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U.S. Department of Commerce
Washington, D.C. 20230

U.S. DEPARTMENT OF COMMERCE



TECHNOLOGY ADMINISTRATION

THE ASSISTANT SECRETARY
FOR TECHNOLOGY POLICY
TECHNOLOGY ADMINISTRATION

FACSIMILE TRANSMITTAL SHEET

Number of Pages (including cover sheet): 13

Telephone Number: 202/377-1581
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Room: HCHB 4814-C

Date: 2/11/91

To: Olin Wethington

Agency/Company: _____

FAX number: 456-7739 Telephone number: _____

From: Deynah L Winee Smitz

Division: _____

Telephone: _____

SPECIAL INSTRUCTIONS/MESSAGE: _____
I have placed a * next to
relevant text for your interest

Why US Conversion to metric system is a Key
Competitiveness issue.

*

World trade is increasingly geared towards the metric system of measurement. Industry in the United States is often at a competitive disadvantage when dealing in international markets because its measurement system differs from that used by the rest of the world, and is sometimes excluded when it is unable to deliver goods which are built to metric specifications.



UNITED STATES DEPARTMENT OF COMMERCE
Technology Administration
Washington, D.C. 20230

DRAFT

Initiative: Voluntary Implementation of the Metric System

Background: The importance of using the metric system in international trade was recently underscored during the bilateral negotiations between the U.S. and Japan on removing structural impediments to trade. The Japanese emphasized that the non-metric character of U.S. goods is a significant impediment to sales in their market. While the importance of metric usage in our products may vary from case to case, the measurements we use in making our products undoubtedly influences their acceptability in many markets. The advice from Japan is not a surprise. Many U.S. companies find that inch-pound standards are out of favor abroad. As the European Community unifies their industrial standards under EC-92, their preferences for metric will grow. These metric standards are already being harmonized informally as the United Kingdom, France, Germany, Japan and other metric countries exploit new business opportunities in Eastern Europe and the Soviet Union

A little noticed provision of the Omnibus Trade and Competitiveness Act which President Reagan signed into law on August 23, 1988 dealt with the adverse impact on U.S. competitiveness of our failure to complete our transition to use of the metric system in trade and commerce.

This law conveys an important policy statement by the Congress that metric is the preferred system of measurement for United States trade and commerce. The law also requires Federal Agencies to lead the process of voluntary change to preferred metric usage through use of metric in government contracts, grants and other business related activities and in government publications.

The law authorizes exceptions where metric use is impractical, disruptive or would adversely impact U.S. businesses. And, of course, our program remains voluntary with private business and the general public.

One thing we have learned from others is that the metric system really is a better system, and the transition is really relatively easy. Within this country the entire U.S. auto and farm equipment industries and their many small business suppliers went metric and achieved enormous savings and operational benefits. Many of our larger multi-national firms in other industries have also changed and in most instances the gains in productivity and competitiveness have been accomplished with little or no adverse impact on small business suppliers or on workers.

Suggested Language: (for State of Union) - or a speech

* An important factor in American competitiveness in international markets is adoption of the standard of weights and measures used throughout the world -- the metric system. Without exception, all of our major trading partners have adopted this standard. While Europe has been on the metric standard for centuries, others have adopted it more recently -- Japan and India in the '50s, the United Kingdom and the Commonwealth Nations in the '60s and '70s, and Canada, which began its conversion program when the U.S. did in 1975, largely completed it in 1985.

*Voluntary Implementation of the Metric System
State of the Union Initiative
Page 2 of 2*

In 1988, President Reagan signed into law the Omnibus Trade and Competitiveness Act, a provision of which established metric as the nation's preferred system of weights and measures. This law called upon federal agencies to lead the process of voluntary change by adopting metric standards in government contracts.

I realize that it is human nature to be concerned about change, no matter how smooth the process and how great the promised benefits. But if we fail to act now, our international competitors will gain a tremendous market advantage.

To demonstrate our resolve and strengthen our commitment to this transition, I am calling upon all federal departments and agencies to expedite their efforts to meet the target dates set forth in the 1988 Trade Act. And I am charging the Secretary of Commerce with the responsibility for leadership and coordination of these efforts.

However, let there be no misunderstanding about our objective. Although use of the metric system by the federal government will be beneficial to the government in its own operations, the most important changes and the greatest benefits of the change will be in American industry, commerce, education and, ultimately, in economic benefits and improved quality of life for our citizens today and in future generations.

FORM CD-183
(REV. 3-88)

U.S. DEPARTMENT OF COMMERCE

ABSTRACT OF SECRETARIAL CORRESPONDENCE

TO: The Secretary The Deputy Secretary Control No:

Date: FEB 4 1991

DECISION MEMORANDUM

From: Robert M. White *R.M.W.* Under Secretary for Technology Wendell L. Willkie, II General Counsel

Prepared by: ASWhelihan TAMPO/377-3754 MALevitt GC/377-3151

Subject: METRIC EXECUTIVE ORDER

DRAFT

STATEMENT OF THE ISSUE

* Presidential commitment and assignment of leadership authority through issuance of an Executive Order on metric conversion is necessary to accelerate that conversion and to implement the 1988 Trade and Competitiveness Act's (the Trade Act) Metric Usage provisions.

BACKGROUND

- * The Department of Commerce has provided federal support for U.S. voluntary metrication activities since funding for the U. S. Metric Board ended on September 30, 1982.
- * The Trade Act changed our national metric policy from "accommodating the increasing use of metric" to a declared preference for metric in U.S. trade and commerce. In addition, all Federal agencies are now directed to implement the new policy through specific metric usage initiatives. No single agency is specifically assigned an overall leadership or management role.
- * The Trade Act's significant amendment of the Metric Conversion Act of 1975 was accomplished with little fanfare. As a result, the level of awareness in government, industry, professional groups and the general public remains very low. This low level of awareness and the lack of an Administration statement on the issue makes it very difficult to develop a broad based voluntary move to promptly implement the transition to preferred use of metric units.
- * An Executive Order on metric would deal with an issue worthy of Presidential attention and would impress on agency heads the commitment of this Administration to achieve preferred metric usage in United States trade and commerce as called for in the Metric Conversion Act, as amended by the Trade Act.

SURNAME & ORGANIZATION (Please type)	PREPARED BY	CLEARED BY	CLEARED BY	CLEARED BY	CLEARED BY	CLEARED BY	CLEARED BY
	R.M. WHITE U/S TECH.	W.L. WILLKIE GC					
INITIALS AND DATE	<i>R.M.W.</i> 1/18						

* In October 1988, OMB offered Commerce the opportunity to develop language for an Executive Order to guide implementation of the Trade Act's Metric Usage provisions. The requested language was prepared and submitted. OMB later decided to combine all of the Trade Act implementation guidance in a single Executive Order. Unfortunately, last minute edits of the metric text and the rush to issue the Order, which implemented sanctions against Toshiba, resulted in dropping the metric language from the Order.

* At Congressional oversight hearings on April 24, 1990, A/S Wince-Smith agreed in principle in response to a question by the Committee Chairman regarding the desirability of an Executive Order. We subsequently drafted a proposed Executive Order and circulated it to the Metrication Operating Committee (MOC), the working arm of the Interagency Council on Metric Policy (ICMP), where various agency suggestions for strengthening the draft were received and subsequently incorporated. The ICMP met on October 24, reviewed the draft Executive Order, and voted unanimously to request your endorsement and forwarding of a request for issuance of an Executive Order to OMB.

RECOMMENDATIONS

1. We recommend that you approve submission of the attached draft Metric Executive Order to OMB which: assigns the Commerce Department to be "lead Agency" for coordinating the Federal Government's metric transition, authorizes you to create necessary interagency and advisory groups to assist you, requires Federal agencies to submit their metric transition plans to the Department for review, and calls for heads of departments and agencies to give their full support to metric transition.

DECISION

Approve _____ Disapprove _____ Let's Discuss _____

2. We also recommend that you approve (but not send yet) the attached letter to each of the ICMP agency heads requesting their strong support for the Order. The letter also exhorts them to take a personal interest in spurring action in their agencies to meet the 1992 target for Federal metric usage implementation. We would send this letter to agency heads at the time OMB releases the draft Executive Order for agency comment.

DECISION

Approve _____ Disapprove _____ Let's Discuss _____

Attachments



**GENERAL COUNSEL OF THE
UNITED STATES DEPARTMENT OF COMMERCE**
Washington, D.C. 20230

FEB 4 1991

DRAFT

MEMORANDUM FOR: ROBERT G. DAMUS
Acting General Counsel
Office of Management and Budget

FROM: Wendell L. Willkie, II

SUBJECT: Executive Order on Metric Usage in Federal Government Programs

X [World trade is increasingly geared towards the metric system of measurement. Industry in the United States is often at a competitive disadvantage when dealing in international markets because its measurement system differs from that used by the rest of the world, and is sometimes excluded when it is unable to deliver goods which are built to metric specifications.

The Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418) (the Trade Act) amended the Metric Conversion Act of 1975 (P.L. 94-168) (the Metric Act), codified in 15 U.S.C. § 205, to designate the metric system as the preferred system of weights and measures for United States trade and commerce. Section 5164(b) of the Trade Act amends 15 U.S.C. § 205b to require Federal agencies, by a date certain, and to the extent economically feasible by the end of fiscal year 1992, to use the metric system of measurement in its procurements, grants and other business-related activities, except to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms. Section 5164(c) further amends 15 U.S.C. § 205 to require Federal agencies to establish guidelines to carry out the policy of the amended Metric Act, and to report to the Congress their metric transition accomplishments and metric implementation plans.

The Trade Act amendments state the need for all agencies of the Federal Government to assist industry, especially small business, as it voluntarily converts to the metric system, and to increase understanding of the metric system through educational information and guidance and in Government publications. The amendments also note that the metric system can provide substantial advantages to the Federal Government in its own operations.

The Commerce Department's involvement in metric conversion arose in 1982 when the United States Metric Board's ("USMB") funding ended. President Reagan, in a letter of appreciation to the Chairman of the Board, stated that the functions of the USMB for voluntary metric conversion would be assumed by the Department.

In light of the 1988 Trade Act amendments and the Department of Commerce's assigned role, we have prepared an Executive Order to clarify and outline Executive Branch policies and responsibilities in implementing the Metric Act as amended. The Executive Order would (i) charge the Executive Branch with the task of implementing metric to provide substantial advantages in its own operations; (ii) require the development by Federal agencies of procedures and techniques to assist industry, especially small business, as it voluntarily converts; and (iii) assign to the Secretary of Commerce specific responsibilities and authority to lead implementation of the new provisions of the Metric Act. The Executive Order addresses coordinating Federal activities in planning for metric transition; assisting industry in its voluntary transition to metric; increasing understanding of the metric system through educational information, guidance and government publications; establishing Federal metric guidelines; and developing Federal agency metric implementation plans. The Executive Order would establish the leadership role of the Secretary of Commerce and the linkage of his responsibilities with the advisory and coordinating role of the Interagency Council on Metric Policy. An ICMP membership list is attached for your reference. The ICMP met recently and voted unanimously to request issuance of a strong metric Executive Order.

I recommend that the Executive Order be cleared for approval by the President. Any questions regarding the Executive Order can be referred to Lisa Sockett of the General Counsel's Office at 377-8843.

Attachments

MEMBERS OF THE
INTERAGENCY COUNCIL ON METRIC POLICY
1990

Department of Agriculture	General Services Administration
Department of Commerce	Government Printing Office
Department of Defense	
Department of Education	Interstate Commerce Commission
Department of Energy	
Department of Health and Human Services	National Aeronautics and Space Administration
Department of Housing and Urban Development	National Science Foundation
Department of the Interior	Nuclear Regulatory Commission
Department of Justice	
Department of Labor	Office of Personnel Management
Department of State	Office of Science and Technology Policy
Department of Transportation	Office of the U.S. Trade Representative
Department of the Treasury	
Department of Veterans Affairs	
Central Intelligence Agency	Small Agency Council/Smithsonian Institution
	Small Business Administration
Commodity Futures Trading Commission	
Consumer Product Safety Commission	
	Tennessee Valley Authority
Environmental Protection Agency	
Export-Import Bank of the United States	U.S. International Trade Commission
	U.S. Postal Service
Federal Communications Commission	
Federal Emergency Management Agency	
Federal Maritime Commission	
Federal Reserve Board	
Federal Trade Commission	

Executive Order No. _____ of _____, 1991

Metric Usage in Federal Government Programs

WHEREAS Congress amended the Metric Conversion Act of 1975 (15 U.S.C. § 205) (P.L. 94-168) (the Metric Act) through Section 5164 of the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418) to designate the metric system of measurement as the preferred system of weights and measures for United States trade and commerce; and

WHEREAS in such amendments Congress provided for the performance of certain functions by the Federal Government with respect to metric usage;

NOW, THEREFORE, by virtue of the authority vested in me as President by the Constitution and laws of the United States of America, including 15 U.S.C. § 205, it is hereby ordered as follows:

Section 1. *Designation of Lead Agency.*

- (a) The Department of Commerce is hereby designated and empowered as the lead agency responsible for coordinating Federal Government metric usage in accordance with 15 U.S.C. § 205b.
- (b) The Secretary of Commerce is hereby authorized to take such actions, including the promulgation of rules and regulations, as may be necessary to carry out the purposes of this Order.
- (c) The Secretary of Commerce is hereby authorized to charter an Interagency Council on Metric Policy (ICMP), which will assist the Secretary in coordinating Federal Government-wide implementation of this Order. The Secretary of Commerce may establish such subcommittees and sub-Chairs within this interagency committee as may be necessary to carry out the purposes of this Order.
- (d) The Secretary of Commerce is authorized to form such advisory committees representing other interests such as state and local governments and the business community as may be necessary to ensure the maximum beneficial effects of this Order.
- (e) The Secretary of Commerce shall report to me on progress made in implementing this Order. The Secretary's report shall include an assessment of progress made by the Federal agencies and of the effect of Federal metric usage on achievement of the National objective of preferred metric usage in United States trade and commerce, as set forth in the Metric Act. On October 1, 1992, the Secretary shall prepare recommendations for any additional measures, including, but not limited to, regulations or legislation, needed to achieve the full economic benefits of metric usage.

Section 2. Department and Agency Responsibilities.

All agencies of the Executive Branch of the United States Government are directed to take all appropriate measures within their authority to carry out the provisions of this Order. Consistent with this mission, the head of each Executive department and agency shall:

(1) Use, by September 30, 1992, or by such other date or dates established by the department or agency in consultation with the Secretary of Commerce, the metric system of measurement in Federal Government procurements, grants, and other business-related activities. Other business-related activities include all use of measurement units in agency mission programs and functions as further defined in Metric Conversion Policy for Federal Agencies (15 CFR Subpart 19). Metric usage shall not be required to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms. Heads of departments and agencies shall establish an effective process for a policy-level review of proposed exceptions to metric usage. Appropriate information about exceptions granted shall be included in the agency annual report along with recommendations for actions to enable future metric usage.

(2) Seek out ways to increase understanding of the metric system of measurement through educational information and guidance and in government publications. The transition to use of metric units in government publications shall be made as publications are revised on normal schedules or new publications are developed, or as metric publications are required for support of metric usage pursuant to paragraph (1) above.

(3) Seek the appropriate aid, assistance and cooperation of other affected parties, including other Federal, state and local agencies and the private sector, in implementing this Order. Appropriate use shall be made of governmental, trade, professional and private sector metric coordinating groups to ensure the maximum beneficial effects of this Order.

(4) Formulate metric transition plans for the department or agency which shall be approved by the department and agency head and shall be in effect by September 30, 1991. Copies of approved plans shall be forwarded to the Secretary of Commerce. Such metric transition plans shall specify, among other things:

(A) the total scope of the metric transition task for that department or agency, including firm dates for all metric accomplishment milestones for the current and subsequent fiscal years;

(B) the department or agency's plans for specific initiatives to assist industry, especially small business, as it voluntarily converts to the metric system, and for cooperating with all affected parties in undertaking the requirements of paragraph (1) of this Section; and

(C) specific steps and associated schedules through which the department or agency will seek to increase understanding of the metric system through educational information and guidance and in department or agency publications.

(5) Designate a senior level official as the Metric Executive for the department or agency to assist the head of each Executive department or agency in implementing this Order. The responsibilities of the Metric Executive shall include, but not be limited to:

(A) acting as the department's or agency's policy level representative on the ICMP and for liaison with other government agencies and private sector groups;

(B) management oversight of department or agency outreach and response to industry and agency client inquiries and questions during the transition to metric system usage; and

(C) management oversight of preparation of the department or agency's metric transition plans and progress reports, including the Annual Metric Report required by 15 U.S.C. § 205j and OMB Circular A-11.

(D) Preparation by June 30, 1992, of an assessment of agency progress and problems together with recommendations for steps to assure successful implementation of this Order. The assessment and recommendations shall be approved by the head of the department or agency and provided to the Secretary of Commerce by June 30, 1992, for inclusion in his September 30, 1992, report on implementation of this Order.

Section 3. *Application of Resources.*

The head of each Executive department and agency shall be responsible for implementing and applying the necessary resources to accomplish the goals set forth in this Executive Order and the Metric Act.

Section 4. *Internal Management Document.*

This Order is an internal Executive Branch management document and is not intended to create any right or benefit, substantive or procedural, enforceable at law by a party against the United States, its agencies, its officers or any other person.

THE WHITE HOUSE

Letter addressed to individual heads of departments and agencies:

Dear:

In June 1989 I wrote to the heads of the departments and agencies represented on the Interagency Council on Metric Policy. In that letter I urged strong support for metric usage. The agencies are required by the 1988 amendments to the Metric Conversion Act to complete their transition to the use of the metric system of units, as set forth in the law, by September 30, 1992, to the extent economically feasible, or by a date certain.

Last year the General Accounting Office reviewed progress in the transition to metric usage by Federal agencies, and its report was somewhat critical of the apparent slow rate of progress in some agencies. A Congressional hearing was held on April 25, 1990, which examined the report and received testimony by several agency officials. At the hearing, the advisability and beneficial effect of a metric Executive Order was discussed.

The Interagency Council on Metric Policy (ICMP), chaired by Dr. Robert M. White, Under Secretary of Commerce for Technology, reviewed a draft Executive Order at its October meeting and voted unanimously for issuance of such an Order, but with even more specific and forceful language. The ICMP members believe, and I agree, that the President's strong policy statement and firm guidance is essential for the Federal government to implement metric usage by September 1992.

The draft Executive Order, which I have sent to OMB, reflects the ICMP consensus and carries my unqualified endorsement. I ask that you support issuance of the Order.

I look forward to your continuing efforts to expedite metric transition.

Sincerely,

Robert A. Mosbacher

OLW

File FCCSET

THE WHITE HOUSE
WASHINGTON

Date: 10/11/90

TO: Ede Holiday

FROM: **STEPHEN I. DANZANSKY**
Deputy Assistant to the President
and Director of Cabinet Affairs

This Bromley memo may provide some background and light on the FCCSET mandate and relationship with the DPC & EPC.

It may be useful later if we get into future "turf" battles on jurisdiction.

THE WHITE HOUSE
WASHINGTON

February 16, 1990

DQB has seen

2/17

MEMORANDUM FOR DAVID Q. BATES

FROM: D. ALLAN BROMLEY *DA*

SUBJECT: FEDERAL COORDINATING COUNCIL FOR SCIENCE,
ENGINEERING AND TECHNOLOGY

Your memorandum of February 5, 1990 concerning the structure and operations of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) is greatly appreciated. Ken Yale's participation in the first FCCSET meeting on January 24, and his subsequent conversations with Tom Ratchford on a variety of issues related to FCCSET have also been immensely helpful. Clearly, it will be a significant challenge to develop and coordinate truly national research programs from various components in several agencies. However, the success of the FCCSET Committee on Earth Sciences in the area of global change does, I believe, point the way for other areas of research and development.

Although the primary responsibility of the FCCSET is to coordinate R&D among the federal agencies, and the overwhelming fraction of the efforts of its committees will be directed toward accomplishment of this mainly technical task, the FCCSET should play a constructive policy role with respect to the Cabinet Councils. Below are some preliminary thoughts on how this might be structured; I would be pleased to discuss the issue with you in more detail, at your convenience.

The major policy role of FCCSET would be to provide expertise and analyses to the DPC, EPC, NSC, as well as the Space and Competitiveness Councils. Typically the issues would be very broad, with science and technology playing an important but subsidiary role. In many - perhaps most - cases, the FCCSET could be tasked by the appropriate council to provide analysis of a particular issue. In some cases, alternative options might be analyzed by the appropriate FCCSET committee, in response to specific requests by a council. In other cases - probably not very many - a broad issue with mainly scientific and technological content might evolve to the point of deserving consideration by a council.

What we need are effective ways for the councils to identify policy issues to be sent to the FCCSET. With some thought and planning, I believe this can be done in an operationally satisfactory manner.

cc: STEVE
OLIN

RICHARD -
NOT SURE WE ARE WORKING
AROUND THESE LINKS - TALK
A MEETING w/ KEN IS IN
ORDER. BARRY

Somewhat easier to conceptualize, is the process by which policy issues might originate in FCCSET and be fed into the appropriate council. As FCCSET chairman, and a member of EPC and DPC, it would be my responsibility to propose these council agenda items.

The above discussion has focussed on what I call science and technology for policy: i.e., making sure that the best science and technology (from the FCCSET) is made available in a timely, "user friendly" manner to the policy fora (Cabinet Councils). An example of this is the input of the FCCSET Committee on Earth Sciences to the DPC Climate Change Working Group.

In addition to science and technology for policy, there is also a need, in some cases, to provide policy for science and technology. This class of issues typically is not important enough - on the national scale - to earn attention from a Cabinet Council, and could be resolved directly by the FCCSET. An example of this class of issues is the setting of priority among and within areas of basic research.

I am convinced that FCCSET, properly organized and functioning smoothly, will make a significant difference in the coordination and priority setting within federal science and technology programs. This is the primary responsibility of OSTP and of FCCSET as set forth in our founding legislation. FCCSET can also be a useful adjunct to the primary policy fora, and we look forward to working with you to see that this is done in the most effective manner possible.

revised 5/16/90

DRAFT

CHARTER OF THE COMMITTEE ON
TECHNOLOGY AND INDUSTRY

The Committee on Technology and Industry is hereby established by action of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET).

Purpose

The purpose of the Committee on Technology and Industry is to examine, monitor, encourage and increase the effectiveness of federal policies, programs and initiatives to enhance the application of technology by U.S. industry to improve global competitiveness. Particular attention will be given to encouraging industry leadership and initiative in meeting our competitive challenges.

Functions

The Committee on Technology and Industry will:

- o improve planning, communication and coordination among federal agencies which conduct programs affecting the use of technology by industry.
- o develop criteria for identifying generic, precompetitive enabling technologies.
- o identify and assess programs which expedite the commercialization of new technologies by industry in less time and at lower cost, resulting in world-class products and services. These should include efforts in concurrent engineering and management, total quality management, and flexible computer-integrated manufacturing.
- o review options for gaining greater commercial advantage from federal science and technology investments.
- o review the record of commercialization of technologies resulting from Federal R&D support, and recommend a policy for future support of dual use technologies with applications in two or more departments/agencies.
- o identify and address issues that limit the diffusion and exchange of technology among universities, federal laboratories, and industry, including: cooperative R&D efforts, intellectual property rights issues, freedom of information policies, and conflict of interest regulations.

- o identify and assess regulatory and legal barriers that limit the competitiveness of industry, including capital formation, investments in R&D, antitrust policies, product liability burdens, and procurement requirements.
- o improve the coordination of federal technology and industry outreach programs with state and local initiatives, and examine the effectiveness of existing mechanisms based largely in the federal laboratories.
- o identify successful examples of federal technology transfer efforts and private sector R&D advisory mechanisms, and recommend steps to build upon these successes.
- o review federal agency technology "intelligence" efforts to track foreign technology advances, and recommend ways to more effectively gather, process and disseminate such information for use by U.S. industry.
- o address specific technology-industry issues and problems that affect two or more federal agencies.

Structure

The Chairman of the FCCSET appoints as Chairman of the Committee on Technology and Industry, the Deputy Secretary of Commerce. The Vice Chairman of the Committee is the Deputy Administrator of the National Aeronautics and Space Administration.

Responsibilities of the Chairman

- o hold regular meetings of the Committee (no fewer than three per year) and approve agendas.
- o submit an annual report to the Chairman of the FCCSET for review by the full Council.
- o appoint (and as necessary abolish) sub-committees, task forces and working groups as necessary to achieve the committee's purpose.
- o meet regularly with the chairman of the FCCSET and other committee chairmen to evaluate progress, discuss policy coordination, receive new instructions from the FCCSET and report on ongoing activities.

The following departments and agencies are represented on this committee, normally at the Assistant Secretary level or above:

Department of Commerce, Chair
Department of Agriculture
Department of Defense
Department of Education
Department of Labor
Department of Energy
Department of Health and Human Services
Department of Interior
Department of Justice
Department of Transportation
Department of Treasury
Environmental Protection Agency
National Aeronautics and Space Administration
National Science Foundation
U.S. Trade Representative
Central Intelligence Agency
Council on Environmental Quality

Ex-Officio members will be provided by the Office of Management and Budget and the Office of Science and Technology Policy.

Membership on subcommittees, task forces, and working groups is not restricted to committee members and is established as the committee chairman may determine appropriate. The Committee will subsume the previously existing FCCSET Committee on Materials.

A Terms of Reference (ToR) will be developed and approved by the committee chairman for all subcommittees, task forces and working groups dealing with significant and complex questions. The ToR will identify and bound the issues to be addressed and will specify the desired products and delivery times.

The Committee will work closely with other FCCSET committees and interagency groups to include the Competitiveness Council headed by the Vice President.

Committee activities will be coordinated by an Executive Secretary, designated by the committee chairman. Additional staff and funding assistance, consistent with the functions of this charter, will be the responsibility of the chairman.

In all matters considered by the Committee, a numerical majority may act for the committee as a whole.

Private Sector Interface

The Committee will recommend to the Chairman of the FCCSET the nature of private sector advice needed to accomplish its mission. The chairman of the FCCSET will take necessary steps to ensure appropriate interaction between the President's Council of Advisors on Science and Technology (PCAST) and the Committee. The Committee may also receive ad hoc advice from various private sector groups as consistent with the Federal Advisory Committee Act.

Compensation

All members are full-time Federal employees who are allowed reimbursement for travel expenses by their agencies plus per diem or subsistence while away from their duty stations and in accordance with standard government travel regulations.

Documentation

Agendas and records of actions of committee meetings are prepared and disseminated to members by the Executive Secretary. Records of actions are submitted to members for approval. Complete records of all committee activities including those of task forces and working groups, are maintained in the office of the chairman. The Committee prepares a report for the Chairman of the FCCSET not later than 60 days after the end of each fiscal year. The report contains, as a minimum, the Committee's functions; a list of members; a list of subcommittees, task forces and working groups and their charters; the dates, places and agendas for all meetings; and a summary of the Committee's activities, accomplishments and recommendations during the year.

Termination date

Unless renewed by the chairman of FCCSET prior to its expiration, the Committee on Technology and Industry shall terminate not later than May 31, 1992.

Determination

I hereby determine that the formation of the Committee on Technology and Industry is in the public interest in connection with the performance of duties imposed on the Executive Branch by law and that such duties can best be performed through the advice and counsel of such a group.

Approved:

Chairman FCCSET

Date

FAXmail FROM:

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. House of Representatives

July 6, 1990
DATE

TO: Olin Westhington

TO FAX NUMBER: 456-7739

ATTN:

FROM: Chris Wydner
Repl. Legis. Dir.
House Cmte on Science,
Space & Technology

NUMBER OF PAGES SENT: 10
(Includes Cover Sheet)

FROM FAX NUMBER: (202) 225-8280

COMMENTS:

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Preeminence Act

Any problems, call: 225-6684

**ROBERT S. WALKER
FLOOR STATEMENT FOR H.R. 4329**

Mr. Chairman, I join Chairman Roe in supporting the need for a comprehensive emerging technology commercialization bill.

At full Committee hearings held last year on "Creating the New Wealth", it was emphasized that technological development is much more than just an issue of Federal funding. There was a virtually united plea by witnesses for antitrust reform and for tax changes to level the international playing field.

With today's bill, the Science Committee, as the House's competitiveness advocate, will recommend to the Congress what needs to be done across the board, not just for one industry or technology and not just for yesterday or today, but for tomorrow. H.R. 4329, co-authored by the Chairman and myself, has drawn upon vast contributions from many Members on both sides of the aisle, especially Representatives Sherry Boehlert, Don Ritter, Tom Campbell and Jack Buechner from the Republican side. It is, therefore, neither a Democrat nor Republican proposal, but a consensus Science Committee initiative. Nevertheless, the Committee's Republicans are flattered that the Democrat leadership is endorsing our work by adopting it as their own.

The existing core program authorizations in this bill are aggressive but responsible. The National Institute of Standards and Technology (NIST) is increased almost 30% in 1991 to meet President Bush's request to make up for those new initiatives in areas such as superconductivity, fiber optics and advanced materials denied by the

Appropriations Committee last year. NIST would then be increased another 15% in 1992, the pace that would be required for doubling the agency in five years. These levels are consistent with our Committee's consensus views and estimates the Chairman sent to the Budget Committee earlier this year.

The newly authorized Advanced Technology Program is a worthwhile effort to reduce the marginal cost of capital for developing new technologies by leveraging the majority funding of industry-led joint ventures. It is a disciplined approach in that it is competitively awarded, seeks proposals requesting a low percentage of Federal funds, requires payback from profits, and does not discriminate based on ownership against companies that are committed to the U.S. market.

But there is one big problem! Although the \$100 million level for this program in 1991 is consistent with the House Science Committee's bipartisan views and estimates sent to the Budget Committee just a few months ago, the \$250 million 1992 level is veto bait, pure and simple. In fact, the House's own Budget Resolution only designates \$47 million for this program. This bill suggests increasing that level by over 500% in 1992. That is very questionable in light of the crisis Federal budget situation the country finds itself in. I will therefore seek to substitute the Administration-suggested language of "such sums" for this number on the floor so the President can sign this bill.

However, as I mentioned earlier, H.R. 4329 is indeed a comprehensive approach addressing those structural barriers and burdens that so badly hurt our international competitiveness. One way it does this is

by creating a Presidential Commission to make legislative recommendations to Congress within one year to encourage greater private capital investment in technological development.

Congressional representation on this Commission is to be offered as an amendment to the bill later. That is acceptable as long as the appointees of the executive and legislative branches are equal. However, if the Commission is stacked in favor of Congressional domination, it will be fundamentally unacceptable. That would be another unnecessarily partisan nail in the coffin of this bill.

H.R. 4329 as reported by the Science Committee also included a title to amend the National Cooperative Research Act to permit joint production arrangements among nonaffiliated firms. This is becoming essential for the successful innovation and commercialization of new technologies due to their staggeringly high front-end capital costs and associated risk. Since the Science Committee's original initiative, the House has passed antitrust language based on H.R. 4329 and I understand the Judiciary Committee has agreed to the Science Committee's full participation in discussions on the issue with the Senate. In light of this agreement, dropping the antitrust reform title from H.R. 4329 is acceptable.

Overall the bill as reported by the Science Committee is a very good one with the exception I have noted. The rule allows us to address that problem and, hopefully, avoid a veto.

Thank you, Mr. Chairman.

WALKER033

AMENDMENT TO H.R. 4329

OFFERED BY MR. WALKER

[The amendment is stated in terms of page and line numbers of
H.R. 5072.]

Page 30, line 18, strike ``\$250,000,000`` and insert in
lieu thereof ``such sums as may be necessary``.

1 the general applicability of any high resolution information
2 systems or advanced materials research and development
3 program results to other advanced technologies.

4 (e) FEDERAL REGISTER NOTICE.—The Secretary of
5 Commerce shall, within 120 days after the date of appropria-
6 tion of funds pursuant to subsection (f) of this section, publish
7 notice in the Federal Register stating that the Department of
8 Commerce is prepared to accept applications for assistance
9 under section 28 of the Act of March 3, 1901, as amended by
10 this section. Such notice shall include a description of eligibil-
11 ity requirements for assistance under such section 28, and
12 maximum assistance levels expected to be available for such
13 assistance.

14 (f) AUTHORIZATION OF APPROPRIATIONS.—There are
15 authorized to be appropriated to the Secretary of Commerce
16 for carrying out section 28 of the Act of March 3, 1901,
17 \$50,000,000 for fiscal year 1990, \$100,000,000 for fiscal
18 year 1991, and ^{such sums...} ~~\$250,000,000~~ for fiscal year 1992.

19 **TITLE III—AMENDMENTS TO STE-**
20 **VENSON-WYDLER TECHNOLOG-**
21 **Y INNOVATION ACT OF 1980**

22 **SEC. 301. FEDERAL LABORATORY CONSORTIUM.**

23 Section 11(e)(7) of the Stevenson-Wydler Technology
24 Innovation Act of 1980 (15 U.S.C. 3710(e)(7)) is amended—

06/18/90 16:11

002



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20500

June 18, 1990
(House Rules)

STATEMENT OF ADMINISTRATION POLICY

(THIS STATEMENT HAS BEEN COORDINATED BY OMB WITH THE CONCERNED AGENCIES.)

H.R. 4329 - American Technology Preeminence Act
(Roe (D) New Jersey and 45 others)

The Administration opposes enactment of H.R. 4329, as reported by the House Science and Technology Committee on May 10, 1990, and as ordered reported by the House Judiciary Committee on June 12, 1990, unless it is amended to:

- Reduce the appropriations authorizations for the Advanced Technology Program to levels in the 1991 Budget (i.e., from \$100,000,000 to \$10,000,000) and authorize "such sums" for FY 1992.
- Amend the "foreign participation" provisions to ensure that foreign-owned or -controlled companies established in the United States will not be discriminated against with respect to participation in the Advanced Technology Program. The provisions in H.R. 4329 appear inconsistent with U.S. obligations under bilateral investment agreements and other accords. If enacted, they would seriously compromise our bargaining position in urging other nations to adopt similar policies of free and open trade and investment.
- Delete the provision elevating the Director of the Office of Science and Technology Policy (OSTP) from Executive Level II to Level I. This provision would be inconsistent with the current Executive Schedule for the Executive branch. Also, the President recently elevated the position of the Director of OSTP to an Assistant to the President for Science and Technology, making further action unnecessary.

H.R. 4329 contains miscellaneous objectionable provisions which impose inappropriate new requirements on Executive Branch agencies, restrict agency flexibility in managing programs, or are duplicative of existing programs.

* * * * *

TALKING POINTS ON ATP AMENDMENT

- o The new Advanced Technology grant Program, or ATP, was funded for the first time this year at \$10 million.
- o The President is seeking to continue that program at \$10 million in 1991.
- o The House passed Budget Resolution would increase the President's request and current funding almost 500% to \$47 million.
- o But this bill would increase that \$50 million level another 500% in 1992 to one-quarter of a billion dollars - new money we are not currently spending and very probably don't have.
- o Now, Chairman Roe and I have been able to agree that \$100 million is a justifiable level for these new grants and, in fact, recommended that level to the Budget Committee earlier this year.
- o But a quarter of a billion dollars of new spending will put tremendous pressure for cuts in critical existing technological research in such areas as superconductivity, fiber optics, and advanced materials at the National Institute of Standards and Technology. We would be trading off core research for handouts.
- o The Administration "opposes enactment of H.R. 4329 unless it is amended to...authorize "such sums" for FY 1992" for the ATP. My amendment does just that - no more. It is not necessarily a reduction or a cut.
- o This simply defers without prejudice setting an unrealistic and, perhaps, irresponsible grant level until we have a better idea what resources are available for 1992. In light of the crisis Federal budget situation taxpayers find themselves in, and with the uncertainty of the Budget Summit outcome, to commit to a level now is not prudent.
- o Remember, if more than \$250 million is possible in the 1992 budget process, my amendment would permit a higher level of funding - the existing language would not.
- o Therefore, as the Ranking Minority Member on the Science Committee and an original author of H.R. 4329 with Chairman Roe, I simply seek a consensus that will avoid a veto of this critical competitiveness package. It will save the bill!

ROBERT S. WALKER
18TH DISTRICT, PENNSYLVANIA
CHIEF DEPUTY REPUBLICAN WHIP

COMMITTEE:
VICE CHAIRMAN
SCIENCE, SPACE, AND TECHNOLOGY

STAFF IN CHARGE:
CONNIE L. THUMMA
WASHINGTON OFFICE
MARC T. PHILLIPS
DISTRICT OFFICES

Congress of the United States
House of Representatives
Washington, DC 20515

June 20, 1990

Dear Colleague:

Wednesday, July 11,
On ~~Thursday, June 21,~~ the House will consider H.R. 4329, the American Technology Preeminence Act, under an open rule. Overall the bill is very good with one exception.

H.R. 4329 authorizes funding for the first time for a limited program to reduce the marginal cost of capital for developing new technologies by leveraging the funding of industry-led joint ventures. It is a disciplined approach in that it is competitively awarded, seeks proposals requesting a low percentage of Federal funds, requires payback from profits, and does not discriminate based on ownership against companies that are committed to the U.S. market.

But there is one big problem! Although the \$100 million funding level for fiscal year 1991 is consistent with the House Science Committee's bipartisan views and estimates sent to the Budget Committee just a few months ago, the \$250 million 1992 level is veto bait, pure and simple. In fact, the House-passed Budget Resolution only provides \$47 million for this program. H.R. 4329 suggests increasing that level by over 500%. In light of the crisis Federal budget situation, that is very irresponsible.

