調査資料

米国国立研究所の運営形態と技術移転

平成１０年3月

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第1章　米国国立研究所の概要（GOGO,GOCO,FFRDCs）

Introduction and overview

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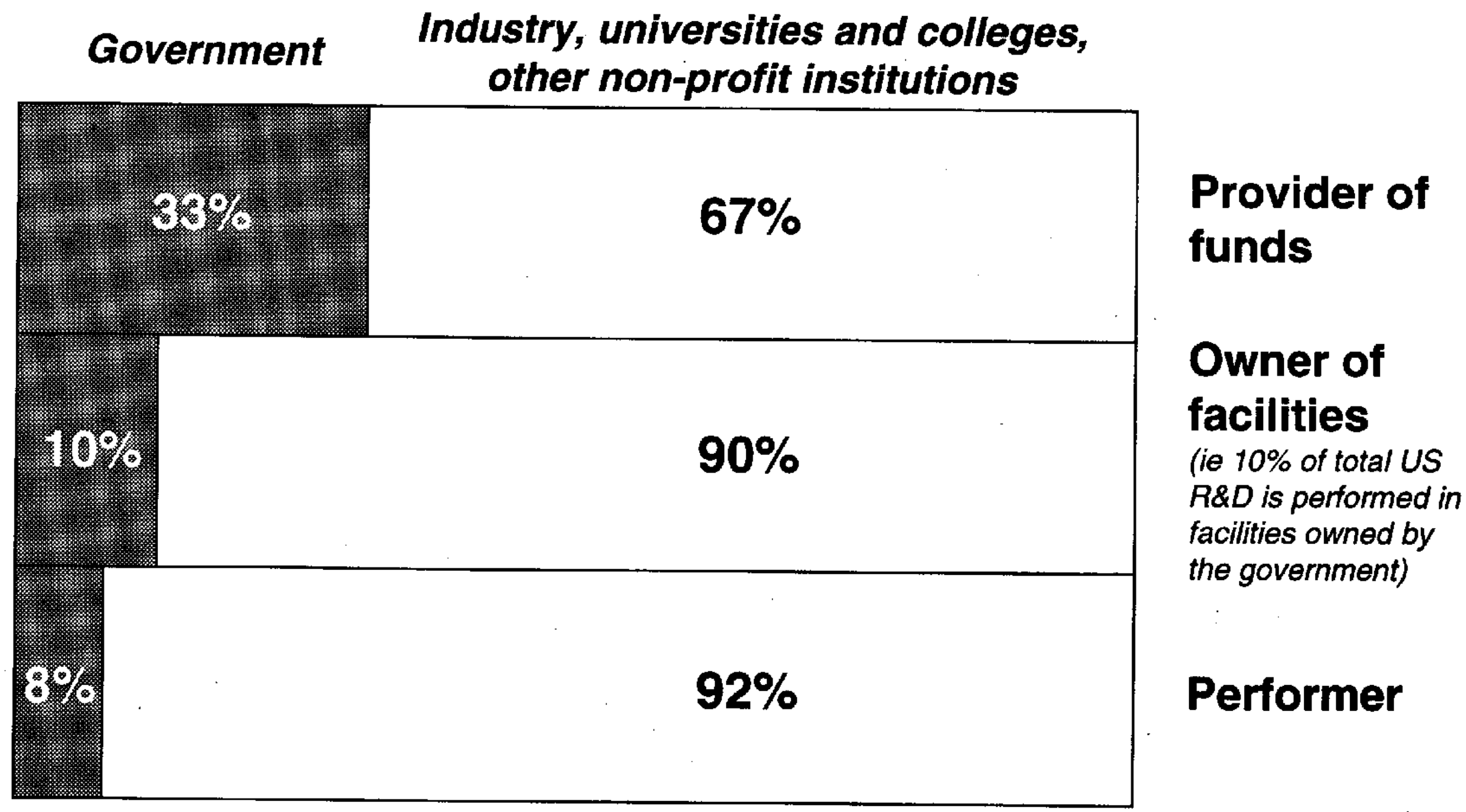
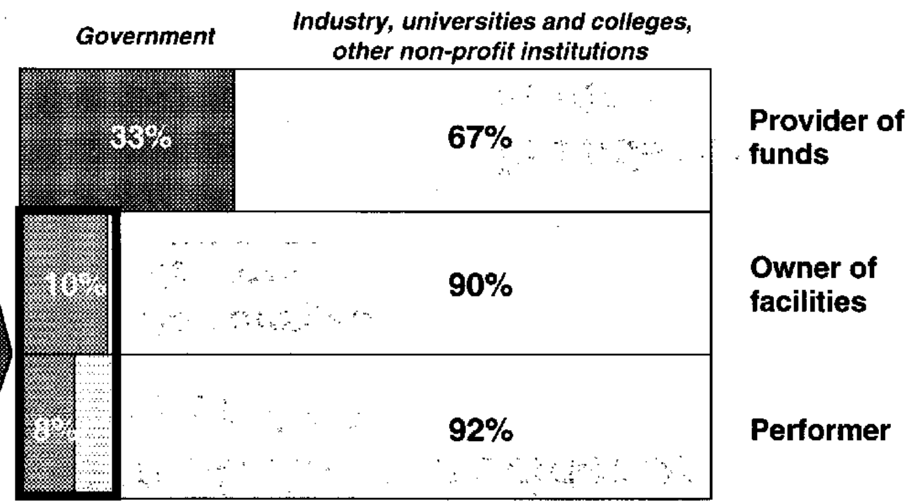
The US government plays three roles in US R&D: provider of funds, owner of facilities, and performer of R&D



Figures are percentages of total 1997 US R&D spend of $205.7bn

The approximately 1100⁺ US national laboratories account for 11% of total US R&D spend (ie 32% of total government spend)

- There are approximately 1100 national laboratories in the US
- These receive a total of $21.6bn in funding, which is 11% of total US R&D spend and 32% of total government R&D funding of $68.1bn*
- The majority (>99%) of the facilities of all these laboratories are owned by the government
- The national labs employ 80-100,000 scientists and engineers
- No precise statistics exist, but 5-10% of the 1100 labs are directly focused on IT, and perhaps 20-30% are researching use of IT to achieve research objectives in their non-IT related fields



⁺ Source US DoC "Federal Laboratory and Technology Resources", 1993
* 1997 figures, source NSF

GOCO (Government Owned Contractor Operated), FFRDC (Federally Funded Research Center) and GOGO (Government Owned Government Operated) are three different subsets of the national labs

GOCO **Total budget c$4.5bn; c27,000 researchers**

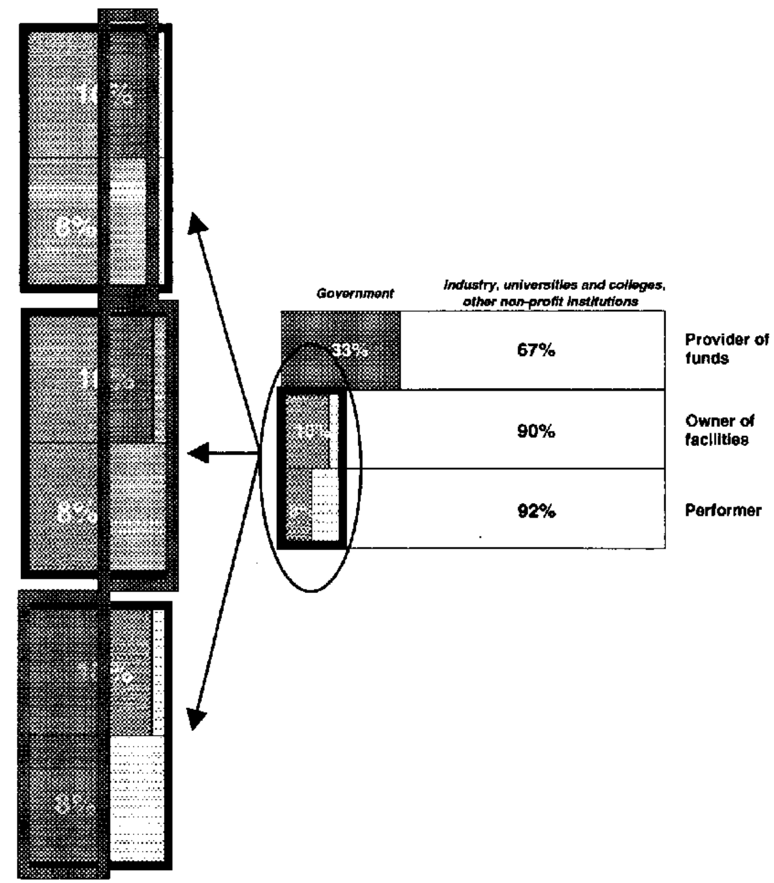
- The 22 GOCO labs are among the largest national labs
- They are operated by a variety of companies and universities

FFRDC **Total budget c$5.2bn; c30,000 researchers**

- The 38 FFRDCs include all 22 GOCO labs and an additional 16 Contractor Owned Contractor Operated (COCO) labs, most of which are defense related

GOGO **Total budget c$16.4bn; c60,000 researchers**

- There are approximately 1060 labs, which together with the FFRDCs make up the 1100 national labs



第2章　GOCOシステムの連邦政府研究開発活動における位置付け

The GOCO system in US Federally-funded research

Contents

The GOCO system of laboratory management is well established and provides several advantages

- 22 US national laboratories are managed under the GOCO system by private contractors; a further 16 COCOs, most of which are defense-related, make up a total of 38 FFRDCs
- The GOCO system had its origins in World War II, but has been refined through policy ever since towards more market-oriented principles
- The GOCO system offers several key benefits: efficiency, independence, technology transfer, and resource sharing
- Three case studies illustrate the typical organizational structure of GOCO institutions: Idaho National Engineering Laboratory, Lawrence Berkeley, and Los Alamos

2 The GOCO system in US Federally-funded research

Laboratories employing the GOCO system receive funding from the government, are owned by the government, but are operated under contract by non-government entities

- 'GOCO' stands for 'Government Owned Contractor Operated'
- As the name suggests, most of the facilities (laboratory site, buildings, and equipment) are owned or funded under contract by the government
- Actual research is performed by private 'contractors',which are a variety of types of organization; management is also largely performed by contractors, although a number of federal employees may also work at the site, and the degree of federal involvement in day-to-day decision-making varies from case to case
- The government retains the power to select, and if necessary change, the operating contractor
- The government retains decision-making authority of the overall themes of research, although at the individual project level funding is determined by professors / researchers / ability to attract grants from funding agencies

22 of the larger US national laboratories employ the GOCO system

US GOCO labs and budgets

1.	Idaho National Engineering Laboratory	$78m
2.	NCI Frederick Cancer Research and Development Center	$142m
3.	Oak Ridge National Laboratory	$288m
4.	Sandia National Laboratories	$654m
5.	Savannah River Technology Center	$30m
6.	National Renewable Energy Laboratory	$102m
7.	Pacific Northwest National Laboratory	$209m
8.	Ames Laboratory	$30m
9.	Argonne National Laboratory	$253m
10.	Brookhaven National Laboratory	$216m
11.	Ernest Orlando Lawrence Berkeley National Laboratory	$171m
12.	Fermi National Accelerator Laboratory	$171m
13.	Jet Propulsion Laboratory	$1057m
14.	Lawrence Livermore National Laboratory	$501m
15.	Los Alamos National Laboratory	$541m
16.	National Astronomy and Ionosphere Center	$8m
17.	National Center for Atmospheric Research	$79m
18.	National Optical Astronomy Observatories	$29m
19.	National Radio Astronomy Observatory	$30m
20.	Oak Ridge Institute for Science and Education	$17m
21.	Stanford Linear Accelerator Center	$118m
22.	Thomas Jefferson National Accelerator Facility	$59m

