Options for Kyoto Laboratories

A Report to the Japan Research Institute

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Preface

This report was commissioned by the Japan Research Institute (JRI) in 2003 to examine the U.S. experience with GOCO laboratories and assess if this management model might be applicable to R&D laboratories in Kyoto Prefecture. Undertaken by the authors as independent consultants in the firm of Technology Policy International*, the work and its findings derive in significant part from their experience in government, the private sector and academic life. The opinions herein do not necessarily reflect the views of JRI or the institutions with which the authors are affiliated.

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Introduction

The purpose of this study is to provide information and analysis about the U.S. system of Government-Owned, Company-Operated ("GOCO") laboratories in order to help the Kyoto Prefecture make decisions about management reforms at its laboratories. Kyoto Prefecture is considering how to make local laboratories more relevant and useful to industry, and how to link the laboratories' research to economically useful outcomes.

The study compares the GOCO laboratory management system with two other general management models for government-funded laboratories: government-owned, government-operated (GOGOs) laboratories and contractor-owned, contractor-operated (COCOs).[1] It discusses the role of government laboratories in the U.S. innovation system, and discusses some options for Kyoto, including modifications to the current GOGO laboratory management system, the use of the GOCO model, and the use of a COCO system.

Government Laboratory Management Models

Government-Owned, Government-Operated Laboratories

Government-Owned, Government-Operated laboratories are the traditional form of government laboratories. In this model, the government owns and manages the laboratory, and the laboratory's research and

[1] It should be noted that the GOGO, GOCO, and COCO management systems are not defined explicitly in law. There is no official list of GOGO, GOCO, or COCO laboratories.

management staff are Federal employees. There is a long history of this kind of laboratory in the United States. Several Federal laboratories, including the National Institute of Standards and Technology and the Agricultural Research Laboratory are over 100 years old.

There are several advantages to this type of management structure. It provides a great deal of stability, because the employees are civil servants who typically have higher job security than most employees and tend to stay in their position for a long time. This kind of stability is important for many long-term government missions, such as measurement research.

With GOGO laboratories, there is no conflict between the interests of the government and the interests of a managing contractor. Because the employees of the laboratory are government employees, they can officially represent the government in governmental functions such as standard setting or managing government research contracts to private organizations.

On the other hand, GOGOs have some serious disadvantages. The high job security means that the labor force is less mobile, and it is often more difficult to move into new technical areas or shut down work in less promising areas. Government personnel rules typically slow down the hiring or firing of people, limit the salaries that can be paid, and limit rewards for outstanding performance. As a result, most Federal laboratories are restricted in the methods they can use to attract and keep outstanding researchers, or remove poor performers. Other government rules and management practices, such as regarding purchasing supplies or equipment, or working with non-governmental organizations, also introduce inefficiencies.

In spite of these limitations, some U.S. GOGO labs are viewed as world class laboratories in their fields. The National Institutes of Health intramural laboratories, the National Institute of Standards and Technology, the NASA centers (other than the Jet Propulsion Laboratory, which is a GOCO), and the Naval Research Laboratory are all recognized as top laboratories. In some cases, the history and tradition of these laboratories have given them a prestige that makes them able to continue to attract top scientists. In addition, the Federal government has made efforts to provide competitive salaries to top scientists. For example, the National Institutes of Health provides higher salaries (compared to regular civil servants) for scientists with medical degrees.

Nevertheless, the trend in the United States has been to move away from the use of GOGOs. Few new GOGOs have been established recently, and there have been repeated efforts to close or privatize small GOGO laboratories. This is part of a broader trend towards increased contracting out of government services.

Government Owned, Contractor Operated Laboratories

Before World War II, the Department of Defense used contractors to operated government-owned facilities for the production of weapons and other defense goods. The GOCO model was first applied to a laboratory during the Manhattan Project to build an atomic bomb – what is now Los Alamos National Laboratory became the first GOCO laboratory. Many of the facilities in the Manhattan project were essentially production facilities, and the reason for using the GOCO management system for these facilities was the same as that for the earlier defense production system: to bring industrial management practices to a governmental function.