Since the Administration "opposes enactment of H.R. 4329 unless it is amended to ... authorize "such sums" for FY 1992" for this new grant program, I will offer an amendment on the floor to do just that.

As the Ranking Minority Member on the Science Committee and the original author of H.R. 4329 with Chairman Roe, I simply seek a consensus that will gain enactment of this critical competitiveness package. It will save the bill.

If you have any questions regarding my amendment or H.R. 4329, please contact Chris Wydler at 5-6684.

Sincerely,



Robert S. Walker



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

June 26, 1990
(House)

STATEMENT OF ADMINISTRATION POLICY

(THIS STATEMENT HAS BEEN COORDINATED BY OMB WITH THE CONCERNED AGENCIES.)

H.R. 4329 - American Technology Preeminence Act
(Roe (D) New Jersey and 45 others)

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- Reduce the appropriations authorizations for the Advanced Technology Program to levels in the 1991 Budget (i.e., from \$100,000,000 to \$10,000,000) and authorize "such sums" for FY 1992.
- Amend the "foreign participation" provisions to ensure that foreign-owned or -controlled companies established in the United States will not be discriminated against with respect to participation in the Advanced Technology Program. The provisions in H.R. 4329 appear inconsistent with U.S. obligations under bilateral investment agreements and other accords. If enacted, they would seriously compromise our bargaining position in urging other nations to adopt similar policies of free and open trade and investment.
- Delete the provision elevating the Director of the Office of Science and Technology Policy (OSTP) from Executive Level II to Level I. This provision would be inconsistent with the current Executive Schedule for the Executive branch. Also, the President recently elevated the position of the Director of OSTP to an Assistant to the President for Science and Technology, making further action unnecessary.

H.R. 4329 contains miscellaneous objectionable provisions which impose inappropriate new requirements on Executive Branch agencies, restrict agency flexibility in managing programs, or are duplicative of existing programs.

* * * * *

Not to be Distributed Outside Executive Office of the President)

This Statement of Administration Policy was drafted by the Legislative Reference Division (Bowers), in consultation with the Departments of Commerce (Clark), Justice (Filippini), State (Rappaport), Energy (Hunsieker), Council of Economic Advisors (Holtz-Eaken), the National Aeronautics and Atmospheric Administration (Stehmer), the National Science Foundation (Chester), the Office of Science and Technology Policy (Wells), the Small Business Administration (Broadbent), the U.S. Trade Representative (Richards), TCJ (Beebe and Schwartz), and ES (Noonan and Schwartz).

Time did not permit responses from the following agencies: Departments of Defense and the Treasury, the General Services Administration and the Office of Personnel Management.

This position statement addresses the latest printed version of H.R. 4329, as reported by the House Science Committee on May 10, 1990, and as reportedly amended on June 12, 1990, by the House Judiciary Committee. However, we understand that the bill is still under review by various committees and further amendments are possible.

OSTP (Wells) does not object to the third bullet above concerning the Director of OSTP. (Generally, with the exception of certain Executive Office of the President officials, only Cabinet officers occupy Level I positions.)

H.R. 4329 would authorize appropriations for and modify Commerce Department and other technology-related programs as described below.

Appropriations Authorizations

H.R. 4329 would authorize the core programs of the National Institute of Standards and Technology at the 1990 appropriated level (\$145,301,000), which is \$1 million over the President's 1991 Budget request. This additional \$1,000,000 would be used to fund three earmarkings for programs not requested by the Administration. For FY 1992, the bill authorizes appropriations which are \$17 million over the level in the 1991 Budget.

Commerce's Technology Administration (TA) would be authorized at \$6 million in 1991 and \$7.5 million in 1992, or \$1.4 million and \$2.9 million, respectively, over the 1991 President's Budget level of \$4.6 million.

The bill would authorize appropriations for the Advanced Technology Program (ATP) at \$50 million in 1990, \$100 million in 1991, and \$250 million in 1992. The President's 1991 Budget requests \$10 million (equal to the 1990 appropriated level for this program.) The appropriations authorization levels are displayed below.

	<u>1991 Budget</u> <u>Request</u>	<u>H.R. 4329</u> <u>1991</u>	<u>H.R.4329</u> <u>1992</u>
	(in thousands of dollars)		
NIST Core Programs*	183,408	184,408	210,000
ATP Program	10,000	100,000	250,000
Other TA	<u>4,583</u>	<u>6,500</u>	<u>9,000</u>
TOTAL	197,991	290,908	469,000

*This includes funding for Manufacturing Technology Centers.

Substantive Provisions

In addition to the objectionable features already described, H.R. 4329 would:

- Expand the authority of the ATP to cover additional technical and service areas. (The ATP, established by the 1988 Trade Act, is designed to foster development of precompetitive generic technologies which have broad application across industries.)
- Require the Secretary of Commerce to give preference, when selecting among Advanced Technology proposals of relatively equal merit, to those requiring the lowest percentage of Federal funds.
- Require development of a five-year National High Performance Computing Technology Plan, as contemplated by the Administration, to develop supercomputer hardware and software, and establish a network to coordinate related federally supported research.
- Establish a number of Presidential commissions and boards, including: (1) a Presidential commission on reducing capital costs for emerging technology chaired by the Director of OSTP; (2) a Presidential commission on procurement and technology, chaired by the Director of OSTP, to study how Federal procurement practices could

improve U.S. competitiveness; and (3) an OSTP-sponsored board to foster and monitor the development of U.S.-based high resolution information systems industries, like advanced television.

- Make permanent the current arrangement whereby Federal agencies involved in R&D contribute a small percentage of their budgets to support the activities of the Federal Laboratory Consortium for technology transfer.
- Authorize matching Federal funds for a two-year pilot project to assist other countries in the development industrial standards.
- Require the Secretary of Commerce to give preference, when selecting among Advanced Technology proposals of relatively equal merit, to those requiring the lowest percentage of Federal funds.
- Direct the National Science Foundation to enter into a contract to develop a methodology to establish international product standards, a clear responsibility of NIST.
- Require numerous reports (e.g., require (1) the Director of OSTP to report annually to Congress on all major Science and Technology proposals involving more than one country and costing over \$1 billion; (2) the Secretary of Commerce to report to Congress on the possibility of establishing a Federal on-line information product catalog; (3) the biennial national critical technologies report to include a list of emerging technologies and potential markets for related products; (4) the Secretary of Commerce to report on the feasibility of establishing a privately-funded Quality Institute; (5) the High Resolution Information Systems Board to report to the President annually; and (6) the Director of OSTP to report to Congress on States that historically receive a small share of the Federal R&D dollars).
- Require minimum expenditure levels for steel technology and NIST's Centers for Building Technology and Fire Research; and bar any merger of the Building Technology and Fire Research centers.

Legislative Reference Division Draft
6/14/90 -- 11:30 a.m.

STATEMENT OF ADMINISTRATION POLICY CLEARANCE FORM

Senate Floor Action
House Floor Action

Brief Title AMERICAN TECHNOLOGY PREEMINENCE ACT

BILL # H.R. 4329

RULES

PAD CLEARANCE

- 1) Grady date 6/14/90
- 2) HALE date 6/14/90
- 3) Howard date 6/14/90

Director/Deputy Director Approval

Dorman date 6/14/90

White House Clearance

date / / time : AM/PM

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

June 18, 1990
(House Rules)

STATEMENT OF ADMINISTRATION POLICY

(THIS STATEMENT HAS BEEN COORDINATED BY OMB WITH THE CONCERNED AGENCIES.)

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- Require minimum expenditure levels for steel technology and NIST's Centers for Building Technology and Fire Research; and bar any merger of the Building Technology and Fire Research centers.

Legislative Reference Division Draft
6/14/90 -- 11:30 a.m.

TALKING POINTS ON COMMISSION

- o The bipartisan, consensus bill reported to this floor included a Capital Costs Commission with 13 members appointed by the President.
- o The Democrat leadership has suggested that Congress also appoint some of the Commission's members. No one has any problem with that.
- o But the specifics of the proposal currently before us would substantially change the makeup and control of the Committee-reported Commission.
- o It would provide for 14 Congressional appointees to only 6 Presidential. In light of the fact that the Executive and Legislative branches of government are Constitutionally equal, their representation on a Commission which is to make consensus legislative recommendations should be equal.
- o Worse, however, is the fact that of the 14 Congressional appointees, 10 are to be appointed by the majority to only 4 from the minority. That represents only 28% for Republicans in the House and Senate, even though they make up 41% and 45% of those bodies, respectively. That is even a worse ratio than on the House Rules Committee.
- o This causes one to pause and wonder what the motivation of the majority is. Why try to stack the Commission with such Congressional domination unless a pre-determined industrial policy outcome is desired?
- o As for having equal representation from both branches of government, it is unrealistic, as we all know, to assume that just because one is appointed by House or Senate Republicans that they will follow the Administration line. In fact, often quite the contrary is true. But, in any case, requiring a two-thirds or three-quarter majority vote on all legislative recommendations would protect against that unlikely concern.
- o And since these recommendations are legislative, they will have to be acted on and disposed of by the Congress. We will get the final say. What's the point of proposing something if it is not even supported by the President.
- o So if the Commission is stacked in favor of Congressional domination it will be fundamentally unacceptable to this Member and be yet another objection to the bill by the Administration.
- o This is an unnecessarily partisan nail in the coffin of this bill and I therefore offer a substitute (or amendment to the amendment) to allow each branch to appoint six Commission members with the Democrats appointing two and Republicans one in each House.

**SCIENCE AND TECHNOLOGY
FOR ECONOMIC GROWTH**

Where Do We Stand?

A consensus has been slowly but relentlessly building that the United States faces major challenges to successfully competing in the rapidly changing global markets of the 1990s. Relative competitive position can only be truly assessed over extended periods of time. To achieve such an assessment, the Council on Competitiveness uses four summary indicators of a nation's competitive position: standard of living, trade (share of world exports), productivity, and investment. Based on these indicators, a comparison with the other Summit Seven nations shows the United States lagging the average growth rates for these countries in all four categories over recent 14 and 15 year periods:

Table 1

**U.S. GROWTH SINCE 1972
RELATIVE TO OTHER NATIONS**

(an Index value of 100 represents the average growth rate for Summit Seven)

<u>Competitiveness Indicator</u>	<u>U.S. Index</u>
Standard of Living (1972-87)	78.9
Trade (1972-87)	82.6
Productivity (1972-86)	68.7
Investment (1972-86)	96.2

The above set of indicators represents the trend for the entire economy over several business cycles, implying that the problem is structural rather than cyclical. Recent data do not indicate that these trends are reversing.

Growth Policy Issues

The process of self-examination and change has been slow because, for several decades after World War II, the United States was the dominant technology-based economy. Technology and related market life cycles were relatively long due to a number of inefficiencies that existed in the R&D, manufacturing, and market development stages of the typical industrial technology. Without substantial foreign competition, incentives were insufficient to address these imperfections. This situation was of little consequence as long as competing industrialized nations did not improve the efficiency of their own technology delivery systems. However, evidence had accumulated by the late 1970s that major foreign competitors had materialized and were catching and even surpassing U.S. firms in a number of important economic sectors such as semiconductors, machine tools, robots, bioprocessing, optoelectronics, and others.

In response, U.S. growth policy in the early 1980s focused on stimulating industrial innovation. The United States had been an innovative economy in the past, and it was natural to assume that "innovativeness" alone would solve what was then referred to as "the productivity problem". In fact, some progress has been made. However, these improvements may have to be strengthened in order to achieve a highly competitive U.S. economy in the 1990s.

The U.S. economy is proceeding as if technology life cycles are still long, when, in fact, they have shortened dramatically. Government funding and conduct of early-stage technology research has not been aimed at commercial markets, but rather at public goals such as national defense. Corporate culture has not adapted to the demands of global markets for increased quality, productivity, and flexibility. Many of the critical elements of manufacturing technologies exhibit significant "economies of scope" and are therefore not being developed by industry. That is, many new technologies have a range of potential market applications that is greater than the set of markets targeted by the strategies of most, if not all, potential market participants. These firms therefore tend to underinvest, especially in the early stages of the technology's development when uncertainty is high as to the eventual size and nature of individual markets.

Even at the marketing stage, significant underinvestment by industry exists. Many of the most important technologies for the 1990s, such as communications, distributed data processing, and factory automation, are *systems* technologies. Such technologies require significant infrastructure to assure private investment. This infrastructure is technologically complex and competitively neutral and will therefore not evolve without significant cooperation and communication between industry and government.

Both industry and state governments have increased pressures for new measures that will restore the major ingredients for successful economic performance. Proposed policy changes fall into two major categories: *macroeconomic* (policies targeted at the national economy as a whole: savings and investment, cost of capital, price stability) and *microeconomic* (policies targeted at sectors of the economy).

Little disagreement exists over the need for macroeconomic policies. Rather, the debate is over their emphasis and timing. The desired level of interest rates, maximum rate of inflation, incentives for saving are continuously debated, but the Federal role is central and accepted. As a nation, we agree that consumption needs to be reduced and savings increased, that inflation needs to be kept at low levels, and that capital must be available, cheap, and patient. The debates are over the particular policy mechanisms to achieve these objectives and the timing of their application.

Microeconomic policies are more controversial. First, they do exist but are focused in two areas: (1) specific public objectives such as national security, space exploration, and (2) economic sectors for which the existence of externalities and hence underinvestment is widely accepted such as in agriculture and health. In the case of agriculture, the small size of the average business prevents the realization of economies of both scale and scope in research as well as in the efficient transfer of technology and the acquisition of market information.

As a result, the Federal Government has traditionally financed and conducted agricultural R&D and transferred it to farmers through an effective, nationwide extension service. In the area of health, the Federal Government has provided an impressive technology infrastructure through the National Institutes of Health (NIH). This infrastructure significantly accelerated the evolution of U.S. health care generally. In particular, NIH was the genesis of the U.S. biotechnology industry and is a major reason for that industry's global superiority today. The Federal Government has also provided measurement infratechnologies through the National Institute of Standards and Technology (NIST). These infratechnologies *leverage* all stages in technology-based competition.

A recent Department of Commerce analysis of emerging technologies that will be critical to U.S. competitiveness in the 1990s identified 12 major technological areas with economic potential similar to biotechnology. However, the investment in infrastructure for most of these is small and uncoordinated. Much of existing investment is through agencies with specific missions whose technological requirements have in general grown increasingly distinct from the needs of commercial markets. In a number of these areas, the agency missions no longer require state-of-the-art technology. For both reasons, spinoffs to commercial applications, which were seldom high, are declining further.

These trends led the President in a March, 1990 speech to the American Electronics Association to state:

"The Administration is committed to working with [industry] in the critical pre-competitive development stage where the basic discoveries are converted into generic technologies that support both our economic competitiveness and our national security."

In releasing OSTP's FY 1991 budget request, the President's Science Advisor, Dr. D. Allan Bromley, stated:

"The sophistication and capital-intensive nature of modern technology require new ways of increasing cooperation between government and industry and of fostering communication on long-term technology goals. SEMATECH is an important example of such government-industry cooperation."

The "Overview" to the Administration's FY 1991 budget pointed out that one of the two areas in which the Federal Government has traditionally supported R&D is:

"to meet broader national needs (e.g., basic research in all areas, measurements and standards R&D, health-related R&D)." This "R&D, for which the Government is not the principal market, includes both basic research and generic applied research. Federal investment in such R&D is warranted to capture the public good benefit."

What Areas of Growth Policy Will Require Particular Attention in the 1990s?

In large, developed economies such as the United States, the appropriate economic growth strategy requires that a *portfolio* of a substantial number of emerging and strategic technologies be under development at any point in time to diversify risk and broaden the future industrial base. This is a very different concept from the hotly debated "targeted industry" strategy. In the latter approach, a few technologies or industries are singled out as priorities and given intensive government support. Such a strategy is appropriate for a developing country with limited technological resources -- most of which it must import. However, a large, technology-based economy can and must continually nurture its comparative advantage -- a diversified technological base -- by simultaneously pursuing development of a large number of emerging technologies. To implement this strategy, industry and government will have to consider the possibility of cooperatively modifying the following activities that make up the technology-based economic process.

Research & Development. Many of the emerging and strategic technologies that will provide a competitive advantage in the 1990s need modest but critical encouragement from government. Industry and government will have to jointly focus on early-stage or "pre-competitive" research. Examples are advanced (engineered) materials, optoelectronics, digital imaging technology (DIT), biotechnology, and factory automation (specifically, flexible computer-integrated manufacturing or FCIM). Several of these, such as DIT and FCIM, have a "systems" character, and therefore require additional infrastructure, particularly standards.

One of the considerations may be that industry and government will, in effect, move the "pre-competitive line" forward to include early-stage generic technology research in the "underinvestment" category. This adjustment is an incremental change from the traditional government role of supporting basic research, and it is the same basic philosophy that has evolved in other industrialized nations over several decades.

Commercialization. Major dysfunctions have occurred in the ability of the U.S. economy to translate the results of R&D into commercially successful products and processes. Reasons include out-of-date industry structures (particularly insufficient vertical integration), poor intrafirm organization (particularly inadequate integration of R&D, production, and marketing), and unwillingness to assume the risks associated with new technologies. These elements interact with each other and collectively inhibit rates of investment in new technology.

Because aggregate productivity growth is driven in the long run primarily by widespread acquisition and use of technology, the entire process, including organizational and behavioral factors, by which technology is acquired and utilized must be examined. Organizational and behavioral factors are important concerns because many U.S. firms have been unable or unwilling to make fundamental internal changes and also because firms, industries, and other institutions (i.e., laboratories, universities, the financial community, etc.) have not been able to effectively interact and cooperate. The "cultural" adaptations required to implement organizational and behavioral change will take place more rapidly with appropriate leadership from government -- that is, with government acting as a catalyst for change through the educational system and within the various evolving cooperative arrangements between industry and government.

Contrary to some elements of economic literature, technical knowledge does not *transfer* or *diffuse* without cost. That is, it is not a "free" good once produced. In fact, considerable effort is often required by individual firms to acquire and internalize generic technology so that it can be effectively used in subsequent internal applied R&D. Studies have shown that direct personal contact is the single most effective means of transferring technical knowledge, but inward-looking corporate culture, the isolation of many Federal laboratories, etc. have inhibited this mode of information sharing.

Moreover, creating a viable technology base is one step; effectively and quickly utilizing it is another. U.S. industry is particularly bad at sharing generic, competitively neutral information in a timely manner. In fact, defining such information as competitively neutral has been a major barrier to getting as fast a start in the R&D stage as do the Japanese when a new development occurs. Systems-type concepts such as *concurrent engineering* and *total quality management* are increasingly important as they greatly improve the efficiency of both R&D and manufacturing across a wide range of technologies. Because of the economies of scope in their development and especially in their diffusion throughout industry, a catalytic role exists for government in facilitating the evolution and transfer of these concepts.

Market Development. European and Asian nations have focused on *market share* as the primary strategy objective, believing that all other strategic objectives follow from this one. In today's highly competitive global economy, market share is determined by five critical variables: productivity, quality, price, timing, and marketing. Technology is the main driver of the first three and, surprising to some, is increasingly important for the last two. Other variables are also important (organizational strategies, human resources development, supplier relationships, etc.), but they are subservient to the five primary ones.

Moreover, access to markets and diversification into related markets often depend on compliance with standards. Because standards can vary depending on the technical basis selected, disputes arise which slow market penetration of the technology. Even when such disputes are resolved in the U.S. domestic market, major foreign markets (Japan and the European Community) increasingly have evolved different solutions, based on different infratechnologies and hence standards. Such situations result in barriers to the penetration of foreign markets by U.S. firms. Conversely, foreign firms can sometimes penetrate the U.S. domestic market while U.S. firms attempt to develop and agree on the technical basis for acceptance testing and other infrastructure for reducing transaction costs.

Summarizing Foreign Competitors' Strategies

Many have asked why the Japanese can make commitments to new technologies when the U.S. cannot. The several reasons are (1) capital is cheaper and more plentiful, meaning that more projects with **longer** time horizons are funded; (2) Japanese understand the importance of economies of scope to a much greater extent than do Americans (for example, they have successively transferred generic production technology from semiconductors to optoelectronics to superconductivity); (3) the Japanese government makes commitments to new infrastructure which has an enormous motivating effect on private investment decisions (they made an early decision to wire the country with optical fiber, while the U.S. is still debating the issue).

In the mid-1970s, Japan perceived the inefficiencies in industry and research structures in the United States and Europe. They first applied this understanding of underinvestment in early-stage or pre-competitive technology research to semiconductor technology. In 1976, they launched their now-famous VLSI (very large-scale integration) semiconductor research consortium. In four years, this cooperative project between industry and government had caught up with and, to some degree, passed U.S. and European firms in semiconductor processing technology.

In a second, less-appreciated application of this approach, Japan adapted the semiconductor processing technology to the important new area of optoelectronics by establishing in 1979 a similar cooperative research project. Optoelectronics is a critical technology for communications, data storage and retrieval, and likely data processing

(through optical computing). By *cooperative* planning and research at the generic technology stage, the Japanese were able to accelerate the optoelectronics technology to the *applied* research stage. At this point, the Japanese Government removed itself from the technology development process (i.e., the pre-competitive line had been crossed). Individual Japanese companies, having the advantage of an early technological lead now greatly increased their *individual* investments in applied optoelectronics R&D. The result is Japanese dominance in this critical technology.

Over the 1980s, the Japanese have applied this model in one emerging technology after another. Their "Key Technology" program provides support to a wide range of technologies through the research consortium mechanism. Support for early-stage technology research is given to emerging technologies that industry and government have *jointly* determined to have significant economic potential. The Japanese Government is therefore neither focusing on a few "picked" technologies, nor is it making funding decisions unilaterally.

The European Community is now pursuing the same general strategy through its EUREKA and ESPRIT programs. Neither Japan nor Europe can be said to be "targeting" specific technologies with these programs. In fact, the opposite is the case. They are removing the underinvestment problem in early-stage technology research across a wide range (i.e., a *portfolio*) of emerging technologies. The ultimate objective is to provide their domestic industries with a broad and deep *technology base* from which private firms will then make decisions with respect to which specific market applications to pursue. That is, the subsequent steps in the economic process -- applied R&D, investment in production facilities, and marketing -- remain the responsibility of the private sector. Thus, the nature, scope, and magnitude of the resulting markets are still determined by private-sector investment decisions; but, with the areas of systematic underinvestment removed, the development and commercialization of a technology can proceed faster than foreign competition.

In summary, the Japanese, other Asian countries, and now the European Community have removed market imperfections in the various stages of technology-based economic activity with the following results:

- The *efficiency of early-stage research* is increased so that technology life cycles are shortened. This creates the critical competitive advantage of strategic technologies being available earlier which, in turn, enables the applied R&D that results in commercialization. Foreign government programs, including laboratory research, government-industry research consortia, etc., have been able to advance generic technologies to the applied R&D stage for a range of economically important technologies such as ceramics, composites, and other materials, biotechnology, computers, software, electronic components, superconductivity, optoelectronics, robotics, machine tools, etc. These more rapid advances give the domestic industry a running start in determining which applications of the generic technology to pursue, conducting the applied R&D, and reaching the marketplace ahead of foreign competitors.

- **Commercialization** is facilitated by more efficient technology transfer. Government laboratories, research institutes, transfer centers and extension services, cooperative programs, trade associations, and other mechanisms have more rapidly diffused new technologies. Wider use means higher percentages of a nation's economy will be introducing new products (innovations) at any point in time -- making a nation's economy as a whole more competitive.
- **Market development** is accelerated by productivity and quality programs, and by other infrastructure such as standards. Market share is the single most important strategy variable for other industrialized nations. These nations therefore target faster productivity and quality growth strategies and allocate more resources to standards in order to move quickly beyond initial commercialization to penetrate global markets and take market share away from lagging countries.

Where Do We Go In the 1990s?

The United States spends more on R&D than the next four countries combined. Yet this country continues to be challenged by our major competitors. A major reason is that U.S. R&D investment is not (1) sufficiently directed at civilian applications, (2) allocated through the right mechanisms. A consensus view is that Germany and Japan currently have the most productive and generally successful economies in the world. The reason for their competitive advantage is indicated in part by *Table 2*, which shows that their economies are 45-55 percent more *civilian* R&D-intensive than is the United States. Over time, this higher rate of investment in technology with direct commercial potential has enriched the technology base of both countries and thereby led to significantly higher rates of new product and process commercialization.

Table 2

NON-DEFENSE R&D AS % OF GNP

<u>Country</u>	<u>1986</u>
United States	1.8
West Germany	2.6
Japan	2.8

Source: National Science Foundation

As a result of policy changes over the past five years, some of the basic *institutional* mechanisms are now in place. For example, the 1984 National Cooperative Act has stimulated approximately 125 research consortia. However, most of these consortia are quite small in scope with limited research objectives. By far the most ambitious consortium is SEMATECH, but it must be considered an exception not only because of its large size but also because of the broad scope of its research objectives (generic technology research through development) and the fact that it receives substantial government funding.

The United States will have to respond to global trends in the 1990s, or its competitive position will continue to be challenged. This response *does not* require an industrial policy of "picking winners and losers". Instead, it requires acceptance that

- the "pre-competitive" line, which in the past was the completion of basic research, has moved somewhat forward into the *early* stages of technology development -- specifically, *generic technology research*; the resulting systematic underinvestment at this early stage in the R&D process requires an industry-government partnership (as the President's Science Advisor, Allan Bromley said, "the sophistication and capital-intensive nature of modern technology require new ways of increasing cooperation between government and industry and of fostering communication on long-term technology goals");
- more effective support for commercialization is required of the technology infrastructure; this means increasing the *efficiency* of technology transfer, the assignment and protection of intellectual property rights, and the provision of science, technology, and market information from all over the world; and
- more encouragement is needed from the technology infrastructure for such corporate strategy and "culture" changes as concurrent engineering, total quality management, productivity-enhancing tools, and other education-based techniques as well as for standards that greatly affect the success of global *market-share* strategies.

Technology infrastructure has been effectively designed and used in a few industries such as aerospace, agriculture, and biotechnology. The increasing technological content of virtually all industries will require technology infrastructure synthesized from the lessons of these past successes and also from the successes of foreign competitors.

The implication is that the United States will have to view its technology infrastructure as a *portfolio* of technologies. This would ensure a diverse and timely technology base that will stimulate higher levels of investment by U.S. industry and can be drawn upon by industry as it develops and markets specific applications.

Other categories of market imperfections exist because of cultural and institutional biases towards information sharing and technology transfer. The Federal Government will have to act as a facilitator in information flows among U.S. firms. Such a role will be required not only in the conventional sense of technology transfer but in the dissemination of holistic organizational methods such as total quality management that embody the systems concepts still foreign to much of U.S. industry.

In conclusion, the increasingly global scope of investments in technology and capital will drive world economic expansion in the 1990s. However, the distribution of the benefits of this growth among nations is highly uncertain. The challenge for the United States is to gain and maintain global market shares that steadily increase the standard of living.

Although the social and economic structures of the United States are different from those of other countries, lessons can be learned from the economic success stories in Japan and Germany. One important conclusion from this discussion is the complexity of the typical technology-based industry. In particular, the process of developing, implementing, and utilizing new technologies is a "systems" process that requires many timely contributions from both industry, academia, and government. Much analysis has been done of other economic systems as well as of the U. S. economy. The time has come to effectively use this knowledge to design and implement a combined macroeconomic and microeconomic strategy that will enable the United States to maintain a position of world leadership across the range of technologies that will be driving the world economy in the 1990s.

GLOSSARY

competitiveness: the ability to systematically increase the performance, productivity and quality of products and services, so that the economy grows fast enough to increase the standard of living at desirable rates.

More specifically, *competitiveness at the industry level* means increasing the performance, productivity and quality of the economy's product and service mix in order to maintain substantial global market shares. Market share is necessary to generate the cash flow which funds subsequent technology and product life cycles. *Competitiveness at the national level* means attaining and maintaining competitiveness in enough industries to achieve a balanced and diversified growth pattern for the economy as a whole, so that the national standard of living increases at acceptable rates over time.

concurrent engineering: the simultaneous design of products and production processes so that on the one hand the production process is optimized with respect to the manufacturing requirements of the product and on the other hand the product is designed to facilitate manufacture. Such "simultaneity" enables, for example, quality-enhancing attributes to be designed into the product, while the production process is configured to ensure maximum yield, thereby increasing productivity.

generic technology research: the first stage in *technology* research; the objective is to show that the technological *concept* "works" in a *laboratory* environment and thus reduce the typically large technical risks before moving on to the more applied stages of R&D. The large technical and market risks at this stage provide the rationales for "risk pooling" through cooperative research.

infratechnology research: the process of creating the basic data, measurement methods, test methods, and measurement-related concepts which increase the productivity or efficiency of R&D, production, and marketing.

Such infratechnologies are by nature widely used and thus are largely nonproprietary from the point of view of individual firms. Their competitive neutrality, use by several industries, and roles in standards development provide rationales for their provision by government laboratories.

innovation: the *first* commercialization or market introduction of a technology. In the case of a new product technology, an innovation is the first market introduction. In the case of a process technology, an innovation is the first use to produce products for sale. Consequently, the term *innovation* has a narrower meaning than is frequently believed.

In particular, it has been used to describe market penetration (i.e., diffusion). Statements such as "innovation determines productivity growth" are misleading. One firm innovates and may earn substantial profits as a result, but until competing firms imitate and the user (i.e., demand) side of the market widely adopts the new product (i.e., technology diffusion occurs), aggregate productivity growth will usually not be significantly advanced.

pre-competitive technology research: early-stage technology research involving some degree of cooperation among firms and government that removes sufficient technical risk to enable *individual* firms to then make applied R&D and subsequent commercialization decisions in a *timely* manner relative to the investment strategies of foreign competitors. For the majority of technologies, the pre-competitive line is at the end of the generic technology research stage.


total quality management: the integration of all aspects of the firm's activity, including R&D, production and marketing, for the purposes of (1) generating and exchanging information of quality-related attributes of both the firm's products and services, and (2) designing and implementing firm-wide strategies. Quality objectives and strategies are viewed not only as a total-firm activity but also includes relationships with suppliers and customers.

THE WHITE HOUSE

WASHINGTON

April 5, 1990

MEMORANDUM FOR OLIN WETHINGTON

FROM: TODD G. BUCHHOLZ 

SUBJECT: Science and Technology

You asked for information on OSTP and for some issues that could be raised with Dr. Bromley. In addition, you asked for information on the Stevenson-Wydler Technology Innovation Act and the Omnibus Trade and Competitiveness Act of 1988.

OSTP; meeting with Dr. Bromley

Bromley's key person on the EPC working group will be Bill Phillips, recently confirmed as OSTP's Associate Director for Industrial Technology. Phillips coordinates the FCCSET committee on technology and industry.

Ken Yale has requested from OSTP an update on FCCSET's current activities, which he will immediately forward to us.

Aside from procedural questions on how he expects FCCSET to coordinate with the EPC working group, you might raise the following broad policy issues with Bromley in order to generate discussion:

- o Do U.S. investors undervalue firms that engage in research and development? If so, is this a cost of capital problem? A perception problem?
- o Who counts as a U.S. company? The biggest selling car in the U.S. is the Honda Accord, largely manufactured in the U.S. Some of Chrysler's biggest sellers are imported, as are many components of Ford and GM cars. Should this issue affect U.S. policy on research consortia or federal labs?
- o Does Bromley think the EPC Working Group should attempt to identify economically strategic technologies (e.g. semiconductors?) that the U.S. should attempt to promote even if not always profitable?
- o What kind of strategy could the U.S. develop to tap into foreign labs or research consortia?

THE WHITE HOUSE

WASHINGTON

o The Superconducting Super Collider (budgeted for \$318m in 1991) and Space Station Freedom (budgeted for \$2.6b in 1991) have each been criticized in the press for their expense. Does Bromley have any doubts about the value of these investments?

o Is the U.S. transportation industry moving as quickly on magnetic levitation as foreign companies?

o Recent studies show that the quality of final products are greatly affected by the manufacturing process, not just by the design of the final product. Engineers and consultants now recommend "design for manufacturing," i.e., designing the final product while simultaneously considering the manufacturing process (as opposed to designing the final product and then developing a process for manufacturing it).

Given the administration's aversion to "industrial policy," how can the federal government encourage "design for manufacturing"?

Stevenson-Wydler Technology Innovation Act of 1980

The Act charges the Secretary of Commerce, on a continuing basis, with a number of responsibilities, including:

o identifying technological needs, problems, and opportunities within industrial sectors;

o assessing whether industries with promising technologies are receiving enough capital and technical resources to promote productivity; and

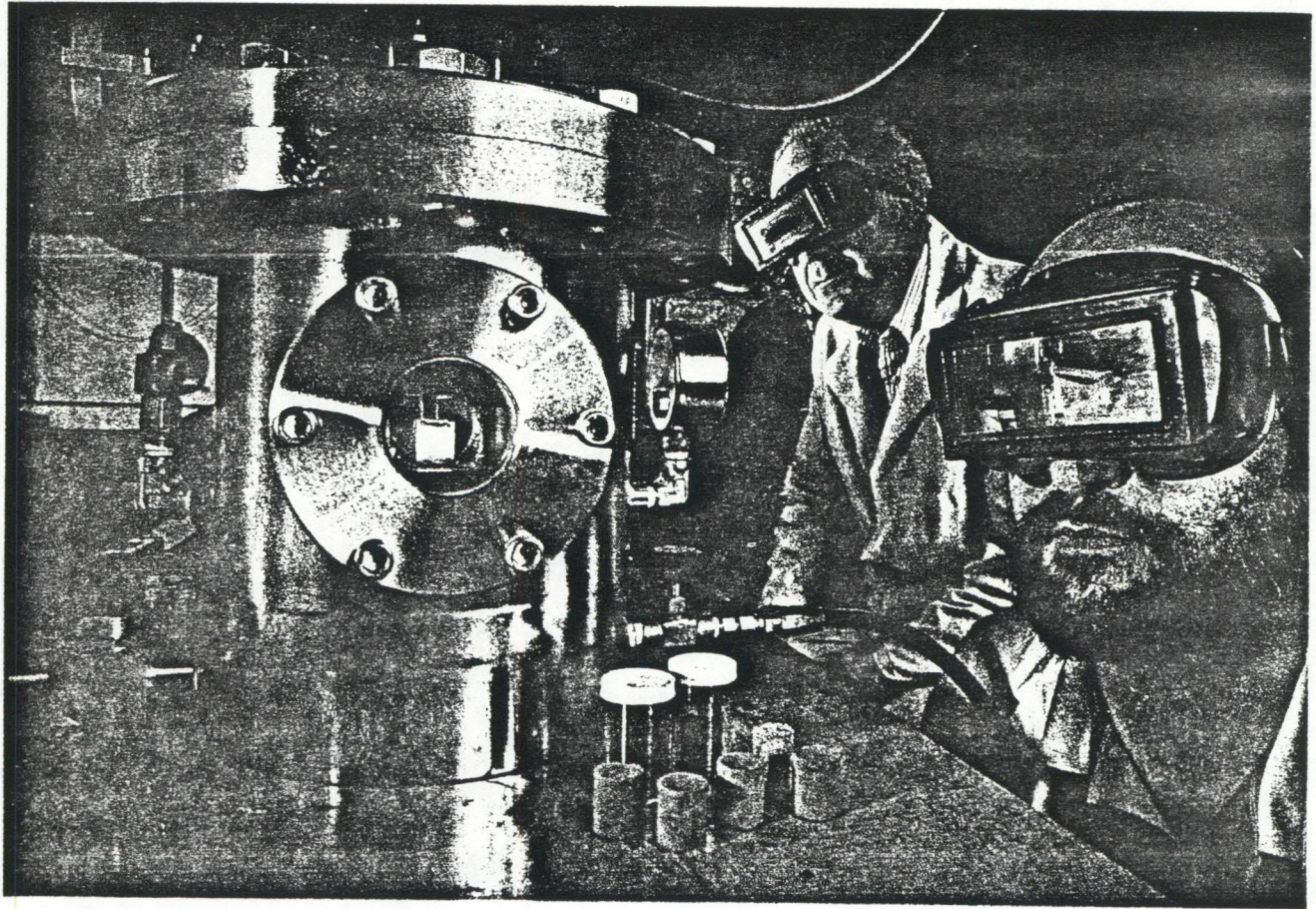
o encouraging and assisting in creating centers and other joint initiatives between private business and all levels of government.

Omnibus Trade and Competitiveness Act of 1988

This Act grants broad powers to the Secretary of Commerce, (through the Director of the National Institute of Standards and Technology), to take any action "necessary and appropriate" to assist industry in developing technology and procedures to "modernize manufacturing processes, to ensure product reliability...and cost-effectiveness, and to facilitate the more rapid commercialization...of products based on new scientific discoveries in fields such as automation, electronics, advanced materials, biotechnology, and optical technologies."

WASHINGTON INC.?

WHILE THERE'S STILL NO CLEAR-CUT POLICY, THE FEDERAL GOVERNMENT IS ACTIVELY FOSTERING TIES BETWEEN SCIENCE AND INDUSTRY



BEGINNING IN 1986, A SERIES OF extraordinary meetings took place at the Commerce Dept. in downtown Washington. Top executives from more than a dozen U.S. semiconductor companies were summoned to hatch an idea that used to be anathema at Commerce—and illegal. The topic: banding together to meet the onslaught of Japanese competition. “We got the companies together and kicked them in the shins,” recalls D. Bruce Merrifield, then Assistant Secretary of Commerce for Productivity, Technology & Innovation.