1995 budget figures. Source NSF

Total GOCO budget was $4.8bn in 1995 ($4.5bn in 1997)

Note.
The Energy Technology Engineering Center, which was included in the 1995 totals, was removed from the government's master list of FFRDCs (see next few pages) in November 1995

GOCO labs are administered by corporations, universities and colleges, and other non-profit institutions

Administered by corporations	1. Idaho National Engineering Laboratory	$78m	**Total budget c$1,200m**
	2. NCI Frederick Cancer Research and Development Center	$142m	
	3. Oak Ridge National Laboratory	$288m	
	4. Sandia National Laboratories	$654m	
	5. Savannah River Technology Center	$30m	
... non-profit organizations	6. National Renewable Energy Laboratory	$102m	**Total budget c$300m**
	7. Pacific Northwest National Laboratory	$209m	
... universities and colleges	8. Ames Laboratory	$30m	**Total budget c$3,300m**
	9. Argonne National Laboratory	$253m	
	10. Brookhaven National Laboratory	$216m	
	11. Ernest Orlando Lawrence Berkeley National Laboratory	$171m	
	12. Fermi National Accelerator Laboratory	$171m	
	13. Jet Propulsion Laboratory	$1057m	
	14. Lawrence Livermore National Laboratory	$501m	
	15. Los Alamos National Laboratory	$541m	
	16. National Astronomy and Ionosphere Center	$8m	
	17. National Center for Atmospheric Research	$79m	
	18. National Optical Astronomy Observatories	$29m	
	19. National Radio Astronomy Observatory	$30m	
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1995 budget figures. Source NSF

The GOCO concept is intimately connected with that of FFRDCs (Federally Funded Research and Development Centers)

- Research at FFRDCs is by definition carried out by contractors; conversely, if research at a national lab is carried out by a contractor then that lab is by definition an FFRDC
- In other words, all GOCOs are by definition FFRDCs
- The US national labs therefore comprise the GOGO labs and the FFRDCs (rather than GOGO + GOCO)
- In addition to GOCO labs, a number of COCO (Contractor Owned Contractor Operated) labs FFRDCs exist
- The discussion of GOCO at a policy level is often combined with that of FFRDCs - in many senses, they are one and the same thing

NSF definition of FFRDCs

'R&D performing organizations that are exclusively or substantially financed by the Federal Government* and are supported by the Federal Government either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. Each center is administered either by an industrial firm, a university, or another nonprofit institution.'

The Government's financial support is further specified as follows:

- The research organization receives the 70 % or more of its financial support from the Federal Government, usually from one agency
- Most or all of its facilities are owned by, or are funded under contract with, the Federal Government

Source: NSF *Federal Funds for Research and Development: Fiscal Years 1995, 1996, 1997*, Volume 45, NSF 97-327

The 38 FFRDCs include all 22 GOCO labs and a further 16 COCO labs

US GOCO FFRDCs & budgets

1.	Idaho National Engineering Laboratory	$78m
2.	NCI Frederick Cancer Research and Development Center	$142m
3.	Oak Ridge National Laboratory	$288m
4.	Sandia National Laboratories	$654m
5.	Savannah River Technology Center	$30m
6.	National Renewable Energy Laboratory	$102m
7.	Pacific Northwest National Laboratory	$209m
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20.	Oak Ridge Institute for Science and Education	$17m
21.	Stanford Linear Accelerator Center	$118m
22.	Thomas Jefferson National Accelerator Facility	$59m

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US COCO FFRDCs & budgets

23	Aerospace Federally Funded Research and Development Center	$137m
24	Arroyo Center	$3m
25	C3I Federally Funded Research & Development Center	$193m
26	Center for Advanced Aviation System Development	$16m
27	Center for Naval Analyses	$44m
28	Center for Nuclear Waste Regulatory Analyses	$6m
29	Critical Technologies Institute	N/A
30	Institute for Defense Analyses Studies and Analyses FFRDC	$56m
31	Institute for Defenses Analyses Studies Computing and Communications FFRDC	N/A
32	Lincoln Laboratory	$159m
33	Logistics Management Institute	$2m
34	National Defense Research Institute	$14m
35	Princeton Plasma Physics Laboratory	$115m
36	Project Air Force	$24m
37	Software Engineering Institute	$22m
38	Tax Systems Modernization Institute	$17m

= 38 FFRDCs, total budget $5.6bn (1995)

Note.
The 1995 figures shown here, did not include figures for the Critical Technologies Institute or the Institute for Defense Analyses Computing and Communications FFRDC. They did include The Energy Technology Engineering Center, which was later removed from the list.

Source: NSF master list of FFRDCs 1997, NSF Federal Funds for Research and Development 1995

The 16 COCO FFRDCs conduct mainly defense-related study and analysis, and hence are not party to the 'technology transfer conduit' implicit in GOCO labs

- 20 of the 22 GOCO labs conduct non-defense-related research, whereas 9 of the 16 COCO FFRDCs conduct defense or national security related study and analysis
- These 9 are sponsored by the DoD, and research for example weapons systems development
- Although a formal technology transfer mechanism is in place in all the GOCO labs, most defense labs are precluded from technology transfer
  - 2 of 11 defense labs have a technology transfer mechanism
  - compared with 25 out of 27 non-defense labs
- Whereas non-defense labs are operated by organizations that were in place before the formation of the lab, defense labs are mostly operated by non-profit organizations established expressly to operate each specific laboratory (and hence are financially 'self-contained')

US COCO FFRDCs

Defense-related research

23.	Aerospace Federally Funded Research and Development Center	$137m
24.	Arroyo Center	$3m
25	C3I Federally Funded Research & Development Center	$193m
26	Center for Advanced Aviation System Development	$16m
27	Center for Naval Analyses	$44m
28	Center for Nuclear Waste Regulatory Analyses	$6m
29	Critical Technologies Institute	N/A
30	Institute for Defense Analyses Studies and Analyses FFRDC	$56m
32	Institute for Defense Analyses Computing and Communications FFRDC	N/A
32	Lincoln Laboratory	$159m
33	Logistics Management Institute	$2m
34	National Defense Research Institute	$14m
35	Princeton Plasma Physics Laboratory	$115m
36	Project Air Force	$24m
37	Software Engineering Institute	$22m
38	Tax Systems Modernization Institute	$17m

FFRDCs are classified into three types reflecting the nature of their research

1. Research and development laboratories

- To maintain over the long-term a competency in technology areas where the Government cannot rely on in-house or purely private sector capabilities
- To develop and transfer important new technology to the private sector so the Government can benefit from a wider, broader base of expertise.

2. Study and analysis centers

- To deliver independent and objective analyses and advise in core areas important to their sponsors in support of policy development, decision making, alternative approaches, and new ideas on issues of significance.

3. System engineering and integration centers

- To provide required support in core areas not available from sponsors' in-house technical and engineering capabilities to ensure that complex systems meet operational requirements
- Often play a critical role in assisting their sponsors in technically formulating, initiating, and evaluating programs and activities undertaken by firms in the for-profit sector.

Most GOCOs are R&D labs, and most COCO FFRDCs are study and analysis centers administered by non-profit organizations

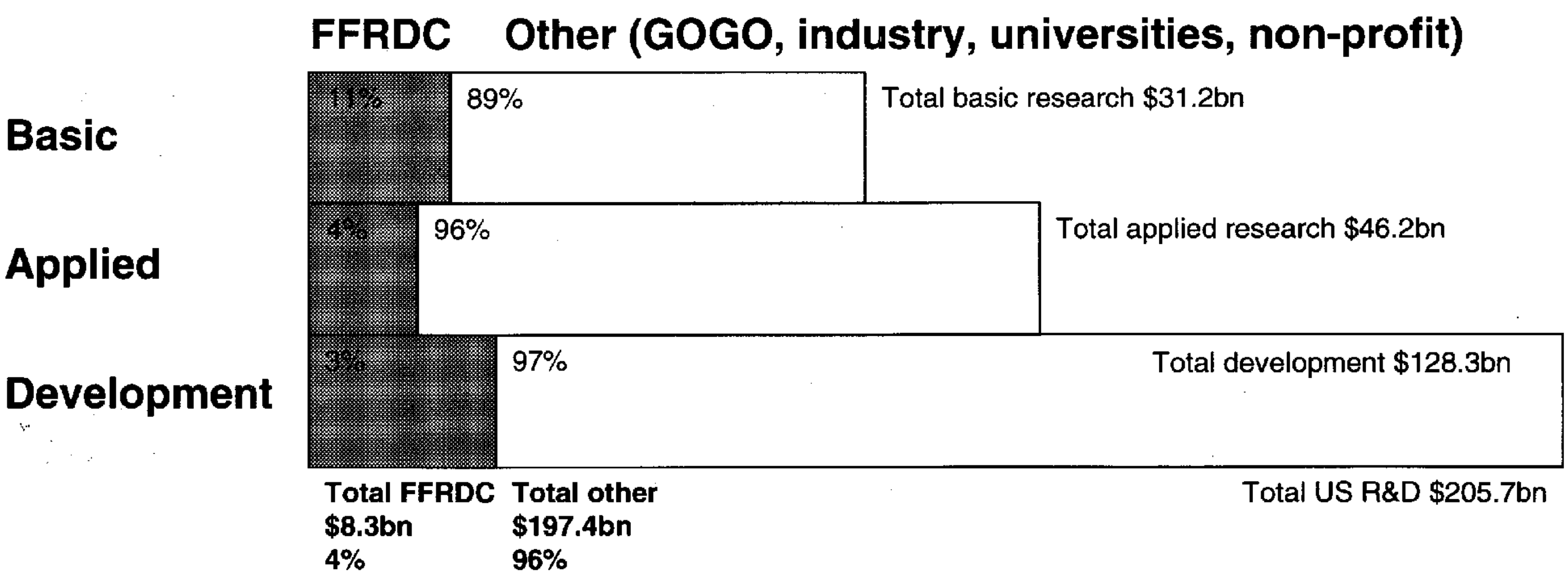
	R&D labs	Study & Analyses Centers	SEI* Centers
Corporations	1. Idaho National Engineering Laboratory 2. NCI Frederick Cancer R&D Center 3. Oak Ridge National Laboratory 5. Savannah River Technology Center	4. Sandia National Labs 26 Center for Advanced Aviation System Development 27. Center for Naval Analyses	23 Aerospace FFRDC 25 C3I FFRDC
Non-profit	6. National Renewable Energy Lab 7. Pacific Northwest National Laboratory	24 Arroyo Center 28 Center for Nuclear Waste Regulatory Analyses 29 Critical Technologies Institute 30. IDA Studies and Analyses FFRDC 31. IDA Computing and Comms FFRDC 33 Logistics Management Institute 34. National Defense Research Institute 36 Project Air Force	38. Tax Systems Modernization Institute
Universities / Colleges	8. Ames Laboratory 9. Argonne National Laboratory 10. Brookhaven National Laboratory 11. Ernest Orlando Lawrence Berkeley Nat Lab 12. Fermi National Accelerator Laboratory 13. Jet Propulsion Laboratory 14. Lawrence Livermore National Laboratory 15. Los Alamos National Laboratory 16. National Astronomy and Ionosphere Center 17. National Center for Atmospheric Research 18. National Optical Astronomy Labs 19. National Radio Astronomy Observatory 20. Oak Ridge Institute for Science and Educ. 21. Stanford Linear Accelerator Center 22. Thomas Jefferson National Accelerator Fac. 32 Lincoln Laboratory 35. Princeton Plasma Physics Laboratory 37. Software Engineering Institute		

