Technology Transfer

Perspectives on Tech Transfer

by Courtney Stadd

Courtney A. Stadd, managing partner of Global Technology Ventures in Maryland and former director of the National Space Institute, offered his perspectives on technology transfer, beginning with an analysis of "the wild and wacky digital-based world" in which we work, and ending with an assessment of the changing political climate. Excerpts of his speech follow:

If the definition of a tech transfer practitioner is someone skilled at leveraging people, assets, capital and ideas, a premium must be placed on constantly getting oneself exposed to the incredible changes shaping the economic landscape . . .

Every one of us in this room faces an average of 300 programmed electronic microcontrollers each day, and my Canon camera has more "intelligence" than an early '80s version of the Apple II . . . The Space Age that gave us the Digital Age is turning the economic world upside down and creating endless entrepreneurial opportunities . . .

Having tried, however feebly, to describe the wacky, bizarre and unpredictable external environment in which tech transfer takes place, I'd like to make some observations on the state of Federally supported tech transfer.

1) I'm tempted to start by saying, "Only in America . . . ." That is, only in this resource rich nation, where our ancestors were pioneers in networking long before they conquered the Wild West (somewhere in Alexis de Toqueville's 19th Century *Democracy in America*, he observes that two Americans getting together guarantees an association), would we go in such a short period from a few lonely tech transfer specialists working the vineyards to the extraordinary proliferation of various organizations at the Federal, state and local levels involved with tech transfer. NASA alone has approximately 130 civil servants and approximately 120 support service contractors and JPL employees whose main job function is technology commercialization. (And these numbers do not include the RTTCs, NTTC employees and any of the other network organizations such as COSMIC.) The good news is that everyone and his uncle seems to be getting in on the act; the bad news is that the whole scene can be pretty confusing for the business sector—especially the small business types that I usually deal with.

2) The successful practitioners of tech transfer are those who appreciate that they are working in a knowledge-based economy and that the fundamental question we all need to be asking ourselves constantly is—Am I adding value to the process? If not, why am I not striving to get additional schooling or training or reaching out to other experts and specialists who can give me the value-added I need? Not surprisingly, this knowledge-based economy is generating a variety in virtual knowledge access—from the various Internet services to the prospect of so-called "software agents" that can be programmed to target and access huge amounts of information while the user is off doing other chores—like saving his or her budget. This virtual, knowledge-based world of ours is a great leveler. At the very least, it tears down the artificial walls separating the public and private sectors. Information is power. But when lots of people have access to the same information stream, the power goes to those most creative in repackaging and adding value to it.

3) There is an inverse relationship between the number of organizations worrying about the problem of tech transfer and their effectiveness in reaching the real engine for economic change—the small business firm. To wit: about 30 states now offer some form of industrial extension assistance. Modeled in part on the successful U.S. Agriculture assistance system, these programs use field agents to diagnose problems in industrial firms and provide one-on-one technological assistance. In some cases, technological demonstration centers have even been formed. In other cases, industrial networks are used in which groups of small firms come together to find solutions to common problems, share information and technologies, and develop new markets. However, their funding, range of services and geographical coverage are still low, with fewer than three percent of U.S. small firms being aided annually.

4) It seems to me that the tech transfer infrastructure, particularly at the Federal level, has grown in a somewhat topsy turvy fashion, and parts of it should at least be reviewed. Centers are waking up to the need to increase their partnering with industry, but they are less than enthusiastic about reporting performance data. (Hopefully, our panelists may address some of these concerns.)

5) This concern is not unique to NASA but applies across the board to people employed in tech transfer in the various organizations referenced earlier. A colleague who has worked in tech transfer for many years—mostly in the university and foundation worlds—believes that there are no more than a dozen effective tech transfer practitioners in the country. That may be a bit harsh. But his point is that an effective practitioner in this field must combine the black arts of effective business experience and skills, interpersonal communications abilities, training in partnership practices, and legal and regulatory frameworks that are fundamental to successful tech transfer....