With Commerce taking the lead, the companies formed Sematech, a consortium designed to develop advanced chipmaking technology to boot the U.S. back into the lead in the international semiconductor race. Fueled by \$200 million from the Pentagon and 14 companies, Sematech is one of the most visible signs of a profound change in the way the U.S. supports technology: Washington is now actively and directly fostering industrial innovation.

**National labs
have been
encouraged
to push their
patents in the
marketplace**



In the past, the government has often focused the nation's scientific and engineering talent on specific problems. Federal dollars tamed the atom, gave birth to the computer, rocketed man to the moon, and spawned the most advanced aerospace industry in the world. Moreover, the development of the supercomputer, artificial intelligence, and advanced materials were driven by military needs and funded by the Defense Dept.

Those programs, however, rightly assumed that the U.S. industrial base was alive and well. But in the 1980s, as one critical industry after another fell to foreign competition, it became obvious that the industrial base was cracking. Suddenly, it was painfully clear that individual companies—even some of the nation's mightiest—often could not compete alone on a global scale.

While there is still no clear policy, over the past eight years Washington has gradually mounted a broad effort to emulate the cooperative successes of Japan Inc. Antitrust laws

PHOTOGRAPH BY ROBERT HOLMGREN

have been relaxed; so have laws restricting the ability of national laboratories, such as Argonne National Laboratory and Oak Ridge, to push their technology into the private sector.

Already, scores of industrial consortiums have been created so companies can conduct joint research on common problems, from superconductors to machine tools. Now Congress may consider relaxing antitrust laws even further so companies can form consortiums that would actually manufacture a product—high-definition television (HDTV) sets. Says Representative Harris Fawell (R-Ill.): "Cooperation is one of the buzzwords for competitiveness."

Washington has created more than 30 centers at universities to marry industry with cutting-edge science. The National Science Foundation was one of the first to make a major push. Under its current director, former IBM Vice-President Erich Bloch, the NSF has set up 18 Engineering Research Centers on university campuses across the country since 1985. The idea is to use the carrot of government funding (the NSF pays approximately half the costs of each center) to lure universities into conducting research directly related to the needs of industry.

Researchers at the national laboratories are also being turned into front-line troops in the international economic battle. Far too much of the useful technology they developed for the government was just sitting on the shelf, instead of being turned into products by industry. So, Congress stepped in. The Stevenson-Wydler Technology Innovation Act of 1980 ordered the labs to pursue applications of their work, while the Federal Technology Transfer Act of 1986 allowed them to collaborate with business.

Take Dieter M. Gruen, a materials scientist at Argonne. In 1983, Gruen and two colleagues discovered a process that allows lasers of certain wavelengths to slice through materials without heating them. "It had tremendous implications," says Gruen. The result: a laser scalpel for repairing damaged eyes that was introduced last year by Summit Technology Inc. in Watertown, Mass.

Other government labs are tackling problems specifically for industry. The Commerce Dept.'s National Institute of Standards & Technology (the old National Bureau of Standards) is building a pilot version of the automated factory of the future. Earlier this year, it formed three centers at college campuses, including Rensselaer Polytechnic Institute and the University of South Carolina, to

spread the gospel to companies that could use the technology.

Fearing that weak U.S. industries threaten national security, the Pentagon is also adjusting its role. The Defense Advanced Research Projects Agency (DARPA) has long funded key studies in computers, electronics, and advanced materials. Now, DARPA is taking a larger, more public role—funding and overseeing Sematech, and awarding grants in HDTV technology. At the same time, Defense's Strategic Defense Initiative agency has moved quickly to dump seed money into new technologies, such as diamond films, that have important short-term applications for industry.

One of the most successful government programs relies on the traditional mother lode of U.S. innovation—entrepreneurial spirit. Small Business Innovation Research grants, for instance, are awarded by federal agencies to small companies with promising ideas. So far, they have nurtured hundreds of new products. Among them: a high-pressure water jet for cutting materials, a crib that soothes colicky babies, and new ceramic materials. "The program has been phenomenally successful," says Merrifield, now a consultant at the American Electronics Assn.

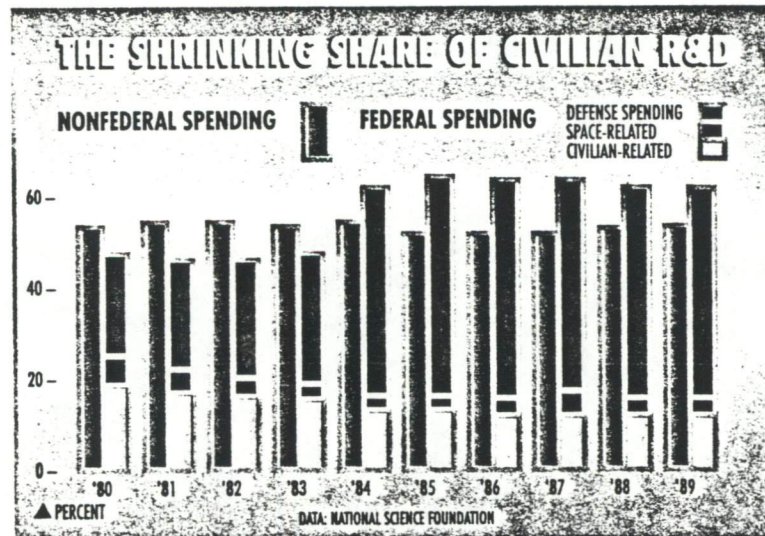
It's too soon to say that consortiums are the way to go. Although they have swept the research-and-development landscape, most are still very new, and few have borne fruit. While consortiums in Japan have clearly pushed their members to world leadership, a recent Commerce Dept. evaluation of Sematech warned that such ventures may not work smoothly in other U.S. industries because many companies don't want to share research results. "The jury is still out," says Robert A. Frosch, vice-president for research at General Motors Corp.

Most experts also believe that it's just as important to boost funds for basic research and for science and engineering education. Over the past decade, the defense-related slice of the government R&D pie has risen from 50% to more than 70%. But over the same period, military spending on basic research dropped dramatically.

Many still think the government's best role is that of hands-off gardener, sprinkling grants on fertile fields and waiting for innovation to spring forth. But the more active role has worked before. And, with U.S. industry taking a drubbing in the marketplace, similar moves may yet prove wise.

By John Carey in Washington

Congress may soon relax antitrust law even more, to let consortiums pursue HDTV



MEET D. ALLAN BROMLEY

'MY RESPONSIBILITY . . . IS SOLID SCIENCE AND TECHNOLOGY INPUT'

IN APRIL, YALE UNIVERSITY PHYSICIST D. Allan Bromley, 63, was named White House science adviser, a job President George Bush elevated to Cabinet rank. The founder of the Arthur W. Wright Nuclear Structure Laboratory at Yale, Bromley is more highly regarded as a scientist than were his two predecessors in the adviser's job. Bromley has also served in a number of science-policy posts over the past decade, including president of the American Association for the Advancement of Science and member of the White House Science Council.

Last month, the new adviser discussed science and technology issues at his Yale office with BUSINESS WEEK's Washington science reporter, John Carey:

Q. Will you have the access to the Oval Office that you need to be effective?

A. I have been assured by the President that I will have direct access. It's absolutely essential that the science adviser be viewed as a member of the President's team. That is obviously something I will not abuse.

Q. You face an unusual situation because White House Chief of Staff John H. Sununu is an MIT-educated engineer. Will that present problems?

A. We both are recognized as having strong opinions, but I think that there is mutual respect. I think the chemistry will be excellent.

Q. There are a number of big science projects pending. Since the budget probably won't cover them all, how will you decide which ones to support?

A. What we're talking about more than anything else is a question of timing. What people have called megaprojects—the superconducting supercollider, the human genome map, the space station, the space plane, the compact-ignition tokamaks—wouldn't have reached this stage if a lot of people weren't actively supporting them. What has to be established is the relative priority.

Q. What about collaborating with other nations on some of these big-ticket projects?

A. We do have to address the question of whether we treat these as uniquely American

projects. Quite frankly, the luxury of going it alone is perhaps no longer available to us.

Q. How much should scientists be involved in setting such priorities?

A. We in this country are already unique in the degree to which our science policy and budget are developed from the bottom up, under proposal pressure, with tremendous input from the scientific community.

But the decisions on major projects are not purely scientific ones. There are political considerations and considerations of national security and national prestige. My responsibility will be to make sure there is solid science and technology input.

Q. What are the most important issues?

A. If our economy isn't strong, then we simply aren't going to be able to do all the other good things we want to do. That means, first of all, we have to find ways to really develop a partnership between research universities, the private sector, and national laboratories. We also have to focus on improving the quality of science and mathematics education, not only in high school but at the grade-school level as well.

Q. Why do countries like Japan seem better able to compete on a global scale?

A. We have tax laws, antitrust laws, and a whole body of legislation that was developed purely with the mindset of a national market. We've been slow to recognize that we are dealing in a global market.

Q. But you don't believe we should prevent Japan and other countries from tapping into U.S. science?

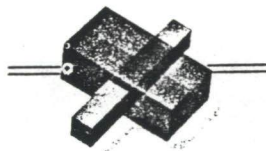
A. No. Science is public knowledge. Anything you hold close to your chest is priestly lore; it's not science. Of course, there's always the question of where the openness of basic sciences ends and where the specific knowhow—the competitive edge in the technology for the production of a product—takes over.

Q. Are you ready for Washington politics?

A. Having survived 30 years on an Ivy League faculty, I doubt there's much in the way of politics that I haven't encountered.

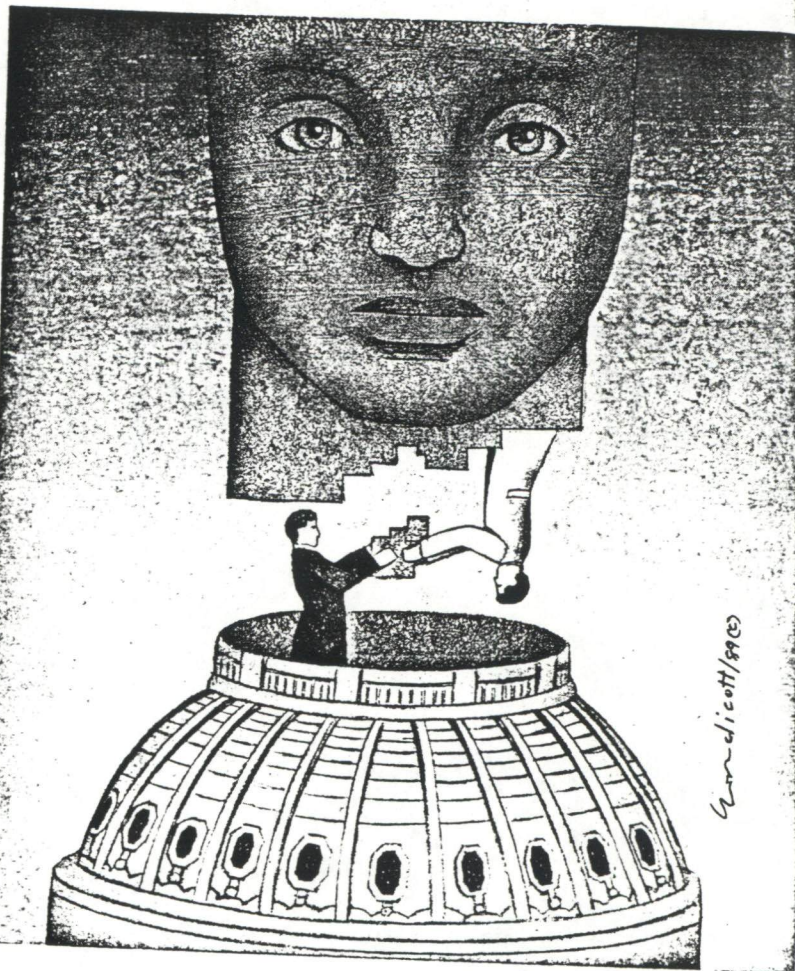


**Bromley is first
in the job of
science adviser
at Cabinet rank**



THE POLICY ELITE

The Bush Administration faces big decisions on big-ticket science projects: the supercollider, the space plane, the human genome map, and more. Here are profiles of 12 Washington players who will be putting their spin on policy-making in science and technology.



San diego/89c

THE TECHNOLOGICAL BASE



DAVID ALLAN BROMLEY

Science Adviser to the President

Key Administration adviser

Born: 5/4/26, Westmeath, Ontario.

■ PhD in physics, University of Rochester. Career path: physicist at University of Rochester, Atomic Energy of Canada Ltd., and Yale; director of the

Office of Science & Technology Policy and assistant to the President for Science & Technology in 1989. Also directs the White House Office of Science & Technology Policy. Earned a reputation as a shrewd politician while serving on the White House Science Council. Faces task of sorting out priorities in an era of tight budgets; must deal with chief of staff with strong ideas on technology.



ROBERT E. GRADY

Assoc. Dir., Office of Mgmt. & Budget

Influences science and technology budget

Born: 10/22/57, Livingston, N. J.

■ MBA, Stanford University. Career path: staffer for former Representative Millicent Fenwick (R-N. J.) and for New Jersey Governor Thomas H.

Kean; speechwriter for Bush; OMB czar for natural resources, energy, and science. No science background, but wrote Bush's first major budget speech, calling for increases for science. Tells the science community it needs to lobby harder for funds, yet has been so optimistic about science faring well in upcoming budget battles that some wonder if he grasps the realities of his job.



BARBARA A. MIKULSKI

Chair, Senate appropriations subcommittee

Holds purse strings for research agencies

Born: 6/20/36, Baltimore.

■ MSW, University of Maryland. Career path: Baltimore City Council; U. S. House of Representatives (D-Md.); U. S. Senate in 1986; chair of subcommittee for HUD and independent agencies in 1988. As

such, oversees NSF, NASA, and EPA, and funds HUD and the VA. Believes science and technology are directly linked to the nation's international competitiveness. Is expected to defend appropriations for her agencies aggressively. Threatens to oppose funding for science if housing funds are inadequate.



ERNEST F. HOLLINGS

Chair, Senate Committee on Commerce, Science & Transportation

Shapes sci/tech agenda in Congress

Born: 1/1/22, Charleston, S. C.

■ LL.B., University of South Carolina. Career path: Army in World War II; South Carolina House of Representatives; U. S. Senate (D-S. C.) in 1966. Chair of the Commerce, Science & Transportation Committee. Heads appropriations subcommittees that control Commerce Dept. budget. Believes technology is key to a strong defense and civilian economy. Spearheaded legislation permitting Commerce to promote technology. Advocates government funding of technologies such as HDTV.

PHOTOGRAPHS BY (TRAXLER, PRESS, ROSENZWEIG) STEINKAMP/PICTURE GROUP, (YOUNG) MENUEZ/PICTURE GROUP

**BOB TRAXLER**

Chair, House appropriations subcommittee

*Holds purse string for basic research**Born: 6/21/31, Kawkawlin, Mich.*

■ LL.B., Detroit College of Law. Career path: Army; county prosecutor; state representative; U. S. Representative (D-Mich.) in 1974. Chair of the appropriations subcommittee over HUD, NSF, NASA, and EPA. Pushed agricultural initiatives in the past. Is not expected to push hard in Congress for science funding. Supports an increase in the NSF budget, but is lukewarm toward the space station. Sees little hope of funding all the science and technology efforts that Bush has put in the proposed Administration budget.

**ROBERT A. ROE**

Chair, House Committee on Science, Space & Technology

*Influence over science priorities**Born: 2/28/24, Wayne, N.J.*

■ Washington State University. Career path: mayor of Wayne, N. J.; New Jersey commissioner for conservation and economic development; U. S. Representative (D-N. J.) in 1969. As chair of the House Committee on Science, Space & Technology, has a visible pulpit. Made a name pushing water projects and probing the space shuttle accident. Fought for the proposed doubling of the NSF budget. Plans legislation to help industry hold key markets, such as supercomputers. Could exercise greater influence.

**ERICH BLOCH**

Director, National Science Foundation

*Directs the important basic research agency**Born: 1/9/25, Sulzburg, West Germany.*

■ BS in electrical engineering, University of Buffalo. Career path: 22 years at IBM—from engineer to vice-president; NSF director in 1984. This visible, powerful, and controversial director persuaded Congress to increase the agency's budget to \$1.8 billion in fiscal 1989. Wants further funding boosts this year. Changed NSF's direction by adding technology—and collaborations with industry—to the agency's mission of supporting basic scientific research. Respected by the Administration and Congress. Tough and abrasive.

**ROBERT M. WHITE**

President, Nat. Academy of Engineering

*Influences Congress on technology policy**Born: 2/13/23, Boston.*

■ PhD in meteorology, Massachusetts Institute of Technology. Career path: meteorologist at MIT; chief of weather bureau at NOAA; president in 1983 of the National Academy of Engineering, a 1,300-member sister organization of the National Academy of Sciences. Is gradually gaining influence as Congress looks more to technology and engineering to solve problems of U. S. industrial competitiveness. Supports funding more applied science, warning: "We fiddle while our engineering and technology base burns."

**FRANK PRESS**

President, National Academy of Sciences

*Influences government on science policy**Born: 12/4/24, Brooklyn, N. Y.*

■ PhD in geophysics, Columbia University. Career path: professor of geophysics at Columbia, California Institute of Technology, and MIT; science adviser to President Carter; president of the National Academy of Sciences in 1981. Under Press, reports and testimony from the Academy's 1,573 elected members are increasingly used to direct science policy. Its recommendations, however, tend to be conservative. He has suggested that scientists should help set priorities in science. Advocates doubling U. S. spending on R&D.

**JOHN A. YOUNG**

President, Hewlett-Packard Co.

*Influential industry voice on policy**Born: 4/24/32, Nampa, Idaho.*

■ MBA, Stanford University. Career path: Joined HP in 1958, president in 1977, CEO in 1978; chair of President's Commission on Industrial Competitiveness in 1983. Founded the privately funded Council on Competitiveness, whose positions became the basis for Bush's science and technology plank. Has stumped for permanent R&D tax credits, for grants or loans for technical professorships, and for doubling the NSF budget. Lobbied for raising status of Science Adviser to Cabinet level. A frequent voice at Congressional hearings.

**RALPH E. GOMORY**

President, Alfred P. Sloan Foundation

*Respected industry voice on R&D issues**Born: 5/7/29, Brooklyn, N. Y.*

■ PhD in mathematics, Princeton University. Career path: 20 years at IBM, director of research in 1970, senior vice-president for science and technology in 1986; president of the Sloan Foundation in 1989. Chaired Presidential advisory committee recommending consortiums develop high-temperature superconductors. Instrumental in creating the superconductivity consortium formed recently by MIT, AT&T, and IBM. Believes product development and manufacturing in industry, not research, is key to competitiveness.

**ROBERT M. ROSENZWEIG**

President, Assn. of American Universities

*Speaks for universities on science issues**Born: 8/27/31, Detroit.*

■ PhD in political science, Yale University. Career path: instructor, dean, vice-president at Stanford; AAU president since 1983. Represents the interests of 56 powerful research universities that receive 60% of federal research funds for all universities. Is a strong presence in Washington because of the universities' clout. Now lobbying Congress for money for bricks and mortar. Is concerned that the rapid deterioration of university buildings and research facilities is putting the U. S. research enterprise in danger.

Additional Discussion and Background Papers on
The "Accounting Problem"
Tip Parker, January 24, 1990

Three terms are key to understanding the literature on accounting for high-tech and modern manufacturing companies:

1. Financial accounting -- the recording and reporting of the operations and financial condition of a company to the general public and investment community. The reports are approved by Certified Public Accountants (CPAs) in accordance with standards developed by the Financial Accounting Standards Board (FASB). Requirements of the Securities and Exchange Commission and the Internal Revenue Service are also important.
2. Management accounting -- the recording, reporting, and interpretation of information for use by managers within a company. This information is often proprietary and need not be comparable from company to company.
3. Cost accounting -- largely an attempt to meet the management accounting needs of a company by adapting information required for financial accounting. Much of the literature is about where cost accounting has not been a successful bridge and companies have made serious mistakes as a result.

Nine Papers:

Paper 1: Perhaps the issue is best framed by Akio Morita of Sony as quoted in "A Japanese View: Why America Has Fallen Behind," Fortune, 9/25/89. He says, "Real business entails adding value to things by adding knowledge to them, but America is steadily forgetting this. That terrifies me. America no longer makes things, it only takes pleasure in making profits from moving money around." A big part of the problem is that accounting (and traditional economics for that matter) treats most knowledge as an intangible of no value.

Paper 2. Morita's point is expanded by Jeffrey Staley in "Forecast 1990," New Technology Week, 1/8/90. His explanation of how accounting turns new technology into hidden assets that companies do not managed well, also applies to knowledge in the form of product designs, employees upgraded through training, and manufacturing computer software.

Paper 3. When Mr. Murrin was at Carnegie Mellon, he encouraged Thomas Johnson and Robert Kaplan to investigate the accounting problem. Paper 3 is my brief review of the resulting book, Relevance Lost -- The Rise and Fall of Management Accounting. My comments are intended to put what Ted Lettes and I have been trying to do for small companies into the context of Johnson's and Kaplan's work which has been mostly with large companies.

There is a scale factor that makes both the financial and management accounting tasks for modern small companies different than those for large companies.

Paper 4. One of the four streams of activity in Ted's Advanced Manufacturing Program is to hold a series of Roundtables where a variety of people and interests are brought together to explore a problem, and if possible, agree to work toward a solution. "FCIM -- A Watershed Opportunity to Improve Accounting Systems for Small and Intermediate Size Firms?" was written two years ago for one of these Roundtables. I include it here for three reasons:

- 1 It gives examples of how cost accounting, as typically employed, fails to bridge the gap between financial and management accounting.
- 2 It discusses the software "repertoire" of a computer controlled manufacturing facility as an asset that is usually overlooked.
- 3 It suggests that solutions may be found to the management side of the accounting problem without treading too hard on FASB standards or current financial accounting.

Paper 5. The tax impact of changing accounting standards is an important question that almost always comes up. The Dual Path P & L Statement is a proposal I floated in another paper on the management accounting problems of small companies. This proposal for retaining the current financial accounting treatment of strategic expenditures but reporting them separately from routine operating expenses on the Profit and Loss Statement would have minimal impact on FASB standards and not change a company's income tax situation. If the Dual Path P & L were allowed as an optional presentation format, a company could use it to explain what it is doing more clearly to the financial community. The hope is that the financial community would then distinguish between strategic expenses intended to yield long term benefits from run-away current costs and treat the company accordingly. The risk of this proposal is that unless it is implemented with care it could allow new opportunities for fraud.

From our standpoint, the proposal is important because it is an idea that a number of accountants and managers agree could work. Like the Wright Brothers' first flight, the importance is not in showing how to do something, but that it can be done. Once the feasibility is demonstrated, others can add the refinements.

Paper 6. "The Cost Accounting Model: A New Proposal" is a technical paper written by Dennis Peavey, a Partner of Coopers & Lybrand. As a result of our 9/26/89 Roundtable, Dennis and Al King, Managing Director of the National Association of Accountants agreed to convert it into a White Paper to place the broad accounting problem on the FASB agenda for the first time. FASB has looked at individual pieces such as inventories and R&D,

but not the cumulative effect of expensing most knowledge-related expenditures. The proposals in the paper are similar to the ideas we floated in the "Watershed" paper (#4 above). The proposals are partially justified by inconsistencies in existing FASB standards. As shown by the example, rather than being tax neutral, this proposal could shift income and taxes forward.

Paper 7. The financial accounting issue is primarily important in relation to U.S. financial markets. The 3/6/89 Dick Davis Digest, a widely read investment newsletter has two front-page articles. The first is part of a review of Peter Lynch's book, One Up On Wall Street. Lynch manages the Fidelity Magellan Fund, the largest and one of the most successful stock mutual funds. He says, "Getting the story on a company is a lot easier if you understand the basic business. That's why I'd rather invest in panty hose than in communications satellites, or in motel chains than in fiber optics. The simpler it is, the better I like it. When somebody says, 'Any idiot could run this joint,' that's a plus, because sooner or later, any idiot is probably going to be running it. If it's a choice between owning stock in a fine company with excellent management in a highly competitive and complex industry, or a humdrum company with no competition, I'd take the latter." This is the view of one of the most influential investment managers in the country.

A similar story is told in the second article on Caterpillar. The point is that CAT stock dropped nearly 10% on the day it announced record sales and earnings, but also said it would increase its strategic expenditures to stay on a long-term growth curve. "As is often the case, the institutional herd on Wall Street has a time horizon substantially shorter than corporate management's" Financial accounting plays to the herd.

Paper 8. To complete the cycle, "New Faith in Old Money" by Diana Henriques in the 1/21/90 New York Times tells of a study showing that some companies which are well managed and kept under family control have grown 1,400% in the last ten years, while the S&P 500 grew by 400%. The article closes with, "the family is the ultimate long-term investor." I think Akio Morita would agree, in part because the Japanese industrial structure is modeled after the extended family.

As a confirmation of this point, Motorola received the Baldrige Quality Award. Two of Motorola executives have told me that they would not have undertaken the knowledge intensive program that led to the award had not 12% of the company's stock been under family control. The risk of hostile take-over from the stock price decline that could be expected to follow depressed earnings reports would have been too great.

Paper 9. For those who are really gluttons, the last paper by Ted and me is scheduled for the August publication in Management Accounting, the Journal of the National Association of Accountants.

A JAPANESE VIEW: WHY AMERICA HAS FALLEN BEHIND

Few Japanese businessmen are as at home in America as Akio Morita, ebullient co-founder of Sony. And few have had as much success. When other Japanese TV makers underpriced U.S. competitors to gain market share, Sony charged more—and set new standards for quality. The Walkman, now ten years old, created not only a new market, but part of a new way of life. Imaginative products, like the Mavica filmless camera (see page 43), keep coming.

With Shintaro Ishihara, a senior Liberal Democratic Party politician who was a candidate for Prime Minister in August, Morita has written *The Japan That Can Say No*. The book has created a sensation in Japan, partly because of Ishihara's flamboyant assertions of Japanese dominance that remind some readers of the country's prewar militancy. Released early this year, it has sold 60,000 copies.

American readers, though, won't get a crack at it soon. Kobunsha, the Tokyo publisher, has talked of an English-language edition but is awaiting a decision by the authors. Insiders say that Morita and Ishihara aren't anxious for the book to reach a foreign audience.

In the book, Morita, 63, chides his countrymen for their penchant for acquiescence. The Japanese, he says, should start being direct and forceful with their trading partners: "Perhaps as a result of Confucian influences, we Japanese find it very difficult to say a clear 'no' in interpersonal relationships. Large numbers of Japanese feel that even if they remain silent, they will be understood."

Americans, says Morita from his Westernized perspective, have no such understanding. The result is massive misunderstanding: "One of the reasons why Japan-U.S. relations have gone askew is that Japan has not said to the Americans what should have been said."

What should have been said? "If Americans want to rectify the trade imbalance, they should pause for reflection

and devote their efforts to making products that really appeal to Japanese people and that they will want to buy. We should have no compunction about asserting this, and Japanese politicians should confidently insist on it."

Morita is disturbed by trends he sees in the U.S. economy. The big problem, he feels, is that America has opted out of



Morita: Beware the ten-minute money manager.

manufacturing: "Real business entails adding value to things by adding knowledge to them, but America is steadily forgetting this. That terrifies me. America no longer makes things, it only takes pleasure in making profits from moving money around."

Nor is Morita impressed by predictions that the service sector will take manufacturing's place. "There has been a lot of hot air about America gradually transforming itself into a post-industrial society," he writes. "But now the country is facing the question of what happens if manufacturing ceases to exist. In fact, even now America is not producing for itself the things that it uses."

U.S. managers are often criticized for their short-term outlook, supposedly forced on them by Wall Street. Morita joins the chorus, recalling a chat with a money trader in New York: "I enquired

how far ahead he looks. One week? 'No, no.' came the reply. 'Ten minutes.' If Americans think only in terms of ten-minute action, while we Japanese think in ten-year terms, America assuredly faces gradual decline."

Morita argues that the U.S., which invented the transistor and semiconductor chip, has forgotten how to innovate: "The main reason why Japan's industrial might has become so strong is not that it borrows basic technologies—though, to be sure, many have been brought in from abroad—but that it leads the world in devising ways of creating products derived from those basic technologies. America is by no means lacking in technology. But it does lack the creativity to apply new technologies commercially. This, I believe, is America's biggest problem. On the other hand, it is Japan's strongest point."

To buttress his assertion that U.S. industry has itself to blame for much of the trade deficit, Morita recalls a golf game with an American friend in the New York City suburbs. "As I stood on the tee I took out my [U.S. made] MacGregor driver. My friend, who likes to tell me that Japan is unfair and how appalling that is, pulled out a [Japanese-made] Yonex. I chided him for using these clubs. He replied that his Yonex clubs gave him better purchase on the ball. So we set off on our round, safe in the new understanding that using Japanese clubs was a necessary evil.

"After the round he invited me back to his home and showed me around while his wife prepared an evening meal. In the garage were a snowmobile, a motorboat, and a four-wheel-drive vehicle—all Japanese. In the house he had a Sony television and stereo. In fact, there were Japanese products everywhere. So I asked him frankly: 'Time and again you have angrily claimed that Japan doesn't buy American products, but if you yourself use only Japanese-made things, what do you suggest we can buy from you?'"

FORECAST 1990

Jeffrey Staley

Surprisingly, some of the most valuable assets possessed by multinational companies are invisible to management. The costs of creating these assets are typically expensed every year resulting in their having absolutely no value on the balance sheet. Since they have no accounting value, they are not included when calculating Return on Assets (ROA). Because they are not counted on ROA, management is not rewarded for using them efficiently or [is not] penalized for wasting them.

These invisible assets are technology assets created through internal research, development and engineering efforts or acquired through joint developments, licenses or acquisitions. Technology assets are not systematically managed today, even in multinational companies considered excellent by other measures. While this problem is not new, methodically addressing it will be much more important in the competitive world of the 1990s.

Manufacturing companies successfully commercialize perhaps 30 or 40 percent of the technology assets they create. If they were measured, the ROAs on these assets would likely be very high. Conversely, the ROAs on technology assets they don't or can't commercialize are typically zero.

...To those who believe in maximization of shareholder value, this practice is an oversight of staggering proportions. To those willing to take a fresh look at this problem, technology assets represent bargaining chips that may play a critical role in creating new alliances, previously unimagined joint development projects or highly leveraged trades for technology assets that can be applied.

In the United States, our accounting standards are fundamentally responsible for the fact that technology assets are not shown on the balance sheet. Our Financial Accounting and Standards Board (FASB) requires [that] R&D and engineering activities be expensed in the current period.

The FASB concluded that measurement of future benefits to be derived from these expenditures was too uncertain to warrant capitalizing them. They arrived at this conclusion despite their admission that certain research and development costs do benefit future periods and are therefore conceptually assets. While this makes good sense as a conservative accounting practice for reporting to current and potential holders of debt and equity, it makes little sense as an internal management accounting practice.

Most corporations devote considerable effort to managing tangible assets like capital equipment and real estate. Few, however, focus on aggressive management of intangible intellectual assets like product, process and service technologies. Global Technology Asset Management involves finding creative ways to extract maximum value from technology assets, wherever they may exist before they become obsolete. The five ideas presented below address this objective.

1. Modify the internal management accounting system to show capitalized R&D and engineering expenditures by project or product line and create a reasonable depreciation schedule.

The information and discipline associated with capitalizing and depreciating research, development and engineering investments that produce technology assets could be very positive.

The potential pain associated with writing off assets that have no foreseeable use should motivate managers to more carefully consider investments in technology and find creative ways of extracting value from them prior to obsolescence.

2. Create technology asset plans for each division and the

company as a whole

Technology asset plans describe product, process, service and infrastructure technologies that will be required to successfully execute strategic plans. They also describe current technology assets and the pattern of financial and human resource investments that will be made to close the gap.

3. Establish an identified set of technology assets available for trade with external organizations.

Creating the ability to trade technology assets could uncover assets held by others that were previously unavailable. Many organizations find licensing fees too small to justify the time and energy required to successfully transfer a technology to another organization. However, the possibility of both parties trading technologies with low perceived values in return for technologies with high perceived values can motivate both sides to overcome barriers.

An explicit inventory of technologies available for trade under defined circumstances is...very important [because] once negotiation of any specific business deal begins, it is very difficult for participants to break away and search for technologies that might be of interest to the other side.

In general, the ability to trade technology assets for other technologies, goods, services or money would represent a new degree of negotiating freedom in many corporations.

4. Establish a geographically distributed network of corporate technology explorers.

5. Develop a process for managing global supplier technology assets as extensions of internal technology assets.

Many companies have been working to create deeper relationships with a reduced number of suppliers. In their efforts to remain among the chosen, suppliers have been working to increase their technological capabilities as well as their ability to deliver quality parts with short lead times.

Jeffrey L. Stanley is founder and president of Hechathorn Technologies of Cambridge, Mass.

RELEVANCE LOST

The Rise and Fall of Management Accounting
by H. Thomas Johnson and Robert S. Kaplan

Accounting

The accounting profession has two branches. First, management accountants do the internal recordkeeping, analysis, and reporting necessary to run a company. Their work is usually a company secret. Second financial accountants develop, review, and approve the reports a company makes to the outside world. Their work is public and is dominated by standards developed by the Financial Accounting Standards Board (FASB) and requirements of agencies such as the Securities and Exchange Commission and the Internal Revenue Service.

Relevance Lost

The book by Johnson and Kaplan is mainly about management accounting. The first half shows how management accounting evolved to control increasingly complex processes and companies. Starting with early textile mills, the evolution is traced through steel, railroads, retailing, vertically integrated firms such as the Du Pont Power Company, and multidivisional organizations such as General Motors. During each of these phases, management accounting systems were created to fit the needs of the companies they served. Managers understood the basic processes of their companies and demanded information in physical terms that were specific to the processes. Costs were important but only in the context of physical operations.

The point of the book is that starting in the mid '20's, there was a shift in management attention from data about the physical processes to financial data intended to represent the processes. A number of reasons are given for the shift including the cost of data collection (e.g. ton-miles, time, fuel consumption, and revenue by individual train run) and the increasing diversity of company products and operations that made it harder to manage a company in physical terms. Most important, however, wider public ownership of large corporations required more accurate public financial statements with particular emphasis on the value of inventories. The concern was less with the cost of manufacturing individual items in inventory, than with their aggregate value to report profits and assets correctly. The cost of running two types of accounting systems became prohibitive, so financial accounting overshadowed management accounting.

One effect of the shift has been to ignore the types of cost information needed to manage a company, and the authors are concerned about cross-product subsidization. By analogy, four people go out to lunch--one orders a second drink and the most expensive entre--then suggests the tab and tip be split equally. This is what happens when different products that use varying

amounts of services (e.g. electricity, floor space, and purchasing transactions) that are charged to a single overhead cost pool and apportioned to the products with a single overhead rate. This can be seriousness when some products are made and sold at a loss; others overpriced enough to invite competition; and management does not know the difference.

The authors' main concern, however, is over the belief that has evolved in this country that a company can be judged and managed primarily by dollar figures, rather than by understanding what is happening physically. The financial view dominates the way accounting staffs are used, and line managers have been denied what they need to manage. In many cases, they are put in charge of small cost centers where they have an incentive not to spend the funds necessary for long term success.

The authors' conclusion is that when U.S. companies competed only with each other, this was less important than it is today when foreign competitors are being managed as U.S. companies used to be prior to 1925. Factors such as total quality control, just in time delivery, computer integrated manufacturing, short life cycle/high technology products, and deregulation must all be considered in physical and operational rather than just dollar terms, while short term profits are a meaningless distraction. Modern automated processes can now provide the data needed for both types of accounting at an acceptable cost.

Comments

1. Converting the history of management accounting into a lively, enjoyable, and useful book was a major achievement.
2. The authors concentrated on large companies. Kaplan is working with Computer Automated Manufacturing--International (CAM-i) the Texas-based research consortium dedicated to the management of advanced manufacturing which is mainly serving large companies.

Our work with small companies, however, has led Ted and me to conclude there is a scale factor that limits what they can do. In many cases, the minimum advanced manufacturing module for small companies is very costly in relation to their capital structures. Small companies can not collect and evaluate ever more data as large companies appear to be doing, and should be offered a management accounting solution of watershed simplicity if one is possible. (This is one of the things we are working with the accounting profession to try to create.) Large companies keep their management accounting data and projections secret, while small ones often must disclose them to raise capital. Large companies, which raise capital on the basis of their total corporate strength, whose cost of capital is related to their quarterly reports, and which may be subject to hostile takeovers after depressed earnings statements, are more directly affected by financial accounting requirements.

3. The authors concentrate on cross-product subsidization, which occurs more in large companies than small. They discuss what we call cross-period subsidization but place less importance on it than we do. Today, unless a small company uses shared facilities to convert to an advanced manufacturing process, it must spend large sums of money, some of which are treated as capital investments. Expenditures for employee training, product redesign, computer software, and other types of knowledge are charged to current expense in accordance with financial accounting standards. Before production begins, these onetime outlays plus the continuing cost of money to finance them may equal 80% of the total cost of everything that will be made during the life of the process. And to make matters worse, if the new process is bought to respond quickly to unpredictable markets, there may be only hunches or hopes of what products and the future utilization will be.