**SEI = Systems Engineering and Integration*

GOCO (shaded)

The majority of FFRDC funds go into development, although FFRDC funds make their greatest contribution to basic research

Total US R&D by performer and type of research



1997 figures. Source NSF

The scope of research of the 24 R&D FFRDCs is broad, and 15 are at least partially involved in IT-related research

Heavily involved in IT research	Partially involved in IT research	Not involved in IT research
6. National Renewable Energy Laboratory (advanced materials, energy efficient systems) 15. Los Alamos National Laboratory (advanced computing, computer simulation) 32 Lincoln Laboratory (advanced electronics, air traffic control, communications systems) 37. Software Engineering Institute (software design, software process management, dynamic systems)	1. Idaho National Engineering Laboratory (sensors, systems engineering) 2. NCI Frederick Cancer Research and Development Center (experimental and computational biology) 3. Oak Ridge National Laboratory (superconductivity, buildings technology) 7. Pacific Northwest National Laboratory (neural networks, pollutant assessments) 8. Ames Laboratory (informatics) 9. Argonne National Laboratory (sensors, information management) 10. Brookhaven National Laboratory (systems analysis) 11. Ernest Orlando Lawrence Berkeley National Laboratory (internet protocols, medical imaging) 14 Lawrence Livermore National Laboratory (supercomputing) 17. National Center for Atmospheric Research (climate modelling) 18. National Optical Astronomy Labs (imaging)	5. Savannah River Technology Center 12. Fermi National Accelerator Laboratory 13. Jet Propulsion Laboratory 16. National Astronomy and Ionosphere Center 19. National Radio Astronomy Observatory 20. Oak Ridge Institute for Science and Education 21. Stanford Linear Accelerator Center 22. Thomas Jefferson National Accelerator Facility 35. Princeton Plasma Physics Laboratory

2 The GOCO system in US Federally-funded research

The GOCO system had its origins in the Manhattan project in World War II

- In 1943,the US government asked Professor Robert Oppenheimer of the University of California to lead 'Project Y', part of the Manhattan Project to develop the world's first atomic bomb during World War II
- Project Y was the formation of a new laboratory at Los Alamos in northern New Mexico
- The laboratory site, buildings and equipment were to be funded and owned by the government
- However due to shortages of appropriate government employees, Professor Oppenheimer was to staff the laboratory with researchers and managers brought form
- Thus was born the present day GOCO model

High level policy governing FFRDCs and GOCOs has been modified by three key documents since the 50s

1967 FCST (Federal Council for Science and Technology) Memorandum

- FCRCs renamed FFRDCs
- Basic framework of FFRDCs was established.

1984 Amendment of the Office of Federal Procurement Policy

- More flexibility in organizational form

  "FFRDCs do not have a prescribed organizational structure. They can range from the traditional contractor-owned/contractor-operated or Government-owned/contractor-operated (GOCO) organizational structures to various degrees of contractor/Government control and ownership."
- Limitation in the role of government in monitoring

  "However, the monitoring shall not be such as to create a personal services relationship, or cause disruptions that are detrimental to the productivity and/or quality of the FFRDCs' work."
- The role of industrial firms explicitly stated

  "The activity is operated, managed and/or administered by either a university or consortium of universities, other nonprofit organization or industrial firms as autonomous organization or as an identifiable separate operating unit of a parent organization."

High level policy governing FFRDCs and GOCOs has been modified by three key documents since the 50s *(continued)*

1990 Federal Acquisition Regulations added criteria for FFRDCs

- Clearer concept of GOCO

  "An FFRDC meets some special long-term research or development need which cannot be met as effectively by existing in-house (intramural GOGO) or contractor resources (COCO)."
- Agencies' access to the private sector resources that would not be available in arm's length contracting

  "FFRDCs enable agencies to use private sector resources to accomplish tasks that are integral to the mission and operation of the sponsoring agency."
- Contracted operators' access to federal resources

  "FFRDC, in order to discharge its responsibilities to the sponsoring agency, has access, beyond that which is common to the normal contractual relationship, to Government and supplier data, including sensitive and proprietary data, and to employees and facilities."

In particular, the above legislation can be interpreted as that the GOCO system has evolved towards more market-oriented principles and government / private sector partnership

- The system has moved towards more market-oriented principles. For example, an agency may change a contract operator, if the performance of the operator is sub-standard
  - At the Brookhaven National Laboratory, the Department of Energy decided in 1997 to change its operating entity from Associated Universities Inc., a consortium and one of the founding members of the lab since 1947, to BSA (a consortium between Battelle and NYSU).
  - DOE emphasized the importance of cultural change, cost efficiency and improved management by the new contractor at the signatory ceremony. The reason for the change was clear
- Since its initiation, the nature of the system has evolved from an arms' length contract-based relationship to more of a partnership between the Government and non-federal sectors for mutual resource utilization yet with clear distinction of the roles of both sides
  - the federal agency determines the content of research, budget and the strategic role of the lab, while the contractor is responsible for the daily operation of the lab

However some conflict has surrounded the benefits and management of GOCO institutions in recent years

- The policy of 'least interference' which began with the defence-related nature of early GOCOs led to criticism of the DOE's lax management of GOCO institutions in the early 1990s

- A General Accounting Office effort supported by the House Government Committee on Reform and Oversight found in 1992 that the DOE's least interference policy led to the DOE's being unaware of contractors' activities, paying every cent those contractors asked for, and not subjecting contracts to competition

- In 1995 and 1997, the GAO reviewed the DOE's progress in reform, and in 1997 found that although the DOE had made concrete action plans, actual reform was being delayed

- In recent years, the DOE has also been at odds with the government over GOCO management policy with regard to CRADAs
  - Since the enactment of 1989 National Competitiveness Technology Transfer Act, authority to enter into CRADAs (See Section 3: GOCO and Technology Transfer for details) with other industrial firms was given to for-profit contractors operating federal GOCO labs. It was expected by legislators that the Act would further develop the transfer of federally funded technologies
  - However, taking advantage of some of the provisions in the Act allowing for agency discretion and oversight in the policy implementation, DOE has been reluctant in approving the CRADAs based on a conservative belief that the federally funded public resources should not be utilized for a specific private interest

2 The GOCO system in US Federally-funded research

GOCO provides four primary benefits: efficient management, academic independence, smooth technology transfer, and efficient resource sharing

1) Efficient management by private sector

By internalizing the non-federal private sector's management know-how and styles, more cost-efficient management/administration of the R&D institutions is made possible. Also the cost sensitivity ensures more flexibility to environmental change. For example, GOCO labs can afford more flexibility in procurement, personnel and accounting due to the freedom of their contractors from the more stringent federal standards.

2) Independence

GOCO system enables the lab to be free from both purely commercial interests and political pressures from governmental agencies and Congress. The double-faceted nature of the GOCO system brings about the effective balancing mechanism of potentially conflicting interests.

3) Technology transfer (This issue will be especially detailed in the next section.)

By allowing technology transfer to private sectors, GOCO labs can contribute to the national economic development. It also works as an incentive for private sectors to be engaged in the activities of GOCO labs either as an operating contractor or a partner under CRADA (See chapter 3: GOCO and technology transfer). This incentive also ensures the lab's better negotiating position in choosing operating contractors.

GOCO provides four primary benefits: efficient management, academic independence, smooth technology transfer, and efficient resource sharing *(continued)*

4) Cross-access to resources between federal agencies and private sectors (mutual benefit and synergy)

- Contractors can access, beyond that which is common to the normal contractual relationship, Government and / or supplier data, employees, and facilities needed to discharge its responsibilities efficiently and effectively.
- Agencies can use private sector resources to accomplish tasks that are integral to the mission and operation of the sponsoring agency.
- Agencies can utilize the above synergetic capabilities to meet some special research or development needs of Government agency or bureau, which cannot be met as effectively by existing in-house (GOGO) or simple outsourcing (COCO). By so doing, the best possible resource allocation (configuration) can be realized to achieve the agency mission.

Comparing the merits and demerits of four different R&D styles (GOGO, GOCO, COCO, and traditional arms' length contracting) shows the management effectiveness and cost-efficiency of GOCO

	GOGO (Intramural)	GOCO (Majority of FFRDCs)	COCO (A part of FFRDCs, mostly Defense labs)	Traditional Contracting (The Gov. buys the research output.)
Flexibility to change the management and operators	Low (Firing and replacing federal employees is not so easy as in contracting.)	High (Operation contractors are chosen by merit based on market principle.)	Mid (Operation contractors are non-profits solely established for the lab by the Gov.)	Does not exist
Effectiveness and efficiency of management and operation	Low (red tape)	High (Private sector's cost efficient management)	Mid (Possibility of cost sensitive management)	Does not exist
Openness to technology transfer	Low (due to its purpose and technological nature: sensitive, security)	High (Based on S-W Act, STTR, SBIR, various tech transfer programs are available. But its degree varies depending on the nature of technology and each lab's policy.)	Low (Mostly highly sensitive technologies are researched and developed in these labs.)	Low (Implicit transfer may be possible as a result. Some cases may even legally problematic. Tight confidentiality clause.)
Incentives for the private sector to get involved	Low (Uncontrollable)	High (Competitive, but opportunity exists.)	Mid (Opportunity is given.)	High (Competitive, but opportunity exists.)
Incentives for smart researchers to join the lab	Low (Legal limitation in taking advantage of the acquired knowledge for their own benefit. Tight confidentiality clause.)	High (Non-federal employment status enables flexible career development including launching spin-off businesses)	Mid (Non-federal employment status helps, but confidentiality is tight and career flexibility is not so high.)	Does not exist.
Potential for better quality research	Low	High (Cross-utilization of resources between the Gov. and private sectors. Motivated smart researchers)	Mid	Mid (Cross-utilization of resources as in GOCO never happens.)
Overall cost-performance	Low	High	Mid	Mid

However the GOCO system is prone to certain weaknesses ...