In the case of laboratories like Los Alamos, the reason for the use of the GOCO management system was primarily in recruiting scientists. The Manhattan project required the participation of the nation's top scientists. While the leader of the Manhattan project, General Groves, wanted to keep the project under tight military control, many of the scientists needed for the project were unwilling to work under a military command. They believed that their science would not flourish under a rigid military command structure. The GOCO management system was used to allow the scientists to continue to be university employees rather than military employees, although many aspects of the project were under military control. The Los Alamos contract with the University of California was signed 1943, and was largely just a funding mechanism; most University of California officials did not know of the existence of Los Alamos, and did not provide much management expertise.

GOCO laboratories today are used primarily for a few roles. These include:

- National security and nuclear power. Government ownership is desirable because these laboratories require high levels of security and often specialized safety and environmental regulation. Examples include Los Alamos, Lawrence Livermore, and Idaho National Engineering Laboratory.
- Very large scientific facilities. Government ownership is desirable because of the large government investment in the facilities (e.g., Fermi National Laboratory, Brookhaven National Laboratory).
- Government missions that require large scale applied research and project management (e.g. NASA's Jet Propulsion Laboratory and the National Renewable Energy Laboratory).

The choice of management mechanism depends substantially on the traditions of the managing agency. The Department of Defense tends to use

GOGO laboratories. The Department of Energy has a tradition of using GOCOs, and thus is more likely to choose the GOCO mechanism for it laboratories. The National Science Foundation, by contrast, tends to operate by providing grants and cooperative agreements to universities.

Relatively few new GOCOs are being created. The Thomas Jefferson National Laboratory, in Newport News, Virginia, was built in the early 1990s and is the most recent of the major GOCOs. GOCO laboratories today continue to include science laboratories that are typically operated by universities (to make them attractive to top scientists) as well as engineering laboratories, which are typically operated by non-profit or for-profit companies (which are used more for their management expertise).

The advantages of GOCOs are that:

- they use the contractor's, rather than the government's, personnel system and they have more flexibility in how they attract top scientists;
- they can manage large scale work and large scale government investments (but not always efficiently);
- they maintain public control over major public investments; and
- the management contractor can be changed if it does not perform well.

The disadvantages of the GOCO system are that:

- the mix of government and contractor roles causes management challenges, including dual management chains and in some cases conflicting authorities;
- in United States, the system has evolved toward greater government regulation (at least at Department of Energy) which increases costs and reduces efficiencies.

The GOCO system works best when the goals of the government and contractor are complementary. Many of the contractors have been university or non-profit corporations whose mission is to conduct research that benefits the

public. If the goals of the contractor and the government are not closely aligned, then the government will be less able to trust the contractor and will need to provide greater oversight, which tends to increase inefficiencies and undermine the benefits of the GOCO system.

Contractor-Owned, Contractor-Operated (COCO) Laboratories

With COCOs, the contractor owns the facility and generally the equipment in the facility. There is a very wide mix of types of COCOs. They include large Federal laboratories (e.g., MIT's Lincoln Laboratory and John Hopkins University Applied Physics Lab), smaller university-based centers, state-funded non-profits, such as the Cleveland Advanced Manufacturing Program (CAMP). They are usually managed by universities or non-profit corporations. They can be operated under grants, contracts, or cooperative agreements.

The advantage of COCOs are that they are very flexible – they do not have to conform to any particularly organizational type – and they are the most open to competition. The management of COCOs is unambiguously done by the contractor – there is not as strong Federal oversight as in the case of GOCOs because there is not Federally-owned property that is being managed. Their ability to attract talented researchers depends, like any other private sector organization, on the pay, benefits, reputation, and other intangibles; they are not restricted by Federal personnel regulations.

A disadvantage of COCOs is that because the government does not own the equipment, it is more reluctant to make long-term capital investments in the

laboratory. Government investments in COCOs are in effect giving resources to a private organization. This generates less concern if the contractor is an organization with a strong public mission, such as a university or a charitable organization.

The U.S. trend is to use the COCO model for most new federally-funded labs, especially for smaller labs. This in part reflects a general trend to contract out more government work, as well as recognition of management problems with government laboratories. Table 1 provides a summary comparison of some of the main features of GOGO, GOCO, and COCO laboratories.