The management accounting challenge has shifted from allocating operating costs such as direct labor to products as they are incurred, to apportioning large, one-time expenditures to an opaque future. There is no accepted basis for making these apportionments. Returning to the analogy of the four diners, the problem is as if they ate in a club that one of them had recently joined, and the member asked to recover a "fair share" of the initiation fee which vastly exceeded the cost of the meal.

4. In summary, under current management accounting practice, nobody knows what a product made with advanced manufacturing really costs. Regardless of what a conventional job cost sheet says, in some cases it can be shown that the cost of not making and shipping a part is greater than the cost of making it. In extreme cases, nobody may know for years after converting to advanced manufacturing, whether a company is making or losing money on the conversion. This creates severe problems for:

- o Companies attempting to do business with DoD or any other government agency on a cost-plus basis,
- o A small company attempting to raise capital to fund its conversion to advanced manufacturing, and
- o A medium or large, publically-held company trying to provide for the future without increasing its cost of capital or inviting a hostile takeover attempt.

A primary measure of U.S. business is profit and profit is what an accounting system says it is. If what accounting systems tell about profits from advanced manufacturing is unreliable, excessively conservative, or outright negative, modernization will continue to be slow until new accounting techniques, investment criteria, or both are found.

Tip Parker
1/10/90

FCIM -- A WATERSHEAD OPPORTUNITY TO IMPROVE ACCOUNTING SYSTEMS
FOR SMALL AND INTERMEDIATE SIZE FIRMS?

A Discussion Paper for the March 30, 1988, OPTI Roundtable
T. J. (Tip) Parker
Office of Productivity, Technology, and Innovation
U. S. Department of Commerce

Watershead developments sometimes have a way of turning up just when they are needed most.

Shortly before jet aircraft engines were introduced, turbo-compound piston engines and propellers had become marvels of technology, complexity, and cost. Before the Salk Vaccine became available, treatment of polio symptoms had become one of the most expensive medical procedures. Transistors arrived as computers reached the limits imposed by electron tubes.

Jet engines, the Salk Vaccine, and solid state electronics were watershead advances. In each case, the process of gradually refining an older technology by adding more complexity was bodily shifted to a new plateau of simplicity and economy.

Many writers and several studies suggest that companies installing Flexible Computer Integrated Manufacturing (FCIM) may have to add new and perhaps costly features to their accounting systems to manage the new technology. Before we accept this conclusion, perhaps we should pause and ask if maybe FCIM brings a watershead opportunity to shift to new levels of accounting accuracy, utility, simplicity, and economy, particularly for small and intermediate size firms.

Traditional cost accounting systems divide a company's expenditures into many categories. For this discussion, the three most important ones are:

- o Capital investments--purchases, usually of tangible assets, that are intended to be useful for several years.
- o Direct costs--expenditures for material, labor, and other items that are used directly in manufacturing specific products.
- o Indirect costs--expenses like heat, light, managers' salaries, strategic marketing, product development, employee training and depreciation of the capital investments. These are combined into cost pools which are then applied to specific products through an overhead rate as a percentage of direct costs.

The object of the game is to record or compute the cost of making each product within the limits of practical accuracy. If most of the costs are direct, this is easy to do and the information is very useful.

But the accuracy and management value of traditional product cost information declines as the proportion of indirect costs increases. When overhead rates reach several hundred to a thousand percent, minor changes in a direct cost such as labor can lead to grossly incorrect indications of total cost.

The normal accounting response to this problem is to obtain more detailed indirect cost data, create multiple overhead cost pools and rates, and subdivide direct costs for application of the new rates. This is what most articles and studies on accounting for FCIM advocate without mentioning that it may add more accounting expense to the company's indirect costs while maybe not adding much utility. It is the accounting equivalent of adding another ignition system to an aircraft engine because with twenty-eight cylinders there will almost always be a bad spark plug.

Comes now FCIM with very high start up and indirect costs, but direct costs of little more than material. Many writers indicate that substituting machine time for direct labor will bring everything to rights. They overlook, however, that labor costs can be measured accurately, are controllable to some degree, and may change significantly if the product or the process is changed. If the product is not made, they may be avoided entirely.

In contrast, the investment in a machine bought three years ago cannot be changed regardless of how much or how little it is used. Different accounting judgements for apportioning the investment and indirect costs to individual products can alter the imputed product costs by several hundred percent or more. If managers treat these apportionments as having the same meaning and validity as direct costs when making decisions on what or how to produce, the decisions can be awfully wrong.

Two simple examples can illustrate this point:

1. It is easy to show how the depreciation rate for a million dollar piece of equipment can be set anywhere between \$10 and \$100 an hour by merely making different judgements about the equipment's useful life and its anticipated rate of use.
2. Before an FCIM system can produce, its every action must be planned and put into machine instructions. There is often a tradeoff between the time a process planner spends developing the instructions and the efficiency of the resulting operation. For some time after a company installs an FCIM system, the equipment is likely to sit idle for extended periods awaiting instructions, while the process planners have a backlog. If the accounting system shows a single dollar amount per hour as the cost of using the equipment, management may be induced to emphasize efficient equipment operation and hire more process planners to cut

down the backlog. This will increase the company's total cost. If, on the other hand, the accounting system stresses best use of whatever is the the critical resource, it might point to forgoing machine efficiency for a while to increase sales without increasing direct costs. As the equipment becomes more fully used, the accounting system might then advise management on whether to improve operating efficiencies or get more equipment.

This may be where the watershead comes in. Perhaps the accounting systems should concentrate on forecasting and recording costs that are variable within the time covered by a particular decision to be made. Rather than than trying to allocate the costs of past decisions to the present question of whether to accept an order, an accounting system should indicate what it would actually cost to accept and fill the order (e.g. material and electricity), as opposed to the cost of money that will continue to be compounded if the sale is not made. The direct cost, subtracted from the selling price in relation to the cost of not receiving the income would be the net benefit of accepting the order and should be the basis for the decision.

This is called marginal costing. It is what economics text books say a business should do, but what few accounting texts say how to do.

This is oversimplified, of course. For one thing, it begs the question of what price to charge or bid for an order. But maybe even that is not all bad. Since a virtue of FCIM is its ability to exploit niche markets, should a company set its prices on the basis of costs imputed from historical events, or on a more value-oriented pricing strategy that takes advantage of the quality, predictability, responsiveness, and other features of FCIM ?

A frequently unrecognized feature of an FCIM system is its ability to remember how to make everything that it has ever made. We are calling the system's memory of what it has done, its "repertoire." Over time, it can build the repertoire of designs that cost money to create, but which can be reused or even licensed to others at little additional cost. Further, each of the designs in the repertoire has the potential of being modified to produce similar but slightly different products at a much lower development cost than completely new designs. A company with an extensive FCIM repertoire has so many cost and responsiveness advantages over firms without similar assets, that the value of the repertoire may become a major element of the value of the company.

To enjoy the greatest benefit from this feature, a company must concentrate on building its repertoire of basic designs and design elements that can sire whole clans of related products; obtain orders that add new product families to the clans; and obtain as many repeat orders for individual products as possible.

Most articles on FCIM concentrate on what goes on within the factory. Taking advantage of the repertoire, however, must also involve salesmen, product designers, and the process planners who develop the detailed FCIM instructions. The machines, for all their accuracy, dependability, and other virtues, will be little more than organized junk without with the living, growing repertoire and the keen people who create and use it. In the last analysis the ability to exploit niches really will depend heavily on using these human and programmed technology resources.

Traditional accounting systems would treat the costs of developing the repertoire as current expenses to be forgotten soon after they are written off. But should not the accounting system concentrate on helping to build and maximize the value and use of the repertoire? Wouldn't a company receive more value from a system that shows the alternative costs of making a product using various combinations of new design elements and elements already in the repertoire than a system which apportions past costs in great detail but ignores what is truly variable at the moment? And couldn't an accounting system be designed to compute sales commissions and other incentive payments on the basis of the actual profit that individuals help generate?

Accountants will point out that their systems must report inventories and profits for investors and tax purposes. While certainly true, one can ask whether these reports could be made more easily. For example, must depreciation be apportioned to each product, or can it just be recorded in one bookkeeping entry each month? If FCIM eliminates the piles of work-in-process sitting around awaiting their next stage of manufacture, is detailed WIP inventory accounting still needed? Would it make sense to shift from emphasizing inventories to maximizing the value and use of the repertoire?

This paper is really asking about something deeper than accounting. The questions go to the very core of what a small or medium size company is trying to do or become. They ask, in essence, whether the management of a company that intends to use FCIM to become a strong innovator of new products for new market niches needs to think about its opportunities and alternatives in more dynamic and holistic way.

If the answer is yes, the paper then suggests the watershed opportunity to invert some present accounting practices. It suggests routinely keeping track of some details that would today be computed as special studies, while treating many of the costs that are now apportioned in great detail as gross numbers .

The Dual Path P & L Statement

A companies displays its financial condition with its Balance Sheet and Profit and Loss Statement. The Balance Sheet is a static snapshot of the company's position as of a point in time, while the P & L Statement is a summary of operations during a period of time. Accounting convention requires changes in the Earned Surplus line of consecutive Balance Sheets to be connected or explained by the P & L Statement for the intervening period.

This convention was developed when company outlays tended to fall into the two relatively neat categories of

- 1 Provision for the future or investment, and
- 2 Current operations or expense.

In simpler days, investment or provision for the future normally yielded something tangible and durable like a machine or building while expensed items were consumed during the period. Over time, the test for whether to show an expenditure as an operational expense or an investment has come to be based on the tangible or durable aspect instead of the reason for making the expenditure or the duration of its anticipated benefits.

Some expenditures, particularly for research and development or employee training have long presented an accounting problem. The objective was clearly provision for the future, but since knowledge and technical capability are not tangible, there was usually nothing concrete to call an asset. The problem was handled two ways. First, in even the most progressive companies, these expenditures were usually modest in relation to overall operations and they tended to occur at a relatively constant rate except during lean years, so they were not much of an issue. Second, providing for the future was viewed as a continuing operational requirement for staying in business--thus the problem was defined away. Over time, the performance of companies with continuing R&D and training programs tended to be recognized by the investment community, and they were often accorded higher price-earnings ratios for their stocks.

Today, many small and medium size companies must develop new technology or create a manufacturing capability that requires a surge in outlays for knowledge or technology which accounting conventions treat as a current expense. These provision-for-the-future or strategic expenses become merged with routine operating expenses on the P&L Statement in a single path that leads from Sales to Changes in Earned Surplus. A bold program for the future can thus appear as mismanagement. The accounting convention, intended to provide a conservative view of the company, when coupled with the normal organization of the P & L Statement, becomes a perverse measure and an incentive not to provide for the future.

The idea of a Dual Path P & L is an attempt to split the statement in two, showing one path for routine operating expenses and a second path for the strategic expenses of providing for the future. Both paths could appear side-by-side and lead to a common bottom line. A P & L Statement organized this way would provide a far more useful display of information without any changes to actual accounting conventions. While this information can be provided in text or footnotes, it does not have the effect that two parallel columns of figures would have. Few investment analysts, for example, routinely calculate two P/E ratios, one for current operations and one for the long term as the dual paths would almost demand.

Managers could be measured by one set of criteria on the operating side and a different set on the strategic side. Bonuses, promotions, stock options and retirements could be designed to take the two paths into account and support both short term profitability and long term strategic objectives. The strategic column would include the costs of the repertoire and a supporting statement could show some multi-year trends. This path can also include more than expenses. If, for example, there is a significant inventory reduction and sale of the space formerly used to store it, these one-time positive cash flows could be shown in the strategic path rather than as nonrecurring income in the routine operations path. The future year reductions in inventory carrying costs and lower space costs would be shown in the as routine operations.

Over time, the strategic path can lead to an indication of how well a company manages its technology. There ought to be a positive correlation between extensive strategic costs and relatively healthy operations data in the future.

The technique would probably also help guard against unfriendly acquisitions by the few who are able to recognize when the value of a company exceeds its reported value because of its repertoire and other investments in technology. The technique is not a general solution to the problems of justifying and measuring investments in technology, but it may be a step forward that would not involve difficult changes in accounting principles or systems.

DRAFT 9/20/89

The Cost Accounting Model: A New Proposal

Much has been written about the shortcomings of the traditional cost accounting model, including the lack of attention given to internal and cost controls and the improper matching of revenue and expenses and their emphasis on conservative inventory valuation at the expense of management reporting. Suggested solutions to these problems generally require an additional set of books or other off-line system to properly analyze and determine real product costs for management purposes. These suggested solutions, although satisfactory treatments for the problem, have two side effects. One, they cause additional and redundant effort and, two, they create inconsistencies between decisions based on management reporting versus financial reporting and the evaluations of those decisions.

An alternative to these suggested solutions is for the accounting profession to adopt new methods of accounting for product costs under generally accepted accounting principles (GAAP).

A Time To Adopt New Methods of Accounting

The reports of American manufacturing's demise, so prevalent only a few years ago, have given way to brighter prognoses. Manufacturing is experiencing a resurgence that cuts across industrial, geographic and company-sized boundaries. It has survived a stock market crash and fierce worldwide competition, and many industries are reaching capacity levels and enjoying increased sales and profits.

A commonality among companies leading this resurgence is a significantly changed manufacturing environment, which is presently characterized by increased automation and computerization, reduced levels of direct labor and inventory, increased attention to product and production planning, and shorter product life cycles. Although manufacturing philosophies such as JIT (just-in-time is a manufacturing approach designed to minimize inventory levels and reduce waste time during the manufacturing process through improved logistics), along with changing technologies, are fueling the traditional resurgence, this is just the beginning. Over 50 percent of the manufacturing executives participating in a 1987 Coopers & Lybrand survey see "very extensive implementation of JIT and CIM (computer-integrated manufacturing is the use of computers and advanced technology to manufacture products) during the next five years." (1)

In light of the revolution taking place in our factories, one would expect to see significant accounting changes under this new environment. After all, the traditional cost accounting approach was designed for a prior era of manufacturing when labor was often the most significant component of product cost and was used as the primary method of allocating overhead and other indirect costs. Today, overhead itself is often the most significant product cost and labor could be characterized as an indirect cost. With labor and overhead costs moving inversely, it is becoming increasingly difficult to determine product costs. Labor costs or hours are no longer an accurate basis to allocate overhead and a convenient substitute is not appeasement.

Still, cost accounting techniques based on a disappearing manufacturing environment prevail today. However, these techniques are no longer appropriate. New generally accepted accounting principles should be adopted to ensure that the traditional model does not inappropriately influence cost management decisions and financial results.

Activity, technology, and life-cycle accounting techniques, discussed below, have been developed to update the traditional cost accounting model to adequately reflect today's manufacturing environment. Activity and technology accounting techniques are interrelated and generally focus on cost control and the elimination of the overhead allocation problems, and could be adopted under the traditional model, although an accounting change under APB No. 20 would most likely occur. For publicly traded companies, a preferability letter would also be required. Life-cycle accounting promotes better matching of revenues and expenses and may require changes in the GAAP model. These techniques are discussed in more detail below to explain why and how the traditional cost accounting model should be changed.

Activity Accounting

Activity accounting accumulates product costs and other financial and operational information based on the activities required to manufacture the product or achieve a financial or operational goal. There is a general agreement that allocating overhead to production, based solely on direct labor, does not adequately reflect the complexity of today's manufacturing environment. It is not unusual to

find direct labor hours, once the benchmark for allocating overhead, to account for only ten percent of total product cost and the trend continues to decline.

Activity accounting is the first step in solving the overhead allocation problem. It starts by analyzing a company to determine all its production and support activities. The activities of a purchasing department, for example, might include raw materials and spare parts purchasing, as well as special work related to new products. Next, all costs are allocated to activities. In our purchasing department example, it may be determined that 40 percent of the purchasing department's costs are attributable to each of the two purchasing activities and 20 percent to the special work.

Next, activity accounting links the activity with the products manufactured by the use of the factor whose occurrence creates the costs. This factor is a measure of activity volume which most directly determines the cost of the activity. To illustrate in our example, the factors of a purchasing department might be as follows:

<u>Activity</u>	<u>Factor</u>
. Raw materials purchasing	. Quantity of materials used in production
. Spare parts purchasing	. Number of different parts ordered
. Special work	. Number of new products

Finished products are then assigned costs based on the factors included in their production. Costs of purchasing raw materials and special work would be allocated based on raw materials used in production and whether it is a new product. The costs of spare parts purchasing would first be allocated to machine activities based on the machines for which the spare parts were ordered. These activities would then be allocated to products based on a factor such as machine-hours. The total cost of finished products would be an accumulation of the activities required to produce the products.

This method of allocation directly relates product costs to the resources used to produce them. This is in contrast to the traditional model which spreads overhead costs between products on a basis such as direct labor-hours which generally does not directly relate to the consumption of the individual overhead items. One company that implemented activity accounting found that overhead costs applied to their products could be as little as one-fifth or as much as 20 times the amounts applied under the traditional model.

Controls are also strengthened under activity accounting since costs are controlled at the activity level where they are being incurred. The traditional model emphasizes cost control at the finished product level once the goods are produced and the costs have been incurred.

Activity accounting is acceptable under the traditional GAAP model but may cause an accounting change under APB No. 20. However, once a company has better allocated overhead using activity accounting, the next logical step may be to change the traditional GAAP model to permit more activities to be allocated to inventory, including some activities traditionally considered general and administrative expenses. The activities of accounts payable, payroll, and personnel are all part of product cost. By selecting the most reasonable factor as a basis of allocation, the costs of these activities can be reasonably allocated to production. These factors might include the number of different raw materials used in a product, number of employees, number of new hires, or number of new products. The line between product costs and general expenses becomes less clear under activity accounting and is an area of the traditional GAAP model that needs to be revised.

Technology Accounting

Technology accounting embodies the concept that technology costs, which include plant, equipment and information systems, should be treated as direct costs, equivalent to direct labor and material.⁽²⁾ Today, technology costs, for the most part, are accounted for by amortization (or depreciation) and included in indirect overhead.

The problem with this method of accounting is that conventional amortization methods are time-based, not production-based. A time-based method equates time with cost and often causes amortization

of idle machinery to increase overhead costs when there is little or no production. This encourages constant and ineffective production to maintain a desired cost per unit. Product costs are further affected by the inclusion of the time-based amortization in overhead which must then be allocated to production. By adopting a direct production-based amortization method, such as units-of-production, costs are more accurately matched with products manufactured.

When determining the number of units over which to amortize an asset, only the planned production of the asset should be considered. To simply use the asset's total lifetime production capacity does not solve the problems associated with a time-based amortization method. Total units used to amortize an asset should be limited by planned production, product demand, and obsolescence of the asset's technology or the manufacturing process.

As discussed in activity accounting, the choice of an overhead allocation method can significantly alter product costing. As technology costs increase as a percentage of total product costs, any misallocation will improperly influence management decisions and possibly the financial results of the company. The GAAP model should require that direct production-based amortization methods replace the indirect allocation that results from time-based methods.

Life-Cycle Accounting

Life-cycle accounting is defined as "the accumulation of costs for activities that occur over the entire life cycle of a product, from inception to abandonment by the manufacturer and the consumer."⁽³⁾ This concept is significantly different from traditional practice. A primary objective of life-cycle accounting is a better matching of revenues and expenses. This is achieved by expensing certain activities based on the total planned number of units to be sold. Life-cycle accounting also requires separate accounting for the risk associated with initially deferring the cost of these activities. Under the traditional GAAP model, this risk is accounted for by expensing such costs as incurred.

Under life-cycle accounting, all costs that benefit the future and are pursuant to management's plan are capitalized as incurred. Requiring costs to be incurred pursuant to a plan before being deferred is important because this requires expenditures to be tied to a future product or objective. These costs would include preproduction costs such as research, development, planning, start-up, and marketing costs.

Conservatism Distorts the Matching Principle

In the interest of conservatism, the traditional GAAP model distorts product costs by expensing a major portion of a product's cost as incurred and before production begins. Further, many of these product-related costs are expensed below

the gross margin line and are, therefore, not viewed as product cost. Many others are included in overhead which is allocated to current production although this production is neither related to nor benefits from these expenses.

Accounting for risk by conservatively expensing costs for which a future benefit is planned also makes it difficult to measure the success or failure of these expenditures. Significant investments are made in these activities but the traditional model does not readily permit the measure of return on those investments. It also encourages many of these expenditures to be considered discretionary when success in today's marketplace requires research, development, and marketing.

Most agree that engineering a product for production is most efficiently done during its preproduction stage. It is easier and more efficient to solve problems at that time rather than after production begins. These preproduction costs directly impact earnings under the traditional model by encouraging many products to be prematurely placed into production. Also, by expensing engineering costs as incurred, the actual cost of a product is unknown and the product may in fact be selling at a loss while the company reports a profit.

Traditional accounting theory says that expensing costs as incurred to account for risk is the correct answer. However, this theory is not consistently applied. When recovery is expected, the same theory requires the capitalization of

goodwill, motion picture production costs, plant additions, and mineral, oil, and gas rights for which there is a risk that the full future benefit will not be received. Other areas of accounting where conservatism does not dominate the matching principle are:

- . SFAS 86, Accounting for the Costs of Computer Software To Be Sold, Leased or Otherwise Marketed, allows costs to be capitalized once technological feasibility is obtained.
- . SFAS 68, Research and Development Arrangements, allows capitalization in certain circumstances of the amount paid for the results of a known successful project.
- . SFAS 25, Suspension of Certain Accounting Requirements for Oil and Gas Producing Companies, allows full costing, where many costs related to unsuccessful efforts are capitalized to be later matched with revenues generated from operations generally within the same country.
- . Program accounting used in the aerospace industry defers learning curve costs of the first units produced over total planned production.
- . Defense contractors capitalize general, administrative, research and development expenses by inclusion in overhead pools as recoverable costs.
- . Completed research and development projects purchased in an acquisition are capitalized along with the costs of research and development results that have alternative future uses.

Risk Accounting

To benefit from improved matching and product costing of life-cycle accounting, risk can no longer be accounted for by directly expensing these product costs as incurred. Under life-cycle accounting all costs that are incurred pursuant to management's plan and expected to benefit a future period are deferred. A risk reserve is then established by management to measure the probability that these deferred product costs will be recovered through related product sales. The risk reserve should be charged to income separate from cost of goods sold.

Under this method, additions to the reserve would be charged to expense and result from the following expenditures based on the possibility that they will not be realized:

- . Research and development costs;
- . Preproduction product costs;
- . Marketing costs; and
- . Additional reserves for changes in estimates of prior reserved amounts.

The reserve would be released as a result of the following determinations:

- . Future benefit becoming more probable;
- . Write-off of deferred expenditure to a realizable amount;
- . Related products are produced or sold; or
- . Abandonment of projects.

Given the numerous reasons why the risk reserve would increase or decrease, it appears at first it would cause income to fluctuate unpredictably from period to period. If objective reserves are established as the risk expenditures are made, subsequent adjustments should be minimal. Any significant changes should be related to a specifically identifiable event occurring in a given year and a change in the reserve would then be expected.

Footnote disclosure of significant changes in the reserve would give financial statement readers an opportunity to assess the success or failure of a company's risk expenditures and determine the return on that investment. Such disclosure is not required under the traditional model. The traditional model often creates more unexplained fluctuations in the income statement than the life-cycle model.

For those who believe risk expenditures should be expensed as incurred, the life-cycle model still works. If all amounts previously expended are fully reserved for when incurred, reported net income would be the same under both models. What would be gained from life-cycle accounting is more accurate product costing because the risk would be accounted for separately from product costs.

An Example of Traditional vs. Proposed Accounting Models

This example demonstrates the significantly different financial results that occur when technology and life-cycle techniques are applied as compared to the traditional model. Which model better reflects the results of operations?

Assumptions:

Year One	- Research and development costs incurred in search of new products	\$ 800
	- Given the early stage of development, a risk reserve is recorded for all expenditures	
Year Two	- Marketing study performed for new product and research and development completed	400
	- Study indicates 3,000 units will be sold at \$15 each and direct materials and labor will be \$5 each	
	- Marketing plan calls for \$4,500 in expenditures over three years	
	- Plant, equipment and information systems purchased with 5,000 unit capacity and five-year estimated life	6,000
	- No additional risk expenditure reserve appears necessary based on marketing study	
Year Three	- Product introduction marketing	2,000
	- 500 units produced and sold	2,500
	- Due to profitability of new product, no risk reserve appears necessary	
Year Four	- 1,500 units produced and sold	7,500
	- Routine marketing	1,000

Year Five	- 2,000 units produced and sold, including 1,000 units more than management's plan	\$10,000
	- Marketing related to increased competition, including \$500 more than management's plan	2,000

Income Statement Under Traditional Accounting Model

	YEAR				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Revenues			\$7,500	\$22,500	\$30,000
Costs of Goods Sold:					
Direct Costs			2,500	7,500	10,000
Depreciation					
<u>\$6,000</u> 5 years			1,200	1,200	1,200
Abandoned Plant					2,400
			<u>3,700</u>	<u>8,700</u>	<u>13,600</u>
Gross Margin			3,800	13,800	16,400
Research and Development	\$800	\$100			
Marketing	—	<u>300</u>	<u>2,000</u>	<u>1,000</u>	<u>2,000</u>
Income (Loss)	<u>(\$800)</u>	<u>(\$400)</u>	<u>\$1,800</u>	<u>\$12,800</u>	<u>\$14,400</u>
Gross Margin (%)*	-	-	<u>51%</u>	<u>62%</u>	<u>55%</u>
Income as a Percent of Revenues*	-	-	<u>24%</u>	<u>57%</u>	<u>48%</u>

*Fluctuation caused by time-based depreciation method and varied marketing needs.

Income Statement Under Proposed Accounting Model

	YEAR				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Revenues			<u>\$7,500</u>	<u>\$22,500</u>	<u>\$30,000</u>
Costs of Goods Sold:					
Direct Costs			2,500	7,500	10,000
Depreciation					
<u>\$6,000</u>					
3,000 units			1,000	3,000	2,000
Marketing					
<u>\$4,800</u>					
3,000 units			800	2,400	2,100
Deferred Costs					
<u>\$900</u>					
3,000 units			<u>150</u>	<u>450</u>	<u>300</u>
			<u>4,450</u>	<u>13,350</u>	<u>14,400</u>
Gross Margin			3,050	1,150	15,600
(Provision for) Benefit from Risk Expenditures					
			<u>(\$800)</u>	<u>800</u>	<u> </u>
Income (Loss)			<u>(\$800)</u>	<u>\$ 9,150</u>	<u>\$15,600</u>
Gross Margin (%)	-	-	<u>41%</u>	<u>41%</u>	<u>52%</u>
Income as Percent of Revenues	-	-	<u>51%*</u>	<u>41%</u>	<u>52%**</u>

*Reflects successful results of risk expenditure.

**Reflects sales in excess of management's plan net of excess marketing costs.

A Time for New Proposals

Clearly, there are apparent shortcomings with the traditional cost accounting model due to the revolution in today's manufacturing environment. The model was formulated in an era that has all but vanished. It's time for the accounting profession to adopt new proposals and make the model a better gauge of manufacturing realities. New techniques have been proposed that are reflective of today's manufacturing environment and may better show the results of management's decisions and better serve users of financial statements. Perhaps most importantly, these techniques appear to more fairly present the results of operations.

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DICK DAVIS

DIGEST

INVESTMENT IDEAS FROM THE BEST MINDS ON WALL STREET.

Personal Note:

**PETER LYNCH PART II:
THE PERFECT STOCK**

Few articles in this publication have generated as much positive response as the recent excerpts from Peter Lynch's upcoming book, *One Up On Wall Street* (Simon & Schuster). Lynch's Magellan Fund is the top performing mutual fund for the past 10-years, with a stunning total return of 1,279% for the period. Clearly, Lynch's market observations are well worth our attention. With this highly-recommended book expected within the next month, we thought we would share excerpts from one particularly astute chapter, "The Perfect Stock."

"Getting the story on a company is a lot easier if you understand the basic business. That's why I'd rather invest in panty hose than in communications satellites, or in motel chains than in fiber optics. The simpler it is, the better I like it. When somebody says, 'Any idiot could run this joint,' that's a plus, because sooner or later any idiot probably is going to be running it. If it's a choice between owning stock in a fine company with excellent management in a highly competitive and complex industry, or a humdrum company with mediocre management in a simpleminded industry with no competition, I'd take the latter. 'Any idiot can run this business' is one characteristic of the perfect company, the kind of stock I dream about. You never find the perfect company, but if you can imagine it, then you'll know how to recognize favorable attributes, the most important of which are as follows:

(Cont. on page 2)



Spotlight Stock:

**CATERPILLAR: EARTH
MOVER IS "DIRT CHEAP"**

James Arnold (*The Primary Trend*, 700 N. Water St., Milwaukee, WI 53202, 24 issues, \$180, 2/21/89) remains an adamant bull, despite recent market weakness. "The market is certainly

entitled to a pause and a rest, given the excellent 300-point rally from mid-November to early-February. So far, the pullback has not been much, yet bearish speculators are coming out of the woodwork, as evidenced by the huge increases in put buying. When speculators in the options market are overwhelmingly convinced that the market will go down, it is a reasonable expectation that the next significant market move will be up. We expect the current pause to be well-contained, and limited in both time and extent. Easy riches will not be garnered by the frenetic gamblers betting on the downside. The real money will be made by patient investors who seek quality and value." Here's the latest featured buy recommendation from Arnold:

"**Caterpillar** (CAT 59 NYSE) is the largest construction machinery maker in the world, with a world-class name. The company has two broad product categories: earthmoving and construction machinery; and gas and diesel engines. During 1988, sales (\$10.4 billion) and earnings set records -- erasing peaks set in 1981. Despite the apparent good news, CAT stock declined some 6 5/8 points or nearly 10% on Jan. 19, the day of the announcement. As is often the case, the institutional herd on Wall Street has a time horizon substantially shorter than corporate management's. In this instance, the disappointment was a realization that CAT will spend 40% more on internal capital improvements in 1989 than earlier thought, penalizing short-term earnings and the expectations of some investors. We view the short-term decline in CAT as an excellent buying opportunity for several reasons:

1) CAT's product lines will benefit from worldwide recovery trends in capital spending. We expect a lot of dirt to be moved around all over the world, and CAT is in the unique position to benefit from that activity -- particularly in housing, highway

(Cont. on page 8)

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(1) The perfect company has to be engaged in a perfectly simple business, and the perfectly simple business ought to be perfectly boring. The more boring it is, the better. Processing paychecks, which is what Automatic Data Processing does, is a good start. That it has a dull name is even better. Pep Boys: Manny, Moe, and Jack is the most promising name I've ever heard. It's better than dull, it's ridiculous. Who wants to put money into a company that sounds like the Three Stooges?

(2) I get even more excited when a company with a boring name also does something boring. Crown, Cork, and Seal makes cans and bottle caps. What could be duller than that? You won't see an interview with the CEO of Crown, Cork, and Seal in *Time* magazine alongside an interview with Iacocca, but that's a plus. A company that does boring things is almost as good as a company that has a boring name, and both together are terrific. If a company with terrific earnings and a strong balance sheet also does dull things, it gives you a lot of time to purchase the stock at a discount. When it becomes trendy and overpriced, you can sell your shares to the trend-followers.

(3) Better than boring alone is a stock that's boring and somehow disgusting at the same time. Something that makes people shrug, or turn away in disgust is perfect. It's hard to think of a more perfect industry than waste management. Now, if there's anything Wall Street would rather ignore besides toxic waste, it's mortality. Service Corp. Int'l does burials. Despite an incredible record, the SCI executives had to go out on cauldrons to beg people to listen to their story. That meant amateurs in the know could buy stock in a proven winner with a record of solid growth in earnings, and at much lower prices than they'd have to pay for a hot stock in a popular industry. Many people prefer to invest in a high-growth industry, where there's a lot of sound and fury. Not me. I prefer to invest in a low-growth industry like plastic knives and forks, but only if I can't find a no-growth industry like funerals. That's where the biggest winners are developed. In a no-growth industry, especially one that's boring and upsets people, there's no problem with competition. You don't have to protect your flanks from potential rivals because nobody else is going to be interested.

(4) Spinoffs of divisions or parts of companies into separate, freestanding entities often result in astoundingly lucrative investments. Large parent companies do not want to spin off divisions and then see those spinoffs get into trouble, because that would bring embarrassing publicity that would reflect back on the parents. Therefore, spinoffs normally have strong balance sheets and are well-prepared to succeed as independents. Spinoffs are often misunderstood and get little attention from Wall Street -- a favorable omen for the stocks.

(5) If you find a stock with little or no institutional ownership, you've found a potential winner. Find a company that no analyst has ever visited or that no analyst would admit to knowing about, and you've got a double winner. When I talk to a company that tells me the last analyst showed up three years ago, I can hardly contain my enthusiasm.

(6) I always look for niches. The perfect company would have to have one. I'd much rather own a local rock pit than a movie company, which has to compete with other movie companies. Certainly, owning a rock pit is safer than owning a

jewelry business. If you're in the jewelry business, you're competing with other jewelers from across town, across the state, and even abroad, since vacationers can buy jewelry anywhere and bring it home. But if you've got the only gravel pit in Brooklyn, you've got a virtual monopoly, plus the added protection of the unpopularity of rock pits.

(7) I'd rather invest in a company that makes drugs, soft drinks, razor blades, or cigarettes than in a company that makes toys. In the toy industry somebody can make a wonderful doll that every child has to have, but the parents only buy one. Eight months later that product is taken off the shelves to make room for the newest doll the children have to have -- manufactured by somebody else. Why take chances on fickle purchases when there's so much steady business around?

(8) There's no better tip-off to the probable success of a stock than that people in the company are putting their own money into it. When insiders are buying like crazy, you can be certain that, at a minimum, the company will not go bankrupt in the next six months. Long term, there's another important benefit. When management owns stock, then rewarding the shareholders becomes a first priority, whereas when management simply collects a paycheck, then increasing salaries becomes a first priority. If the stock price drops after the insiders have bought, so that you have a chance to buy it cheaper than they did, so much the better for you. Buying back shares is the simplest and best way a company can reward its investors. If a company has faith in its own future, then why shouldn't it invest in itself, just as the shareholders do?

The greatest company of all -- fictitious, of course -- would have to be Cajun Cleansers. Cajun Cleansers is engaged in the boring business of removing mildew stains from furniture, rare books, and draperies that are victims of subtropical humidity. It's a recent spinoff from Louisiana BayouFeedback. Its corporate headquarters are located in the bayous of Louisiana, and to get there you have to change planes twice, then hire a pickup truck to take you from the airport. Not one analyst from New York or Boston ever visited Cajun Cleansers, nor has any institution bought a solitary share. Mention Cajun Cleansers at a cocktail party and soon you'll be talking to yourself. It sounds ridiculous to everyone within earshot. No popular magazines except the ones that think Elvis is alive have mentioned Cajun or its product patents. The stock opened at \$8 in a public offering seven years ago and soon rose to \$10. At that price, corporate directors bought as many shares as they could afford. I hear about Cajun from a distant relative who swears it's the only way to get mildew off leather jackets left too long in dank closets. I do some research and discover that Cajun has had a 20 percent growth rate in earnings for the past four years, it's never had a down quarter, there's no debt on the balance sheet, and it did well in the last recession. I visit the company and find out that any trained crustacean could oversee the making of the gel. The day before I decide to buy Cajun Cleansers, noted economist Henry Kaufman has predicted that interest rates are going up, and then the head of the Federal Reserve slips on the lane at a bowling alley and injures his back, both of which combine to send the market down 15 percent, and Cajun Cleansers with it. I get in at \$7.50, which is \$2.50 less than the directors paid. That's the situation at Cajun Cleansers. Don't pinch me. I'm dreaming."

spending, commercial and industrial construction, and mining activities. The firm will also benefit from a resurgence in agriculture and in the petroleum industry. Importantly, we also believe that the warming of U.S./Soviet relations, the industrial expansion of China and other Far East countries, and the relaxation of tensions in the Persian Gulf area hold promise for significant sources of future demand. 2) CAT possesses a significant asset in its worldwide dealer network, which will ensure a competitive advantage both in domestic and foreign markets. The lower dollar, plus aggressive cost-cutting, has restored the CAT's position as the industry's low-cost producer and price leader. 3) CAT is in the midst of a major cost-reduction and modernization program. Designed to reduce costs by approximately \$1.6 billion below levels of the mid-1980s, the cost of the six-year program (1987-1992) will approximate \$600 million. As costs of this reorganization wane in 1991, profits should accelerate as the benefits of these programs materialize. 4) From the \$6.07 earned per share in 1988, Caterpillar has the potential to double earnings per share by 1991-1992, as the benefits of rising demand and cost cutting are realized. In 1989, we expect earnings of \$6.50-6.75 per share; in 1991-1992, earnings of \$10-15 a share are a definite possibility. 5) As investors look to participate in capital goods and export-related industrial stocks, a 'scarcity value' exists -- there are few high quality, large cap issues. Reflecting this, CAT has historically sold at a P/E premium to the general market. Currently, the P/E is at an approximate 15% discount relative to the general market. In all, the stock is dirt cheap -- selling at the lower end of its historic valuation range for the last 15 to 25 years. We expect Caterpillar to be a big mover down the road, and recommend purchase up to a limit of 65."