Authority of the agency is still strong

Some leeway is still left to the government agencies in day to day operations. This leeway has been used in some labs to undermine decentralization of technology management (one of the initial purposes of GOCO). Yet, as long as GOCO assumes the government ownership, this problem is hard to be resolved

Inconsistent management policies and practices across labs

Because of decentralized management authority, inconsistent policies and practices may occur across GOCOs sponsored even by the same agency. Decentralization has its pros, and cons as well

Ex. The extent to which contractors must bear the cost of clean-up of environmental contamination at each site varies significantly across DOD-owned GOCO plants

Intellectual property ownership problem (patent granting issue)

Assignment of intellectual property rights or patent ownership to the for-profit contractors has been experiencing resistance from the side of DOE that sponsors the majority of GOCO labs in FFRDCs. This may significantly diminish the technology transfer incentive to potential contractors

Lax management

As was found by the GOA investigation in 1990, GOCO can be prone to lax supervision, improper funds reimbursement, and lack of competition

2 The GOCO system in US Federally-funded research

GOCO Case Study 1

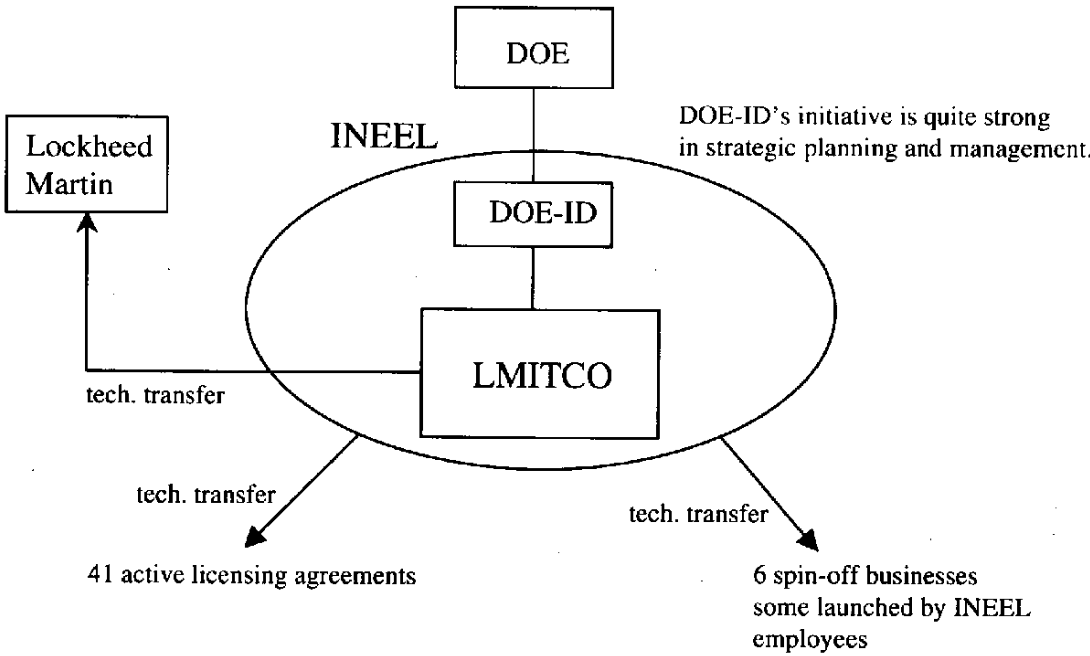
Idaho National Engineering and Environmental Laboratory (INEEL)

Sponsor: U.S. Department of Energy

Overseer: U.S. Department of Energy Idaho Operations Office (DOE-ID), exclusively set up for INEEL

Contractor: Lockheed Martin Idaho Technology Company (LMITCO), a subsidiary of Lockheed Martin.

Areas of research: nuclear reactors, biotechnology, energy and materials, conservation and renewable energy, and waste treatment and clean-up.



History:
1949 Established by the Fed as the National Reactor Testing Station
1974 Renamed as INEEL reflecting its broadening multi-program nature

Employees: 8,000
- 450 federal employees for DOE-ID,
- Vast majority of the rest work for LMITCO.
- Others work for other contractors or institutions such as Westinghouse Electric and Argonne National Lab-West.

Annual Budget: $300M in 1997, ($377 in 1994)
–Cooperative R&D agreements (CRADAs) as a source of funds (gov : private= 1:7)

Technology Transfer Program:
–Stevenson-Wydler Technology Innovation Act
–41 active royalty-bearing technology licenses
–6 new spin-off companies lunched in 1997
–450 technologies indentified in the inventory of technology commercialization opportunities

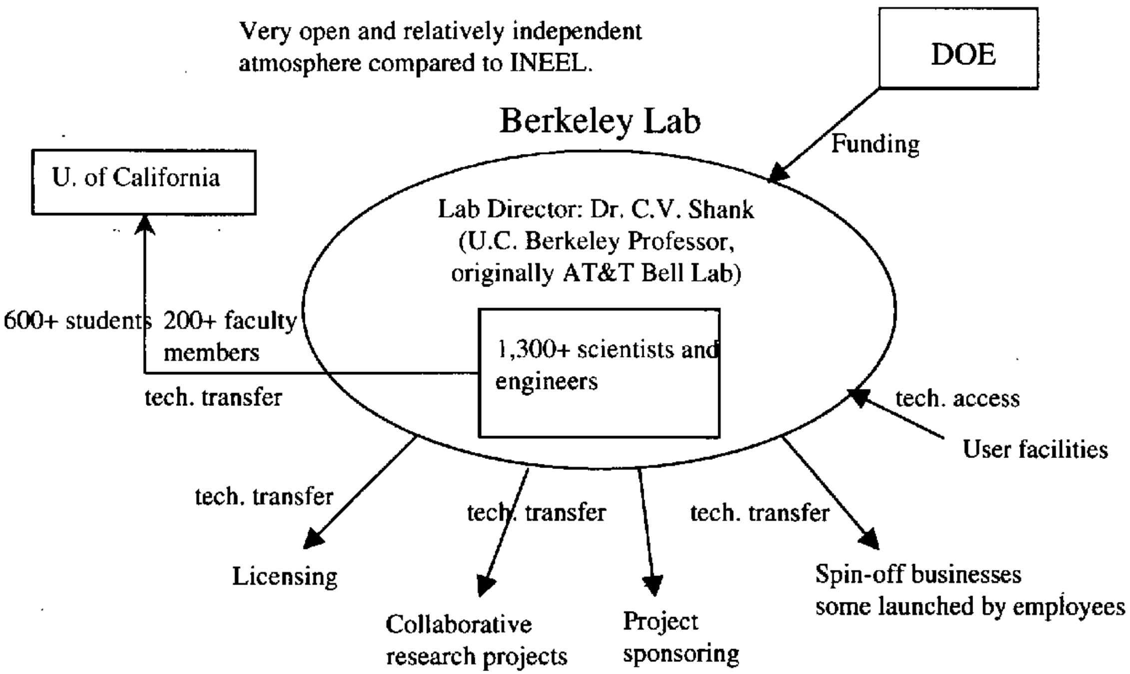
GOCO Case Study 2

Ernest Orlando Lawrence Berkeley National Laboratory (Berkeley Lab)

Sponsor: U.S. Department of Energy

Contractor: the University of California system

Areas of research: particle physics, advanced materials, life sciences, energy efficiency, detectors and accelerators.



History:
1931 Established by Dr. Lawrence, who invented the cyclotron which lead to the Golden Age of particle physics discovering the nature of the universe. Since then, Berkeley Lab has broaden its research scope. Nine Nobel Prizes.

Employees: 3,249 (as of the end of 1995) , all of which are employed by the lab.

- 913 scientific staff
- 875 technical staff
- 245 faculty
- 390 graduate students
- 146 undergraduate
- 149 postdoctoral
- 531 administrative support
- additional 800 guest scientists each year

Annual Budget: $389M 1997-98 fiscal year

Technology Transfer Program:

- Many collaborative research projects with the private sector also as a source of funding and expertise.
- Supporting new company spin-offs
- Licensing
- Sponsored projects
- Visitor/staff exchanges
- Gifts and graduate support
- User facilities

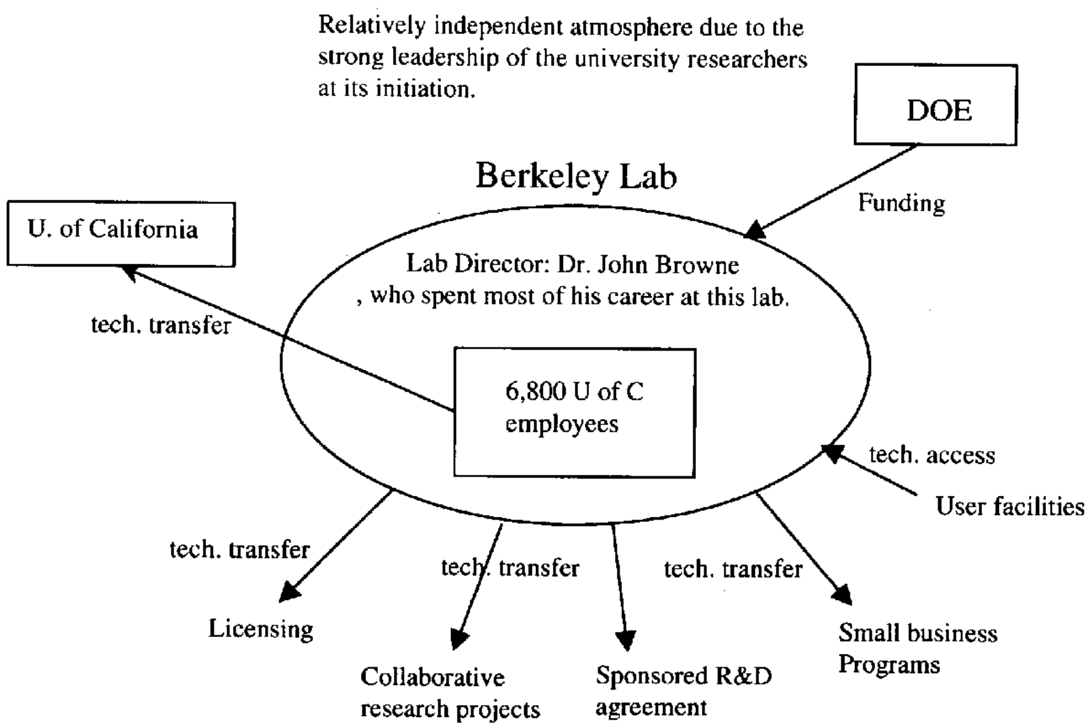
GOCO Case Study 3

Los Alamos National Laboratory

Sponsor: U.S. Department of Energy

Contractor: the University of California system

Areas of research: nuclear weapons science, earth and environmental systems, advanced materials, and bioscience.



History:
1943 Established by Dr. Oppenheimer, then University of California Professor, as a part of the Manhattan Project to create the first atomic weapons.
Employees: some 10,000, of which
- 6,800 University of California employees
- 2,800 other contractors' employees

Annual Budget: $1.2B 1997 fiscal year
Technology Transfer Program:
- Cooperative research arrangements including CRADA.
- Licensing
- Sponsored projects
- Visitor/staff exchanges
- User facilities
- Small Business Initiative

第3章　GOCOシステムと技術移転

GOCO and technology transfer

Contents

A well-developed system of technology transfer highlights the importance the US attaches to commercialization of research wherever possible

Brief history:

- Federal technology transfer has more than a century-long history beginning with the transfer of agricultural technologies to farmers. It dates back to 1862, when the Morrill Act provided the states the wherewithal to develop colleges that would offer practical instruction in agriculture and mechanical art.
- In 1914, the Smith-Lever Act created the Cooperative Agricultural Extension Service, a partnership among federal, state, and county governments to deliver the practical benefits of research to citizens. Since then, the Department of Agriculture has been spending nearly half of its R&D budget on dissemination and transfer of agricultural technologies.
- Until the end of 1970s, the philosophy behind the dissemination of federally funded research was that the resulting intellectual property should be available to all interested parties (universal access). However, this universal access policy did not satisfy the industry which prefers the exclusive usage of technologies. As a result, overall, very little government technology was commercialized.

A well-developed system of technology transfer highlights the importance the US attaches to commercialization of research wherever possible *(Continued)*

Current system:

- In 1980, Congress changed the philosophy of universal access when the Bayh-Dole and Steven-Wydler Acts were passed (See .) . This legislation provided federal labs flexibility in granting individual companies varying degrees of *exclusive* access to federal intellectual properties.

- Philosophies behind this legislation are that the national economic development can be enhanced by leveraging the federally-owned technologies in the private sectors, and that private entities, given the incentives of the patent system, would do a better job of commercializing inventions than federal agencies.