6) While we're on the topic of bridging, I can't emphasize enough the need for the government tech transfer and private investment worlds to do a better job of intercommunication. For example, about a month ago, I received a call from a certain field center planning to hold a technology fair. I was told that the intent of the fair was to showcase the Center's many technologies and try to encourage the emergence of a regional mini-Silicon Valley-like phenomenon. This person went on to ask me how they could get interest from the investment community—ten days before the fair!! Not exactly advance planning . . .

In that void, the political system, it seems to me, is grappling with no less than a fundamental redefinition of roles and missions. There is no question that the current Congressional leadership brings a set of presumptions to the policy table—a preference for government to focus on basic vs. applied R&D; a preference for creative ways to drastically reduce Federal overhead while leveraging limited resources to produce more robust results; a preference for reviewing government's functions and identifying candidates for privatization or outright termination; a preference to identify ways to relocate resource and administration from Washington and assign those responsibilities to state and local entities.

Beyond these presumptions, I have noticed that some groups with access to the leadership are now pushing a slogan that supports replacement of entire agencies vs. modification. As skeptical as many of you may be about the viability of such radical suggestions, the fact of the matter is that the world has indeed shifted on its

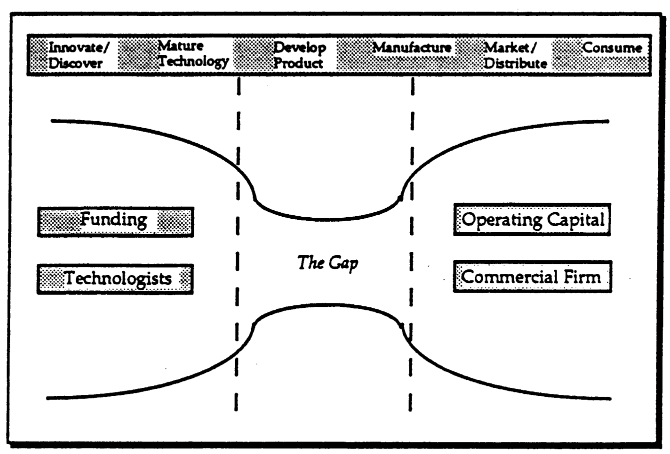

Figure 21. Bridging the Gap of Technology and Commercialization.

axis—and yesterday's rationale that persuaded the political system to support one's program could well be today's rationale for termination. All bets are off.

The same attributes that make for successful entrepreneurship in the marketplace—agility and constant adaptation in the face of daily adversity—will characterize those who succeed in the public sector. No question. It's an Age of High Anxiety. It's been 50 years since the post-WW II generation set this nation's course in technology policy. It is overdue for all of us who worry about this nation's future leadership in technology to join in the larger debate about roles and missions, and lay the groundwork for the next 50 years. The consequences of inaction or sitting in our respective corners and allowing ourselves to be disenfranchised from the debate are simply too serious for our future.

American Competitiveness

by Tom Walters

Dr. Thomas Walters has served as president of the American Competitiveness Enterprise Institute since 1992, specializing in technology commercialization program development. For eight years he has worked at the Jet Propulsion Laboratory in small business innovation research, technology affiliation and technology utilization. In his presentation, Walters showed the strengths and weaknesses of U.S., E.C. and Japanese economic models for developing and marketing high tech products.

In the European Community, especially Germany, "the research community serves corporate interests," but it is moderately difficult for anyone independently to start high tech companies. In Japan also, large corporations can commercialize easily and efficiently through "industrial policy" targeted at specific areas, but there are almost no opportunities for potential entrepreneurs. In the United States, public/private co-funded technology commercialization projects may take a long time to negotiate, coordinate and execute, but creative funding options and minimal government regulation make it comparatively easy to start new companies.

Thus, Walters says the U.S. should not copy Japan or Western Europe in technology transfer. In addition, NASA should focus on what customers want and need, and then arrange management systems that agree with the product or service offered.