DESPITE TRAGEDY, BOEING'S A BUY

"In light of the recent United Airlines 747 incident, we feel it is timely to reiterate our buy recommendation on Boeing (BA 61 NYSE)," says Michael Rosen of Drexel Burnham Lambert. "The 747 involved was over 18 years old -- one of the oldest in United's fleet. This will likely re-raise the 'aging-of-the-fleet' issue and increase our conviction of an extended aircraft cycle due to replacement aircraft requirements. Despite our projections for a domestic recession in 1990, we do not feel production rates at Boeing will be negatively impacted, as fleets need to be modernized and foreign demand remains strong. Investors should be reminded that the 1988 Aloha incident, when part of the top structure came off an aircraft, led to a surge in new orders for Boeing. Based on current production rates, BA already has a 3 1/2 year backlog for 747-400s. These aircraft are the company's most profitable line. Our earnings estimate for 1989 remains \$6.25 a share, with \$7.50 expected in 1990. Our 9 to 12 month price target, given our outlook for a static overall stock market, is the mid \$70s."

FIXED-INCOME DOUBLE PLAY

"Franklin Resources (BEN 26 NYSE), with \$37 billion of assets under management, is one of America's premier management companies," says The Callard Report (PO Box 3000, Denville, NJ 07834, 24 issues, \$450, 2/16/89). "The company has been very versatile through its history, including great success in gold and other precious-metals funds in the 1970s. Today, the fund is heavily oriented to fixed-income funds. The largest funds, which account for 73% of managed assets are Franklin's Government Securities, California and New York tax-free, and federal tax-free funds. The company has a very strong market franchise. Its funds are well-known and the firm has excellent relations with the brokers and dealers who distribute them. In 1988, BEN was the top selling outside fund group for Merrill Lynch. In a climate of declining interest rates, the bond holdings of BEN's funds will rise, carrying fee income up. In addition, a climate of rising stock and bond prices will stimulate added investor purchases. Thus, there is a double-play benefit for Franklin in a positive investment climate. The company earned \$2.51 a share in 1988, up 15% from 1987. Forecasts call for \$2.75-\$2.90 a share in 1990. In 1987, the stock traded in the low 40s. A strong market climate could easily carry BEN to new highs by year-end."

ALD: UNPOPULAR AND MISUNDERSTOOD

"Our favorite rule for investing is 'Buy ignored, misunderstood stocks when they are cheap relative to sales, book value, cash flow, earnings, and dividends,'" says The Value-Income Investor (PO Box 2151, Winter Park, FL 32790, 24 issues, \$200, 2/17/89). "One stock that definitely meets this criteria is Allied-Signal (ALD 35 NYSE). In 1983, Allied, then Allied-Chemical, acquired Bendix Corp. In 1985, it merged with Signal. In 1986, Allied spun off 35 subsidiaries, know as The Henley Group. Criticized in the past for wasteful spending, ALD is attempting to mend its ways -- and is now well-positioned in its various markets. The company has a strong presence in aerospace, supplying wheels and brakes to Boeing, McDonnell Douglas and Airbus. The firm's auto segment is one of the leading suppliers of car and truck braking systems and turbochargers. The company spent over a billion dollars on research in 1987. Allied recently received a patent for a new substitute for Freon in auto air conditioners. This environmentally safe product could be a significant breakthrough. The firm has also developed a new material ten times stronger than steel, which can be used in bulletproof vests, military helmets, and armored cars. Earnings peaked in 1984 at \$5 and have since fluctuated around \$3 per share. Earnings are estimated in the \$3.60 area for 1989, up 16% from 1988's \$3.10 per share. We believe that Allied's highly-publicized past problems are overshadowing the company's vast future potential. Further, we note that if Allied continues to flounder, its strong asset value and low valuation make it vulnerable to a takeover. Buy."

Wall Street/Diana B. Henriques

New Faith in Old Money

OLD money. America has always been fascinated by family wealth, rooted in some corporate bedrock and carefully handed down from one generation to the next.

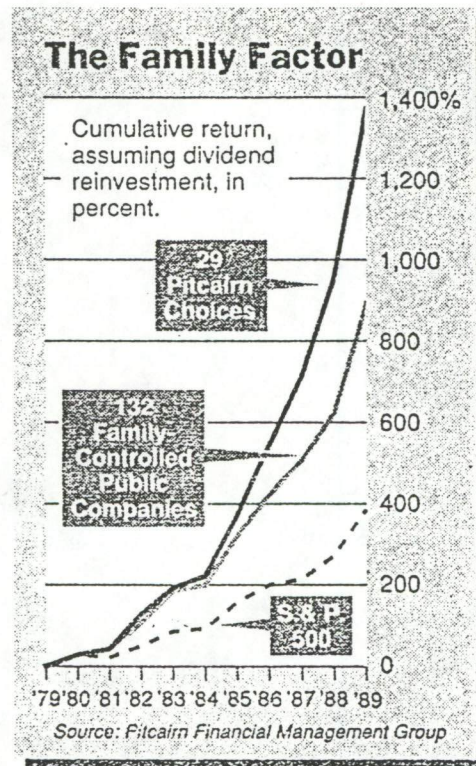
Perhaps the volatility of today's marketplace has heightened the vague sense that inherited wealth is somehow more stable than the cash flashed around by leveraged millionaires. In any case, men who were branded robber barons by their 19th century contemporaries are now cited as the heroes of a golden age before Wall Street became obsessed with quick profits.

Nostalgia is notoriously myopic, of course, and the past had its fair share of short-sighted entrepreneurs and fast-buck investors. But some intriguing research by the Pitcairn Financial Management Group, a small financial services firm in Jenkintown, Pa., suggests that there may be more than just wishful thinking behind the notion that family wealth is somehow special. This research indicates that public companies dominated by a single family may be much better long-term investments than the modern corporation run by professionals and owned by a host of passive pension funds.

To be sure, the researchers may have had a slight bias in favor of family firms. Pitcairn Financial Management Group began life in 1923 as the "family office" providing investment and tax administration services to the heirs of John Pitcairn, the co-founder of Pittsburgh Plate Glass, now PPG Industries. While the firm is still owned by the family and serves a host of Pitcairn offspring, stretching to the fifth generation, its officers decided 18 months ago to sell its services to outsiders, chiefly to other well-endowed families, provided they have liquid net worth of at least \$10 million.

The focus on family is more than a marketing gimmick; it is the heart of the Pitcairn Group's investment strategy. After diversifying out of the family's PPG holdings in the mid-1980's to give the family greater liquidity, the company decided to put its equity investments to work in the same vineyard where the family's own wealth was cultivated: family-dominated companies.

To guide their investment policy, the firm used the Pitcairn family's connections, scholars and lots of old-fashioned research to identify a universe of 132 publicly traded companies where wealthy family owners hold at least 10 percent of the outstanding



The New York Times/Jan. 21, 1990

shares and have managerial control.

The resulting roster is an idiosyncratic mix of household names and obscure companies in industries ranging from long-haul trucking to pizza retailing to shampoo. The Fords, the Belzbergs, the Chandlers and the DuPonts are there. But so are the Carvers (Bandag Inc.), the Ueltschis (Flight Safety International), the Sobey's (Hannaford Bros.) and the Kriebels (Loctite Corporation).

After identifying this set of family firms, analysts at the Pitcairn Group compared those companies' performance to the S.& P. 500 over the past two decades. The results were impressive: The family firms beat the broader measure in both bull markets and slumps. In 1986, for example, the annual return of the family firms was 27 percent, compared with a 19 percent gain in the S.& P. 500. And in 1987, when the October crash cut the return on the S.& P. 500 to a scant 3 percent, the family firms' annual return was 11 percent.

"But a family stake alone isn't enough,"

said Dirk Junge, vice chairman of the Pitcairn Group and one of the PPG heirs. "When a family firm is good, it is very, very good. But when it is bad, it can be more terrible than you could ever imagine."

Family discord, inept heirs who take on more than they can handle and self-indulgent owners who live high at the company expense are just some of the sins that can befall the family firm. So the analysts sifted further to find family firms that displayed the hallmarks of managerial discipline: low debt, good cash flow, reinvested earnings, thoughtful capital spending and fat profit margins.

The result is a portfolio of 29 stocks in which the Pitcairn Group has taken an investment stake. And Pitcairn research shows that its choices, based on historic data, have outpaced both the S.& P. 500 and the larger roster of family-controlled firms.

There are other wrinkles in the group's stock selection strategy, too. For example, the Pitcairns like the Walton family's firm, Wal-Mart, but for a different reason than most of its fans. "When you have a family-controlled company in an industry that is not generally family-controlled, the family firm has a really tremendous advantage," explained D. Mark Cunningham, an assistant vice president. "You can see that difference between Wal-Mart and K-Mart."

A less familiar stock that the Pitcairns have included in their portfolio is Hubbell Inc., the electronics company that grew up from founder Harvey Hubbell's invention of the pull-chain electric light switch. For almost three decades, Hubbell has reported consistently higher operating earnings, said David Lawson, the portfolio strategist for Pitcairn. "It has a very, very strong balance sheet, and has been a consistent generator of excess cash," he said. In a market where investors are very jittery about the reliability of corporate earnings, he added, "this is a 'sleep-well-at-night' kind of stock."

To keep the Pitcairns sleeping soundly, Mr. Junge said, the investment committee constantly watches for any sign that the family fabric underlying portfolio companies is fraying. "If there is divisiveness or a dissident factor in the family, there can be a very mixed agenda presented to the company in terms of its direction and its long-term commitments," he said. That could prompt the Pitcairns to sell. Otherwise, he said, "the family is the ultimate long-term investor." ■

IS ACCOUNTING STANDING IN THE WAY OF
FLEXIBLE COMPUTER INTEGRATED MANUFACTURING? -
A NATIONAL PERSPECTIVE

INTRODUCTION

Current accounting practices are having a negative impact on the ability of small companies 1) to justify moving to advanced manufacturing, 2) obtain adequate financing for the move, 3) operate modern processes effectively, and 4) do business with the Department of Defense. This serious condition requires national attention. Accounting practices will have to be modernized to meet the new realities.

The key elements of competitiveness for manufacturing companies in many of today's global markets are quality, life cycle cost, just-in-time delivery, and the ability to rapidly change product. Flexible Computer Integrated Manufacturing (FCIM) provides the capability to meet these criteria, if effectively applied in the context of a company's total business operation. However, current accounting practices do not recognize these new key elements of competitiveness; they are considered intangibles and do not "quantify" easily. Thus, justification of investment in advanced manufacturing is often a leap of faith. After the fact, on the basis of reported operating experience, it may be considered a mistake. These management accounting limitations provide a major barrier to FCIM adoption, especially for small firms which have to rely on conventional financing sources.

FLEXIBLE COMPUTER INTEGRATED MANUFACTURING

There are two striking economic characteristics of a factory that makes extensive use of current FCIM technology.

Startup Costs -- The first characteristic is the large startup costs in relation to modest operating costs. This characteristic applies to the initial facility, each enhancement, and each new product to be made. In an FCIM environment determining the manufactured cost of an individual part involves allocating large one-time costs and overhead, far more than measuring direct costs. Put another way, the costs of FCIM facilities are driven or caused by actions taken independently of, and frequently long before, the decision to produce a particular batch of parts.

In addition to the planned startup costs, there may also be events

that produce unplanned additional startup costs. These events typically occur when the various components of hardware and software, obtained from different sources, are brought together to work as a single system. These events may produce cost overruns, or, less obvious but equally serious, shortfalls from planned capabilities where too much was paid for what was obtained.

Retained Knowledge -- The second characteristic stems from the ability of an FCIM facility to learn how to perform a series of operations. Because the facility can remember and build a repertoire of all that it has done, the cost to make a repeat batch of parts can be far less than the cost of the first batch. Similarly, developing a new part as an adaptation of a previously produced part may cost much less than starting from scratch. The more the facility knows how to produce, the lower the cost of adding to its repertoire. Most of the repertoire is in computer software and NC data that can be kept in confidence, duplicated, shared, or sold. Yet the value of this knowledge base is not captured in any existing accounting reports.

ECONOMICS OF A FCIM

Each of the following five primary elements of cost of an FCIM facility are driven or caused by specific decisions, most of which are made long before any routine production runs:

1. Capital Equipment -- Except for the building, the facility's largest investment is in the machinery comprising the original cell. The CAD system hardware is a relatively minor investment.

The equipment will be depreciated on the basis of anticipated useful life, residual value, number of shifts of use, and expected use rate per shift. It is easy to show how legitimate but different choices among these factors could lead to a range of hourly charges from x dollars to 10x dollars for a particular machine. Selecting these factors are among the most critical decisions to be made in justifying and measuring an FCIM facility. If, for example, the equipment is depreciated on the basis of a one shift operation, the depreciation charged to its products will be three times greater than if a three shift operation is planned. But if machine time is priced on the basis of three shifts and that level is not reached, the facility will appear to run at a loss which might have been avoided had a lower use factor been anticipated.

2. System Software -- The computer software necessary to link the cell machines with the control computer and link the control computer to the CAD computer is often a mix of purchased software products and individually tailored programs. This software must

be operational before the facility begins production, and if it is developed entirely on site, its cost could approach the cost of the equipment. Normal accounting practice and tax laws call for this software cost to be treated as an expense as it is developed, even though it is for use in future periods. Selecting, developing, and controlling the initial cost of system software is second only to hardware in its effect on the eventual costs of FCIM products.

3. Product Technology -- Once the equipment and system software are operational, the cell must be programmed or "taught" how to make each type of part. Special hardware may be needed and one or more pilot runs may be necessary to test and improve the process. In this analysis, we are calling the combination of steps needed to make a new part or family of parts, "product technology". Each decision to create new product technology is a cost driver. We would include the setup for the initial or test batch as part of the cost of new product technology, as opposed to the costs of routine setups for subsequent batch runs which are operating costs. The cost of creating product technology includes the following three items:

- (1) Software and NC Data -- There are several ways to instruct the cell, ranging from developing the design of a part through the CAD process to putting a robot in a learn mode and manually guiding it through its paces while it creates its own code to repeat what it is being taught. In general, the more this form of programming can build on programs, codes, and data already in the system, the lower the cost for a new type of part.
- (2) Special Tools, Jigs, and Fixtures -- The efficiency of repetitive process can often be increased by using hardware, such as special cutting tools or devices, to hold the work. Decisions to make and use this hardware are usually a function of inventiveness, cost of the hardware, and anticipated savings. With FCIM systems, there may be tradeoffs between using special hardware or developing software.
- (3) Testing and Debugging -- While computers bring new economies and predictability they also bring new opportunities to make mistakes. Each time product technology is developed for a new type of part, it may have to be tested and perhaps modified before it can be used for production.

4. Operations -- By some estimates, upwards of ninety percent of the cost of making a part with FCIM may be committed before production starts. While there is little of the direct labor that characterized earlier manufacturing, a factory does cost something to run. Here are four examples of costs which can be measured and

may, to varying degrees, be attributed directly to the specific product.

- (1) Routine Batch Setup -- Traditional manufacturing attempts to use long production runs to minimize setup costs. One of the advantages of FCIM is low setup cost for economical production of short runs. (An FCIM cell may be less efficient for long runs than more specialized equipment designed for sustained performance of a few operations.) It may be possible to schedule the cell to make sequential batches of similar parts so that little time is spent shifting from one batch to another, but some machine time and labor will probably be needed for most setups. These times and costs are measurable and may be attributed directly to specific batches, particularly if they include adding or removing special hardware. Once the product technology to make a part is fixed, there are two cost drivers for each batch setup. The first is the decision to order the batch, and the second is when it is scheduled in relation to other jobs. Other things being equal, schedule driven costs may be saved if orders provide enough lead time to optimize setup activities.
- (2) Production -- The direct costs of production are relatively easy to measure. Material, abrasives, lubricants, and tools may be consumed directly. If the cell is attended, there is direct labor. Electricity can be metered, though judgment may go into setting the rate to charge. These costs are driven by the quantity, type, and production processes for the parts rather than the number of batches.
- (3) Maintenance -- Maintenance costs can be driven by the passage of time, operating hours, types of operation, abuse, and unanticipated failures. Examples of these are:
 - (a) Routine -- Lubrication, checking and adjusting for wear, and reviewing computer driven self-diagnostic tests are normal maintenance procedures that are intended to prevent costly equipment failure. They can be measured easily, but judgement is needed in allocating them to individual production runs.
 - (b) Tool Wear and Replacement -- Cutting tools need to be sharpened or replaced, and if desired, computer records can trace their use to individual production batches. But decisions on what types of tools to use and how fast to feed them can be important. Both the volume of production and the choice of process can be cost drivers.
 - (c) Specific Use Factors -- Some products may require more of a machine's capabilities or cause more rapid deterioration

than others. A worn machine may be able to hold to wide tolerances but not meet more demanding requirements. It appears that Japanese firms run machines below their rated capacity, to limit wear. Thus, the type of use may drive some maintenance costs, while actions to avoid wear can lead to increased production time.

(d) Unusual Events -- Sooner or later, most machines break down or need unscheduled maintenance. Although normally hard to predict, these events may be caused by abuse or the way the machine is used.

- (4) Education and Training -- By training, we mean teaching people how to operate the equipment and software to make products. By education, we mean helping managers as well as technical people expand their abilities to think. Running a company that uses FCIM successfully requires new ways of thinking. Both education and training can involve initial and continuing costs, all of which are intended to improve future performance and are hard to link to specific products.
- (5) Other Factory Overhead -- Most of the ongoing operating costs of the facility will be treated as overhead. These include space charges, heat, light, fire protection, insurance, materials handling outside the cell, purchasing, financial operations, management, and the cost of money. It is important to understand the significance and causes of these costs, but they will normally not be driven by decisions to use the cell itself.

THE FCIM ACCOUNTING PROBLEM

Up to this point, we have alluded to product costs as if they were readily determinable. Unfortunately, this is not quite so.

The accounting problems of FCIM systems are caused by:

- o The way standard accounting practice treats some of the large, early expenditures.
- o The long delays between the expenditures and the resulting sales.
- o The way accounting systems treat various types of knowledge.
- o The difficulty of relating expenditures to specific sales.
- o The way accounting systems combine current direct costs with

apportionments of previous expenditures.

o The tendency of accounting systems to ignore other critical information that are not collected in financial terms.

1. Early Expenditures -- Standard accounting practices requires a company to record as current expenses, the expenditures it must make to develop computer software, program FCIM equipment to make its current products, do strategic market analysis, develop new products, train its people, and make other provisions for the future. The effects of this treatment of strategic costs are to:

- (a) Reduce reported current profits and report the company as being in a poorer position than it would have been had it not provided for the future. This lower reported profit may, therefore, act as an incentive not to modernize.
- (b) Lose track of these early strategic costs when they are incurred. There is a cross-period subsidization and the true costs of future production are understated.

2. Long Delays -- Regardless of whether modernization expenditures are treated as investments or expenses, the time lag between outlays and the sales-produced revenue has two effects:

- (a) The risk of not recovering the expenditures may be large.
- (b) The cost of capital during the period of negative cash flow becomes important to the point of being one of the largest elements of the cost of modernization.

3. Accounting Treatment of Knowledge -- When a company pays for the research and development necessary to make new products, train its people, or develop a repertoire of computer-encoded production technology, it is investing in knowledge. Because accountants do not know how to accurately or precisely measure the value of knowledge, as an easy way out they assign it a value of zero.

An effect of this is illustrated in spare parts inventories. Although treated as an asset on a company's books, most companies strive to reduce parts inventories to minimize risk, reduce carrying charges, and apply the just-in-time concept. One way to reduce these inventories is, to simply do away with them and keep the knowledge of how to produce in an FCIM computer. When this is done, the repertoire becomes in effect an infinite inventory with no risk or carrying charges on inventory. But on the company's books, the physical inventory, which was an asset of value, is replaced with the repertoire which is treated as having no value. Yet we can envision the time when small companies are bought and

sold for the value of their repertoires.

4. Relating Costs to Sales -- In its early days, accounting was largely a process of relating labor and material costs to particular jobs and to the sales receipts from those jobs. As centralized activities such as purchasing and accounting grew, and more capital equipment was used, these costs were pooled and charged to production through an overhead rate, usually as a percentage of direct labor. Today, with FCIM, direct labor costs have declined almost to the vanishing point and most of the costs are what used to be treated as overhead. Yet there is no labor base!

5. Mixing Current Direct Costs with Apportionments of Previous Expenditures -- The typical factory cost accounting system treats labor, material, and depreciation as similar costs. A ten dollar hourly use charge based on a schedule to recover the purchase price of a machine over many months is treated as being equal to ten dollars worth of material just purchased. For making operating decisions about how to make a product, the two are not comparable. The machine was bought and the money is gone. Purchasing material creates a new out-of-pocket cost, while the real cost of using an otherwise idle machine may be negligible. The normal accounting approach overstates the ~~real~~ cost to process something with capital equipment, and can lead to buying more expensive, pre-processed material to reduce the use of an already under used machine.

The typical cost accounting system also ignores the interest cost of unrecovered money used to buy capital equipment. Thus, by overstating the true cost of processing and understating the continuing cost of idle capacity, accounting systems can lead to wrong cost estimates, wrong decisions on what orders to accept, and mistakes in weighing tradeoffs among processing alternatives.

Accounting experts are currently developing what they call "activity based accounting" which measures various support costs like accepting an order, purchasing material, stocking material, shipping, etc., and traces them directly to decisions such as the acceptance of an order. This work will help users of FCIM, but some fundamental problems will still remain. These include:

- (a) Only direct costs such as material are proportional to sales. The startup costs of pre-production years have no relationship to sales at all. Even though these expenditures for computer software, employee training, factory rearrangement, etc. are made to obtain future sales or reduce future costs, they are treated as expenses when incurred because they do not yield tangible assets of readily determinable value. Normal accounting practices does not allow a company to shift its

expenses from prior years into current accounts.

- (b) A firm can charge depreciation on the basis of use, making it more parallel to the direct variable costs. This would be managerially sound, but if this approach is used to calculate profits while accelerated depreciation is used for tax purposes, the minimum income tax provision may come into play.
- (c) The choice of number of hours of planned use for the system can be as important as the choice of the depreciation schedule. Any formula for computing hourly costs or charging rates has a dollar figure as the numerator and number of hours over which the dollars are to be spread as the denominator.
- (d) Defensible choices for depreciating capital investments can vary by an order of magnitude, while prior period strategic costs simply disappear from view. Thus product "cost" is no longer a function of measurement, and instead has become a function of company strategy.
- (e) While major corporations can use complex accounting systems such as Activity Based Costing to determine product costs, there is a scale factor that prevents small companies from using similar systems.
- (f) Finally, the only point at which the one-time strategic costs and capital investments can be controlled is when the expenditures are being made. Although these expenditures will determine the bulk of a company's product costs for years to come, most accounting systems tend to ignore them and concentrate on today's routine, repetitive operations that are of decreasing importance.

6. Other Critical Information -- Advanced manufacturing is becoming increasingly dependent on quantifiable information other than dollars. The measures used in statistical process control, product reliability, and short run setup times are examples of information that may be more important to factory operations than typical cost numbers, yet what they measure have a major effect on costs. Accounting will have to be extended beyond its traditional bounds.

THE IMPORTANCE OF PROPER ACCOUNTING

The importance of the FCIM accounting problem for small businesses can be seen in terms of two of the functions of an accounting system.

- (a) Relate how funds are used to the incomes received to measure

changes in inventories and profit or loss. We have shown how it is impossible to relate much of the outflow of funds directly to resulting sales. Instead, actions taken to benefit future operations are treated as current expenses which detract from profit when they are incurred. For firms and managers measured on the basis of their quarter-to-quarter and year-to-year profitability, this can provide a strong incentive not to undertake FCIM systems.

It may be hard to prevent allowing the initial years that bore the startup costs from subsidizing future years. As sales and expenses are reported in normal financial statements, a company might appear profitable shortly after its sales of FCIM manufactured products take off, but on a cumulative cash flow basis, the breakeven point is probably much later. Because of subsidization by the startup years, a company could be made to run at an indicated profit each year after startup and never reach the cash flow breakeven point before the system is scrapped.

- (b) 'Help managers make decisions regarding products, prices, and costs to attain successful operations.' So far, we have been primarily discussing sales and total costs of a company using an FCIM system, but operating decisions are made for individual jobs or increments--not the totals. In simpler times, records for each job would show profit or loss by customer, job type, or individual job. From this information, sound decisions could be made on what work to seek and how to control costs.

A prime advantage of an FCIM system is its ability to produce short runs of many different parts. But if each run is a sale, how does a company determine what orders to accept and what price to charge to yield a desired profit if it can't determine its cost to make the run? Further, while each initial run of a product involves preparatory work that need not be done for subsequent runs, how does a firm estimate the number of production runs to use as the basis for spreading the preparatory costs? How does it decide what new products to make, or choose its mix of new products and repeat runs?

CONTROLLABLE AND CONTINGENT COST DRIVERS

The term "cost driver" is increasingly popular in cost accounting literature. The idea is to identify the activities that cost money with greater accuracy and sensitivity to cause and effect. This paper emphasizes the importance of startup costs to the success of an FCIM system. Startup cost drivers can be divided into two

categories:

- (a) Controllable Cost Drivers -- individual activities or decisions that lead directly to planned expenditures, and
- (b) Contingent Cost Drivers -- the interaction, often delayed, among individual actions or decisions that lead to unexpected costs.

Ordering a piece of equipment is a controllable cost driver, as is ordering software to use with it. Finding that the equipment and software are not compatible and the subsequent actions taken to try to recover from the unanticipated problem are contingent cost drivers.

The concept of "contingent costs"--a thought normally restricted to expenses such as bad debts in most accounting texts--may be important to establishing FCIM systems. To be successful, these systems require people and organizations to do things right the first time, things they may not have done before. A single, runaway contingent driver can increase the cost of an FCIM system to the point where it may never be profitable. By the time accounting reports indicate the problem, most of the damage will already have been done.

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~~We are developing an FCIM System Planning Chart to help organizations develop their management processes. In its present form, the chart indicates 43 events--from writing the initial concept paper to completion of the first production batch. The events are organized by five streams of activity for Marketing, Product Design, the CAD/CAM Design and Instruction System, the FCIM Equipment, and the Facility. Twenty of the events are identified as controllable cost drivers, and of the twenty, only 6 are directly related to producing a specific product.~~

An additional 5 events, where different lines of activity come together for testing, are identified as contingent cost drivers. If work up to these points has been done well, the tests will be almost cost-free. But if mistakes have been made, these are the points where problems will be most likely to surface. Because they are not routine, companies find the costs produced by these contingent drivers are difficult to predict and control.

Companies might formally budget amounts for each of the contingent cost drivers they can identify. This would underscore the contingency aspect of the possible costs, and just thinking about them may lead to actions that minimize them.

~~(The FCIM System Planning Chart is too bulky to include with this~~

~~paper and is subject to frequent revision. Draft copies are available on request.)~~

PROVIDING FOR THE FUTURE

Some expenditures, particularly for research and development or employee training have long presented an accounting problem. The objective was clearly provision for the future, but since knowledge and capability are not tangible, there was usually no result to call an asset. The problem was handled two ways. First, in even the most progressive companies, these expenditures were usually modest in relation to overall operations and they tended to occur at a relatively constant rate so they were not much of an issue. Second, providing for the future was viewed as a continuing operational requirement for staying in business--thus the problem was defined away. Over time, the performance of companies with continuing R&D and training programs tended to be recognized by the investment community, and they were often accorded higher price-earnings ratios for their stocks.

Today, more than ever before, companies must develop new technology or create manufacturing capabilities that require a surge in outlays which accounting conventions treat as a current expense. These provisions-for-the-future expenses become merged with routine operating expenses on the P&L Statement in a single path that leads from Sales to Changes in Earned Surplus. A bold program for the future can thus appear as mismanagement. The accounting conventions, intended to provide a conservative view of the company, when coupled with the normal P&L Statement, become a perverse measure and an incentive not to modernize.

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CUMULATIVE CASH FLOW ACCOUNTING

Several people are working on an idea based on cumulative cash flow that may provide small companies with a watershed opportunity to simplify their accounting problem. If, as we believe, accounting has become more a function of strategy than measurement, then the strategic plan or multi-year budget of a company may be the best basis for evaluation.

Under this notion, only two sets of numbers really matter from an operating management standpoint--the cumulative outlays and the cumulative receipts. Concentrating on these two numbers and how decisions affect them, would show whether a company is doing what it undertook to do in the same way a lender looks at the company.

To illustrate the idea, when a company decides to convert to FCIM, it would make a cumulative cash flow projection for several years. This projection would show the planned cumulative outlays,

receipts, interest costs and profit by the end of the projected period--let's say five years. As the company makes startup expenditures, it would relate the cumulative outlays, the passage of time, and what is accomplished to the projection. As production starts and sales begin, the cash flow effects would be compared to the plan.

During any period, if the accomplishments and the net cash flow is on target, the company would have attained the anticipated goals. A variance between the anticipated net cash flow position and accomplishments would be shown as a profit or loss.

These ideas are preliminary. They will not satisfy all requirements for an accounting system. But they may be useful for guiding the internal operating decisions of a small company. Their ideas are presented as an example of the type of accounting innovation that may have to precede successful use of FCIM by small U.S. companies.

GOVERNMENT PROCUREMENT

At this point, the implications of the FCIM accounting problems for Government procurement should be clearer. What sort of negotiations and subsequent audit can lead to a fair distribution of costs among products made for the Government and private sector customers? If it is hard for a company to estimate its costs for its own purposes, how will it ever be able to reach agreement on the cost of sales to the Government? We don't have easy answers. But if industry and government together do nothing, the industrial base so necessary for U.S. defense purposes will be irrevocably hurt. This is a National problem, requiring answers from Government, Industry and Accounting--and not necessarily in that order.

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Editorial Notes on

"Is Accounting Standing in the Way of Flexible Computer Integrated Manufacturing?"

Minor changes on pages 1, 2, 6, 7, and 9.

Signifncant changes on pages 10 and 11.

Insert 1.

In order to examine this concept, we developed an FCIM Systems Planning Chart that shows 43 events--from writing the initial concept paper to completing the first production batch. The events are organized in five streams of activity for Marketing, Product Design, CAD/CAM and Process Control Systems, FCIM Equipment, and the Facility. Twenty of the events are controllable cost drivers, but of the twenty, only 6 are directly related to making a specific product.

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An alternative might be a dual path P&L Statement with two columns, one for routine operating expenses, and one for the uncapitalized costs of providing for the future or strategic costs. Both paths would lead to a common bottom line. Over several years (which could include recaps of past years) the relationship between the strategic and the routine operating paths could show how well the company is managed. Two P/E Ratios could be used by investors, one for the whole company and one for routine operations. Incentive systems could use both. With this approach, more accurate information could be provided with minimal changes to accounting conventions.

REFORMING MANAGEMENT ACCOUNTING TO SUPPORT TODAY'S TECHNOLOGY

Technical managers are in a unique position to lead in developing management accounting systems more suited to the needs of modern technology.

Lynn W. Ellis and Robert G. McDonald

Accounting for management should provide a basis for making correct decisions not only for the current business but also for building the future value of its activities. Much of what has been written recently on the problems with our present management accounting practices, as applied to modern technology, is a litany of its many deficiencies (1-5). In proposing reforming management accounting to overcome these cited inadequacies, we shall summarize, first, the key points of criticism; then address the role of research-technology managers in preparing this reform; and, finally, offer four specific proposals for a new management accounting system.

Critics of current management accounting cite four distinct categories of shortfalls:

1. The dominance of financial accounting for those outside the firm over internal management needs.

Financial accounting, sanctioned by the Securities and Exchange Commission and the Financial Accounting Standards Board (FASB), is concerned with reports to outside creditors and investors and not what is reported internally to managers. The financial accountant values the inventories of the firm by the "costs attach" approach in which the cost of the product will only include the manufacturing costs. Administrative, marketing and R&D charges are considered costs of the period in which they are incurred, and expensed immediately. The result of these calculations is a value for the cost of inventory on the balance sheet and a value for the cost of products sold on the income statement. The latter understates the true product cost by not including any of the costs incurred before manufacturing.

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One source of this problem is the recognized career path for corporate controllers and treasurers, which has been to work in public accounting and auditing, get the CPA qualification, and be hired by the firm which had been audited. This placing of key management accounting positions in the hands of those who have a financial reporting orientation readily explains why management accountants lack a production or internal focus and formulate internal reporting on that financial accounting perspective. As a consequence, managers' horizons contract to the short-term cycle of their monthly profit and loss statements served up with the biases of those who have been trained in the financial accounting viewpoint.

2. Management reports are of little help to operating managers attempting to reduce costs and improve productivity. Accounting reports are too aggregated; they are too late by the time all the data are run; they use allocation methods that result in cross-subsidies of different products giving incorrect costs; and they are prepared under improper bases, such as the use of direct labor to spread unallocated costs as overhead onto products. With the evolution toward high-technology manufacturing operations, the overhead items such as industrial engineering and production control have increased, while increasing use of capital to replace labor has cut the direct labor content to as little as 5 to 10 percent of manufacturing costs. This shift in costs, plus the spreading of overhead onto product through direct labor, has contributed to skyrocketing overhead rates due to many more dollars of overhead per hour of direct labor.

When operating managers are presented with these apparent high labor costs, one natural tendency is for them to try and reduce costs by still further reducing direct labor. This wastes much effort, however, because attention is directed to the least important cost category instead of directing efforts to analysis and control of those overhead items which are susceptible to reduction.

3. The management accounting system fails to provide accurate product costs. Accountants only include as a product cost the manufactured cost of direct material, direct labor and allocated overhead; they leave out the specific costs attributable to marketing, product management, administration and planning, R&D, and manufacturing development undertaken prior to launching the product into manufacture and sales. Thus, in a high-technology environment, product costs are understated and this may lead to improper decision-making.

4. *The subordination of growth-producing strategic activities (including R&D) to the bottom line of return on investment* Since it is past investment, expending funds on growth-producing strategic activities, such as R&D, tends to produce a lower current return as measured by the accounting system. However, proper management needs to balance today's return with tomorrow's, and this means optimizing the net present value of the combination of present and future streams of income, considering the time value of money, in order to maximize the value to shareholders (8,9). A consequence of this erroneous focus is that growth-enhancing activities such as R&D, market development and manufacturing development, are treated as expenses to be minimized rather than as investments in the future (7).

Even though one of accounting's main principles is the matching of revenues to the expenses of those revenues, the current system fosters a bad match. With short product life cycles, which are natural in the high-technology environment, money spent today on design and development of new products will be expensed immediately for "conservative accounting." Then, in the future, the product's revenues will be matched with that period's spending for even more distant product innovations. With today's revenues matched to spending for tomorrow's products, and the costs of developing today's revenues matched to yesterday's revenues, the accounting mismatch is shifted one whole cycle.

Prior to 1974, companies were at least allowed to capitalize R&D expenditures (6). One benefit showed up when a research effort came up dry, and the capitalized amounts were written off. Stock analysts looked for these write-downs as evidence of where the firm sought results and where it failed. Normally it would be very difficult for an analyst to be aware of a firm's direction in the R&D area due to the complexity of the research and the firm's efforts to maintain secrecy. With write-downs, the analyst could gauge where the remaining efforts were directed, or how the firm might regroup and redouble its efforts. The analyst could also compare firms' write-downs and estimate future successes. Since current financial accounting no longer allows capitalizing R&D, the information once contained in these write-downs is now hidden. Conservative accounting has thus generated less disclosure about R & D efforts than before.

Another consequence of this accounting treatment for R&D is the lost opportunity of emphasizing design engineering. With shorter life cycles, more savings may be realized from better design than from efforts to squeeze out efficiencies from the production line; however, no common yardstick exists between these two activities in current management accounting systems. Accounting reports show R&D as a cost of the period, and not of the product, as a consequence of financial accounting's treating costs by function (manufacturing, marketing and administration) and not by product or product line.

Growth-enhancing activities such as R&D are treated as expenses to be minimized rather than as investments in the future.

Why Technical Managers Should Care

There are several reasons why managers of research, development and technology should be concerned with the problems thus far outlined. First, they are in the business of addressing the corporation's future through the growth of the firm's product and service base. Any management accounting system that does not support this goal is a handicap to proper business management (10).

Second, computers (and particularly personal computers) are now so readily available as to make more practical the use of accurate costing systems focusing on management's goals. With the lower cost of processing data on computers, it is no longer necessary to economize by having one system do the accounting valuation, and have that system suffice for all other internal management reporting needs. It should be remembered that the internal reporting and the information needs of management are in no way bound by the FASB rules. These rules come into play only when the firm reports to outside (and presumably uninformed) investors and creditors. For inside reporting, a company can do anything it wants—even reading tea leaves or checking zodiac signs! Of course, an accounting system that easily reconciles financial and management accounting would have somewhat greater credibility.

Finally, in the words of a leading critic of present management accounting systems, who has repeatedly invited engineers to become involved in this area:

Management accountants who leave their offices will not find it difficult to discover ... the engineers who are in the forefront of implementing these changes ... we need to again learn from engineers how to design more effective internal measurement systems ... the professional organizations in the forefront of promoting change in management accounting systems are basically production and engineering organizations. (2, sidebar).

Research and technology managers should accept this challenge and devise reformed rules of measurement which will address the shortfalls identified by these critics.

Proposals for Reform

The FASB has a conceptual framework for accounting theory to ease later rule making which concludes that

for financial accounting, users' (creditors and investors) needs are primary. It would appear time for management accountants, in partnership with their research and technology managers, to present their own conceptual framework and declare that for management accounting, internal user needs are primary, and that they differ from outside user needs.