Technology developed using government funding can be "transferred" to the private sector through either direct industry research funding or leverage of academic / government research

Mechanisms of federal technology transfer in the US
Cooperative Research and Development Agreement (CRADA)
Licensing of federally owned technologies
Start-up or spin-off companies
Technical assistance (mostly supports small firms in the same state or region as the lab.)
Information dissemination
Exchange programs (the exchange of research personnel between federal labs and private firms.)
"Work for others" and user facilities
Consulting
Collegial interchange, workshops and conferences

Technology transfer policies and procedures refer to patent ownership policy (which determines the incentive for federally-funded research performed by industry/academia) and the transfer of federally-owned technologies into the private sector

Patent ownership policy

Two opposite perspectives exist in treating the ownership of inventions made by federally funded R&D: "title in the government" policy and "title in contractor" policy. Traditionally, agencies such as DOE and NASA had long-established policies of claming ownership to inventions made with their support, while many others including NSF, NIH and DOD already allowed contractors to retain patent rights to their inventions long before Bayh-Dole Act in 1980 (See the next page for details). Thus, there had been no uniform government-wide treatment of inventions until 1980.

Transfer of federally-owned technologies

Two primary policies behind this are that agencies should ensure the full use of the results of the nation's federal investment in R&D, and that the government should strive to transfer federally-owned or originated technology to both state and local governments and to the private sector. These policies are legitimatized through the Stevenson-Wydler Act in 1980, which is the basic federal technology law

Based on the belief that commercial entities would better commercialize patents, patent ownership has gradually moved into contractor hands, in particular as a result of the 1980 Bayh-Dole Act.

The impact of the Bayh-Dole and subsequent Acts on patent ownership

- **1980 Bayh-Dole Act**. "Title in contractor" policy was applied to small business and non-profit organizations such as universities. They were given a statutory right to choose to retain title to inventions made during federally-assisted R&D as long as they were interested in patenting and attempting to commercialize those inventions. *At this point, operating contractors of GOCO labs were excluded.* Also, much discretion was left in the hands of agencies, which resulted in different practices by different agencies.

- **1983 "Government Patent Policy" memorandum by Reagan Administration**. As a result of failure in persuading Congress to expand the coverage of the Act, the Administration instructed that agencies *not prohibited by statute* treat *all contractors* in accordance with the Act, not just small business and non-profits. *DOE refused to extend to GOCOs citing old DOE statutes.*

- **1984 Amendment to the B-D Act.** *Non-profit (university-operated) GOCOs were included, but not industry contractors.* Still applies only for small businesses and non-profit organizations

- **1987 President Reagan urged** that to the extent permitted by law agencies extend ownership of patents and data to all contractors. *DOE refuses to extend to for-profit operators of its GOCOs*

Mechanisms for leverage of government research into the private sector were largely established by the Stevenson-Wydler Act in 1980

- **Stevenson-Wydler Act**

  – **1980 Steven-Wydler Act**'s basic principles are that agencies should ensure the full use of the results of the nation's federal investment in R&D, and that the government should strive to transfer federally-owned or originated technology to both state and local governments and to the private sector.

  –The Act allows agencies to *exclusively license* federally developed inventions. The Act required agencies to establish Offices of Research and Technology Applications (ORTAs) at federal labs, and to devote a percentage of their R&D budgets to technology transfer. These ORTAs are to be coordinated by the Center for Utilization of Federal Technology (currently the National Institute of Standards and Technology) established within the Dept. of Commerce.

For federal labs and GOCOs, the key mechanism of transfer is the CRADA, (Cooperative Research and Development Agreement) established by the FTTA (for GOGO) and the NCTTA (for GOCO)

CRADA is a written agreement between a private company and a government agency to work together on a project. CRADA vehicles provide excellent incentives to speed up the commercialization of federally-developed technologies.

The non-federal partners provide funds, personnel, services, facilities, equipment or other resources to conduct the focal research, while the federal institution provides similar resources but funds except for DOE GOCOs after 1989, that have specific funds for CRADAs.).

1986 Federal Technology Transfer Act (FTTA) amended S-W Act to authorize the cooperative R&D agreements (CRADAs) between federal labs and nonfederal entities. It also authorized award programs for federal employees who are responsible for inventions and required royalty sharing whenever an agency retains patent ownership. However, ***the Act covers only GOGOs not GOCOs.***

1989 National Competitiveness Technology Transfer Act (NCTTA) extended the the coverage and ***authorized GOCO labs to enter into CRADAs*** on the same basis as its GOGOs. However, the administrative treatment of CRADAs widely varies across agencies (See page ## for details.)

Aggressiveness towards technology transfer policies widely varies across agencies. Especially, DOE has been, until recently, reluctant to conform with patent and technology transfer legislation

Bayh-Dole Act (patent ownership policy)

1983 DOE refused to conform to the Presidential Memorandum instructing all agencies to extend patent ownership to all contractors.

1984 DOE urged Senator Dole to drop the entire FTTA bill citing its willingness to solve the problem administratively. Dole refused.

1987 DOE refused to extend the patent ownership to for-profit operators of GOCOs

1989 Because of the continued resistance by DOE, the bill was introduced, which requires all GOCOs to be covered by FTTA. DOE submitted the counter-bill which virtually exempted DOE from Bayh-Dole Act and FTTA. Rejected.

Stevenson-Wydler Act (technology transfer and CRADA)

1989 Bingham-Dominici Bill required the agency to complete the review process of CRADA proposal within 30 days. And if not accepted, to report to Congress 'why' in 10 days. To attempt to limit DOE's abuses of its own statute.

1994 Amendment of FTTA to assign intellectual property rights or exclusive use of license to CRADA partners automatically.

Ironically, as DOE's resistance has continued, the legislation has become more stringent. DOE gradually soften its negative stance toward technology transfer policies.

The CRADA concept took off rapidly, and began moving to more involved consortia-based joint research projects

- The CRADA concept was introduced in 1986 for GOGOs and in 1989 for GOCOs, and by 1993 approximately 1500 CRADAs were active or had already been completed
- The DOE reported in 1993 that it had already far exceeded its goal of issuing 1000 CRADAs by fiscal year 1995. The DOE had halved the time necessary to complete agreements with industry
- The focus in CRADAs is now shifting from technical assistance (technology transfer from the government to the private) to consortia (joint R&D)
- More recently, the trend is to recognize CRADAs more as cost-shared joint R&D

第4章　GOCOシステムが日本に示唆するもの

Implications for Japan

Contents

The essence of the GOCO system could be employed in Japan

- Essentially, the GOCO system of laboratory operation could be applied to management of Japanese laboratories
- In many ways, given the lesser importance of defense-related research in Japanese labs, there is more scope for private involvement and open technology transfer in Japanese labs than in US labs
- In the short term, the key task would be to select corporations to manage labs on the basis of a level of management ability
- Longer term, an important goal of policy would be to foster and create non-profit organizations with the management ability and know-how to manage labs
  - non-profit organizations provide the same independence from government bureaucracy that corporations can
  - in addition, they are free from any (foreseen or unforeseen) commercial pressures

Additionally, the Japanese system could learn several important lessons from what works well and what goes wrong in the US GOCO system

Things to learn #1: How to separate the planning and policy-drafting function and executing function in the governmental tasks.

- The Japanese reform is based on the important assumption that the governmental tasks can be clearly divided into two functions: 1) Planing and policy-drafting functions and 2) executing functions; and the latter function is the primary target of the reform. Some doubt the separability of the two, believing that the feedback and linkage between the two is indispensable.
- The Japanese system could benefit by studying how on-going GOCO lab operators in the US are assigned their actual role as executing entities

Things to learn #2: How to design and implement the integrated technology transfer and cooperative research mechanism in GOCO type arrangement.

- The discussion in Japan is still at the primitive stage in designing the technology transfer mechanism, where the main issue is the modification of surrounding regulatory environment such as the treatment of the national employee status, the absent or leave when engaged in cooperative research.
- The US system is based on well-grained legislation specifically intended to *assure the outcome of the policy intention*. Legislation not only *defines* the concept (Japanese system is still at this level), but also clarifies *how to ensure the actual execution* of the ideas.

Additionally, the Japanese system could learn several important lessons from what works well and what goes wrong in the US GOCO system *(continued)*

Things to learn #3: How to coordinate the central authority and the decentralized ones in dealing with the GOCO entities.

- In the US, the persistent conflict between DOE and Congress finally seems to be resolved through the highly practical and detailed legislation which clarifies minute procedures that could bring uniform guidelines of GOCO management/operation across agencies.

Japanese national laboratories could benefit from a more lively and open environment, and the economy as a whole could benefit from increased technology transfer

GOCO benefits in US		*Transferability to Japan*
• Efficient lab management	✓	
• Independence	✓	• More so once non-profit organizations established
• Resource sharing	✓	
• Effective technology transfer	✓	• With careful legislative implementation

GOCO weaknesses in US		
• Unclear balance of power	✗	• With careful legislative implementation
• Inconsistent policy	✗	• With careful legislative implementation
• Unfair IP ownership	✗	• With careful legislative implementation
• Lax supervision	✗	

参考資料

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Appendices

Appendix 1
Individual FFRDC details

	Ownership	*BUDGET*	*Sponsor*	*Admin Type (I / U / NP)*	*Administrator*	*Nature of contract*	*Technology Transfer*	*year est.*	*initiative by whom*	*initial area*	*historical background*
1 Idaho National Engineering Laboratory	**GOCO**	78	DOE	I	Lockheed Martin	contract	S-W	1949	Fed Gov.	nuclear reac	Cold War
2 NCI Frederick Cancer Research and Development Center	**GOCO**	142	DOHHS	I	Science Applications International Corp.; Advanced BioScience Laboratories, Inc.; Charles River Laboratories, Inc.; Data Management	contract	through NCI	1972	NCI (gov)	cancer	
3 Oak Ridge National Laboratory	**GOCO**	288	DOE	I	Lockheed Martin	contract	partnership, consulting	1942	Fed Gov.	atomic bomb	WWII
4 Sandia National Laboratories	**GOCO**	654	DOE	I	Lockheed from 1993,AT&T 1949-1992	contract	partnership, consulting	1945	Fed Gov.	atomic bomb	WWII
5 Savannah River Technology Center	**GOCO**	30	DOE	I	Westinghouse	contract	S-W	1950s	Fed Gov.	nuclear ener	Cold War
6 National Renewable Energy Laboratory	**GOCO**	102	DOE	NP	Midwest Research Ins.	contract	various, strong	1977	Solar Energy	Act of 1974	
7 Pacific Northwest National Laboratory	**GOCO**	209	DOE	NP	Battelle	contract	various, strong	1965	Fed/Battelle	various fields	
8 Ames Laboratory	**GOCO**	30	DOE	U	Iowa State	contract	various	1947	Fed Gov.	nuclear ener	WWII, Cold War
9 Argonne National Laboratory	**GOCO**	253	DOE	U	Chicago	contract	various	1946	Fed Gov.	physical, life	
10 Brookhaven National Laboratory	**GOCO**	216	DOE	U	AUI / BSI	contract	various	1947	AUI	various fields	
11 Ernest Orlando Lawrence Berkeley National Laboratory	**GOCO**	171	DOE	U	UC Berkeley	contract	various	1931	Fed Gov.	cyclotron, pa	
12 Fermi National Accelerator Laboratory	**GOCO**	171	DOE	U	U. Research Assoc.	contract	various	1969	Fed Gov.	nuclear accelerator	
13 Jet Propulsion Laboratory	**GOCO**	1057	NASA	U	CIT	contract	various	1936	Fed Gov.	space exploration	
14 Lawrence Livermore National	**GOCO**	501	DOE	U	Univ. of California	contract	various	1952	U.C.	nuclear ener	Cold War
15 Los Alamos National Laboratory	**GOCO**	541	DOE	U	Univ. of California	contract	various	1943	Fed Gov.	atomic bomb	WWII
16 National Astronomy and Ionosphere Center	**GOCO**	8	NSF	U	Cornell	CA	open facilities	1963	Fed Gov.	astronomy	
17 National Center for Atmospheric Research	**GOCO**	79	NSF	U	Univ Corporation for Atmospheric Research	CA/contract	licensing, open facilities	1959	UCAR	astronomy	
18 National Optical Astronomy Observatories	**GOCO**	29	NSF	U	Assoc. of Univs for Research in Astronomy, Inc.	CA	open facilities	1957	AURA/NSF	astronomy	
19 National Radio Astronomy Observatory	**GOCO**	30	NSF	U	Associated Universities, Inc.	contract=>CA	open facilities	1957	AUI	astronomy	
20 Oak Ridge Institute for Science and Education	**GOCO**	17	DOE	U	Oak Ridge Assoc. US Inc	contract	training, education	1947	Fed Gov.	nuclear ener	WWII
21 Stanford Linear Accelerator Center	**GOCO**	118	DOE	U	Stanford.	contract	STTR, SBIR	1962	Fed Gov.	accelerator	
22 Thomas Jefferson National Accelerator Facility	**GOCO**	59	DOE	U	Southeastern URA	contract	User Facilities	1984	SURA	accelerator	
23 Aerospace FFRDC	COCO	137	DOAF	NP	Aerospace Corp	SA	*precluded*			space military	
24 Arroyo Center	COCO	3	DOARMY	NP	Rand Corp	SA	*precluded*	1982	Fed Gov.	Army suppor	
25 C3I Federally Funded Research & Development Center	COCO	193	DOD	NP	Mitre Corp	SA	*precluded*	1958	Fed Gov.	intelligent sy	Cold War