Regardless of which laboratory ownership and management system is used, attempts can be made to improve the performance of the laboratory. Under any laboratory management system, some of the goals for laboratory are system are to create:

- a competitive environment for staff hiring and promotion, and R&D project selection;
- incentives for individuals and organizations to achieve excellence;
- mechanisms for working with industry;
- connections to customers and stakeholders (which may include industry, universities, and government agencies).

These goals can be achieved under any management structure, but are often easier under a more privatized structure.

Table 1. Comparison of Management Models

Category	GOGO	GOCO	COCO
Personnel	Government – subject to government salaries and rules	Contractor – market salaries, flexible rules, subject to government oversight	Contractor – market salaries, flexible rules, less government oversight
Facilities and Equipment Ownership	Government	Government	Contractor
Management	Government	Contractor, subject to oversight	Contractor
Competitive pressure on management	Little – Institutional change is difficult	Management contractor and team can be re-competed and changed (research staff doesn't change)	Funding can be cut; new contractor can be found
Research Priorities and Funding	Set by government	Government or contractor propose, government decides	Government or contractor propose, government decides
Work for Others & Cooperative R&D	Contract work for non-governmental clients is rare. Work for other government clients and CRADAs are common	Work for other clients, CRADAs allowed with government approval	Work for other clients, CRADAs allowed (with government approval for FFRDCs)
Intellectual Property	Government/inventor	Contractor/inventor	Contractor/inventor
Environment Safety and Health Management	Government	Contractor, subject to oversight of parent agency, as well as general laws and regulations	Contractor, subject to applicable laws and regulations
Financial & Property Management	Government	Contractor with government oversight	Contractor
Strategic and institutional planning	Government	Government-contractor jointly	Contractor, with some government participation

The Role of U.S. Laboratories in the U.S. Innovation System

In the United States, government-funded laboratories play a limited but still significant role in the national innovation system. Almost all of them have some relationships with industry. However, different government laboratories have very different missions and capabilities, and this affects their particular work with industry.

Most federally-funded laboratories – GOGOs, GOCOs, and COCOs – focus on specialized government missions and not on the needs of general industry. The principal missions are defense, energy, space, agriculture, and health. Los Alamos and Sandia, for example, focus on nuclear weapons work and other defense and energy missions. With the exception of the National Institute of Standards and Technology (NIST),[2] helping general U.S. industry is *not* their main mission. Some federal laboratories, however, play significant roles in specific industries:

- The laboratories of the U.S. Department of Agriculture (USDA) have long helped U.S. farmers. In addition, USDA has long funded agricultural research and agricultural extension programs at U.S. universities.

- The National Institutes of Health (NIH) contain both a GOGO laboratory and a much larger extramural grant program. The intramural laboratory has made major contributions to U.S. medicine and to the U.S. pharmaceutical and biotechnology industries.

[2] NIST is a GOGO laboratory in the U.S. Department of Commerce, which supports industry by setting measurement standards; providing technical references, calibrations, and conformity assessment; providing technical support to private U.S. groups setting product standards; and working with industry to improve process and quality control.

- Several of NASA's R&D centers have programs to assist the U.S. aircraft industry.

- In the Department of Energy (DOE) laboratories, some programs assist energy-related industries. For example, the National Renewable Energy Laboratory (NREL) conducts research helpful to the solar, wind, and related industries.

In general, though, the largest government laboratories – those in the Energy and Defense Departments and in NASA – focus on specialized government missions and *not* on helping general U.S. industry. These laboratories do work with industry, however, in several main ways.

First, companies work with federal laboratories to get access to unique technical capabilities – either special expertise or technology at the laboratories or specialized facilities and instruments. The U.S. Congress has usually, but not always, encouraged these kinds of laboratory-industry interaction.

- In the 1980s Congress allowed federal laboratories to license inventions to industry and to enter into "cooperative research and development agreements" (CRADAs) with companies and other organizations.