The following four proposals for changes in management accounting might be the start of such a framework:

1. *Extract strategic expenditures from present manufacturing costs, leaving true operating costs.* The present income statement which is split between "costs of goods sold" (manufacturing expenses) and general expenses (administration, marketing, and R&D) needs to be shifted into one which more nearly represents the line between operating and strategic decisions, as was pointed out nearly two decades ago (8). Operating expenses entered as "costs of goods sold" should clearly exclude those activities which are aimed at future years business. As shown in the Table below, under manufacturing in the first column, the activities in the upper block relate to current operations, while those in the lower block represent expenses being incurred now for the benefit of future operations. Also in the next three columns, the expensed activities under financial accounting are similarly divided into operating and strategic sectors. The primary effect of such a change would be to ensure that decisions to reduce operating costs would be made separately from, and thus not impact, preparing for tomorrow's products and services.
2. *Allocate operating overhead costs to machines and materials rather than only to direct labor.* In automated factories, where machines have replaced human labor, the concept of machine labor needs to be introduced.

Conservative accounting has thus generated less disclosure about R&D efforts than before.

Costs associated with machines, such as depreciation, interest, taxes, floor space occupancy, and electric power, need to be in the machines' overhead rates, rather than in that of the few people left on the factory floor. Similarly, direct materials, purchased parts, etc., generate their own overhead costs in purchasing, logistics and storage, which belong in a materials burden or overhead rate. Human labor overhead would then be reduced to costs really attracted by people, such as fringe benefits, and the building occupancy costs only for those areas used by people. In this manner, operating cost reduction efforts can be focused correctly on the cost drivers and not just the direct workers.

It is even possible that three systems may have to be set up until we learn to integrate them better: One each for process control, inventory valuation and product cost (11). The time frame dictates the response of each system: Process control monitors material and/or labor down to the hour or minute with real time capability—not summary reports at the end of the week or month. Inventory valuation can be accomplished on existing systems with little change. Product costs should be long term, in most cases over a one-year horizon, as covered below.

Comparison of Accounting Systems

Financial Accounting (and Present Management Accounting)				A Possible New Management Accounting System
Inventoried	Expensed			
Manufacturing	R, D & E	Marketing & Sales	General & Administrative	
Fabrication Assembly Production Control Purchasing	Engineering	Sales	General Accounting	Operating Expense for current busi- ness (sub-total of items at left)
Industrial Engineer- ing Manufacturing Development Process Develop- ment Employee Training	Research Product Develop- ment	Market Develop- ment Product Manage- ment Advertising Promotion	Strategic Planning	Strategic develop- ment expense for future business (sub-total of cur- rent projects of items at left)
Inventoried Sub- total = "Cost of Goods Sold."	R,D & E Sub-total	Marketing Sub-total	G & A Sub-total	Total for reconcilia- tion of the two systems

3. Separate functional expenses on the current income statement into a new category of strategic investment activities, corresponding to those allocatable to true product cost, as shown in the Table. Included in the strategic investment activities would be the costs associated with future products such as R&D; market development, product management, and long-term promotion from marketing; training and organizational development from human resources management; and value analysis, product start-up, process development, and programming robots from manufacturing (12). These activities should be budgeted and approved on an investment basis, as with capital plant, so that all investments in the future by a company share a common accounting yardstick.

Internal reporting can adopt any convention it wishes for product cost and not be bound by financial accounting's inventory cost. For management decisions, therefore, true product cost would equal inventoried product cost plus an additional cost representing investments made in the past for the product, which financial accounting has required to be expensed. This approach would try to calculate "life-cycle" standard costs of a product, to include manufacturing, marketing and R&D (5). Lest this seem strange to readers, consider that marketing has for some time used a standard cost of sales for many products—it is just labeled a "dealer discount." This approach would match costs with the transactions that cause them, and not be content to believe that costs are affected by volume alone.

As a consequence of such a shift in emphasis, efforts to define an optimum functional budget, such as for the R&D function, would be replaced by the more correct management task of determining an optimum strategic investment budget. Once this budget was set, balancing the company's present and future, it would then be apportioned among functional project proposals according to their relative contribution to the firm's net present value (NPV), as recommended for R&D return (13). Thus, a common measurement would apply for the R&D project, cost reduction in the factory, new machinery, or opening a branch sales office in a new territory. The management accounting task under such a scheme would become the task of project accounting against preestimate, a radically different task from the present focus on accounting by functional department.

As such an accounting system requires a record of past project expenditures, some investment portfolio valuation scheme needs to be devised. While the FASB requires that these strategic investment activities be expensed in external reporting, they may be "capitalized" for the purposes of internal accounting by writing them into a shadow investment account for each product or product line. When the products are sold and revenues recorded, the "standard cost" of each item in the shadow account would then be written out of the account and into the true product cost of goods sold. The new management accounting would recognize not only true product profitability but also the strategic return from the sum of such products, based on their contribution. More important, however, product pricing would need to recognize true product cost, and neither

Views from Abroad

The need to reform management accounting has not gone unnoticed outside the U.S. Not surprisingly, proposals from other countries differ in substance from the suggestions in this article. Japanese management accounting is used to play a role in integrating the efforts of employees with the long-term strategies of management (15). An alternative concept put forward in the United Kingdom, is to calculate an annual innovation expenditure in the form of a value-added statement (16). Neither of these, in our opinion, get to the heart of the matter in recognizing the investment nature of product decisions.—L.W.E. and R.G.M.

price too low products with high strategic investments nor price too high long-running products which have depreciated their shadow investment accounts to zero.

4. Use option theory as a value of those strategic assets. A fourth element of such a conceptual framework should be a means of policing the values in the shadow investment account. While the initial values will be the costs incurred, good practice in managing such an account requires that the value of each project carried forward annually should be the lesser of cost or current market value, as is the practice with inventories of goods. Thus, if the market value is lower than costs spent less writeoffs to date, additional writeoffs would be required beyond the standard amounts determined in setting true product costs. This would trigger review by management, reevaluation of the standard amounts, and thus recalculation of true product costs.

This raises the issue of how to calculate market value, since there is no free market on which to rely. Clearly, the benefits of a product or project which is well past its initial launch or operational date can be reforecast in terms of the NPV of its future streams of income, thereby providing a comparison with costs being carried forward in the shadow account.

Option theory provides an alternative solution to valuation early in the product life cycle (14). An option gives the investor the right to make a decision in the future. This is the equivalent of doing the R&D in anticipation of a later decision on launching the product if the prospective return is right, or cutting losses if it is not. This right has value whenever there is uncertainty, such as early in the R&D cycle. Thus, the value of initiating R&D is the right it gives to be in a position to make the later commitment, with maximum loss limited to the negative cash flow of the R&D.

The formulas for calculating option value are complicated, but have been reduced to tables in finance textbooks and programs usable in personal computers. These tables and programs depend on two principal inputs:

- The ratio of projected NPV of income streams to product launch costs is one input, with the value of the option increasing accordingly. This is just the R&D

We are really talking about investment decisions.

return as recently defined (13). While this needs to be greater than one in investment theory, it may be less than one in option theory in the expectation that fluctuations in the period before launch might raise it above one by then.

• If the NPV of future income streams at the time of launch is not above the launch cost, the option will not be exercised. However, the more this NPV is above the launch cost, the greater is the project's profitability. This input is not linear, but works out to the multiple of the project's standard deviation (risk) times the square root of the number of years to the launch decision. Higher risk and longer time to hold off deciding increase the value of initiating the project.

For example, for a R&D return of 1.4 and a 40 percent per year standard deviation, with four years to exercise date, the option is worth 43 percent of the launch cost, setting a market value on the early R&D stages of the project.

With an option, as the time until decision nears zero, the ratio of the NPVs dominates the value formula, and thus carries smoothly into the post product launch calculation referred to earlier.

What Managers Should Do

It is clear that many management accountants have hidden behind the facade of the FASB and may continue to do so. The authors believe that as the principal potential beneficiaries of a more appropriate accounting system, research and technology managers should get involved and create the needed system for providing the requisite management information. After all, engineers are fortunate in that they are not bound by the 500 years of accounting tradition now codified in the statements of the FASB.

A similar switch of roles took place years ago when the management information (MIS) specialists overtook the accountants. As computers were introduced for the accounting needs of order processing, payroll and inventories, MIS personnel reported to the controller. While the accountants were satisfied with financial accounting rules and obsolete procedures, the new capabilities of information systems thrust MIS staff from reporting to the controller to equality with the controller, and in some firms superior to the controller. The controller's data base became a subset of today's MIS. A similar sequence could happen again in tomorrow's microcomputer-dominated environment if

today's management accountants and MIS specialists fail to perceive the need for the reforms expressed above. Research and technology managers are now in a unique position to exert leadership in developing the management accounting systems for future of modern technology. ④

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THE FINANCIAL ACCOUNTING STANDARDS BOARD (FASB)
AND U.S. COMPETITIVENESS

I. ISSUE

Financial accounting procedures have not kept up with industrial changes brought about by global competition, new technologies, emphasis on quality, use of computers in manufacturing, and needs for higher skilled workers. As a result, investments that firms must make to be competitive are discouraged because accounting systems often overstate initial costs and understate future benefits. This, in conjunction with efficient capital markets that stress short-term performance, is impeding the modernization of U.S. industry.

II. DISCUSSION

Profits are the main goal of most U.S. companies, and financial accounting provides the report card that shows how well they are doing. Accounting procedures have been developed over many years to measure profit, preserve assets, protect the interests of owners and creditors, prevent fraud, provide a basis for interfirm comparisons by investors, and help managers control routine operations. Applying these procedures often requires judgement, so standards have been developed to help accountants and auditors ensure that a company's financial condition is reported with completeness, accuracy, and fairness in ways that will be comparable from company to company over time.

While the standards emphasize stability, many of the businesses they measure are changing rapidly as product development and manufacturing operations become knowledge-intensive. In order to be competitive, emphasis in manufacturing has shifted from using unskilled labor to make long runs of identical products, to highly skilled and professional employees who use computers and other expensive equipment to make new, varied, and rapidly changing products. This shift, which is required to meet the new market requirements for quality, just-in-time delivery, and flexible manufacturing capability, requires companies to spend large amounts to develop new products and processes long before production begins but spend relatively little during actual production.

In the past, long term expenditures usually resulted in tangible assets like buildings and machinery. Today, in addition to buying tangible assets, companies must increasingly pay for the costs of strategic activities such as long term marketing, research, product development, education and training, computer programming, and product testing. These activities produce critical knowledge in the form of know-how, product designs, computer software and data that controls manufacturing equipment, and employee skills. This knowledge, critical to survival and growth, operates as a long term asset (perhaps the most important

asset in the firm), but current accounting standards require most of it to be treated as an intangible with a value of zero, and its development costs are charged to current expense. X

X The primary accounting challenge in modern manufacturing and high-tech firms, should change from measuring operating costs when they are incurred, to apportioning one-time expenditures for years after they have been incurred. But accounting standards inhibit this change. For example, inventories are treated as assets, even though companies usually try to minimize them. With modern manufacturing processes, inventories can be replaced by a repertoire of computer code that directs machine tools to make small batches of products and replacement parts as they are needed for the life of the product. Present accounting standards require the cost of the computer code to be charged to expense when the code is created; the code to be assigned a value of zero because it is an "intangible"; and the asset value of the inventory to be reduced -- all of which reduce the company's stated value and profit.

In other words, providing for the future through strategic activities that are not allowed to be capitalized leads to a direct reduction of current profits even though they are intended to result in long term profits. The result is a negative incentive, or an incentive for managers not to modernize. This is compounded for publicly traded companies whose stock drops after reports of lowered earnings, and for small companies that must borrow for expansion. There is reason to believe that some companies avoid modernization for fear that current expense charges and resulting drop in stock value will lead to a hostile takeover.

Thus the lag between evolving industrial processes and accounting systems that measure them allows costs and profits to be seriously understated or overstated for different products and different periods of time. The report card, based on existing accounting standards, is no longer reliable, and it is becoming increasingly difficult to determine whether actions a company takes to achieve its profit goal are working.

Company managers who are trying to justify modernization programs or raise financing for them are increasingly aware of parts of the accounting problem, but few of them have spoken out on the broader issue of how the accounting lag has combined with the changing nature of manufacturing, short term investment emphasis, and high capital costs, to impose a severe handicap on U.S. companies.

III. COMMERCE DEPARTMENT ACTIONS

Solutions to the accounting problem will not come quickly, but a start appears to have been made. The Advanced Manufacturing Program of the Department of Commerce's Technology Administration recently held a roundtable with representatives from the

manufacturing, financing, accounting (including the Financial Accounting Standards Board) sectors, universities, and several federal agencies including SBA and DoD to consider the financing problems of small manufacturing companies seeking modernization. The FASB representative commented that while specific questions such as treatment of inventories and R&D had been considered, the fundamental issue of accommodating basic changes in the nature of product development and knowledge-intensive manufacturing processes had not previously been understood or considered. An outcome of the meeting was an agreement among the accountants to begin consideration of the broad problem. It must be remembered, however, that the process of changing accounting standards can take years.

The Technology Administration could bring together a group of key managers to explain the problem to Treasury, CEA, and OMB officials. The group might include about ten people like:

Robert Frosch -- former Administrator of NASA, now General Motors VP for Research who is investigating the accounting problem.

Steven Jobs -- who obtained significant financing from Japan to ensure stability for his new company.

Robert Galvin -- Two of whose officers at Motorola explained that the company's efforts to win the Baldrige Quality Award might not have been possible had not a significant block of its stock been privately held.

In bringing this issue to the attention of the policy level, DOC could address it with the appropriate Federal agencies while the Advanced Manufacturing Program continues to encourage private sector actions by the manufacturing, financing, and academic communities. The parallel paths could be mutually reinforcing and expedite the necessary changes.

4/10

TECHNICAL COMMENTS* ON THE PAPER,
"COMPETITIVENESS & THE COST OF CAPITAL:
EXECUTIVE SUMMARY"

(Paper prepared for the EPC Working Group
on Competitiveness and the Cost of Capital)

Section II: Defining the Cost of Capital

NEWS ITEM: On March 28, Oracle Systems Corporation, whose revenues have doubled in 12 of the past 13 years, announced that its quarterly earnings were a flat 18 cents a share, instead of the anticipated 23 to 25 cents predicted earlier. The difference was due to auditors' disallowance of sale-on-trial contracts which customers might still decline. The next day, Oracle closed at \$17.50, down \$7.875 or 31%. (From a 4/5/90 New York Times article which discusses business problems that Oracle may or may not have.)

Comment: The paper defines the cost of capital as the return a corporation has to pay to attract investors. It might be useful to define investors in terms that support the concept of competitiveness. Investors, including managers of large investment funds, can have a variety of motivations, many of which have nothing to do with the competitive success of the companies in which they invest. Those who dumped oracle are an example. Failure to distinguish between the types of investors at the outset may limit the value of the paper.

Section III: Why the Cost of Capital is Important to Investment

Comment: It might help to distinguish the business objectives of different groups of technology company owners or their representatives. Some "owners" manage funds for others and are measured on the basis of safety and consistent earnings. Often, these "owners" even set their target selling price for a stock when they buy it, and have no continuing interest in the companies contained in their portfolios. Expenditures made for long term competitive benefits, particularly those such as R&D, process improvement, and worker training which accounting conventions treat as expense, destroy values for this class of "owners." Should the study serve to aid, discourage, or be neutral toward "owners" of this type of disengaged owner/representative?

*Prepared by the Office of Technology Policy, Technology Administration, U.S. Department of Commerce.

We are testing the idea that investors can be classified as "conservative" or "productive." On a typical cash flow chart, the conservative investor seeks predictable and steady gains from the outset with no chance for loss of principal. Buyers of Treasury bills fit this profile. The productive investor, on the other hand, accepts the fact that the value of the investment will decline before it produces a revenue stream which is intended to recover the investment plus profits. The productive investor, who is needed to finance new competitive products and new processes, also recognizes that the entire investment may be lost.

Most investors fall between these two extremes, but it appears that capital increasingly is being concentrated toward the conservative end of the spectrum in the hands of managers of large pension, mutual, and trust funds. Since the objectives and methods of the two types of owners are so different, the effects of the cost of capital probably are also different.

Reducing the cost of capital is not a cure-all for U.S. competitiveness. For example, sharp reductions in the cost of capital will not change corporate management strategies in such key areas as quality, concurrent engineering or management, or the formation of long term relationships between suppliers and their primes (e.g., Xerox and Honda of America).

Section IV: Factors Impacting the Cost of Capital

Comment: It may be useful to compare investment rates with GNP for the 1980s. For example, the February Business Conditions Digest shows that commercial and industrial loans outstanding in 1982 dollars grew about 74% while GNP in fixed dollars grew only about 30%. A Federal Reserve Board chart shows a similar pattern for 1953-77. If other measures also show that investment grew more than GNP, perhaps there is more of a capital productivity problem than a cost of capital problem.

One way of looking at interest rates for an industrial project is that they comprise at least four components:

- (a) The price paid for the privilege of using the money (overcoming the lender's liquidity preference).
- (b) Anticipated loss of the principal's purchasing power due to inflation.
- (c) The risk of loss of the principal or interest.

- (d) The opportunity to earn significantly more than the minimum acceptable interest rate.

But for the types of productive investments we are seeking, with a period of negative cash flow, (c), the risk of loss, becomes the most important factor. This varies with each investment. It is outside the range of macro economic control but is reflected in hurdle-rate calculations. Since risk normally grows with time because of unknowns like unanticipated technical problems, market responses, and competitor actions, the risk element of the interest rate normally will be higher for longer range projects. It seems unlikely that changes in (a), which most observers appear to advocate, can offset the increases in (b) and (c) to cause longer range investments.

Conservative capital managers must ignore (d) if significant risk is indicated by (c); and, if they are obliged to show steady growth, they cannot accept the time delay. So, while (d) is what drives the truly productive capital managers, it is of little interest or incentive value to the conservative ones.

Savings and Macroeconomic policies

Comment: This section opens by saying that savings supplied by individuals, governments, and businesses determine the amount of funds which are available for investment. It may be useful to point out that much U.S. functional investment is treated as expense. Private autos used for commuting are consumption while taxis and buses are investment. Similarly, company expenditures for knowledge-related activities such as education, worker training, R&D, and most software are booked as current expenses although they are made for long-term reasons. If discrepancies such as these were resolved, the investment rate and the savings rate might show more favorably.

Market efficiency

Comment: This section begins by saying, "The extent to which impediments to capital flows remain between nations and within a given country determine how efficiently capital is allocated, which in turn, influences its cost to specific users." As this paper is directed toward competitiveness, it may be important to distinguish between capital market efficiency and capital use efficiency. The Japanese are widely cited for both their competitiveness and their low capital cost. But they created an inefficient capital market to the degree that they restricted both capital exports

and low cost loans for consumption. For years, they induced capital use efficiency by restricting capital market efficiency.

There is a serious question of how much new capital that is raised is used for productive investment. According to an article in the April 2, 1990 New York Times business supplement, from 1982 to 1989, new investments by venture capital companies in buyouts and acquisitions tripled. As of 1988, only 13% of venture capital firms' dollar commitments went to startups. And these are supposed to be the classic productive capitalists.

It is not clear that new capital such as pension fund contributions will be channeled into productive investment as opposed to speculation. It also appears that much of the pension fund money "invested" in blocks of S&P 500 stocks did little more than inflate their market price value while adding few productive assets.

The Japanese are now having to cope with the effects of low cost capital in land and stock speculation.

Agency Costs and Costs of Financial Distress

Comment: This may well be where most of the U.S. problem is located. There seems to be a growing gap between the "Techies" who need money for new products, processes, training, etc., and the "Buckies" who control the money. Although the theory of efficient markets rests on a presumption of perfect knowledge, most of these people just don't understand each other, and so far, the Buckies have done well enough without even trying to.

One of the elements of an interest rate calculation discussed above was (c), or the risk of loss of the principal or interest. There is also a (c')--the risk or cost of the capital manager's inability to understand and evaluate the factors that cause (c).

This leads to the conclusion that the highest cost of capital situations probably occur when (c) and (c') are cumulative. Unfortunately, this is increasingly the case, with most productive investments now carrying a significant (c) factor, and capital increasingly being concentrated in the hands of investment managers who add the (c') factor. Whether or not one wants to call this a cost of capital issue, it appears to be a primary reason why productive investment is lagging.

The Japanese keiretsu are ideally suited to handle the (c) and (c') problem. Members of the same industrial group can, together, explain to their member megabank how one company's advanced development program will help the others, and an assured partial market can be established even prior to the investment. Given assurances like this, the project has a lower (c) cost, and the lender who may be a member bank, customer, or a supplier, has much less of a (c') problem. This is where the Japanese can obtain a lower cost of capital.

Section V: Policy Implications

Comment: This section proposes policies that reduce the cost of capital. As the debate proceeds on this, it would be useful to distinguish the particular aspects of the cost of capital affected--liquidity preference cost, inflation adjustment, project risk, and investors' lack of knowledge of the risk.

If the (c) and (c') problem is the real capital cost driver, the actions mentioned above under Section IV dealing with agency costs may be the most useful part of the paper. For example, there is some evidence that family controlled businesses outperform others because they have more latitude to make long term strategic investments. The Japanese keiretsu are similar.

Another mechanism to reduce the cost of capital in an important area would be an investment tax credit for the purchase/lease of flexible, automated computer integrated manufacturing equipment, including related training and software expenses.

Analysis of the Research Tax Credit*

Background

Under section 41 of the U.S. Tax Code, a 20 percent tax credit is available for certain incremental expenditures related to two types of research activities: (1) qualified research and (2) basic research. The credit for qualified research activities, which is the subject of this paper, is calculated based on the increase in a taxpayer's qualified research expenditures in the current year over a "base amount" for that year. The credit for basic research is available to corporations funding certain research activities by universities and other qualified organizations.

The research credit was enacted originally in 1981 as part of President Reagan's first tax package. According to the 1981 House Report 4242, the stated purpose of the credit was "to reverse [a] decline in research spending by industry" and to "overcome the reluctance of many ongoing companies to bear the significant costs of staffing and supplies, and certain equipment expenses such as computer charges, which must be incurred to initiate or expand research programs in a trade or business."

Since its enactment, the concept of a research credit has enjoyed almost universal support by Congress and the Administration, as well as business. Controversies that have surrounded the credit have dealt with the question of how to create an efficient mechanism to encourage businesses to increase their R&D expenditures beyond the level they would have spent in the absence of a credit, and how to do this with a minimum revenue loss to the Treasury.

Major changes to the research credit were made by Congress in 1986, 1988, and 1989. The character of these changes clearly reflects the tension between Congress' desire to ensure a strong R&D incentive and Congress' need to exercise fiscal restraint. Beginning in 1986 the dollar value of the credit has been significantly reduced by reducing the rate from 25 to 20 percent, narrowing the definition of qualifying research activities, and disallowing section 174 research deductions. On the other hand, the incentive value of the credit has been increased by reforming the base amount and making the credit available to new technology ventures. These changes are detailed below.

*Prepared by the Office of Technology Policy, Technology Administration, U.S. Department of Commerce, April 6, 1990.

Legislative History

The 1981 Act

Credit Rate and Base Period: As enacted in 1981 on a temporary five-year basis, the rate of the research credit was 25 percent. This rate applied to the excess of a taxpayer's qualified research expenditures for the taxable year over the taxpayer's "base period research expenses," i.e., the average amount of such yearly expenditures in the base period (generally the preceding three years). At a minimum, the amount of base period research expenses is treated as equal to 50 percent of a taxpayer's qualified expenditures for the current year. The incremental nature of the credit was designed specifically to limit the credit only to those research expenditures that would not have been undertaken in the absence of the credit.

Definition of Qualified Research: Under the 1981 Act, "qualified research" had the same meaning as the term "research or experimental" under section 174 (the R&D deduction), i.e., R&D in the experimental or laboratory sense. However, certain expenditures such as research conducted abroad and for the humanities or social sciences were specifically excluded from eligibility for the credit.

Limitations on Qualified Research Activity: Only certain types of expenditures for qualified research activities could be included in the research credit calculation. These include in-house expenditures for research supplies and wages paid to individuals who are supervising, performing or directly supporting research activities. In addition, 65 percent of the amount paid or incurred by a taxpayer for contract research conducted on the taxpayer's behalf could be included.

Availability: Significantly, the research credit was made available only for research expenditures paid or incurred in carrying on a trade or business of the taxpayer. This meant that the credit was unavailable to start-up firms, many joint ventures, or existing firms entering a new line of business. Thus, from its inception, the research credit encompassed a more limited array of research activities than those eligible for current deductibility under section 174.

The 1986 Act

Credit Rate Reduction: The Tax Reform Act of 1986 significantly modified several important credit provisions, the most important of which were reduction of the rate from 25 to 20 percent and the tightening of the definition of qualified research. According to Congressional explanations of the 1986 Tax Reform Act, the rate reduction was deemed appropriate "in the context of the base broadening and rate reduction provisions of the Act, and the continued allowance of full expensing of research expenditures."

Narrowing the Definition of Qualified Research: Following several years of debate, Congress, Treasury, and representatives from industry arrived at a compromise definition that narrows the definition of "qualified research" for R&D credit purposes. Proponents of a narrower definition believed that the 1981 definition had been applied too broadly, and that taxpayers had claimed the credit for virtually any expense related to product development regardless of whether the taxpayer's activities involved any attributes of technological innovation. Thus, the new definition is intended to limit the research credit to research activities undertaken to discover information that is technological in nature and reflects a process of experimentation. Specifically excluded activities include: research conducted after a business component has been developed to its functional and economic requirements, and adaptation of existing business components (e.g., modifications for the needs of a particular customer).

While some have argued that the narrower definition provides little incentive for the final phases of technology commercialization and the adoption of advanced manufacturing processes, industry has not advocated reopening the issue. Considering the fact that both Treasury and the Congress regard the definition as settled, proponents of greater tax support for technology commercialization might have more success in advocating a separate tax provision (e.g., an investment tax credit for the purchase of flexible computer automated manufacturing equipment).

The 1988 Act

Deduction Disallowance: A new Code provision enacted by the Technical and Miscellaneous Revenue Act of 1988 limits the deduction available when a taxpayer claims a research credit. As enacted by the 1988 Act, section 280C(c) disallows section 174 research deductions for the portion of a taxpayer's qualified R&D expenses that equalled 50 percent of the taxpayer's research credit. According to one estimate this new disallowance reduced the credit's effective rate from 20 to 16.6 percent.

GAO Report: The 1988 Act also required GAO to report to Congress on the operation and effectiveness of the research credit, and to consider alternatives to the structure of the credit. Issued in September 1989, the GAO report concludes that the credit "stimulated between \$1 billion and \$2.5 billion of additional research spending between 1991 and 1995 at a cost of \$7 billion in tax revenues." Although the revenue cost was greater than the additional spending stimulated by the credit, the report acknowledges that the credit may still be sound tax policy due to the larger social benefits of increased R&D activities. The GAO report also noted that the research credit is difficult for the IRS to administer and that the incentive value of the credit would be increased if the moving-average base enacted in 1981 was replaced with a fixed base indexed to GNP growth or some other factor.

The 1989 Act:

More Deduction Disallowance: The Revenue Reconciliation Act of 1989 amended section 280C(c) to further increase the deduction disallowance to 100 percent of the research credit, thereby further reducing the credit's effective rate to 13.2 percent.

The Base Amount: The 1989 Act redefines the "base amount" used to calculate the proper amount of the incremental research credit. The three-year moving base period that had applied since 1981 had been long criticized as reducing the marginal incentive of the credit because it so intricately linked current spending to future base amounts. Thus, while an increase in research expenditures would result in an increased credit for that year, it would also result in increased base period amounts and a tendency towards smaller credits in

the following three years.

The provisions adopted in the 1989 Act attempt to enhance the credit's incentive effect while retaining a structure designed to limit the credit to those expenditures that would not have been undertaken in the absence of the credit.

The new provisions define the base amount in terms of two different elements: (1) the ratio of each company's spending on qualified research activities during a five year period to the company's total gross receipts during the same period (referred to as the "fixed base percentage"), and (2) the taxpayer's average annual gross receipts for the four taxable years preceding the taxable year for which the credit is claimed.

The fixed base percentage is the percentage that the taxpayer's qualified research expenditures for the five taxable years beginning in 1984 through 1988 is to the taxpayer's total gross receipts for the same period. (This percentage may not exceed 16 percent and is three percent for certain categories of start-up companies).

The base amount is determined by multiplying this fixed base percentage by the taxpayer's average gross receipts for the four taxable years preceding the taxable year for which the credit is claimed. Thus, for a company to receive the credit its research expenditures in given tax year must exceed a fixed base that is indexed to the company's average growth in receipts for the four preceding years. As under previous law, the base amount used for R&D credit calculation purposes may not be less than 50 percent of the taxpayer's qualified R&D expenditures for the year.

Expanded Availability: The 1989 Act expands the availability of the research credit by modifying the requirement that expenditures must be incurred "in carrying on a trade or business" to qualify for the credit. With respect to in-house research expenditures of certain start-up ventures, the trade or business limitation is deemed to be satisfied if the principal purpose of the taxpayer in making the expenditures is to use the results of the research in the active conduct of a future trade or business.

Need for Permanence

Lack of permanence is the most common business complaint concerning the research credit. Re-extended for an additional three years by the 1986 Act until December 31, 1988, the credit has been renewed twice more on a one year basis by the 1988 and 1989 Acts. It is now scheduled to expire at the end of 1990 (although as a practical matter, the credit will be effective only through September 1990 due to a special provision that prorates expenditures incurred before January 1, 1991, i.e., allowing only 75 percent of expenditures to qualify for purposes of computing the credit). Thus, although taxpayers did not know from year to year whether the research credit would remain, it was available continuously from the time of its enactment in 1981 through 1990.

The fact that Congress regarded research credit legislation as experimental in 1981 was the principal rationale for making it temporary. However, with the enactment of structural refinements in subsequent years and the increasing recognition that the provision's very impermanence may be its greatest detriment, this rationale has lapsed. Currently, Congress' desire to reduce revenue losses is the chief roadblock to permanence as evidenced by the reduction of recent extensions to only one year.

While it is generally believed that the research credit has contributed to industrial R&D efforts and the general prosperity of U.S. business, the start and stop nature of the credit to date has created a degree of uncertainty that impairs the ability of firms to make long-range plans. Complex, sophisticated research programs must necessarily be planned years in advance. With a constantly expiring credit provision, however, firms must make such plans completely in the dark without foreknowledge of the tax consequences.

Proponents of a permanent research credit argue that a stable tax provision would permit firms to plan and undertake research activities with a much greater assurance of the tax consequences. Accordingly, firms could establish and expand their research facilities and projects without the concerns brought about by constantly changing tax rules.

Administration Position

The Administration's budget for FY 1991 "proposes to make the 20 percent research tax credit permanent by allowing 100 percent of total research expenses to be used for computation

of the credit for all years after December 31, 1989." The Administration estimates that permanent enactment of the credit will incur revenue losses of \$0.5 billion in 1991, \$0.9 billion in 1992, and \$1.1 billion in 1993. To assure tax stability the Administration concurs with industry that the current research credit should be made permanent and allowed to operate for a while before considering any further changes or structural adjustments.



DEC 4 1989

MEMORANDUM FOR SECRETARY MOSBACHER
DEPUTY SECRETARY MURRIN
WAYNE L. BERMAN
MICHAEL SKARZYNSKI
BRUCE SOLL

FROM: Wendell L. Willkie, II *WLL*
General Counsel

SUBJECT: Research and Experimentation (R&E) Tax Credit and
Rule 861 R&E Allocation Rules

Following up on our conversation of this morning, set forth below is a summary of current law and changes made by the Reconciliation Bill (which has yet to be formally transmitted by the Congress to the President for his signature) regarding the R&E tax credit and R&E allocation rules.

I. Research and Experimentation Tax Credit

Current Law.

The current research and experimentation credit expires at the end of 1989. It is available for research expenditures paid or incurred in carrying on the trade or business of the taxpayer.

The credit is equal to 20 percent of the excess of qualified R&E expenditures for the current taxable year over the base amount. The base amount is equal to the average of the previous 3 years' R&E expenditures. The base is subject to the limitation that it never be less than 50 percent of qualified expenditures for the current taxable year.

Any deduction taken against taxable income for research expenditures must be reduced by 50 percent of the credit taken.

Changes Made by Reconciliation Bill.

The credit was extended for amounts paid or incurred up to December 31, 1990.

The current 20 percent tax credit is retained, but the formula for computing the base amount has changed. The base amount will now be computed by multiplying the taxpayer's "fixed-base percentage" by the average amount of the taxpayer's gross receipts for the four preceding years. The "fixed-base percentage" for existing

firms is the ratio of total qualified research expenditures to total gross receipts for the 1984-88 period. Start-up companies which did not both incur R&E expenses and have gross receipts during each of at least three years between 1984 and 1988 are assigned a fixed-base percentage of 3 percent. No taxpayer's fixed-base percentage can exceed 16 percent.

Any deduction taken against taxable income for research expenditures must be reduced by 100 percent of the credit taken, and must be "reasonable under the circumstances."

(The Administration's proposal would have made the tax credit permanent. It also would have made the base a fixed historical base equal to the average of the firm's qualified R&E expenditures for the years 1983 to 1987, indexed to GNP growth.)

II. Section 861 -- Allocation and Apportionment of Research and Experimental Expenditures Between Foreign and Domestic Income.

Current Law.

Until the recent R&E allocation rules expired on May 1, 1988, domestic firms were allowed to allocate 64 percent of their expenses for research performed in the United States to U.S. source income. The remaining expenses were allocated to foreign source income on the basis of gross sales or (subject to a limitation) gross income.

Changes Made by the Reconciliation Bill.

The Reconciliation Bill basically recodified the law as it existed prior to May 1, 1988. The new provision is effective only for the taxable year beginning after August 1, 1989 and before August 2, 1990, and applies only to research expenses paid or incurred during the first nine months of that period.

(The Administration's proposal would have made the R&E allocation rules permanent. The Administration also wanted a 67 percent R&E expense allocation, and no limitation on the use of the gross income method for foreign source allocation, but is generally satisfied with the recodification of prior law.)

NOTE: Between May 1, 1988 and the effective date of the new provision, firms were allocating R&E expenses based on Treasury regulations promulgated in 1977.



DEC 26 1989

MEMORANDUM FOR Wendell L. Willkie, II

FROM: Michael A. Levitt *MA*
Lisa Sockett *LS*

SUBJECT: **Examples of Research and Experimentation (R&E)
Tax Credit and Rule 861 R&E Allocation Rules.**

This memorandum responds to Deputy Secretary Murrin's request for examples of the impact of the Omnibus Budget Reconciliation Act of 1989, Pub. L. No. 101-239, as enacted into law on December 19, 1989, on the above-referenced tax provisions. Set forth below are some numerical examples and a further discussion of the changes made by the Reconciliation Act.

I. Research and Experimentation Tax Credit

The way the base period was calculated under the previous R&E tax credit, an increase in research expenditures in one year resulted in higher base period amounts (and therefore smaller credits) in following years unless research expenditures were increased by ever greater amounts. It also benefitted cost increases due to inflation rather than real increases in research activity. The Reconciliation Act ties research expenditures to gross revenues. This has the advantage of indexing the credit for inflation, and ameliorating the impact of increasing research expenditures as long as firms maintain research expenditures commensurate with their own sales growth.

The following example calculates the R&E tax credit for the taxable year 1990 under the previous law and under the Reconciliation Act (which is effective for taxable years beginning after December 31, 1989) to demonstrate the application of the new base period formula.

Example

A calendar-year taxpayer, X, is created in 1984. X's qualified research expenditures for 1984-1990 are as follows:

1984	.....	\$ 0
1985	.....	\$ 10,000
1986	.....	\$ 20,000
1987	.....	\$ 30,000
1988	.....	\$ 40,000
1989	.....	\$ 50,000
1990	.....	\$ 60,000

X's gross receipts for 1984 through 1990 are as follows:

1984	\$100,000
1985	\$125,000
1986	\$200,000
1987	\$275,000
1988	\$300,000
1989	\$325,000
1990	\$400,000

The amount of X's research credit for 1990 is determined as follows:

Under previous law - The credit is equal to 20 percent of the excess of qualified R&E expenditures for the current taxable year over the base amount. The base amount is equal to the average of the previous 3 years' R&E expenditures. The base is subject to the limitation that it never be less than 50 percent of qualified research expenditures for the current taxable year.

1990 qualified research expenditures.....	\$ 60,000	
Less the base amount, which is the larger of:		
(1) Average base period research expenses of previous three years (\$50K + \$40K + \$30K/3).....	\$ 40,000	
(2) Minimum average base period research expenses (50% of \$60,000).....	\$ 30,000	\$ <u>40,000</u>
Remainder of qualified research expenditures available for credit.....		\$ <u>20,000</u>
Research credit (20% of \$20,000).....		\$ <u><u>4,000</u></u>

Under the Reconciliation Act - The base amount is computed by multiplying the taxpayer's "fixed-base percentage" by the average amount of the taxpayer's gross receipts for the four preceding years. The "fixed-base percentage" for existing firms is the ratio of total qualified research expenditures to total gross receipts for the 1984-1988 period. No taxpayer's fixed-base percentage can exceed 16 percent. As under current law, a taxpayer's base amount may not be less than 50 percent of qualified expenditures for the current taxable year.

