personnel on matters related to Defense policies, programs and interests, and to create better understanding and teamwork within the Department of Defense.

Published weekly by the American Forces Press Service, 1117 N. 19th St., Arlington, Va. 22209, a unified activity of the Office of Information for the Armed Forces, OASD (M&RA). Reproduction of content is authorized.

Telephone: (202) OXford 4-4912
Autovon 224-4912

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
Subscription Price: $12.55 domestic per year; $3.15 additional for foreign mailing; 30 cents per single copy.
☆U.S. GOVERNMENT PRINTING OFFICE 541/437/Z-53