Appendix 1
Individual FFRDC details

26	Center for Advanced Aviation System Development	COCO	16	DOTRANSF	NP	Mitre Corp	SA	contract, licensing	1960s	Mitre	aviation
27	Center for Naval Analyses	COCO	44	DONAVY	NP	CNA Corp	contract	*precluded*	1943	Fed Gov.	decision anal WWII
28	Center for Nuclear Waste Regulatory Analyses	COCO	6	NRC	NP	Southwest Research Inst.	contract	limited	1987	SRI	nuclear wast
29	Critical Technologies Institute	COCO	N/A	NSF	NP	Rand Corp	SA/contract	*precluded*	1991	Congress	national polic
30	Institute for Defense Analyses Studies and Analyses FFRDC	COCO	56	DOD	NP	IDA mainly MIT	SA	*precluded*	1956	Fed Gov.	weapon syst Cold War
31	Institute for Defense Analyses Computing and Comms FFRDC	COCO	N/A	DOD	NP	IDA mainly MIT	SA	*precluded*	1956	Fed Gov.	weapon syst Cold War
32	Lincoln Laboratory	COCO	159	DOAF	U	MIT	contract	STTR, licensing	1951	Fed Gov.	radar networ WWII, Cold War
33	Logistics Management Institute	COCO	2	DOD	NP	Logistics Mgmt Institute	SA	conditional	1970s	Fed Gov.	military logistics
34	National Defense Research Institute	COCO	14	DOD	NP	Rand Corp	SA	*precluded*	after 1948	Fed Gov.	policy research
35	Princeton Plasma Physics Laboratory	COCO	115	DOE	U	Princeton	contract	various	1951	Princeton U.	fusion
36	Project Air Force	COCO	24	DOAF	NP	Rand Corp	SA	*precluded*	1946	Fed Gov.	intercontiner
37	Software Engineering Institute	COCO	22	DOD	U	Carnegie Mellon	SA	education, licensing	1984	Fed Gov.	software eng.
38	Tax Systems Modernization Institute	COCO	17	OTRES, IF	NP	IIT Research Institute	contract	none	1980s	Fed Gov.	tax IS reform

SA: sponsoring agreement

CA: cooperative agreement

STTR: The Small Business Technology Transfer Program

S-W: Stevenson-Wydler Technology Innovation Act of 1980

Appendix 2
Individual FFRDC funding by source of funds

Federally funded research and development centers	Total	Dept of Commerce	Dept of Defense	Dept of Energy	Dept of Health & Human services	National Aero-nautics & Space Admin	National Science Foundation	Other
Total, all FFRDCs	5,609,641	129	823,106	3,295,890	186,057	1,047,684	141,476	115,299
FFRDCs administered by Industrial firms	1,203,899	0	93,468	935,637	142,164	0	10	32,620
Energy Technology Engineering Center	11,783	0	48	11,526	0	0	0	208
Idaho National Engineering & Environmental Laboratory	77,745	0	1,578	53,753	0	0	0	12,414
NCI Frederick Cancer Research and Development Center	141,707	0	72	0	141,635	0	0	0
Oak Ridge National Laboratory	288,332	0	9,066	267,663	529	0	10	11,044
Sandia National Laboratories	654,472	0	82,659	562,860	0	0	0	8,953
Savannah River Technology Center	29,860	0	25	29,835	0	0	0	0
FFRDCs administrated by universities & colleges	3,574,349	129	261,520	2,057,324	24,478	1,043,913	140,883	46,102
Ames Laboratory	29,815	0	30	25,930	0	0	0	3,855
Argonne National Laboratory	252,879	4	1,841	246,877	0	240	0	3,917
Brookhaven National Laboratory	216,094	50	2,696	199,269	2,806	353	1,448	9,472
Ernest Orlando Lawrence Berkeley National Laboratory	170,870	75	879	156,754	12,343	703	116	0
Fermi National Accelerator Laboratory	170,917	0	0	170,917	0	0	0	0
Jet Propulsion Laboratory	1,056,916	0	25,778	0	0	1,031,078	80	0
Lawrence Livermore National Laboratory	500,622	0	32,857	461,840	3,192	1,016	2	1,715
Lincoln Laboratory	158,648	0	150,206	0	0	343	0	8,099
Los Alamos National Laboratory	540,637	0	24,781	489,485	5,537	812	1,152	18,860
National Astronomy and Ionosphere Center	7,669	0	0	0	0	0	7,669	0
National Center for Atmospheric Research	79,483	0	462	0	0	7,449	71,572	0
National Optical Astronomy Observatories	29,099	0	0	0	0	0	29,099	0
National Radio Astronomy Observatory	29,960	0	0	0	363	0	29,597	0
Oak Ridge Institute for Science and Education	16,747	0	25	14,330	237	1,919	52	184
Princeton Plasma Physics Laboratory	115,284	0	0	115,178	0	0	106	0
Software Engineering Institute	21,965	0	21,965	0	0	0	0	0
Stanford Linear Accelerator Center	117,713	0	0	117,713	0	0	0	0
Thomas Jefferson National Accelerator Facility	59,031	0	0	59,031	0	0	0	0
FFRDCs administered by nonprofit institutions	831,393	0	468,118	302,929	19,415	3,771	583	36,577
Aerospace Federally Funded Research and Development Center	137,495	0	136,552	0	0	738	205	0
Arroyo Center	2,621	0	2,621	0	0	0	0	0
C3I Federally Funded Research & Development Center	192,993	0	190,330	0	0	2,549	114	0
Center for Advanced Aviation System Development	15,961	0	7,073	0	0	0	0	8,888
Center for Naval Analyses	44,143	0	44,056	0	0	0	87	0
Center for Nuclear Waste Regulatory Analyses	5,795	0	0	0	0	0	0	5,795
Inhalation Toxicology Research Institute	7,417	0	0	6,648	769	0	0	0
Institute for Defense Analyses Studies and Analyses FFRDC	56,215	0	56,038	0	0	0	177	0
Logistics Management Institute	2,271	0	1,871	0	0	200	0	200
National Defense Research Institute	14,326	0	2,633	0	11,558	135	0	0
National Renewable Energy Laboratory	102,278	0	0	102,278	0	0	0	0
Pacific Northwest National Laboratory	208,529	0	2,944	194,003	7,088	0	0	4,494
Project Air Force	24,149	0	24,000	0	0	149	0	0
Tax Systems Modernization Institute	17,200	0	0	0	0	0	0	17,200

Source: NSF Federal Funds for Research and Development, Fiscal Years 1995,6,7
Figures above 1995 (latest year available at individual FFRDC level)

Appendix 3
Total federal RandD by performer

Funding Sector:	Total U.S.	Federal Government								Industry				U&Cs	Nonprofits			Nonfed. Govt.[5]
Performing Sector	Total U.S.	Total	Federal Govt.	Industry[2]	Industry FFRDCs[2]	U&Cs	U&C FFRDCs[3]	Non-profits[2]	Nonprofit FFRDCs[2]	Total	Industry[4]	U&Cs	Non-profits	U&Cs	Total	Non-Profits	U&Cs	U&Cs
Data Column	[1]	[37]	[2]	[4]	[6]	[8]	[13]	[15]	[18]	[38]	[5]	[10]	[16]	[11]	[39]	[17]	[12]	[9]
Calendar Year[6]	Millions of current dollars																	
1990	151,655	61,456	15,671	25,802	2,323	9,785	4,894	2,346	636	83,374	81,602	1,147	625	3,096	2,367	1,147	1,220	1,361
1991[7]	160,521	60,563	15,249	24,095	2,277	10,447	5,120	2,679	696	92,484	90,580	1,224	680	3,412	2,585	1,252	1,333	1,478
1992	164,932	60,693	15,853	22,369	2,353	11,306	5,259	2,806	748	96,404	94,388	1,300	716	3,558	2,770	1,342	1,428	1,508
1993	165,188	60,350	16,532	20,844	1,965	12,129	5,289	2,841	749	96,704	94,591	1,376	737	3,646	2,928	1,419	1,510	1,561
1994	168,554	60,692	16,440	20,261	2,202	12,826	5,305	2,899	759	99,332	97,131	1,437	764	3,867	3,074	1,489	1,585	1,588
1995	183,013	63,147	17,231	21,178	2,273	13,434	5,405	2,822	804	110,998	108,652	1,516	830	4,069	3,129	1,516	1,613	1,670
1996 prelim.	193,206	62,810	16,774	20,931	2,273	13,855	5,405	2,871	702	121,156	118,648	1,613	895	4,255	3,250	1,575	1,676	1,736
1997 prelim.	205,742	62,745	16,450	20,787	2,273	14,285	5,405	2,900	644	133,308	130,631	1,710	967	4,457	3,411	1,653	1,759	1,821
Data Column	[19]	[40]	[20]	[22]	[24]	[26]	[31]	[33]	[36]	[41]	[23]	[28]	[34]	[29]	[42]	[35]	[30]	[27]
Calendar Year[6]	Millions of constant 1992 dollars																	
1990	161,957	65,631	16,736	27,555	2,481	10,450	5,226	2,505	679	89,038	87,145	1,225	667	3,307	2,527	1,224	1,303	1,454
1991[7]	164,940	62,230	15,669	24,758	2,340	10,734	5,261	2,753	715	95,030	93,073	1,257	699	3,506	2,656	1,287	1,369	1,518
1992	164,932	60,693	15,853	22,369	2,353	11,306	5,259	2,806	748	96,404	94,388	1,300	716	3,558	2,770	1,342	1,428	1,508
1993	160,977	58,811	16,111	20,313	1,915	11,820	5,154	2,769	730	94,238	92,180	1,340	718	3,553	2,853	1,382	1,471	1,521
1994	160,592	57,825	15,663	19,304	2,098	12,220	5,054	2,762	724	94,640	92,543	1,369	728	3,685	2,929	1,419	1,510	1,513
1995	170,142	56,706	16,019	19,689	2,113	12,489	5,025	2,623	747	103,192	101,011	1,410	772	3,783	2,909	1,409	1,500	1,553
1996 prelim.	175,610	57,090	15,246	19,025	2,066	12,593	4,913	2,609	638	110,121	107,842	1,466	813	3,867	2,954	1,431	1,523	1,578
1997 prelim.	182,217	55,571	14,569	18,410	2,013	12,652	4,787	2,569	571	118,066	115,695	1,515	856	3,947	3,021	1,464	1,557	1,612

[1] The next updates of these data, covering the years 1953-98, along with technical notes explaining methodological issues of measurement, will be provided in NSF *National Patterns of R&D Resources: 1998* (forthcoming).