1990 qualified research expenditures..... \$ 60,000
Less the base amount, which is the larger of:

A. (1) Average amount of taxpayer's gross receipts
for four previous years (\$325K + \$300K + \$275K
+ \$200K/4)\$275,000

multiplied by the

(2) Fixed-base percentage, which is the smaller of

(a) Total qualified research expenditures for
1984-1988 (\$0K + \$10K + \$20K + \$30K + \$40K =
\$100,000), divided by total gross receipts for
1984-1988 (\$100K + \$125K + \$200K + \$275K +
\$300K = \$1,000,000) = 10 percent

(b) Minimum fixed-base percentage
..... 16 percent

(\$275,000 x 10%) \$27,500

B. Minimum average base period research expenses
(50% of \$60,000) \$30,000 \$ 30,000

Remainder of qualified research expenditures
available for credit.....\$ 30,000
Research credit (20% of \$30,000).....\$ 6,000

II. Section 861 -- Allocation and Apportionment of R&E Expenses

Under the U.S. Tax Code, each item of income of a multinational company is assigned either a U.S. source or a foreign source. A tax credit is available, subject to a limitation, for foreign taxes paid on foreign source income. The limitation is that the credit cannot exceed the amount that would be payable if the taxpayer's U.S. tax rate was applied to the foreign source income.

In calculating the amount of foreign source income available for the foreign tax credit, taxpayers are required to apportion expenses such as R&E expenses between foreign source income and U.S. source income. Subject to the foreign tax credit limitation, the lesser the expenses apportioned to foreign sources, the greater the amount of foreign source income available for the foreign tax credit, resulting in lower U.S. taxes.

The Reconciliation Act provides that a taxpayer shall allocate 64 percent of R&E expenses for research conducted in the United States to U.S. source income, and 64 percent of R&E expenses for

research conducted in a foreign country to foreign source income. The remainder of total R&E expenses can be allocated by either the gross sales or gross income method. If the gross income method is chosen, the amount apportioned to foreign source income can be no less than 30 percent of the amount calculated under the gross sales method. (There is no restriction on the gross sales method.)

The following example compares the gross sales method to the income method under the Reconciliation Act, which recodifies previous law. In the example, the income method is preferable for allocating R&E expenses, because less expenses need to be allocated to foreign sources, thereby leaving a greater amount of foreign income available for the foreign tax credit.

Example

Company Y has a wholly owned foreign subsidiary. In 1989, Y had \$100 of U.S. research expenses and \$100 of foreign research expenses. 50 percent of Y's gross sales produced U.S. source income, and 50 percent produced foreign source income. 90 percent of Y's gross income is from U.S. sources, and 10 percent is from foreign sources.

Allocation of qualified R&E expenses: U.S. Foreign

Gross Sales Method

Allocation of R&E expenses for

-- research conducted in the U.S. (\$100 x 64%)	\$ 64.00	
-- research conducted in foreign country (\$100 x 64%)		\$ 64.00

Allocation of Remaining \$72 (\$200-\$128)
based on gross sales

U.S. (\$72 X 50%)	\$ 36.00	
Foreign (\$72 x 50%)		\$ 36.00
Total Allocations	<u>\$100.00</u>	<u>\$100.00</u>

Gross Income Method

Allocation of qualified R&E expenses:	U.S.	Foreign
Allocation of R&E expenses for		
-- research conducted in		
the U.S. (\$100 x 64%)	<u>\$ 64.00</u>	
-- research conducted in		
foreign country (\$100 x 64%)		<u>\$ 64.00</u>
Allocation of Remaining \$72 (\$200-\$128)		
based on gross income		
Foreign -- Larger of		
(\$72 x %10)	\$ 7.20	
or		
30% Gross Sales Limitation,		
(\$36 x 30%)	\$10.80	<u>\$ 10.80</u>
U.S. (\$72 - \$10.80)	<u>\$ 61.20</u>	
Total Allocations	<u>\$125.20</u>	<u>\$ 74.80</u>

TECHNICAL COMMENTS* ON THE PAPER,
"COMPETITIVENESS & THE COST OF CAPITAL:
EXECUTIVE SUMMARY"

(Paper prepared for the EPC Working Group
on Competitiveness and the Cost of Capital)

Section II: Defining the Cost of Capital

NEWS ITEM: On March 28, Oracle Systems Corporation, whose revenues have doubled in 12 of the past 13 years, announced that its quarterly earnings were a flat 18 cents a share, instead of the anticipated 23 to 25 cents predicted earlier. The difference was due to auditors' disallowance of sale-on-trial contracts which customers might still decline. The next day, Oracle closed at \$17.50, down \$7.875 or 31%. (From a 4/5/90 New York Times article which discusses business problems that Oracle may or may not have.)

Comment: The paper defines the cost of capital as the return a corporation has to pay to attract investors. It might be useful to define investors in terms that support the concept of competitiveness. Investors, including managers of large investment funds, can have a variety of motivations, many of which have nothing to do with the competitive success of the companies in which they invest. Those who dumped oracle are an example. Failure to distinguish between the types of investors at the outset may limit the value of the paper.

Section III: Why the Cost of Capital is Important to Investment

Comment: It might help to distinguish the business objectives of different groups of technology company owners or their representatives. Some "owners" manage funds for others and are measured on the basis of safety and consistent earnings. Often, these "owners" even set their target selling price for a stock when they buy it, and have no continuing interest in the companies contained in their portfolios. Expenditures made for long term competitive benefits, particularly those such as R&D, process improvement, and worker training which accounting conventions treat as expense, destroy values for this class of "owners." Should the study serve to aid, discourage, or be neutral toward "owners" of this type of disengaged owner/representative?

*Prepared by the Office of Technology Policy, Technology Administration, U.S. Department of Commerce.

We are testing the idea that investors can be classified as "conservative" or "productive." On a typical cash flow chart, the conservative investor seeks predictable and steady gains from the outset with no chance for loss of principal. Buyers of Treasury bills fit this profile. The productive investor, on the other hand, accepts the fact that the value of the investment will decline before it produces a revenue stream which is intended to recover the investment plus profits. The productive investor, who is needed to finance new competitive products and new processes, also recognizes that the entire investment may be lost.

Most investors fall between these two extremes, but it appears that capital increasingly is being concentrated toward the conservative end of the spectrum in the hands of managers of large pension, mutual, and trust funds. Since the objectives and methods of the two types of owners are so different, the effects of the cost of capital probably are also different.

Reducing the cost of capital is not a cure-all for U.S. competitiveness. For example, sharp reductions in the cost of capital will not change corporate management strategies in such key areas as quality, concurrent engineering or management, or the formation of long term relationships between suppliers and their primes (e.g., Xerox and Honda of America).

Section IV: Factors Impacting the Cost of Capital

Comment: It may be useful to compare investment rates with GNP for the 1980s. For example, the February Business Conditions Digest shows that commercial and industrial loans outstanding in 1982 dollars grew about 74% while GNP in fixed dollars grew only about 30%. A Federal Reserve Board chart shows a similar pattern for 1953-77. If other measures also show that investment grew more than GNP, perhaps there is more of a capital productivity problem than a cost of capital problem.

One way of looking at interest rates for an industrial project is that they comprise at least four components:

- (a) The price paid for the privilege of using the money (overcoming the lender's liquidity preference).
- (b) Anticipated loss of the principal's purchasing power due to inflation.
- (c) The risk of loss of the principal or interest.

- (d) The opportunity to earn significantly more than the minimum acceptable interest rate.

But for the types of productive investments we are seeking, with a period of negative cash flow, (c), the risk of loss, becomes the most important factor. This varies with each investment. It is outside the range of macro economic control but is reflected in hurdle-rate calculations. Since risk normally grows with time because of unknowns like unanticipated technical problems, market responses, and competitor actions, the risk element of the interest rate normally will be higher for longer range projects. It seems unlikely that changes in (a), which most observers appear to advocate, can offset the increases in (b) and (c) to cause longer range investments.

Conservative capital managers must ignore (d) if significant risk is indicated by (c); and, if they are obliged to show steady growth, they cannot accept the time delay. So, while (d) is what drives the truly productive capital managers, it is of little interest or incentive value to the conservative ones.

Savings and Macroeconomic policies

Comment: This section opens by saying that savings supplied by individuals, governments, and businesses determine the amount of funds which are available for investment. It may be useful to point out that much U.S. functional investment is treated as expense. Private autos used for commuting are consumption while taxis and buses are investment. Similarly, company expenditures for knowledge-related activities such as education, worker training, R&D, and most software are booked as current expenses although they are made for long-term reasons. If discrepancies such as these were resolved, the investment rate and the savings rate might show more favorably.

Market efficiency

Comment: This section begins by saying, "The extent to which impediments to capital flows remain between nations and within a given country determine how efficiently capital is allocated, which in turn, influences its cost to specific users." As this paper is directed toward competitiveness, it may be important to distinguish between capital market efficiency and capital use efficiency. The Japanese are widely cited for both their competitiveness and their low capital cost. But they created an inefficient capital market to the degree that they restricted both capital exports

and low cost loans for consumption. For years, they induced capital use efficiency by restricting capital market efficiency.

There is a serious question of how much new capital that is raised is used for productive investment. According to an article in the April 2, 1990 New York Times business supplement, from 1982 to 1989, new investments by venture capital companies in buyouts and acquisitions tripled. As of 1988, only 13% of venture capital firms' dollar commitments went to startups. And these are supposed to be the classic productive capitalists.

It is not clear that new capital such as pension fund contributions will be channeled into productive investment as opposed to speculation. It also appears that much of the pension fund money "invested" in blocks of S&P 500 stocks did little more than inflate their market price value while adding few productive assets.

The Japanese are now having to cope with the effects of low cost capital in land and stock speculation.

Agency Costs and Costs of Financial Distress

Comment: This may well be where most of the U.S. problem is located. There seems to be a growing gap between the "Techies" who need money for new products, processes, training, etc., and the "Buckies" who control the money. Although the theory of efficient markets rests on a presumption of perfect knowledge, most of these people just don't understand each other, and so far, the Buckies have done well enough without even trying to.

One of the elements of an interest rate calculation discussed above was (c), or the risk of loss of the principal or interest. There is also a (c')--the risk or cost of the capital manager's inability to understand and evaluate the factors that cause (c).

This leads to the conclusion that the highest cost of capital situations probably occur when (c) and (c') are cumulative. Unfortunately, this is increasingly the case, with most productive investments now carrying a significant (c) factor, and capital increasingly being concentrated in the hands of investment managers who add the (c') factor. Whether or not one wants to call this a cost of capital issue, it appears to be a primary reason why productive investment is lagging.

The Japanese keiretsu are ideally suited to handle the (c) and (c') problem. Members of the same industrial group can, together, explain to their member megabank how one company's advanced development program will help the others, and an assured partial market can be established even prior to the investment. Given assurances like this, the project has a lower (c) cost, and the lender who may be a member bank, customer, or a supplier, has much less of a (c') problem. This is where the Japanese can obtain a lower cost of capital.

Section V: Policy Implications

Comment: This section proposes policies that reduce the cost of capital. As the debate proceeds on this, it would be useful to distinguish the particular aspects of the cost of capital affected--liquidity preference cost, inflation adjustment, project risk, and investors' lack of knowledge of the risk.

If the (c) and (c') problem is the real capital cost driver, the actions mentioned above under Section IV dealing with agency costs may be the most useful part of the paper. For example, there is some evidence that family controlled businesses outperform others because they have more latitude to make long term strategic investments. The Japanese keiretsu are similar.

Another mechanism to reduce the cost of capital in an important area would be an investment tax credit for the purchase/lease of flexible, automated computer integrated manufacturing equipment, including related training and software expenses.

THE FINANCIAL ACCOUNTING STANDARDS BOARD (FASB)
AND U.S. COMPETITIVENESS

I. ISSUE

Financial accounting procedures have not kept up with industrial changes brought about by global competition, new technologies, emphasis on quality, use of computers in manufacturing, and needs for higher skilled workers. As a result, investments that firms must make to be competitive are discouraged because accounting systems often overstate initial costs and understate future benefits. This, in conjunction with efficient capital markets that stress short-term performance, is impeding the modernization of U.S. industry.

II. DISCUSSION

Profits are the main goal of most U.S. companies, and financial accounting provides the report card that shows how well they are doing. Accounting procedures have been developed over many years to measure profit, preserve assets, protect the interests of owners and creditors, prevent fraud, provide a basis for interfirm comparisons by investors, and help managers control routine operations. Applying these procedures often requires judgement, so standards have been developed to help accountants and auditors ensure that a company's financial condition is reported with completeness, accuracy, and fairness in ways that will be comparable from company to company over time.

While the standards emphasize stability, many of the businesses they measure are changing rapidly as product development and manufacturing operations become knowledge-intensive. In order to be competitive, emphasis in manufacturing has shifted from using unskilled labor to make long runs of identical products, to highly skilled and professional employees who use computers and other expensive equipment to make new, varied, and rapidly changing products. This shift, which is required to meet the new market requirements for quality, just-in-time delivery, and flexible manufacturing capability, requires companies to spend large amounts to develop new products and processes long before production begins but spend relatively little during actual production.

In the past, long term expenditures usually resulted in tangible assets like buildings and machinery. Today, in addition to buying tangible assets, companies must increasingly pay for the costs of strategic activities such as long term marketing, research, product development, education and training, computer programming, and product testing. These activities produce critical knowledge in the form of know-how, product designs, computer software and data that controls manufacturing equipment, and employee skills. This knowledge, critical to survival and growth, operates as a long term asset (perhaps the most important

asset in the firm), but current accounting standards require most of it to be treated as an intangible with a value of zero, and its development costs are charged to current expense.

The primary accounting challenge in modern manufacturing and high-tech firms, should change from measuring operating costs when they are incurred, to apportioning one-time expenditures for years after they have been incurred. But accounting standards inhibit this change. For example, inventories are treated as assets, even though companies usually try to minimize them. With modern manufacturing processes, inventories can be replaced by a repertoire of computer code that directs machine tools to make small batches of products and replacement parts as they are needed for the life of the product. Present accounting standards require the cost of the computer code to be charged to expense when the code is created; the code to be assigned a value of zero because it is an "intangible"; and the asset value of the inventory to be reduced -- all of which reduce the company's stated value and profit.

In other words, providing for the future through strategic activities that are not allowed to be capitalized leads to a direct reduction of current profits even though they are intended to result in long term profits. The result is a negative incentive, or an incentive for managers not to modernize. This is compounded for publicly traded companies whose stock drops after reports of lowered earnings, and for small companies that must borrow for expansion. There is reason to believe that some companies avoid modernization for fear that current expense charges and resulting drop in stock value will lead to a hostile takeover.

Thus the lag between evolving industrial processes and accounting systems that measure them allows costs and profits to be seriously understated or overstated for different products and different periods of time. The report card, based on existing accounting standards, is no longer reliable, and it is becoming increasingly difficult to determine whether actions a company takes to achieve its profit goal are working.

Company managers who are trying to justify modernization programs or raise financing for them are increasingly aware of parts of the accounting problem, but few of them have spoken out on the broader issue of how the accounting lag has combined with the changing nature of manufacturing, short term investment emphasis, and high capital costs, to impose a severe handicap on U.S. companies.

III. COMMERCE DEPARTMENT ACTIONS

Solutions to the accounting problem will not come quickly, but a start appears to have been made. The Advanced Manufacturing Program of the Department of Commerce's Technology Administration recently held a roundtable with representatives from the

manufacturing, financing, accounting (including the Financial Accounting Standards Board) sectors, universities, and several federal agencies including SBA and DoD to consider the financing problems of small manufacturing companies seeking modernization. The FASB representative commented that while specific questions such as treatment of inventories and R&D had been considered, the fundamental issue of accommodating basic changes in the nature of product development and knowledge-intensive manufacturing processes had not previously been understood or considered. An outcome of the meeting was an agreement among the accountants to begin consideration of the broad problem. It must be remembered, however, that the process of changing accounting standards can take years.

The Technology Administration could bring together a group of key managers to explain the problem to Treasury, CEA, and OMB officials. The group might include about ten people like:

Robert Frosch -- former Administrator of NASA, now General Motors VP for Research who is investigating the accounting problem.

Steven Jobs -- who obtained significant financing from Japan to ensure stability for his new company.

Robert Galvin -- Two of whose officers at Motorola explained that the company's efforts to win the Baldrige Quality Award might not have been possible had not a significant block of its stock been privately held.

In bringing this issue to the attention of the policy level, DOC could address it with the appropriate Federal agencies while the Advanced Manufacturing Program continues to encourage private sector actions by the manufacturing, financing, and academic communities. The parallel paths could be mutually reinforcing and expedite the necessary changes.

REFORMING MANAGEMENT ACCOUNTING TO SUPPORT TODAY'S TECHNOLOGY

Technical managers are in a unique position to lead in developing management accounting systems more suited to the needs of modern technology.

Lynn W. Ellis and Robert G. McDonald

Accounting for management should provide a basis for making correct decisions not only for the current business but also for building the future value of its activities. Much of what has been written recently on the problems with our present management accounting practices, as applied to modern technology, is a litany of its many deficiencies (1-5). In proposing reforming management accounting to overcome these cited inadequacies, we shall summarize, first, the key points of criticism; then address the role of research-technology managers in preparing this reform; and, finally, offer four specific proposals for a new management accounting system.

Critics of current management accounting cite four distinct categories of shortfalls:

1. *The dominance of financial accounting for those outside the firm over internal management needs.*

Financial accounting, sanctioned by the Securities and Exchange Commission and the Financial Accounting Standards Board (FASB), is concerned with reports to outside creditors and investors and not what is reported internally to managers. The financial accountant values the inventories of the firm by the "costs attach" approach in which the cost of the product will only include the manufacturing costs. Administrative, marketing and R&D charges are considered costs of the period in which they are incurred, and expensed immediately. The result of these calculations is a value for the cost of inventory on the balance sheet and a value for the cost of products sold on the income statement. The latter understates the true product cost by not including any of the costs incurred before manufacturing.

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One source of this problem is the recognized career path for corporate controllers and treasurers, which has been to work in public accounting and auditing, get the CPA qualification, and be hired by the firm which had been audited. This placing of key management accounting positions in the hands of those who have a financial reporting orientation readily explains why management accountants lack a production or internal focus and formulate internal reporting on that financial accounting perspective. As a consequence, managers' horizons contract to the short-term cycle of their monthly profit and loss statements served up with the biases of those who have been trained in the financial accounting viewpoint.

2. *Management reports are of little help to operating managers attempting to reduce costs and improve productivity.* Accounting reports are too aggregated; they are too late by the time all the data are run; they use allocation methods that result in cross-subsidies of different products giving incorrect costs; and they are prepared under improper bases, such as the use of direct labor to spread unallocated costs as overhead onto products. With the evolution toward high-technology manufacturing operations, the overhead items such as industrial engineering and production control have increased, while increasing use of capital to replace labor has cut the direct labor content to as little as 5 to 10 percent of manufacturing costs. This shift in costs, plus the spreading of overhead onto product through direct labor, has contributed to skyrocketing overhead rates due to many more dollars of overhead per hour of direct labor.

When operating managers are presented with these apparent high labor costs, one natural tendency is for them to try and reduce costs by still further reducing direct labor. This wastes much effort, however, because attention is directed to the least important cost category instead of directing efforts to analysis and control of those overhead items which are susceptible to reduction.

3. *The management accounting system fails to provide accurate product costs.* Accountants only include as a product cost the manufactured cost of direct material, direct labor and allocated overhead; they leave out the specific costs attributable to marketing, product management, administration and planning, R&D, and manufacturing development undertaken prior to launching the product into manufacture and sales. Thus, in a high-technology environment, product costs are understated and this may lead to improper decision-making.

4. *The subordination of growth-producing strategic activities (including R&D) to the bottom line of return on investment.* Since it is past investment, expending funds on growth-producing strategic activities, such as R&D, tends to produce a lower current return as measured by the accounting system. However, proper management needs to balance today's return with tomorrow's, and this means optimizing the net present value of the combination of present and future streams of income, considering the time value of money, in order to maximize the value to shareholders (8,9). A consequence of this erroneous focus is that growth-enhancing activities such as R&D, market development and manufacturing development, are treated as expenses to be minimized rather than as investments in the future (7).

Even though one of accounting's main principles is the matching of revenues to the expenses of those revenues, the current system fosters a bad match. With short product life cycles, which are natural in the high-technology environment, money spent today on design and development of new products will be expensed immediately for "conservative accounting." Then, in the future, the product's revenues will be matched with that period's spending for even more distant product innovations. With today's revenues matched to spending for tomorrow's products, and the costs of developing today's revenues matched to yesterday's revenues, the accounting mismatch is shifted one whole cycle.

Prior to 1974, companies were at least allowed to capitalize R&D expenditures (6). One benefit showed up when a research effort came up dry, and the capitalized amounts were written off. Stock analysts looked for these write-downs as evidence of where the firm sought results and where it failed. Normally it would be very difficult for an analyst to be aware of a firm's direction in the R&D area due to the complexity of the research and the firm's efforts to maintain secrecy. With write-downs, the analyst could gauge where the remaining efforts were directed, or how the firm might regroup and redouble its efforts. The analyst could also compare firms' write-downs and estimate future successes. Since current financial accounting no longer allows capitalizing R&D, the information once contained in these write-downs is now hidden. Conservative accounting has thus generated less disclosure about R & D efforts than before.

Another consequence of this accounting treatment for R&D is the lost opportunity of emphasizing design engineering. With shorter life cycles, more savings may be realized from better design than from efforts to squeeze out efficiencies from the production line; however, no common yardstick exists between these two activities in current management accounting systems. Accounting reports show R&D as a cost of the period, and not of the product, as a consequence of financial accounting's treating costs by function (manufacturing, marketing and administration) and not by product or product line.

Growth-enhancing activities such as R&D are treated as expenses to be minimized rather than as investments in the future.

Why Technical Managers Should Care

There are several reasons why managers of research, development and technology should be concerned with the problems thus far outlined. First, they are in the business of addressing the corporation's future through the growth of the firm's product and service base. Any management accounting system that does not support this goal is a handicap to proper business management (10).

Second, computers (and particularly personal computers) are now so readily available as to make more practical the use of accurate costing systems focusing on management's goals. With the lower cost of processing data on computers, it is no longer necessary to economize by having one system do the accounting valuation, and have that system suffice for all other internal management reporting needs. It should be remembered that the internal reporting and the information needs of management are in no way bound by the FASB rules. These rules come into play only when the firm reports to outside (and presumably uninformed) investors and creditors. For inside reporting, a company can do anything it wants—even reading tea leaves or checking zodiac signs! Of course, an accounting system that easily reconciles financial and management accounting would have somewhat greater credibility.

Finally, in the words of a leading critic of present management accounting systems, who has repeatedly invited engineers to become involved in this area:

Management accountants who leave their offices will not find it difficult to discover ... the engineers who are in the forefront of implementing these changes ... we need to again learn from engineers how to design more effective internal measurement systems ... the professional organizations in the forefront of promoting change in management accounting systems are basically production and engineering organizations. (2, sidebar).

Research and technology managers should accept this challenge and devise reformed rules of measurement which will address the shortfalls identified by these critics.

Proposals for Reform

The FASB has a conceptual framework for accounting theory to ease later rule making which concludes that

for financial accounting, users' (creditors and investors) needs are primary. It would appear time for management accountants, in partnership with their research and technology managers, to present their own conceptual framework and declare that for management accounting, internal user needs are primary, and that they differ from outside user needs.

The following four proposals for changes in management accounting might be the start of such a framework:

1. *Extract strategic expenditures from present manufacturing costs, leaving true operating costs.* The present income statement which is split between "costs of goods sold" (manufacturing expenses) and general expenses (administration, marketing, and R&D) needs to be shifted into one which more nearly represents the line between operating and strategic decisions, as was pointed out nearly two decades ago (8). Operating expenses entered as "costs of goods sold" should clearly exclude those activities which are aimed at future years business. As shown in the Table below, under manufacturing in the first column, the activities in the upper block relate to current operations, while those in the lower block represent expenses being incurred now for the benefit of future operations. Also in the next three columns, the expensed activities under financial accounting are similarly divided into operating and strategic sectors. The primary effect of such a change would be to ensure that decisions to reduce operating costs would be made separately from, and thus not impact, preparing for tomorrow's products and services.

2. *Allocate operating overhead costs to machines and materials rather than only to direct labor.* In automated factories, where machines have replaced human labor, the concept of machine labor needs to be introduced.

Conservative accounting has thus generated less disclosure about R&D efforts than before.

Costs associated with machines, such as depreciation, interest, taxes, floor space occupancy, and electric power, need to be in the machines' overhead rates, rather than in that of the few people left on the factory floor. Similarly, direct materials, purchased parts, etc., generate their own overhead costs in purchasing, logistics and storage, which belong in a materials burden or overhead rate. Human labor overhead would then be reduced to costs really attracted by people, such as fringe benefits, and the building occupancy costs only for those areas used by people. In this manner, operating cost reduction efforts can be focused correctly on the cost drivers and not just the direct workers.

It is even possible that three systems may have to be set up until we learn to integrate them better: One each for process control, inventory valuation and product cost (11). The time frame dictates the response of each system: Process control monitors material and/or labor down to the hour or minute with real time capability—not summary reports at the end of the week or month. Inventory valuation can be accomplished on existing systems with little change. Product costs should be long term, in most cases over a one-year horizon, as covered below.

Comparison of Accounting Systems

Financial Accounting (and Present Management Accounting)				A Possible New Management Accounting System
Inventoried	Expensed			
Manufacturing	R, D & E	Marketing & Sales	General & Administrative	
Fabrication Assembly Production Control Purchasing	Engineering	Sales	General Accounting	Operating Expense for current business (sub-total of items at left)
Industrial Engineering Manufacturing Development Process Development Employee Training	Research Product Development	Market Development Product Management Advertising Promotion	Strategic Planning	Strategic development expense for future business (sub-total of current projects of items at left)
Inventoried Sub- total = "Cost of Goods Sold."	R,D & E Sub-total	Marketing Sub-total	G & A Sub-total	Total for reconcilia- tion of the two systems

3. *Separate functional expenses on the current income statement into a new category of strategic investment activities, corresponding to those allocatable to true product cost, as shown in the Table.* Included in the strategic investment activities would be the costs associated with future products such as R&D; market development, product management, and long-term promotion from marketing; training and organizational development from human resources management; and value analysis, product start-up, process development, and programming robots from manufacturing (12). These activities should be budgeted and approved on an investment basis, as with capital plant, so that all investments in the future by a company share a common accounting yardstick.

Internal reporting can adopt any convention it wishes for product cost and not be bound by financial accounting's inventory cost. For management decisions, therefore, true product cost would equal inventoried product cost plus an additional cost representing investments made in the past for the product, which financial accounting has required to be expensed. This approach would try to calculate "life-cycle" standard costs of a product, to include manufacturing, marketing and R&D (5). Lest this seem strange to readers, consider that marketing has for some time used a standard cost of sales for many products—it is just labeled a "dealer discount." This approach would match costs with the transactions that cause them, and not be content to believe that costs are affected by volume alone.

As a consequence of such a shift in emphasis, efforts to define an optimum functional budget, such as for the R&D function, would be replaced by the more correct management task of determining an optimum strategic investment budget. Once this budget was set, balancing the company's present and future, it would then be apportioned among functional project proposals according to their relative contribution to the firm's net present value (NPV), as recommended for R&D return (13). Thus, a common measurement would apply for the R&D project, cost reduction in the factory, new machinery, or opening a branch sales office in a new territory. The management accounting task under such a scheme would become the task of project accounting against preestimate, a radically different task from the present focus on accounting by functional department.

As such an accounting system requires a record of past project expenditures, some investment portfolio valuation scheme needs to be devised. While the FASB requires that these strategic investment activities be expensed in external reporting, they may be "capitalized" for the purposes of internal accounting by writing them into a shadow investment account for each product or product line. When the products are sold and revenues recorded, the "standard cost" of each item in the shadow account would then be written out of the account and into the true product cost of goods sold. The new management accounting would recognize not only true product profitability but also the strategic return from the sum of such products, based on their contribution. More important, however, product pricing would need to recognize true product cost, and neither

Views from Abroad

The need to reform management accounting has not gone unnoticed outside the U.S. Not surprisingly, proposals from other countries differ in substance from the suggestions in this article. Japanese management accounting is used to play a role in integrating the efforts of employees with the long-term strategies of management (15). An alternative concept put forward in the United Kingdom, is to calculate an annual innovation expenditure in the form of a value-added statement (16). Neither of these, in our opinion, get to the heart of the matter in recognizing the investment nature of product decisions.—L.W.E. and R.G.M.

price too low products with high strategic investments nor price too high long-running products which have depreciated their shadow investment accounts to zero.

4. *Use option theory as a value of those strategic assets.* A fourth element of such a conceptual framework should be a means of policing the values in the shadow investment account. While the initial values will be the costs incurred, good practice in managing such an account requires that the value of each project carried forward annually should be the lesser of cost or current market value, as is the practice with inventories of goods. Thus, if the market value is lower than costs spent less writeoffs to date, additional writeoffs would be required beyond the standard amounts determined in setting true product costs. This would trigger review by management, reevaluation of the standard amounts, and thus recalculation of true product costs.

This raises the issue of how to calculate market value, since there is no free market on which to rely. Clearly, the benefits of a product or project which is well past its initial launch or operational date can be reforecast in terms of the NPV of its future streams of income, thereby providing a comparison with costs being carried forward in the shadow account.

Option theory provides an alternative solution to valuation early in the product life cycle (14). An option gives the investor the right to make a decision in the future. This is the equivalent of doing the R&D in anticipation of a later decision on launching the product if the prospective return is right, or cutting losses if it is not. This right has value whenever there is uncertainty, such as early in the R&D cycle. Thus, the value of initiating R&D is the right it gives to be in a position to make the later commitment, with maximum loss limited to the negative cash flow of the R&D.

The formulas for calculating option value are complicated, but have been reduced to tables in finance textbooks and programs usable in personal computers. These tables and programs depend on two principal inputs:

- The ratio of projected NPV of income streams to product launch costs is one input, with the value of the option increasing accordingly. This is just the R&D

We are really talking about investment decisions.

return as recently defined (13). While this needs to be greater than one in investment theory, it may be less than one in option theory in the expectation that fluctuations in the period before launch might raise it above one by then.

• If the NPV of future income streams at the time of launch is not above the launch cost, the option will not be exercised. However, the more this NPV is above the launch cost, the greater is the project's profitability. This input is not linear, but works out to the multiple of the project's standard deviation (risk) times the square root of the number of years to the launch decision. Higher risk and longer time to hold off deciding increase the value of initiating the project.

For example, for a R&D return of 1.4 and a 40 percent per year standard deviation, with four years to exercise date, the option is worth 43 percent of the launch cost, setting a market value on the early R&D stages of the project.

With an option, as the time until decision nears zero, the ratio of the NPVs dominates the value formula, and thus carries smoothly into the post product launch calculation referred to earlier.

What Managers Should Do

It is clear that many management accountants have hidden behind the facade of the FASB and may continue to do so. The authors believe that as the principal potential beneficiaries of a more appropriate accounting system, research and technology managers should get involved and create the needed system for providing the requisite management information. After all, engineers are fortunate in that they are not bound by the 500 years of accounting tradition now codified in the statements of the FASB.

A similar switch of roles took place years ago when the management information (MIS) specialists overtook the accountants. As computers were introduced for the accounting needs of order processing, payroll and inventories, MIS personnel reported to the controller. While the accountants were satisfied with financial accounting rules and obsolete procedures, the new capabilities of information systems thrust MIS staff from reporting to the controller to equality with the controller, and in some firms superior to the controller. The controller's data base became a subset of today's MIS. A similar sequence could happen again in tomorrow's microcomputer-dominated environment if

today's management accountants and MIS specialists fail to perceive the need for the reforms expressed above. Research and technology managers are now in a unique position to exert leadership in developing the management accounting systems for future of modern technology. ④

Acknowledgement

Thanks are due Robert Rainish for his many provocative ideas and critiques during the preparation of this paper.

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The Federal Technology Transfer Act of 1986:

The First **2** Years



**Report to the President and the Congress
from the Secretary of Commerce**

July 1989



THE SECRETARY OF COMMERCE
Washington, D.C. 20230

JUL 05 1989

The President
The White House
Washington, D.C. 20500

Dear Mr. President:

It is my honor to transmit to you and to the Congress the first report on the extent to which federal agencies are using the authorities vested in them by the Federal Technology Transfer Act of 1986. This report is required on a biennial basis by Section 3710(g)(3) of Title 15, United States Code.

The report comes at a time of challenge to our Nation's technological leadership. The signs are everywhere. The rate of increase in research and development in the United States is declining. Foreign applicants are obtaining increasing percentages of patents issued in this country. U.S. industry has become increasingly dependent upon foreign-born scientists and engineers.

Nevertheless, this Nation is determined to retain its scientific and technological leadership. Tax and antitrust policies have been adopted that, as President Reagan's last Economic Report stated, "have strengthened incentives for the private sector to put the results of R&D into commercial use." Congress and the executive branch have protected our Nation's innovators through strengthened intellectual property laws and unwavering insistence on international respect for such rights. Funding for basic research through the National Science Foundation has been substantially increased.

With so much at stake, a top priority must be to get more commercial value from our enormous \$63 billion annual federal investment in research and development. It is important that we continue to invest in generating new knowledge. However, we must also make sure that the knowledge generated at federal laboratories or developed elsewhere with federal support contributes to long-term U.S. competitiveness in the form of new products, new processes, new industries, and new jobs.

This report focuses on one of our greatest national resources - federal laboratories. Much of the work done in federal laboratories is at the cutting edge of technology. With proper incentives and management tools, this technology can be transferred successfully to the private sector for commercial development. The Federal Technology Transfer Act provided these incentives and tools.

As the report indicates, although many viewed the Act as a challenge to their long-held views on the proper role of federal laboratories and scientists, most agencies have eagerly embraced it and are implementing the law as Congress intended. I believe that in future years we will look back on this Act as one of the seminal developments in the history of federal efforts to put technology to work for the taxpayers who paid for it.

Although the Stevenson-Wydler Technology Innovation Act calls for a biennial report of somewhat broader content, much of that ground was covered in the June 1988 report by your Office of Science and Technology Policy entitled "Progress in Facilitating Access to Science and Technology, Highlighting Superconductivity."

I look forward to working with you to ensure that this Nation maintains its technological leadership.

Sincerely,

A handwritten signature in cursive script, appearing to read "R. Mosbacher", written in dark ink.

Robert A. Mosbacher

Enclosure



THE SECRETARY OF COMMERCE
Washington, D.C. 20230

JUL 05 1989

Honorable Dan Quayle
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

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As the report indicates, agencies have now completed most of the internal administrative arrangements necessary for full implementation of the Act as Congress intended. More than one hundred cooperative agreements have been concluded and the pace is clearly accelerating. The incentives to federal scientists and engineers are working beyond expectations, as demonstrated by the dramatic increase in the number of reported inventions at some agencies in just one year.

Some problems remain. The Act does not provide a suitable basis for commercializing the valuable software that is often produced at federal laboratories. Laboratory officials tell us that the private sector remains concerned that valuable information generated under these agreements may be inadequately protected from disclosure to competitors.

Nevertheless, the inescapable conclusion is that the Act is achieving its intended purpose of linking the research capabilities of federal laboratories with the research needs of U.S. business and is fostering a new era of public and private sector cooperation for the benefit of all Americans.

Sincerely,

A handwritten signature in dark ink, appearing to read "R. Mosbacher", is written over the word "Sincerely,".

Robert A. Mosbacher

Enclosure



THE SECRETARY OF COMMERCE
Washington, D.C. 20230

JUL 05 1989

Honorable Thomas S. Foley
Speaker of the House of Representatives
Washington, D.C. 20515

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Robert A. Mosbacher

Enclosure

FEDERAL TECHNOLOGY TRANSFER ACT OF 1986:

THE FIRST TWO YEARS

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THE FEDERAL TECHNOLOGY TRANSFER ACT: THE FIRST TWO YEARS

EXECUTIVE SUMMARY

The Federal Technology Transfer Act (FTTA) of 1986 (P.L. 99-502) was designed to provide a bridge between the superb research facilities of government-owned, government-operated (GOGO) laboratories and the research needs of the private sector. At the time it was pending in Congress, United States citizens were investing more than \$50 billion annually in R&D. Many in Congress and the Executive branch believed that this investment, however vital for federal programs, was not returning to the taxpayers sufficient dividends in terms of new products, new processes, new jobs, and enhanced international competitiveness.

Reflecting the principle that those who best understand a technology and its economic potential are the ones who created it, the FTFA authorized agency heads to delegate to their GOGO directors the authority to enter into cooperative research and development agreements (CRADAs) with private firms and other appropriate parties, to agree in advance on rights the parties could expect in any inventions made by a federal scientist under the CRADA, to reward the inventor with at least 15% of any royalties received by the agency from the invention, and to review and clarify the missions of their laboratories.

In doing so, the FTFA required a change in prevailing agency practice and management prerogatives by transferring power from headquarters to the field. Some were concerned that the Act could interfere with agency management responsibilities, that it could divert attention from mission-related research, and that commercial considerations could discourage the free exchange of scientific information.