- Federal laboratories may, under certain circumstances, perform what is called "work for others." Instead of a joint R&D project (the type covered by a CRADA), work for others is more of a contract research project or access to a major research facility. For example, semiconductor companies and other materials companies use the Energy Department's large neutron and photon sources to characterize materials. These "user facilities" are important parts of the nation's technological infrastructure.[3]

[3] Companies can generally use "user facilities" at little or no cost if they are doing peer-reviewed scientific work that is published in the open literature. They can use the facilities for proprietary work if they pay the full cost for their use of the facility.

Second, laboratories work directly with industry to develop and procure specialized technologies that they need. Examples include the development of supercomputers, high powered lasers, and scientific instruments. An additional type of interaction with industry comes when employees leave laboratories to start companies based on technologies they developed at the laboratories and then licensed. These entrepreneurs are rare, however, and researchers from federal laboratories are a very small percentage of America's overall group of high-tech entrepreneurs.

In addition to the Federally funded laboratories, the Federal government and state governments also support technical programs that help companies. State governments have long played an important role in state and regional economic development but usually do not create their own laboratories to support industry.[4] Instead, state governments traditionally have turned to state universities, two-year community colleges, and other non-profit organizations to provide assistance to companies.

The United States has a strong set of state universities largely because of the federal Morrill Act of 1862, which created the "land-grant" college system. Under this law, the federal government gave federal land to state governments to establish colleges of "agriculture and mechanics." Later federal laws and spending helped this system of state colleges and universities to grow. In the 1890s, Congress established a system of agricultural experiment stations at land-grant institutions to conduct agricultural research. These laws created a tradition

[4] Most state governments do have a few laboratories, but generally these are public health laboratories and law-enforcement laboratories.

of using universities to provide research and technical services. And since the 1940s the federal government has invested large amounts of money for research at both state and private universities.

Both the federal government and the states support university programs to help U.S. industry. The National Science Foundation's support of university-industry engineering research centers is an example. A number of U.S. states have their own university-based programs to provide R&D and technical services for industry. Ohio has its Edison Program, which supports university research centers, and Pennsylvania has a similar Ben Franklin Program. California's state government now helps support four large California Institutes for Science and Innovation at campuses of the University of California.

In addition to supporting university research programs, Federal and state agencies also contract with special non-profit organizations to provide specialized technical services to industry. These organizations are also COCOs. Three examples illustrate how diverse these organizations can be.

- In Ohio, the Cleveland Advanced Manufacturing Program (CAMP) is a highly respected organization providing technical advice, training, and contract research services for local manufacturing firms. It receives money from the federal government, Ohio's state government, and local businesses.[5]

- The U.S. Department of Commerce provides financial assistance for a nationwide system of Manufacturing Extension Partnership (MEP) centers. Many state governments also contribute, and centers receive fees from business clients. CAMP is an example of one organization that operates an MEP center. All MEP centers are COCOs. Some are based at universities, but most are independent non-profit

[5] See www.camp.org.

organizations. They have to pass regular reviews in order to continue to receive federal funding.

- SEMATECH, the Semiconductor Manufacturing Technology consortium, is another example of a COCO that has received both federal funding and state government assistance. Created by U.S. semiconductor companies in the late 1980s to help the industry improve manufacturing, SEMATECH received federal funding for its first seven years.

This wide variety of federally and state-funded laboratories and technical service providers are part of the larger U.S. national innovation system that contains these key elements:

- Significant government and industry investments in research and development (R&D) create new knowledge and skilled researchers. This R&D is particularly important for innovation in "research-driven" sectors such as biotechnology and nanotechnology, where laboratory discoveries and inventions are important.

- A "technological infrastructure," which includes not only R&D but also a set of other technical capabilities. These other capabilities include organizations, specialized facilities, and experts in areas such as measurements and standards, design and engineering, testing, technical education, and technical assistance for small companies. These are the capabilities and skills that help individual companies and entire industries to succeed.

- High-quality educational institutions and sufficient funding for them. Well-educated and well-trained people are the most important resource in a high-technology economy (also known as a "knowledge economy"). Because the United States Government invests heavily in research universities, companies, and laboratories, the U.S. has created a significant group of highly-skilled and competitive researchers and engineers.