[2] For 1953-54, expenditures of industry FFRDCs were not separated out from total Federal support to the industrial sector. Thus, the figure for Federal support to industry includes support to FFRDCs for those two years. The same is true for expenditures of nonprofit FFRDCs, which is included in Federal support for nonprofit institutions in 1953-5

[3] Includes all R&D expenditures of FFRDCs administered by academic institutions. In 1994, 99 percent of total funds used were from Federal sources.

[4] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[5] Because of limitations in the survey information, data on nonfederal government funding to other performers are not available, and are consequently included in other sectors' support for their own R&D performance. For example, nonfederal government support to nonprofits is included in nonprofits' support for their own R&D (data column[17]

[6] Expenditure levels for academic and Federal government performers are also in reference to calendar years, which represents a change from previous reporting in *National Patterns of R&D Resources*. These levels are approximations based on fiscal-year data. For academic expenditures, and Federal government expenditures starting in 1977, the calendar-year approximation is equal to 75 percent of the amount reported in the same fiscal ye plus 25 percent of the amount reported in the subsequent fiscal year. For Federal government expenditures prior to 1977, the respective percentages are 50 and 50, since earlier fiscal years began on July 1 instead of Octobe

[7] Due to revisions in survey methodology and sampling of industrial R&D, data for 1991 and subsequent years may not be comparable to data for previous years. (See *National Patterns of R&D Resources: 1996* or *National Patterns of R&D Resources: 199*, forthcoming.)

Key: FFRDCs=Federally Funded Research and Development Centers; U&C=universities and college

NOTES: Data are based on annual reports by performers except for the nonprofit sector; R&D expenditures by nonprofit sector performers have been estimated since 1973 on the basis of survey conducted in that year. Data are preliminary for 1996 and 1997

SOURCES: National Science Foundation/SRS. Data were derived from NSF/SRS, Research and Development in Industry 1995; NSF/SRS, Academic Science/Engineering: R&D Expenditures Fiscal Year 1995; NSF/SRS, Federal Funds for Research and Development; Fiscal Years 1995, 1996, and 1997; industry data available in Standard and Poors Compustat; and an independe survey conducted by the Industrial Research Institute

Appendix 4
Total federal RandD by source of funds

Performing Sector:	Total U.S.	Federal Govt.	Industry			Industry FFRDCs	Universities & Colleges						U&C FFRDCs	Other Nonprofit institutions				Nonprofit FFRDCs
Funding Sector:	Total U.S.	Federal Govt.	Total	Federal Govt.[2]	Industry[3]	Federal Govt.[2]	Total	Federal Govt.	Nonfed. Govt.	Industry	U&C	Non-Profits	Federal Govt.[4]	Total	Federal Govt.[2]	Industry	Non-Profits	Federal Govt.[2]
Data Column	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
Calendar Year[5]							Millions of current dollars											
1990	151,655	15,671	107,404	25,802	81,602	2,323	16,610	9,785	1,361	1,147	3,096	1,220	4,894	4,117	2,346	625	1,147	636
1991[6]	160,521	15,249	114,675	24,095	90,580	2,277	17,892	10,447	1,478	1,224	3,412	1,333	5,120	4,611	2,679	680	1,252	696
1992	164,932	15,853	116,757	22,369	94,388	2,353	19,099	11,306	1,508	1,300	3,558	1,428	5,259	4,864	2,806	716	1,342	748
1993	165,188	16,532	115,435	20,844	94,591	1,965	20,221	12,129	1,561	1,376	3,646	1,510	5,289	4,997	2,841	737	1,419	749
1994	168,554	16,440	117,392	20,261	97,131	2,202	21,305	12,826	1,588	1,437	3,867	1,585	5,305	5,152	2,899	764	1,489	759
1995	183,013	17,231	129,830	21,178	108,652	2,273	22,303	13,434	1,670	1,516	4,069	1,613	5,405	5,167	2,822	830	1,516	804
1996 prelim.	193,206	16,774	139,579	20,931	118,648	2,273	23,134	13,855	1,736	1,613	4,255	1,676	5,405	5,340	2,871	895	1,575	702
1997 prelim.	205,742	16,450	151,418	20,787	130,631	2,273	24,031	14,285	1,821	1,710	4,457	1,759	5,405	5,520	2,900	967	1,653	644

Data Column	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]
Calendar Year[5]							Millions of constant 1992 dollars											
1990	161,957	16,736	114,700	27,555	87,145	2,481	17,738	10,450	1,454	1,225	3,307	1,303	5,226	4,397	2,505	667	1,224	679
1991[6]	164,940	15,669	117,832	24,758	93,073	2,340	18,385	10,734	1,518	1,257	3,506	1,369	5,261	4,738	2,753	699	1,287	715
1992	164,932	15,853	116,757	22,369	94,388	2,353	19,099	11,306	1,508	1,300	3,558	1,428	5,259	4,864	2,806	716	1,342	748
1993	160,977	16,111	112,492	20,313	92,180	1,915	19,705	11,820	1,521	1,340	3,553	1,471	5,154	4,870	2,769	718	1,382	730
1994	160,592	15,663	111,847	19,304	92,543	2,098	20,298	12,220	1,513	1,369	3,685	1,510	5,054	4,909	2,762	728	1,419	724
1995	170,142	16,019	120,699	19,689	101,011	2,113	20,734	12,489	1,553	1,410	3,783	1,500	5,025	4,804	2,623	772	1,409	747
1996 prelim.	175,610	15,246	126,867	19,025	107,842	2,066	21,027	12,593	1,578	1,466	3,867	1,523	4,913	4,854	2,609	813	1,431	638
1997 prelim.	182,217	14,569	134,105	18,410	115,695	2,013	21,283	12,652	1,612	1,515	3,947	1,557	4,787	4,889	2,569	856	1,464	571

[1] The next updates of these data, covering the years 1953-98, along with technical notes explaining methodological issues of measurement, will be provided in NSF, *National Patterns of R&D Resources: 1998* (forthcoming).

[2] For 1953-54, expenditures of industry FFRDCs were not separated out from total Federal support to the industrial sector. Thus, the figure for Federal support to industry includes support to FFRDCs for those two years. The same is true for expenditures of nonprofit FFRDCs, which is included in Federal support for nonprofit institutions in 1953-54.

[3] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[4] Includes all R&D expenditures of FFRDCs administered by academic institutions. In 1994, 99 percent of total funds used were from Federal sources.

[5] Expenditure levels for academic and Federal government performers are also in reference to calendar years, which represents a change from previous reporting in *National Patterns of R&D Resources.* These levels are approximations based on fiscal-year data. For academic expenditures, and Federal government expenditures starting in 1977, the calendar-year approximation is equal to 75 percent of the amount reported in the same fiscal yea plus 25 percent of the amount reported in the subsequent fiscal year. For Federal government expenditures prior to 1977, the respective percentages are 50 and 50, since earlier fiscal years began on July 1 instead of October 1

[6] Due to revisions in survey methodology and sampling of industrial R&D, data for 1991 and subsequent years may not be comparable to data for previous years. (See *National Patterns of R&D Resources: 1996* or *National Patterns of R&D Resources: 1996*, forthcoming.)

Key: FFRDCs=Federally Funded Research and Development Centers; U&C=universities and colleges

NOTES: Data are based on annual reports by performers except for the nonprofit sector; R&D expenditures by nonprofit sector performers have been estimated since 1973 on the basis of a survey conducted in that year. Data are preliminary for 1996 and 1997.

SOURCES: National Science Foundation/SRS. Data were derived from NSF/SRS, Research and Development in Industry 1995; NSF/SRS, Academic Science/Engineering: R&D Expenditures, Fiscal Year 1995; NSF/SRS, Federal Funds for Research and Development; Fiscal Years 1995, 1996, and 1997; industry data available in Standard and Poors Compustat; and an independent survey conducted by the Industrial Research Institute.

Appendix 5 GOCO-related URLs and references

I. US R&D funding

- "R&D Exceeds Expectations Again, Growing Faster than the U.S. Economy during the Last Three Years" NSF summary report, 97Nov http://www.nsf.gov/sbe/srs/databrf/sdb97328.htm (Source for chart p15 of interim - Total US R&D spend by performer / source)
- Historical table of US R&D 1953-1977 http://www.nsf.gov/sbe/srs/natpat97/tables/tb7.xls
- "National patterns of R&D resources: 1997 data update" (contains link to above table plus its constituent tables) http://www.nsf.gov/sbe/srs/natpat97/start.htm
- List of 'Federal Funds for Research and Development' publications http://www.nsf.gov/sbe/srs/fedfunds/start.htm
- Federal Funds for Research and Development FY 1995, 1996, and 1997 Volume 45: Section A, B, and Section C: List of Tables: In Section C, Tables C-1, C-2, C-3, C4, C8, C-9, C-10, C-11,C-12,C-13 http://www.nsf.gov/sbe/srs/nsf97327/start.htm tables C4-C15 (pdf)
- Federal Funds for Research and Development: Fiscal Years 1994, 1995, and 1996 http://www.nsf.gov/sbe/srs/fedfunds/pubs/dst44/start.htm
- Federal Funds for Research and Development FY 1992, 1993, and 1994. Tables C-1, C-2, C-7, C-8, C-9, C-10, C-12, C-13, C-14, C-154, C-154a, C-159, C-159a http://www.nsf.gov/sbe/srs/fedfunds/pubs/dst42/cont1w.htm
- Industrial Research and Development: list of NSF statistics http://www.nsf.gov/sbe/srs/indus/start.htm
- Academic Research and Development expenditures: list of NSF statistics http://www.nsf.gov/sbe/srs/rdexp/start.htm

II. National Labs / FFRDCs

- OFPP circular 84-1: "Federally-funded research and development centers" (established policy on operation, selection and classification of FFRDCs http://www.arnet.gov/References/Policy Letters/PL84-1.html
- Magellan guide to US National Labs (features 9 DOE multiprogram labs) http://www.mckinley.com/magellan/Reviews/Science/Academies and Organizations/United States National Labs/
- University of Kent (UK) index of US national labs http://unix.hensa.ac.uk/parallel/internet/www/sites/america/usa/national-labs.html
- List of all .gov servers http://www.zurich.ibm.com/wwwgovdirectory.html
- RaDiUS database (Research and Development in the United States) http://www.rand.org/radius/index.html

III. GOCO in the context of "small government" and privatization/outsourcing

- GOGO-Privatization continuum: "GOGO: GOod bye to the GOvernment?" http://www.govexec.com/tech/articles/1196sys8.htm
- Potential problem of GOCO: Not always rosy. GAO investigation and testimony http://www.gao.gov/AIndexFY97/subject/GOCO.htm
- Cost sharing problem of GOCO between DOE and contractors for unexpected events. An important issue to cover in the interim http://www.fas.org/man/gao/ns97032.htm
- GOGO/GOCO status evolution http://www.nttc.edu/aftte/goco.html