Under these circumstances the Department of Commerce, which plays a general oversight and coordinating role, was concerned that the Act would be interpreted in the narrowest possible manner. Instead, the Department found the following:

- o Most agencies with substantial GOGO activity are relying on the FTFA and have completed the necessary internal administrative arrangements for implementing it. Although the delegations vary in scope, most have attempted to delegate authority to the smallest unit that can be realistically called a laboratory. The National Aeronautics and Space Administration is the one major research agency whose organic statutes, rather than the FTFA, guide their technology transfer policy. The Department of Commerce will continue to monitor the various agency arrangements to ensure that the principle of decentralization is preserved.

- o As of the close of FY 1988, agencies had negotiated more than 100 CRADAs and the pace has accelerated in the current fiscal year. Several agencies believe that even though some of this research may have occurred under other authorities, the FTTA nevertheless provides a much more useful tool for structuring the collaborative arrangements.
- o The FTTA has spurred agencies to think creatively in developing technology transfer initiatives. Examples include USDA's Peoria Biotechnology Consortium and the Army's Construction Productivity Advancement Research (CPAR) Program.
- o The incentives to federal scientists appear to be working beyond expectations. Agencies have been generous in using their royalty-sharing authority, in some cases allowing inventors to retain as much as 35% of the royalty income. The number of reported inventions increased by more than 40 percent in some agencies between FY 1987 and FY 1988. Although CRADAs are too new to have generated royalties, the pattern of payments to inventors under the Bayh-Dole Act (P.L. 96-517, as amended), including the Department of Energy's government-owned, contractor-operated facilities, suggests that substantial royalties may be generated.

Nevertheless, there are still obstacles to be overcome:

- o Barriers to commercialization of Federally developed software are still a problem. Software often has substantial commercial value which may not be realized because most U.S. firms will not make the investment necessary to bring it to the marketplace without adequate proprietary protection.
- o Agencies repeatedly report that private sector collaborators worry that proprietary data will be made available to their competitors through FOIA. Such concerns may have deterred some firms from seeking to enter into CRADAs.
- o The private sector does not always use federal facilities when they might. In order to facilitate identification of relevant areas of cooperation, agencies must continuously examine and define their laboratories' missions, as required by the FTTA, especially in those cases where the program justification is not clear. Foreign entities, on the other hand, are adept at identifying valuable research projects at federal facilities.

In general, agencies heads and laboratory personnel have greeted the Act with enthusiasm. U.S. firms are becoming increasingly aware of its relevance to their needs. The FTTA may well be creating the framework for a new era of scientific cooperation between the public and private sectors.

THE FEDERAL TECHNOLOGY TRANSFER ACT: THE FIRST TWO YEARS

1. Introduction and Overview

Enactment of the Federal Technology Transfer Act (FTTA) of 1986 (P.L. 99-502) was largely a response to the increasingly tough international economic competition facing the United States. By all accounts, this competition will intensify as more countries, anxious to promote their economic development, enter the high technology competition. This is a healthy competition. The United States, however, will be unable to meet this challenge if it takes its technological leadership for granted.

Remaining competitive in fields such as superconductivity, biotechnology, new materials, pharmaceuticals, and other research-intensive areas could depend in large measure on our ability to link more closely our unsurpassed public research institutions with the needs of the private sector. U.S. industry's cooperation with universities and federal laboratories will become even more critical in determining whether we will be able to remain on the cutting edge of technology.

The Federal Government funds a substantial share of the R&D performed in this country - some 47%, according to the 1989 Economic Report of the President. Thus, a substantial share of the world's new scientific knowledge is paid for by the U.S. taxpayer. If this public investment is not translated into new jobs, products, and processes, we will have lost a significant opportunity for improving this nation's economic position.

The FTFTA was enacted in response to these concerns. This law, along with former President Reagan's multi-phased program for improving access to federally funded research contained in Executive Order No. 12591, charged Federal agencies with linking their government-owned, government-operated (GOGO) laboratories to the private sector. This report summarizes how agencies have prepared to meet these challenges in the more than two years that have passed since the FTFTA became law.

Most federal agencies have now completed, or are close to completing, the internal administrative arrangements necessary for managing programs of cooperative research with the private sector, universities, and state and local governments under the Act. Many have begun to negotiate agreements and a number of these have already been put into effect.

In general, agencies have made substantial progress and have developed firm foundations for successful technology transfer operations. By necessity, they concentrated first on resolving sensitive internal questions of control and accountability. Now they are addressing the practical problems of attracting the interest of the private sector and designing appealing arrangements.

To help them accomplish this and to ensure that Congress is kept fully informed on their progress, the FTTA required the Secretary of Commerce to: (a) report to Congress every two years on how agencies are using their new authorities, (b) report to Congress on barriers to the commercialization of computer software and on the feasibility of maintaining an inventory of federally funded training software, and (c) provide agencies with model cooperative research and development agreements and other appropriate technical assistance.

Taking these in order, this report is the first of the biennial reports required by the FTTA. It is based on information provided to the Department by agencies represented on the Interagency Committee for Federal Laboratory Technology Transfer, a forum established by former Secretary of Commerce Malcolm Baldrige to provide a continuing high level mechanism for addressing problems in implementing the Act and developing solutions. It is also based on follow-up questions and discussions within the Committee's Executive Working Group, a forum of senior headquarters and laboratory personnel which meets on a regular basis and which has become an important support network for addressing the practical problems agencies face in implementing the law and Executive order.

Major agencies providing information included the Departments of Agriculture (including the Forest Service and the Agricultural Research Service), Commerce (including the National Institute of Standards and Technology, the National Oceanic and Atmospheric Administration, and the National Telecommunications and Information Administration), Defense (including the individual military departments), Energy, Health and Human Services (including the Public Health Service agencies), Interior, Transportation, and Veterans Affairs, as well as the Environmental Protection Agency and the National Aeronautics and Space Administration.

The report on barriers to commercialization of software and on federal training software was submitted in May, 1988. These barriers are discussed in this report in Section 9.a.

As to technical assistance, the Department has provided agencies with draft model agreements and continues to work with them on technical issues through the Interagency Committee and its Executive Working Group. This Group has met 13 times. In addition to the development of model agreements for working with industry, the Group has addressed model delegations of authorities for federal laboratories, employee conflict of interest issues, impact of the Freedom of Information Act, access by foreign companies and scientists to federal laboratories, protection of intellectual property in international science and technology agreements, problems in commercializing computer software, and training laboratory personnel in technology transfer.

But the real credit goes to the individual agencies. Their accomplishments have been particularly gratifying, given the many

obstacles that had to be overcome before the FTTA could be successfully implemented. These obstacles must be understood if progress to date is to be evaluated properly.

First, the FTTA challenged the status quo. As a general observation, the FTTA forced many agencies to confront and reassess long-held attitudes with respect to:

- o the role of federal laboratories and scientists in promoting joint R&D with industry and transferring the results to the marketplace,
- o the necessary methods and incentives for accomplishing this, and
- o the relationship between the laboratories and their parent organizations.

These various factors are discussed more fully in the pages that follow. Evidence has shown to date that most agencies are taking advantage of the opportunities the new law afforded them. Agency personnel at headquarters and in the laboratories are making sincere efforts to implement the new law as the President and Congress intended. Many practical problems have been resolved.

In short, federal technology transfer has gotten off to a good start and can look forward to a very promising future.

2. Technology Management Principles and the FTTA

The fundamental objective of the FTTA is to promote U.S. competitiveness by allowing the private sector to pursue original R&D with our public research institutions, and by adapting the fruit of that research to the marketplace.

By 1986, Congress began to examine how the U.S. could reap substantial commercial returns on the \$52 billion (now up to \$63 billion) annual federal investment in research and development. A common complaint heard was that the U.S. wins Nobel Prizes while other countries walk off with the markets.

The designers of the FTTA responded by building upon certain fundamental principles:

- o First, the federal government will continue to underwrite the cost of much important basic research in scientifically promising areas that takes place in the United States.
- o Second, transferring this research from the laboratory to the marketplace is primarily the job of the private sector, with which the Federal Government should not compete.
- o Third, the Federal Government can encourage the private sector to undertake this by judicious reliance on market-

oriented incentives and protection of proprietary interests.

These principles were first tested by the Bayh-Dole Act (P.L. 96-517) upon which the Federal Technology Transfer Act was modeled. The Bayh-Dole Act generally allowed universities and small businesses to elect to own inventions made by them with federal funding and required universities to share royalties with the inventor. This was accomplished without diverting the universities from their primary educational missions.

That Act has been very successful in promoting university-industry cooperation. In its April 1987 report to Congress (GAO/RCED-87-44), the General Accounting Office found that such cooperation had increased 74% since passage of the Act.

Certain fundamental factors to the university successes quickly became evident:

- o First, the translation of technology into commercial products usually requires the full cooperation and involvement of the people who created it and who best understand its potential. Research reports can never hope to convey all that the researchers have learned and absorbed. This is especially so in the case of federally-supported R&D where the resulting technologies tend to be far from commercialization. As such, supervision from "headquarters" must be such as to ensure proper accountability, but not so heavy as to discourage active involvement by laboratory personnel.
- o Second, there must be early interaction between the creators of the technology and those who understand the complexities of manufacturing and marketing it. Technology developed in disregard of these practical considerations will often not benefit the public through practical application.
- o Third, to bring this about there must be powerful incentives for all sides to cooperate. This is especially true for employees of public sector institutions such as our universities and federal laboratories where research is normally undertaken for broad public purposes.

The FTTA responded to these lessons. The new Act authorizes agency heads to delegate to laboratory directors the authority to enter into cooperative research and development agreements with the private sector and other entities, and to agree in advance on the rights the cooperating parties would have in any resulting inventions made by a federal employee. The employee was entitled to a guaranteed share of the royalties received by the government. The lab itself was also entitled to retain the majority share of the remaining royalties.

In addition, a mechanism was put in place designed not only to transfer federally-developed technology to the private sector but to make private sector scientific talent available to federal

researchers as well, thus making the flow of information a two-way street and increasing the skills and expertise of all participants.

Thus, the key principles of decentralization of technology management, federal-private sector interaction, and suitable incentives were all satisfied in the new statute.

The Act did not specify exactly how it was to be implemented. Even the FTTA's most enthusiastic supporters knew that it would take time to change a culture that had existed for so long. President Reagan ended any lingering debate over how the law would be applied by issuing Executive Order 12591 on April 10, 1987. The President instructed the agencies to delegate authorities to their laboratory directors to implement the Federal Technology Transfer Act.

3. The Relationship of the Laboratory to its Parent

Decentralization of technology management is a central feature of the Federal Technology Transfer Act. Consistent with the principle that those who understand a developing technology best are those who created it, the Act encourages agency heads to make appropriate delegations to laboratory directors instead of retaining such authorities at headquarters, except as necessary to satisfy legitimate oversight needs.

In providing for a decentralized approach, the FTTA implicitly reflected a concern of the 1983 Report of the White House Science Council's Federal Laboratory Review Panel which had deplored the tendency of some agencies to micromanage their laboratories. The commission had emphasized that "excesssively detailed direction of laboratory R&D activities from agency headquarters...has seriously impaired R&D performance in some laboratories."

A review of agency rules implementing the Act reveals that agencies have displayed considerable sensitivity to the need to decentralize and to reduce the administrative burden on individual laboratories. All recognize that the point at which "the rubber meets the road" - where the heart of an agreement is developed - is the point at which contact between industry representatives and federal scientists occurs.

Most have made efforts to delegate authority to enter into agreements, subject to appropriate higher level review, to the smallest practical unit that can realistically be called a laboratory, which is defined in the Act as "a facility or group of facilities." But because of differences in agency missions, structures and traditions, different approaches have been taken toward decentralization.

For example, within the Department of Commerce, authority has been delegated to the Director of the National Institute of Standards and Technology (NIST), formerly the National Bureau of

Standards, for all arrangements within the scope of that organization's program responsibility. The Director has in turn delegated the authority to the directors of NIST's major laboratories: the National Engineering Laboratory, the National Measurement Laboratory, the Institute for Materials Science and Engineering, and the National Computer Systems Laboratory.

The National Oceanic and Atmospheric Administration, also at Commerce, has delegated authorities to five laboratories and three Assistant Administrators for research services.

The Department of Agriculture, on the other hand, has delegated authority to the Agricultural Research Service which, unlike NIST or NOAA, has chosen to treat itself as a single laboratory. To some degree, USDA's decision is rooted in practical considerations: it has 120 field locations, many of which are two- and three-scientist operations. USDA's approach is intended to ensure that these smaller operations receive encouragement and administrative support.

On the other hand, some of ARS's facilities have over 200 scientists. Accordingly, ARS and other organizations with similar arrangements must nurture decentralized technology management by the larger, more capable facilities while assisting their smaller, less capable components.

The Environmental Protection Agency has defined laboratories broadly so that it can apply to very small operations and even to those not normally considered to be laboratories in the layman's use of that term, such as its Policy Office. EPA's view is that even its Policy Staff develops computer models and that such models eventually may have commercial applications.

Given different agency needs and organizational charts, we cannot conclude that there is one "right" way. In future reports, the Commerce Department will address how particular delegation modes are working. Right now it is simply too soon to tell.

Although NASA is using the authorities of the FTTA as the basis for sharing royalties with its inventors, it has chosen to continue its centralized technology management system based on the authorities of the Space Act.

The Space Act, unlike the FTTA, (a) permits the agency to commit federal funds to cooperative ventures and (b) provides for greater centralization of authority, which NASA believes is more appropriate for its needs. NASA also has a long history of working with the private sector under this law. In future reports we will compare NASA's record with respect to the number of cooperative agreements with industry, royalties returned to the agency, number of inventions reported by its laboratories, and any other relevant factors, with the records of other agencies relying on the FTTA.

In the final analysis, however, the success of the FTTA depends

less on the degree of freedom that laboratories have to enter into cooperative arrangements than it does on the respect which private firms have for the laboratories, their knowledge about laboratory capabilities, and their perception that these capabilities are consistent with their own needs.

It is here that the agency headquarters have a major role to play. The previously cited 1983 White House Science Council's report in reviewing agency-laboratory relations, complained that many laboratories had only ill-defined missions or obsolete missions and that "in most cases, the agencies' oversight means an excessive amount of reporting and paperwork, but inadequate scrutiny of the quality and relevance of the laboratories' activities." The Commission was concerned that a laboratory would confuse its mission with its preservation.

The FTTA recognized the importance of a clearly stated mission by (a) requiring each agency to make separate determinations of the mission or missions of each of its laboratories, and (b) making technology transfer a laboratory responsibility, to the extent consistent with its mission responsibility. Some of these facilities, such as those concerned with national security or national defense, have missions that are likely to result in only limited opportunities for pursuing private sector responsibilities. But for those whose missions are less clear, the degree or absence of private sector interest may be a useful indicator as to whether that facility's charter warrants reexamination.

The Department notes that the establishment of research advisory committees, such as those of USDA and NIST, could be important devices for agency use in ensuring that their R&D has practical applications.

4. Cooperative Agreements Under the Act

The Department of Commerce estimated that, as of the close of FY 1988, federal agencies had concluded, or were in the final stages of negotiating, approximately 111 cooperative agreements within the meaning of the FTTA. Many of these are based on a model agreement which was developed by Commerce's Office of Federal Technology Management and modified by individual agencies to meet their specific needs.

These included agreements involving the Department of Agriculture (39), the Department of Health and Human Services (29), the Department of the Air Force (17), the Department of Commerce (10), the Department of the Army (7), the Department of the Interior (6), the Department of Veterans Affairs (2) and the Environmental Protection Agency (1). Agreements in fairly early stages of negotiation are not reflected in the above figures.

A number of points should be kept in mind in evaluating these figures. First, the pace is clearly accelerating. NIH, a part

of HHS, has informally advised us that it is now processing approximately 5 proposed R&D agreements each month. As such, the numbers for FY 1989 should be much higher. NIST, in the Department of Commerce, has advised us that in the few months since the close of FY 1988, its agreements have almost tripled from the 10 noted above to 28.

Second, some agencies do enter into agreements similar to those described in the FTTA but rely on other authorities. NASA is a notable case. To the extent that they do so, the figures above are lower than they might otherwise be.

Third, some agencies perform much of their research through facilities other than GOGOs, such as DOE's contractor-operated facilities, and this research has commercial potential in areas ranging from solar energy to superconductivity. Such activities in support of technology transfer are not reflected in the above figures.

Fourth, agency use of the FTTA does not necessarily mean that the cooperation is "new" - i.e., that it would not have taken place in its absence. Many agencies have long and rich histories of cooperation with the private sector, state and local governments, and academic institutions. The Forest Service's record goes back to its establishment more than a century ago. NIST representatives have advised us that much of the research covered by its ten agreements might have occurred anyway, but that the FTTA is often a better vehicle for establishing these cooperative relationships.

Fifth, simply counting numbers misses the importance of vital new relationships formed under the Act such as USDA's Peoria, Illinois Biotechnology Consortium. This noteworthy project combines the resources of the USDA's Northern Regional Research Center, the University of Illinois, six private companies contributing \$1 million each, the State of Illinois (which is investing \$4 million), and the city of Peoria. This type of highly promising cooperation fulfills the promise of the the Federal Technology Transfer Act and would be impossible without its sensitivity to the proprietary interests and motivations of the private sector.

Other notable examples of initiatives inspired by the FTTA include the following:

- o In October 1988 HHS held its first NIH and ADAMHA-Industry Collaboration Forum which was attended by more than 250 representatives of leading pharmaceutical and biotechnology companies. The forum provided a means by which those representatives could meet directly with individual NIH and ADAMHA scientists to discuss potential cooperative research.
- o The U.S. Army's Electronics Technology and Devices Laboratory developed a formal, comprehensive, well-focused

procedure for implementing the Act which includes establishment of teams in specific technology areas, careful definition of objectives and responsibilities of each player, methods for developing statements of work for the research project, customization of model agreements and attendant legal reviews - all of which make it easier to obtain necessary approvals from higher authority. In short, ETDL appears to be striving to make the process routine while treating each agreement as a unique case.

- o The Environmental Protection Agency has institutionalized the FTTA by forming an Office of Technology Transfer and Regulatory Support within its Office of Research and Development and has also established a Technology Transfer Advisory Committee to ensure that technology transfer issues are factored into program planning at its earliest stages.
- o The Army's Corps of Engineers, by combining the intellectual property provisions of the FTTA with certain cost-sharing authority vested in it by the Water Resources Development Act of 1988 (P.L. 100-676), has developed a foundation for its new Construction Productivity Advancement Research (CPAR) Program. This initiative is designed to improve the applied research base that is available to the U.S. construction industry - an industry that has traditionally invested little in R&D.
- o The Department of Energy has similarly combined FTTA-type concepts with other authorities as the basis of its Clean Coal Technology Project, a joint government-industry effort to demonstrate a new generation of environmentally clean, highly efficient coal technologies.

Some tentative conclusions regarding use of the law can be drawn:

- o First, many agency officials are of the view that the FTTA is more than "business as usual" and that a good number of the agreements represent research and cooperation that would not have otherwise taken place -- illustrated most dramatically in the Peoria Biotechnology Consortium. Representatives of the Army, Health and Human Services, and USDA's Agricultural Research Service were especially convinced of this. For future reports, the Department will closely watch for new relationships with the private sector that are forming because of the FTTA.
- o Second, officials of other agencies that believe the research would have taken place anyway note that the FTTA provides a better basis for undertaking it than was previously available to them.
- o Finally, most personnel believe that the Act has greatly stimulated agency personnel to think creatively in terms of technology transfer. That is discussed more fully in the

next section.

5. Impact on Laboratory Personnel

Federal scientists have traditionally had little reason to delay publication of their research, even though the disclosure of an invention in a printed publication before a patent application is filed destroys patentability in those countries that, unlike the United States, have no grace period that permits patenting within a specified period following publication. Most nations have no such provision.

As the White House Science Council reported more than five years ago - and as the Navy Department's experience confirms - many federal scientists rightly take great satisfaction from being able to advance scientific knowledge through publication of research results. Traditionally many federal scientists have viewed the private sector as an awkward partner with a different value system, and have published their findings even when this would prevent a patent from issuing.

The Federal Technology Transfer Act addressed this problem by creating important rewards for successful technology transfers for federal scientists and their laboratories. The FTTA directs agencies to pay the inventors at least 15% of any royalties their invention might bring in, and by allows the laboratories to share in the royalty stream as well. (Although the FTTA also permits agencies to develop alternative inventor incentive plans, all agencies have opted for the automatic royalty sharing plan.)

Thus, R&D funding under the FTTA has two vital goals: the traditional one of advancing scientific knowledge, and an important new element of seeking commercial applications for resulting discoveries.

A review of agency experience to date permits certain observations:

a. Increase in Number of Reported Inventions

The widespread publication of information about the possibility of receiving royalties and the growing commitment of agencies to the principles of technology transfer appears to have contributed to the remarkable upsurge in the number of reported inventions by federal scientists during FY 1988, the first full fiscal year since enactment of the FTTA.

In FY 1987, the Department of Agriculture reported 76 inventions; in FY 1988 this figure had increased to 139. The Army reported 309 inventions in FY 1987; this figure was up by almost 40% in FY 1988 to 424. The Navy, where the tendency to publish had been particularly strong, saw its reported inventions increase by more than a third - from 336 in FY 1987 to 463 in FY 1988.

HHS figures, reported on a calendar basis, reveal that the number of inventions (133) reported during the first nine months of 1988 approximated the number (132) reported for all of CY 1987, a figure which itself represented an increase of almost a fourth over the number (109) reported in CY 1986.

This bodes very well for the impact of the Act. A similar jump in invention disclosures at the universities was the first sign of the impact of the Bayh-Dole Act. In 1976 there were about 230 patents issued to universities. By 1986 the number had tripled to about 700, increasing to 900 in 1987. Particularly striking is that this sharp increase in university patenting and invention reporting by federal scientists is occurring at a time when U.S. patent rates have levelled off or have declined for other sectors. Discussions with federal officials suggest that this increase in federal invention activity is likely to have real commercial significance, rather than leading to "paper" patents. This is an encouraging sign that U.S. creative activity is alive and well in our public sector and underscores the wisdom of President Lincoln's observation as to the importance of adding "the fuel of interest to the fires of genius."

Today, universities are becoming engines for economic development because of their successful technology transfers. High technology centers across the United States are forming around them. Future reports will closely monitor whether the federal laboratories are following this heartening example.

b. Diversity of Plans

The agencies have shown remarkable resourcefulness in devising royalty payment plans to suit their individual needs. Many recognize that inventions may bring in relatively modest dollar amounts and, to ensure some meaningful return, allow inventors to keep higher percentages of the first dollars that come back to the agency.

The military services, for example, will allow their inventors to keep 20% or the first \$1000, whichever is greater. Within HHS, the National Institutes of Health, the Centers for Disease Control, and the Alcohol, Drug Abuse and Mental Health Administration allow their inventors to keep 25% of the first \$50,000 in royalties, 20% of the next \$50,000 and 15% of any additional royalties.

The Food and Drug Administration, also within HHS, takes the opposite approach. Greater percentages of the first dollars are retained by the agency. The FDA allows its inventors to keep 15% until program costs are recovered and 35% of any additional royalties. EPA allows its inventors to keep a flat 35% of all royalties.

Congress evidently recognized that agencies would take different approaches and encouraged experimentation. It directed the Comptroller General to report to it on the efficacy of different

plans in 1991, thus giving agencies a chance to experiment and to alter their programs, if appropriate.

Accordingly, the Commerce Department will withhold further comment at this time except (a) to note that such differences do exist, (b) to express the hope that GAO's report will also discuss the experiences of agencies, such as NASA, which prefer to rely on authorities other than the FTTA, and (c) to assure the Congress that the Commerce Department will also monitor these various plans.

c. Royalties to Date

Although interest is high and implementation plans are in effect, the agreements under the FTTA are too new to have generated any significant royalty income.

However, data from the Department of Energy and the National Technical Information Service provide some useful insights.

In 1980 Congress enacted legislation which, as discussed earlier, allowed certain federal contractors to own and license inventions made with federal funding. This law applied to many of DOE's contractor-operated facilities. The remaining DOE contractor-operated facilities received ownership on a case-by-case basis under other authority. All of these facilities, however, established royalty sharing programs with their employed inventors.

In 1981, DOE's contractor-operated laboratories received \$14,000 in royalties. In FY 1985, these royalties had increased to \$144,000 and in FY 1987 they stood at \$297,000. For FY 1988 the figure reached \$584,000.

Preliminary data from the National Technical Information Service (NTIS) suggest the same trend is beginning for federally-owned and -operated laboratories. NTIS, even prior to enactment of the FTTA, licensed federally owned patents for royalties or other consideration under the provisions of Section 207 of Title 35. It also paid inventors a share of resulting royalties, but its authority to do so was uncertain. The FTTA made it clear that inventors were entitled to a share of royalties under either a cooperative R&D agreement or the Government's "207" program.

For FY 1985, NTIS collected \$1.5 million in royalties in connection with 146 federally owned inventions and paid out approximately \$69,000 to inventors. For FY 1988, by which time federal scientists became more aware of the possibility that they could profit from their inventions and legal confusion had been resolved, royalty payments had increased almost fourfold to \$5.6 million, the number of inventions increased by almost 40% to 201, and awards to inventors amounted to \$356,200.

These results have been achieved in a manner consistent with the objective of preserving the free flow of information. As noted

earlier, we have already seen a dramatic increase in the number of reported inventions at universities without any corresponding decrease in the number of scholarly publications. At most, there has been short-term publication delay to afford the laboratory an opportunity to decide if a patent should be sought. Indeed, universities are generally seeing an increase in both patenting and publishing rates, including a striking increase in co-authored university-industry publications in the decade following enactment of Bayh-Dole.

In short, if the experience of the universities and NTIS is any guide, a fair program of royalty sharing, when coupled with support and encouragement by laboratory managers and the parent agencies, should yield steady progress.

6. International Considerations

The ultimate aim of all federal technology transfer initiatives is, as indicated in Section 2, to promote the ability of U.S. firms to compete in world markets. U.S. taxpayers contribute more than \$63 billion each year to federal R&D initiatives. To the extent that this investment can yield new products, new processes, new industries and new jobs, those taxpayers ought to be the principal beneficiaries.

In the Bayh-Dole Act, Congress prohibited not-for-profit contractors electing to take title to federally financed inventions from giving exclusive licenses to firms that did not agree to manufacture the invention in this country - except to the extent that domestic manufacture was impractical or efforts to find licensees that would agree to such terms proved unsuccessful.

During the 1980's, as concern about U.S. competitiveness began to mount, this emphasis on domestic manufacture as a means of protecting the taxpayers' investment was seen as insufficient. Focus shifted from the relatively narrow issue of where a particular invention might be used or manufactured to the broader question of whether the taxpayer-financed technology on which the products of tomorrow might be based was being given away without receiving an adequate quid pro quo, particularly as other nations demonstrated an adroitness at turning basic research into products for the marketplace.

It has long been evident that our foreign competitors routinely scour our public R&D institutions looking for technology leads. Historically the United States has been by far the leader in conducting - but not necessarily commercializing - basic research. Countries such as Japan are redoubling their efforts to close the basic research gap.

Thus, the drafters of the Federal Technology Transfer Act were concerned that the advantages of entering into cooperative research arrangements with federal laboratories not be extended

to participants from foreign countries that deny U.S. entities the right to enter into similar ventures. The Act required laboratory directors to consider such practices when deciding which proposals to pursue.

Since then there have been a number of other instances in which Congress and the Executive branch have expressed their determination that the United States receive an appropriate quid pro quo before making its technology available to foreign entities whose governments fail to protect our interests or discriminate against us.

In Executive Order No. 12591, President Reagan expanded upon that principle by requiring laboratory directors to consider also the extent to which the relevant foreign government protects intellectual property. Subsequently, in the Omnibus Trade and Competitiveness Act of 1988, Congress required that federally supported international science and technology agreements be negotiated so as to ensure: 1. that the United States enjoys similar access to the research facilities of the other countries as we grant here (i.e., the agreement should ensure "symmetrical access"); and 2. that the other country provides proper protection for intellectual property. It also required that proposed science and technology agreements be reviewed for their consistency with the principles of the Bayh-Dole Act and the Federal Technology Transfer Act.

In short, the requirements of the FTTA should not be viewed in isolation but as part of broader, evolving policies aimed at encouraging agencies to exercise greater discretion with respect to, and control over, commercially valuable, federally financed technology.

In consultation with the various agencies, an informal system has been devised whereby laboratories will simply notify the Department of Commerce when they have identified a party proposing an agreement as being foreign controlled and the Department will consult with the United States Trade Representative. The laboratories then will be advised as to whether the home country's protection of intellectual property is adequate and whether there is any evidence that it denies U.S. firms the right to enter into similar agreements or otherwise precludes their access to its research facilities.

It should be noted, however, that Congress has not provided agencies with much guidance for determining what is meant by "foreign controlled." However, Congress recently defined the concept in the "Buy American Act of 1988" (see Title VII of P.L. 100-418) and the Department and USTR are considering the extent to which these standards can be adapted for use by agencies in implementing the FTTA.

The Department of Commerce published a request in the Federal Register in April 1988 for information from the public concerning denial of access to foreign research facilities. It followed up

with press releases, letters to private firms and calls to trade associations to urge them to bring the request to the attention of their members. To date, the Department has received some information as to potential problems but no specific, identifiable cases of governmentally-imposed barriers to U.S. participation in foreign R&D programs.

This response is not surprising given that the concept of conducting R&D with foreign research institutions is generally new to American industry. U.S. firms, until recently, have shown only limited interest in working with federal facilities, much less with those operated by foreign governments. Many domestic companies are skeptical as to whether invitations from foreign entities to enter into such agreements are made in good faith or are attempts to tap into our existing technology base. These views may change with the increased internationalization of science and technology.

The Department of Commerce will continue to monitor this situation so that it can advise federal laboratory directors when barriers are encountered in specific countries. It is currently participating in an interagency task force chaired by the National Science Foundation which is aimed at developing concepts for measuring the symmetry of access in the context of the recently-concluded U.S.-Japan Science and Technology Agreement. The Committee's work should be useful in reviewing U.S. access in other situations.

Congress' concern that agencies be sensitive to these various international considerations is not surprising. Foreign nations have been remarkably adept at identifying the sources of valuable technology in the United States that will lead to new products. The extent of foreign participation in federal laboratory research was recently documented in an August 1988 report by the General Accounting Office entitled "U.S. and Foreign Participation in R&D at Federal Laboratories" (GAO/RCED-88-203BR).

It would be ironic if these foreign firms prove themselves to be more farsighted in identifying opportunities for cooperation with federal facilities - and in reaping the attendant technological advantages - than our own domestic companies. As GAO's Report found, given staffing and space constraints that limit the number of outside researchers who can conduct R&D at federal laboratories, "the best way to control foreign participation is to stimulate U.S. participation." (Id., p. 52).

Accordingly, even though the relative newness of the FTTA and the small number of agreements entered into thus far permit no conclusions to be drawn, it will be necessary to monitor the relative degree of foreign versus domestic interest in entering into collaborative arrangements under the FTTA.

7. Statutory and Other Problems

a. Computer Software

Because copyright law prohibits federal employees from obtaining copyright protection for works created in the course of their official duties, the incentives of proprietary protection and royalty sharing - so vital in the case of inventions - are unavailable to spur the development of computer software that for legal or practical reasons cannot be patented. Such software can have substantial commercial value.

DOE's GOCOs are not subject to this prohibition and their experience reveals just how important proprietary rights can be as a spur to the commercialization of software developed in connection with federal programs. A good example is DOE's encouragement of an Oak Ridge National Laboratory consortium. This consortium is a cooperative agreement between twelve sponsoring companies who are co-funding the development of user friendly and intelligent software systems for more easily accessing a highly complex set of finite element analysis models.

GOGO research should yield equally satisfying results. The Department of Defense, for example, expends considerable effort in developing computer-based vocational training materials which may have significant commercial value for a wide range of vocations and disciplines.

The Agriculture Department noted that virtually none of the cooperative agreements signed or under negotiation dealt with expert systems, artificial intelligence or other forms of knowledge engineering, even though the systems approach and software-derived technology reflected a growing portion of its research. Indeed, USDA also noted that this problem antedated the FTTA and that the government's inability to provide software protection had been a major factor in its inability to interest the private sector in its activities in such fields as crop production, forage-livestock interaction, and food processing-quality interaction.

It thus appears that the absence of an ability to convey proprietary rights might result in the loss of significant opportunities for federal-private sector cooperation in areas of significant commercial potential.

Merely making software available without proprietary protection, may be insufficient to ensure its effective commercialization. Much of today's software is complex, containing thousands of lines of code. It is often useless to businesses unless they are willing to make substantial investments of time and money. For software to be commercially valuable, it has to be debugged, simplified and customized and training manuals must be available as well. Without an appropriate license, a firm could not be assured of recouping the necessary investment in providing such services.

Simply stated, the plain fact is that without an appropriate policy dealing with the commercialization of federally-developed software, the prospects for its development and commercialization will probably be limited.

The drafters of the FTTA were certainly aware of this. The legislation specifically required the Commerce Department to study the issue and make appropriate recommendations. In May 1988 then Secretary of Commerce C. William Verity submitted the required report recommending corrective legislation; at about the same time, the General Accounting Office issued a report to Congress (GAO/RCED-88-116BR) which also noted that the absence of copyright protection for computer software was perceived by laboratory and agency officials as a technology transfer constraint.

The Department of Commerce, in consultation with other agencies, is developing suggestions for legislation that could be reviewed by the Administration. The Department and agencies will also consider the question of whether a similar limitation on the ability of federal scientists to obtain protection for semiconductor chip mask works should also be lifted. Such works are not protected by copyright but, rather, receive a sui generis form of protection under Title 17. Nevertheless, the same limitation applies.

b. Freedom of Information Act

One major incentive for the establishment of cooperative relations between a private firm and the government is the existence of an expensive or unique research facility where federal scientists and scientists employed by a firm can work "shoulder to shoulder" on proprietary research. But, as GAO's March 1988 report found, the opportunities for this are limited at least in part by the government's inability to assure the firm that the results will not be made public to its foreign or domestic competitors under the Freedom of Information Act (FOIA). The experience of the federal laboratories since that report was issued confirms GAO's earlier finding. Many agencies reported that protection of proprietary information was one of the first issues raised by potential R&D partners. The frequency and regularity with which the issue is raised to laboratories by the private sector suggests that such concerns may have deterred many firms from seeking cooperative arrangements with federal institutions in the first place.

Accordingly, the Department will continue to work with agencies to determine the extent to which FOIA may impede the negotiation of advantageous cooperative research and development agreements. Laboratory officials have informally advised the Department that they believe that the objectives of FOIA, the goal of preserving open scientific communication, and the proprietary interests of sponsoring partners can be balanced by offering the sponsoring partner a limited period of exclusivity after which the information would be subject to disclosure under FOIA.

c. Personnel Matters

Personnel in federal laboratories often do not have the knowledge and skills essential for effectively negotiating complex agreements with the private sector. This limitation could undermine the FTTA's basic objective of encouraging the laboratories themselves to take an active role in promoting the transfer of federally funded technology.

Accordingly, it would be helpful to consider methods that could be used to improve the skills of technology managers and scientists in negotiating agreements with the private sector.

Several agencies also have indicated that they may be unable to hire enough patent attorneys to support their technology transfer programs. These agencies note that patent lawyers command far higher compensation in the private sector than federal agencies can hope to offer. Contracting for such services may be an available alternative. Patent counsel are essential to the process of determining patentability, drafting technical documents, and negotiating advantageous licensing arrangements. The FTTA does authorize agencies to use royalties to pay for such services. Perhaps as royalties increase this problem may be somewhat eased.

At the present time, the Department of Commerce does not believe it has sufficient data to justify any specific recommendations. However, these personnel matters warrant careful monitoring. We expect to return to it in the next biennial report.

d. Conflicts of Interest

In September 1988 the U.S. Office of Government Ethics (OGE) advised the Department of Commerce that royalty sharing under the FTTA is "a form of compensation from the Government which does not cause an employee to have a personal financial interest to which the conflict of interest laws are applicable." OGE noted that under the statutory scheme, a federal employee is not placed into a direct relationship with the party paying royalty fees.

However, agency employees remain bound by the statutory provision (18 USC 207) that bars a former federal employee from representing another person before an agency on matters that the ex-employee worked on while at the agency. Any matter in connection with the invention in question would appear to bring that section into play.

In addition, some agencies, while aware of OGE's opinion, believe that their particular mission may obligate them to impose special rules. The Food and Drug Administration, for example, has expressed concern about potential conflicts that could arise when its scientists stand to profit from inventions that cannot be marketed without that agency's express approval. FDA is in the process of reviewing its regulations to ensure that its concerns are addressed without unduly limiting the ability of its

personnel to take advantage of the opportunities accorded them by the FTTA.

The Commerce Department expects shortly to issue FTTA conflict of interest guidelines to assist agencies in this area and will be pleased to work with them individually, if requested.

8. Conclusion

In summary, progress to date under the FTTA has been good.

- o Agency administrative personnel understand the Act's merits and are anxious to make it even more effective.
- o Laboratory personnel are becoming more and more interested in making their work useful to the private sector.
- o U.S. firms are becoming increasingly aware of the Act and in many cases are finding out that the federal laboratories are conducting research that can valuable to them.

There is still work to be done, but the Act's goal of fostering a new era of scientific and technical cooperation between the public and private sectors appears well on the way to becoming a reality.