Delivering Accountability

by Molly Macauley

Dr. Molly K. Macauley is a senior fellow at Resources for the Future, a nonprofit and nonpartisan research institute in Washington, and a professor of economics at Johns Hopkins University. Following are her comments on the ways and means of delivering accountability for technology transfers:

Headlines such as "Reinventing Government," "Study Finds Space Support Dwindling," and "NASA Cuts Would Cost 55,000 Jobs" reflect the need for greater accountability of the public sector to its taxpayer constituency. Delivering accountability is problematic for science, technology, and technology transfer activities, however, because of difficulties in specifying and measuring the returns to these investments. Typical approaches have included studies of knowledge diffusion by analysis of the numbers of patents awarded and the geographic and industrial distribution of patent citations; econometric studies relating changes in gross national product to levels of investment in science and technology; and case studies of "spillovers."

These approaches have many shortcomings. For instance, in the case of patent studies, not all activities result in patents; in the case of GNP, spending on space activities is generally too small for its effect on a six trillion dollar economy to be identified through econometric studies; and spillover studies have largely been discredited.

Perhaps a more promising approach is through objective, detailed case studies of the activities themselves. Such a tack is being taken by Stennis Space Center in one of NASA's programs to commercialize remote sensing, the Earth Observations Commercialization Applications Program (EOCAP). In EOCAP, measures of success are agreed upon by Stennis and commercial partners at the very outset of the program; progress towards these goals is measured during program execution and interim results are shared with all participants; and final results are packaged and communicated publicly. The success "metrics" include three measures: (1) net return on government plus industry investment (that is, net commercial profitability); (2) the development of efficiency enhancing, general technologies that improve the health of the spatial information industry (such as widespread adoption of user friendly iconography, commercial practice standards, standardized data formats); and (3) lessons directly learned from EOCAP that contribute to public policy issues (for instance, EOCAP experiences had a direct bearing on some aspects of the 1992 Land Remote Sensing Policy Act). Where possible, these metrics are quantified (calculations have been made of net return and productivity gains enabled by the generic technologies). Documentation about the EOCAP metrics and their measurement is available.

More general observations about how to build an accountable tech transfer program, specifically using government/industry co-funded partnerships, include the following: (1) use private sector business and technical experts, rather than government officials, to select partnerships competitively; (2) define success metrics at the outset, establish quantitative measures of them, periodically measure progress towards these goals, and feed back results to partners and the taxpayer; (3) break large programs into smaller, decentralized profit and loss centers; (4) allocate sufficient resources for program management and metrics definition, collection, analyses, and reporting—including site visits and customer interaction; (5) make public and private managers personally accountable through public recognition; (6) require a business plan; (7) introduce competition among partners to the extent possible; (8) require real co-funding or risk sharing on the part of commercial partners; (9) avoid making awards on the basis of job creation (jobs are a cost, not a benefit); and (10) terminate projects that aren't performing.

NASA's Commercial Technology Program

by Kevin Barquinero

Kevin Barquinero is executive secretary of the NASA Commercial Technology Management Team and a member of the Commercial Technology Division in OAST. "All of us must be involved in technology transfer," he said. "We are a Cold War agency and the Cold War is over. We must push knowledge out of the Agency, and from contractors, to the general public." His prepared remarks follow:

Over the past two years a NASA-wide team, the NASA Commercial Technology Management Team, dedicated itself to reinventing how NASA maximizes its contribution to the nation's economy through technology investments. Last July, Administrator Goldin approved the team's strategic plan titled "NASA Commercial Technology: Agenda for Change." This presentation reviews the team's reinvention process and progress.

The first issue the team addressed was leadership. Successful technology commercialization involves NASA technologists (the knowledge "owners") at field centers interacting with industry technologists (the knowledge "seekers"). Success, therefore, requires that the majority of activity must occur between a field center and a firm. However, NASA's traditional approach was a technology transfer process centered at Headquarters in Washington, with minimal field center participation. The Agenda for Change changed this. It established a field center-led program with increased resources for marketing, business practices, metrics, training, and an electronic network. In addition, it delegated authority and responsibility for creating commercial technology partnerships with industry on each NASA program and technical organization.