- DOE's self assessment of its lab management system: 1994 White Papers on Alternative Futures for DOE Labs, Galvin taskforce http://apollo.osti.gov/html/doe/whatsnew/galvin/v2.html http://vm1.hqadmin.doe.gov/SEAB/galvin/v2.html#ZZ0
- DOE's GOGO, GOCO management http://www.npr.gov/library/reports/doe03.html
- The role of DOE offices in GOCO management http://www.fedlabs.org/flc/regdir/MW/251.htm
- GOCO manufacturing plants http://147.217.15.5/rm/ioc org/goco-a.htm
- GOCO movement in the UK: Documentation of the application of GOCO to UK national labs http://ing.iac.es/~swu/director/npl.html http://ing.iac.es/director/po.html http://ing.iac.es/director/dtilabs.html
- Practical protocols and rules in handling GOCO http://147.217.15.5/is/isl/cbco97/index.htm http://147.217.15.5/is/isl/logist.html

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IV. GOCO reform / debate etc

- "DOE contract management" report by US Comptroller General to Senate / House on status of DOE's contract reform initiative 97Mar http://www.gao.gov/highrisk/hr97013.txt
- "Making Contracting Work Better and Cost Less; Report of the Contract Reform Team", DOE, 94Feb
- "DOE announces actions to implement contract reform", 96Jun http://www.doe.gov/html/doe/whatsnew/pressrel/pr96090.html
- DOE contract reform initiatives homepage http://www.hr.doe.gov/innovate.html

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V. Technology Transfer legislation

- Comprehensive summary of all US Technology Transfer legislation by FLC (Federal Laboratory Consortium) http://www.zyn.com/flc/chap63.htm http://www.fedlabs.org/flc/chap63.htm
- Small Business Technology Transfer Program http://www.sbaonline.sba.gov/SBIR/sttr.html
- Steven-Wydler Technology Innovation Act of 1980 http://www.nttc.edu/aftte/stev wyd.html

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VI. Technology Transfer mechanisms / institutions

- Overview of federal technology transfer http://www.fplc.edu/risk/vol5/spring/rudolph.htm
- National Technology Transfer Center http://www.nttc.edu/ http://www.nttc.edu/home/full service.html http://www.nttc.edu/tech transfer.html
- The Federal Laboratory Consortium for Technology Transfer (FLC) http://www.fedlabs.org/flc/theflc.htm
- "Technology from the federal labs: transfer creates success and satisfaction" article summarizing " Industry Perspectives on Commercial Interactions With Federal R&D Laboratories: Does the Cooperative Technology Paradigm Really Work?" http://www.spie.org/web/oer/july/tech trans survey.html
- The Association of Federal Technology Transfer Executives http://www.nttc.edu/aft2e.html
- Textbook for DOE officers on Technology Transfer http://www.nttc.edu/env/techfund.html
- EPA's pollution control R&D and technology transfer http://es.epa.gov/program/exec/epafedgu.html#lead

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VII. Contact list

- The entire contact list of Technology Transfer officers in DOE http://www.nttc.edu/technews/whoswho.html
- DOE Tech Transfer Officer, Chicago Operation Office http://www.fedlabs.org/flc/regdir/MW/251.htm
- Federal tech transfer through the government assets "disposal" program http://www.gsa.gov/pbs/pr/r7/brochure/mission.htm http://www.gsa.gov/pbs/pr/r4/brochure/goco.htm

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VIII. Japan

- Philosophy and Objectives of Administrative Reform in http://www.kantei.go.jp/foreign/971228finalreport.html (English)
- Administrative Reform Council http://www.kantei.go.jp/jp/gyokaku/index.html#gaiyou
- Japanese national R&D centers http://www.kantei.go.jp/jp/gyokaku/report-final/IV.html
- Independent Organs, Independent Administrative Corporations http://www.kantei.go.jp/jp/gyokaku/report-final/III.html http://www.kantei.go.jp/jp/gyokaku/report-final/IV.html http://www.kantei.go.jp/foreign/971228finalreport.html
- National employee status and double engagement prohibition, and other technology related policy by the Science and Technology Agency http://www.sta.go.jp/policy/kihonkeikaku/honbun.html
- Two objectives of IAC & related discussion by a committee chair of the Reform Council http://www.law.tohoku.ac.jp/~fujita/gyokakukaigi7.html
- MITI document on tech transfer and cooperative R&D http://www.miti.go.jp/topic-j/e3275a2j.html
- Negative reaction to IAC from stakeholders in Japan (mindset) http://endo.phys.saga-u.ac.jp/union/reform¥reform772.html http://endo.phys.saga-u.ac.jp/union/reform¥reform761.html

http://endo.phys.saga-u.ac.jp/union/reform¥reform769.html
http://endo.phys.saga-u.ac.jp/union/reform¥reform770.html

- The policy proposal of National R&D Evaluation system by S&T Agency
http://www.sta.go.jp/shimon/cst/hyoka/GAIYO.HTM

XI. National labs and FFRDCs

- Milkern (?) full list of US federal laboratories http://millkern.com/rkcarr/mainlabs.html
- FLC (Federal Laboratory Consortium) http://www.fedlabs.org/
- DOE's list of all its labs and facilities http://www.doe.gov/html/servers/labtitls.html
- Annotated list of FFRDC (list, brief overview of each lab) http://www.nsf.gov/sbe/srs/anno96/start.htm
- The actual master list for the above (organizations + administrators)
http://www.nsf.gov/sbe/srs/ffrdc96/mastlist.htm

Links to all 38 FFRDCs

1. Idaho National Engineering & Environmental Laboratory http://www.inel.gov/ http://www.inel.gov/about/about.html http://www.id.doe.gov/

2. NCI Frederick Cancer Research and Development Center http://www.ncifcrf.gov/ http://www.ncifcrf.gov/FCRDC/information/history/ http://www.nci.nih.gov/ttran/ttfp/general.htm#General Information

3. Oak Ridge National Laboratory http://www.ornl.gov/glance/sharing.html

4. Sandia National Laboratories http://www.sandia.gov/Working.htm http://www.sandia.gov/guide2.htm

5. Savannah River Site http://www.srs.gov/ http://www.srs.gov/general/srmain/srmisn.htm

6. National Renewable Energy Laboratory http://nrelinfo.nrel.gov/lab/facts.html http://nrelinfo.nrel.gov/lab/buyingpower/ http://nrelinfo.nrel.gov/lab/buyingpower/business.html http://www.nrel.gov/businessventures/

7. Pacific Northwest National Laboratory http://www.pnl.gov/glance.html http://www.pnl.gov/glance/history.html http://www.battelle.org/default.htm

8. Ames Laboratory http://www.external.ameslab.gov/Overview/glance.html http://www.external.ameslab.gov/techtransfer/index.html

9. Argonne National Laboratory http://www.anl.gov/ http://www.itd.anl.gov/ http://www.itd.anl.gov/working.htm

10. Brookhaven National Laboratory --- contractor transition is happening. http://www.pubaf.bnl.gov/mission.html#knowledge http://www.pubaf.bnl.gov/transition.html

11. Ernest Orlando Lawrence Berkeley National Laboratory http://www.lbl.gov/LBL-PID/LBL-Overview.html http://www.lbl.gov/LBL-PID/LBNL-intro.html http://www.lbl.gov/Tech-Transfer/ http://www.lbl.gov/Tech-Transfer/HowTo.html

12. Fermi National Accelerator Laboratory http://www.fnal.gov/ http://www.fnal.gov/directorate/profiles/AsstSciTech.html http://www.fnal.gov/directorate/budget annrep.html

13. Jet Propulsion Laboratory http://www.jpl.nasa.gov/about/ http://techtransfer.jpl.nasa.gov/ http://techtransfer.jpl.nasa.gov/about.html http://techtransfer.jpl.nasa.gov/mission.html http://techtransfer.jpl.nasa.gov/withus/withus.html http://lightbulb.jpl.nasa.gov/index.html

14. Lawrence Livermore National Laboratory http://www.llnl.gov/IPandC/IPandC.shtml http://www.llnl.gov/IPandC/ipc-home/top10.html

15. Los Alamos National Laboratory http://www.lanl.gov/external/welcome/ http://www.lanl.gov/external/science/ http://www.lanl.gov/external/science/academia.html http://www.lanl.gov/Internal/projects/IPO/oppor.html

16. National Astronomy and Ionosphere Center http://www.naic.edu/home.htm http://www.naic.edu/about/ao/descrip.htm http://www.naic.edu/vscience/general/visiting.htm

17. National Center for Atmospheric Research http://www.ncar.ucar.edu/info/about.html http://www.ucar.edu/ucar.html http://www.ucar.edu/tech/ http://www.ucar.edu/tech/aboutus.html http://www.ucar.edu/tech/contact.html http://www.ucar.edu/ucargen/plans/UCAR2001/

18. National Optical Astronomy Observatories http://www.noao.edu/noao.html http://www.aura-astronomy.org/reports/president.htm

19. National Radio Astronomy Observatory http://www.nrao.edu/ http://www.cv.nrao.edu/html/headquarters/contracts.html http://www.aui.edu/aui back.html

20. Oak Ridge Institute for Science and Education http://www.orau.gov/orise.htm http://www.orau.gov/orise/tour1.htm

21. Stanford Linear Accelerator Center http://www.slac.stanford.edu/
http://www.slac.stanford.edu/welcome/history.html http://www.slac.stanford.edu/grp/irm/techtransfer/sbir97.html
http://www.slac.stanford.edu/grp/irm/techtransfer/sttr96.html

22. Thomas Jefferson National Accelerator Facility http://www.cebaf.gov/media_relations/newwhatis.html
http://www.cebaf.gov/expuser.html

23. Aerospace Federally Funded Research and Development Center (server apparently unobtainable)

24. Arroyo Center http://www.rand.org/organization/ard/overview.html http://www.rand.org/organization/orgchart.html

25. C3I FFRDC (MITRE, the non-profit org contractor, is also in charge of FFRDC 26) See MITRE site:
http://www.mitre.org/about/history.html

26. Center for Advanced Aviation System Development http://www.caasd.org/About/index.html#Tag0
http://www.mitre.org/about/

27. Center for Naval Analyses http://www.cna.org/

28. Center for Nuclear Waste Regulatory Analyses http://www.swri.org/3pubs/brochure/d20/cnwra/cnwra01.htm
http://www.swri.org/7biz/bizhome.htm http://www.swri.org/7biz/cont_veh/sa-alc.htm

29. Critical Technologies Institute http://www.rand.org/centers/cti/mission.html

30. Institute for Defense Analyses Studies and Analyses FFRDC http://www.ida.org/ida/aboutida/history.htm
http://www.ida.org/ida/aboutida/overview.htm

31. Institute for Defense Analyses Communications and Computing FFRDC
http://www.ida.org/ida/currentr/annualre/annualre.htm

32. Lincoln Laboratory http://www.ll.mit.edu/ http://www.ll.mit.edu/Links/history.html
http://www.ll.mit.edu/Links/spinoffs.html

33. Logistics Management Institute / Center for Defense Logistics http://relm.lmi.org/welcome.html
http://www.lmi.org/organization/whtiscdl.htm http://www.lmi.org/executive_off/contract/howtocon.htm

34. National Defense Research Institute http://www.rand.org/organization/nsrd/

35. Princeton Plasma Physics Laboratory http://www.pppl.gov/oview/pages/oview_home.html
http://www.pppl.gov/oview/pages/history.html http://www.pppl.gov/oview/pages/tech_transfer.html

36. Project Air Force http://www.rand.org/organization/paf/

37. Software Engineering Institute http://www.sei.cmu.edu/ http://www.acq.osd.mil/acqweb/intro.html
http://www.sei.cmu.edu/participation/participation.html

38. Tax Systems Modernization Institute http://www.iitri.com/iitri/atg/#tsmi http://www.iitri.com/

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