- A national culture and government policies that support entrepreneurs. Taking risks and even failing are acceptable in the United States. And government policies do encourage and assist entrepreneurship.[6]

Federal GOGO and GOCO laboratories primarily help with the second element: the technological infrastructure. However, in the U.S. most new high-tech entrepreneurs and their technologies come out of either existing companies or major research universities – not from government GOGO or GOCO laboratories.

Government laboratories are also part of regional innovation systems. Regional "clusters" – regional groups of companies such as automobile production in Detroit or electronics in Silicon Valley – are also an important part of a nation's economy. The economic theory of clusters[7] suggests several points:

- Clusters of older companies need skilled workers, technically-sophisticated suppliers, and sometimes help with product development.

- In the United States, the creation of new high-technology clusters in fields such as biotechnology, electronics, and nanotechnology depends on attracting and supporting entrepreneurs. Entrepreneurial companies tend to emerge in regions with several characteristics: (1) world-class researchers (usually in universities but also sometimes in

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[6] Many government policies affect entrepreneurship, including tax policies, patent policies (including Bayh-Dole), regulations that permit small firms to launch initial public offerings in the stock market, and direct government research grants to small firms (including those of the Small Business Innovation Research Program and the Advanced Technology Program).

[7] For a general discussion of cluster theory, see Michael Porter, "Clusters and Competition: New Agendas for Companies, Governments, and Institutions," in Porter, *On Competition*, Cambridge, MA: Harvard Business School Press, 1998. For one discussion of how communities can try to help build new high-tech clusters, see Mary L. Walshok, Edward Furtek, Carolyn W.B. Lee, and Patrick H. Windham, "Building regional innovation capacity: The San Diego experience," *Industry & Higher Education*, February 2002.

corporate research laboratories), some of whom become entrepreneurs; (2) university policies that encourage and assist entrepreneurs (including policies to encourage the licensing of university-owned inventions); (3) the availability of skilled business professionals who can help start and run new companies (and this factor depends in part on locating new firms in nice geographical locations where skilled people want to live and work); and (4) "business support infrastructures," by which we mean social networks and organizations that provide entrepreneurs and would-be entrepreneurs with mentoring, contacts, and important support services (such as venture capital, skilled lawyers and accountants, specialized real estate groups, and specialized suppliers).[8] Of course, in order to succeed these startup companies also need sound business plans, access to markets, and luck.

- In the United States, it is unclear whether "business incubators" or other government-funded centers provide much help to aspiring entrepreneurs. But in some cases local organizations that mentor new entrepreneurs and provide social and business contacts appears to help.[9]

- In the U.S., government and business leaders in each state and region need to decide what their strategy is and how best to pursue it. In particular, do they want to help keep existing local industries strong and competitive, or do they have research and technical capabilities that provide a real opportunity to succeed in highly competitive new high-fields such as biotechnology and nanotechnology? The first goal leads to a strategy focused on helping existing firms and their

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[8] For two valuable discussions of the role that "star" researchers, usually university researchers, play in the creation of new high-technology clusters, see Lynne G. Zucker and Michael R. Darby, "Star scientists and institutional transformation: Patterns of invention and innovation in the formation of the biotechnology industry," *Proceedings of the National Academy of Sciences, USA*, Volume 93, pages 12709-12716, November 1996; and Michael R. Darby and Lynne G. Zucker, "Chapter 2: Formation and Transformation of Industries: Nantotechnology," in California Council on Science and Technology, *Nanoscience and Nanotechnology: Opportunities and Challenges in California*, January 2004. The nanotechnology report is available at: http://www.ccst.us/ccst/pubs/nano/NanoReport.pdf.

[9] See Walshok and others, "Building regional innovation capacity: The San Diego experience," cited earlier.

suppliers, with particular attention to such areas as lean production and supply-chain optimization. A strategy focused on high-tech startups will focus more on strengthening university research and helping new entrepreneurs.

It is important to recognize that government laboratories are only a small part of the innovation system of a region. While it is appropriate for strategies to improve the innovative capacity of a region to involve the regions laboratories, it is important that the laboratories be viewed as only one part of a comprehensive strategy to improve the innovation capacity of a region.