These changes are consistent with the National Performance Review's requirement that NASA devote 10 percent to 20 percent of its budget to R&D partnerships with industry. The team recognized two prerequisites to meet the NPR requirement. First, the agency must understand the commercial value embedded in its technology investments. This knowledge will enable managers to actively seek partnerships with industry. Second, we must be able to track these partnerships. Since such a management information system does not exist, the team is creating one. "TechTracS" will integrate existing financial and procurement data and serve as an inventory of all NASA technologies, including those with potential commercial value. It will be a record of commercial technology partnerships and will enable future assessments of the partnerships' contributions to the economy. The most important aspect of this system is that each Associate Administrator will be responsible for assessing and reporting on his or her respective technology investments.

As the team delved deeper, it recognized a fact that has been overlooked in most technology transfer discussions: as measured by budget, 90% of NASA's investment in technology flows through procurement actions, hence 90% of NASA technology knowledge "owners" are not civil servants! The knowledge "owners" are the contractors, grantees, and others working for NASA. They, too, must establish commercial technology partnerships, or commercialize the technology themselves. This recognition places a new obligation on NASA managers to manage their programs such that our contractors and grantees are motivated to develop commercial technology partnerships as part of the technology programs in which NASA is both the customer and sponsor—and do so while accomplishing the mission's goals. This task is not as daunting as it seems. First, the top 25 contractors are responsible for over two-thirds of NASA's total investments. By successfully modifying our working relationships with these companies we will affect the majority of our technologies. Second, by establishing these partnerships at the inception of a project, the manager will increase the likelihood of commercializing technology while maintaining appropriate program control.

Realizing the commercial potential of our technology investments while accomplishing NASA's aeronautics and space missions is a challenge. It requires a new way of doing our business, a new way of managing our programs. Successfully performing the Commercial Technology Mission will demonstrate that the taxpayer's investment in NASA is an investment in the nation's future for aeronautics, space, and U.S. economic competitiveness.

The Future of Technology Policy

by Steve Moran

Steve Moran is with the White House Office of Science and Technology Policy. His wide-ranging topic dealt with "The Future of Technology Policy, Agency Collaboration and the Restructuring of the Federal Laboratory System."

Moran began with an overview of the Administration's science and technology initiatives, including the restructuring of the International Space Station and the Advanced Technology Program. "The space station is restructured but saved," he said, "and it is very important we maintain it." He added: "International cooperation is crucial in the future of lower budgets." With the Russians brought on board as full partners, Moran felt it was also necessary for the Department of Defense, the Department of Energy and NASA to collaborate to meet national needs, such as joint use of facilities and joint efforts.

"Commercial space is becoming a reality," Moran stated, pointing to the once mainly military and now mainly commercial use of the Global Positioning System for ship navigation, air traffic control and mobile communications. "By 2005, this will be a $5 billion-a-year industry," he predicted, noting its potential in direct broadcast television services. He lamented our ground based hybrid of fiber optics, copper and coaxial cable communications. "Emerging nations can leapfrog us" if we do not agree on a National Information Infrastructure.

These and other Administration initiatives were expected to be unveiled in a Presidential Directive slated for January 1996. Besides new directions for a national space policy, building and construction initiatives and advances such as enhancements to the World Wide Web White House Home Page, the directive will focus on transportation infrastructure in a $70 billion research and development proposal. The Advanced Technology Program under ARPA, for example, will be a "high priority" since the U.S. civil aircraft market has lost a 30% share to a company, Airbus, that did not even exist 15 years ago.

"Faster, better, cheaper has a lot of support in the Administration," Moran stated, but the new Republican majority threatens not only new science and technology initiatives, but also existing high tech programs. "The reality is grim for R&D in S&T," he said, noting that "Japan now invests more in R&D than the U.S." while the Congress "erroneously labels it as 'corporate welfare.'"

During open discussion, Moran failed to provide a satisfying answer to the question: "Why the [recently announced] $5 billion cut in NASA's budget?" Another comment suggested we are not in a Cold War but a Technology War instead. Agreement did seem to emerge around the statement that "science may be the engine of economy, but technology is the driver."

Project Management Development Process (PMDP)

by Dr. Edward J. Hoffman

PPMI Program Manager Ed Hoffman outlined the new NASA Project Management Development Process. Two years ago, PPMI sponsored a study of career paths at NASA, interviewing 150 people and groups at system and subsystem levels, asking them: What is required for excellence in project management? The results are charted on the next two pages, under Requirements and Core Training. This led NASA senior management to support the first NASA-wide formal development process for project management.

During visits to each NASA Center, Hoffman and General Spence "Sam" Armstrong, Associate Administrator for Human Resources and Education, uncovered only one sticking point: that career development for project management should not become a "certification program," neither a barrier nor a guarantee, but rather a professional career opportunity. As a result, the project management development process is designed to be voluntary (not selected into it), non-bureaucratic (with a minimum of paperwork), and fair to all who participate. General John R. Dailey, Acting Deputy Administrator, announced his support for the process shortly after the program.

Armstrong and Hoffman were then featured in a 14-minute video on the "Project Management Development Process." (This tape, as well as indepth handbooks describing the process, is available through all Center training or project offices. In addition, interested individuals can contact Ed Hoffman at (202) 358-2182 to discuss the PMDP.) Four levels, as depicted on the chart, were explained, along with the development system.

Hoffman noted that this is a process, not a program, because it is ongoing, even for senior managers. In a question-answer session, a participant wondered aloud, Why go through this when agencies are downsizing? Hoffman replied that the world may be in continuous change for a long time, and that development opportunities make people more valuable on the outside, too. "In addition, the development process is the right idea at the right time. We have received much interest from within NASA, as well as from industry and other government agencies." He added that both a manager's guide and a participant's guide to the process would be available in a week. "We tried to get fairness in the structure," he noted, "and put down on paper what was identified by members of the project management community."

Requirements (knowledge, skills and abilities, experiences and other characteristics) for effective performance at the four levels of program and project management follow on the next two pages.

Career Development for Project Management

	LEVEL ONE — REQUIREMENTS	LEVEL TWO — REQUIREMENTS
Organizational Knowledge	All of the following: • NMI 7120.4 • Mission operations policies, processes and organizational aspects • NASA Project Life Cycle	• Developing and overseeing Agency or multi-installation mission operations conceptualization, training, testing, review and implementation (O) • Knowledge of NASA's political environment (E)
Technical	• Hands-on hardware/software/operations (R) • Configuration management systems and procedures (R) • Quality assurance (R) Three of the following: • Systems engineering (design, development and integration) • Operations research • Systems performance and testing • Ground system configuration, plans and procedures • Breadboarding • Performance analysis • Construction of facilities process • Engineering fabrication process • Materials selection • Knowledge of logistics	Two of the following: • Designing and developing hardware/software • Testing and reviewing hardware/software • Systems performance and testing • Overseeing the creation, maintenance, and reporting of data/records regarding the verification of hardware and software items
Technical Management	• Reviewing other engineers' work	Two of the following: • Managing contractor technical work • Supervising hardware/software implementation • Integrated Logistics Support (ILS) planning and implementation • Managing people
Project Life-Cycle and Program Control	All of the following: • Knowledge of budget cycle and process • Knowledge of program flow • Work breakdown structure definition • Knowledge of scheduling process and tools	• Budget creation and management (R) All of the following: • Cost estimation and control (balancing costs with schedule and performance, controlling money, measuring earned value, etc.) • Projecting the effects of program/project changes on life cycle costs • Work breakdown structure definition • Scheduling process and tools • Requirements definition and documentation • Program Operating Plan (POP) development
Contract/Acquisition	• Knowledge of contract administration (contract types, role of COTR, procurement law, SOW preparation, etc.) (R)	All of the following: • Contract administration (contract types, role of COTR, federal procurement law, SOW preparation, etc.) • Involvement in evaluating contractor progress in light of project characteristics (schedule, cost, etc.) • Involvement in general management and execution of systems engineering in conjunction with the contractor team • Designing an acquisition management approach, including advance planning and post award contract management
Individual and Team Development	All of the following: • Communication (verbal and written): reports, presentations, listening • Participation in team problem solving activities • Reading to continuously update technical knowledge	All of the following: • Knowledge of human motivation and small group dynamics • Knowledge of NASA personnel system • Participation in team problem-solving activities • Delivering presentations • Writing reports, requirements, SOWs, etc. • Leading teams (setting direction, managing work, motivating workers)
Agency, Business and International Relations	• Knowledge of issues in intra/inter-center relations (R)	All of the following: • Knowledge of business management and its relationship to government • Knowledge of issues in inter-agency and international relations
Risk Management and Safety	One of the following: • Knowledge of probabilistic risk analysis • Safety and risk management processes, strategies and requirements	Two of the following: • Knowledge of probabilistic risk analysis • Knowledge of risk management processes and strategies • Identifying and evaluating risks
	Core Training Task Management (R) Systems Engineering (R) Management of Major System Programs and Projects (R) Crossing Department Lines (O) Installation-level Professional Development Program (O) Program Control Overview (O)	**Core Training** Project Management (R) Program Control Overview (R) Installation Leadership Programs (O) Professional Development Program (O)

KEY

(O) = Optional
(R) = Required
(E) = Encouraged

Career Development for Project Management

	LEVEL THREE REQUIREMENTS	LEVEL FOUR REQUIREMENTS
Organizational Knowledge	• Knowledge of NASA's political environment (R) • Strategic Planning (E)	All of the following: • Knowledge of NASA's political environment • Strategic Planning
Technical	Maintain knowledge of technical state-of-the-art concepts and techniques (R)	• Maintain knowledge of technical state-of-the-art concepts and techniques (R)
Technical Management	Four of the following: • Coordinating and overseeing the identification of systems engineering design issues • Oversee total system trade-off and design • Management of designing engineering products and fabrication processes • Managing total contract • ILS planning and implementation • Customer interface and management	• Ensure projects are managed consistent with NMI 7120.4 • Knowledge of program system/requirements • Interface with program office
Project Life-Cycle and Program Control	Three to five of the following: • Assessing affordability and ensuring consistency with Agency requirements • Projecting the effects of program and project changes on life cycle costs • Preparing a Program Operating Plan (POP) • Maintaining fund data • Developing and monitoring master schedules	All of the following: • Budget creation and management • Developing and monitoring project schedules • Project control and oversight – Total project accountability – Lead formulation of project – Advocacy – Ensure mission success – Interfacing with all project implementation organizations and Headquarters
Contract/Acquisition	Three of the following: • Contractor management (establishing realistic procurement plans, proposal review, contract negotiation, etc.) • Acquisition management policies and procedures • Designing an acquisition management approach • Linking acquisition management to control gates of NASA project life cycle • Contractor management • Monitoring contractor progress using contractor-provided financial reports and project execution (performance) information	• Determining award fee (R) • Managing the entire acquisition process (R)
Individual and Team Development	All of the following: • Knowledge of NASA training and career development systems • Knowledge of NASA personnel system • Teamwork (including team selection, rewarding, participation, empowerment and conflict management) • Managing people (including recruiting, developing, coaching and evaluating) • Delegating responsibility and authority • Planning (such as contingency, resources, roles and plans) • Decision making • Creative problem-solving and trouble shooting • Conflict management and resolution	Management of human resource and organization system development to ensure the following: • Knowledge of formal training courses and programs available for employees • Teamwork (including team selection, rewarding, participation, empowerment and conflict management) • Managing people (including recruiting, developing, coaching and evaluating) • Delegating responsibility and authority • Planning (such as contingency, project, strategic, resource and meeting) • Negotiating and compromise (on requirements, resources, roles and plans) • Decision making • Creative problem-solving and trouble shooting • Conflict management and resolution
Agency, Business and International Relations	All of the following: • Business management in government • Working across installation and organizational lines • Public relations strategies	All of the following: • Working across Agency, field installation, and international lines • Handling the press
Risk Management and Safety	One of the following: • Compiling a risk management plan • General oversight of a Safety Management Plan • Safety requirements and related design requirements	• Providing general oversight of risk and safety issues, procedures and programs
	Core Training Advanced Project Management (R) Source Evaluation Board (O) Management Education Program (O) Managing the Influence Process (O) SES Candidate Development Program (O)	**Core Training** Executive Project Management Conference (O) Senior Executive Program (O)

KEY

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(R) = Required
(E) = Encouraged