Applicability of Laboratory Management Systems to Public Laboratories Managed by Kyoto Prefecture

The Context of Kyoto's Labs

TPI understanding of the context of the Kyoto laboratories is based on interviews by JRI and TPI principals in October 1993. These including visits to or interviews with:

- a growing high tech company;
- the Kyoto Prefectural Comprehensive Center for Small and Medium Enterprises;
- the Kyoto Municipal Industrial Research Institute;
- the Kyoto Research Park/ Osaka Gas/ Kansai Technology Licensing Organization;
- the Advanced Software Technology and Mechatronics Research Institute Of Kyoto, ASTEM; and
- the Kyoto Institute of Technology

Based on our observations, the following statements characterize our understanding of the context of Kyoto laboratories:

- Established companies currently use the laboratories to test prototypes and solve operating problems.
- Industry wants the laboratories to generate new ideas for exploitation and to link university research results with industry users.
- New companies need low-cost start-up space and business assistance.
- Economic development officials want the laboratories to create new ideas to generate new companies, jobs and wealth, as well as to link university research to industry, especially to small and medium sized enterprises.

Based on our understanding of the situation in Kyoto, we note that there are significant difference between the Kyoto laboratories and the U.S. GOCO labs. The Kyoto labs are much smaller (between 10 to 1000 times smaller) than the major U.S. GOCOs. They are typically focused on near-term applied projects, rather than fundamental research or long-term applied research. They typically provide service to companies, rather than address government needs. Unlike U.S. GOCO laboratories, they are not organized around large, expensive, and unique facilities. They typically focus on materials and parts, not on components or complex technical systems. In these ways, the Kyoto laboratories resemble US regional and state laboratories intended to provide services to industry, rather than the U.S. National laboratories. Like the Kyoto laboratories, U.S. state and regional laboratories tend to apply existing knowledge to solve problems, rather than develop new knowledge.

Our perception is that the current linkages between the Kyoto laboratories and Kyoto-area universities are weak and infrequent. Our impression was that links between Kyoto University and local industry are limited. The Kyoto Institute of Technology, for example, reports only occasional faculty consulting with laboratories. On the other hand, the co-location of several existing labs on Osaka Gas property is a strategic asset, and opportunities for collaboration are

good. Consolidation of the Kyoto laboratories might make sense, although the ownership is currently quite diverse.

From TPI's limited view of the Kyoto laboratories, it is not clear that the laboratories have sufficient resources (people, money, facilities) to develop new technologies or to build credible links to leading edge university researchers. There seems to be a need for labs to convene and coordinate multi-organizational projects with national or industry funding. The laboratories have difficulty giving competitive advantage to singles firm by engaging in close partnerships. The laboratories currently have the authority to hire experienced staff but it is very difficult in practice—salaries are too low.

Our overall impression is that the Kyoto laboratories are good at what they now do, but that new roles will be difficult to fulfill within current organizational and funding constraints. In summary, the Kyoto laboratories are currently small laboratories that provide industrial services but conduct relatively little leading edge research. They need more flexibility in human resources, better mechanisms for working with firms, and better mechanisms to fund and perform cutting-edge, competitive work.

Options for Kyoto

As noted previously, there are several basic options for changing the management structure of the Kyoto laboratories. One option would be to keep government ownership and operation, but to make reforms within this system, such as changing human resources practices and strengthening industrial partnership mechanisms. A second option is to maintain government ownership of the laboratories, but to outsource the management and operations;

i.e., turn the laboratories in to GOCO laboratories. A third option is to turn both ownership and operation of the laboratories over to a private entity; i.e., convert the laboratories to a COCO laboratory. The following sections will provide additional information on each option.

Reform Operations of Laboratories within the GOGO Structure

To achieve the goals for the laboratory within the GOGO structures, the laboratories need several changes to current practices. Desirable changes include changes to the personnel system in order to:

- increase the number of temporary workers; and
- provide incentives for performance and innovation, such as royalty sharing and salary differentials based on skill and performance.

It is also desirable to improve interaction with industry through such steps as:

- establishment of an industrial advisory board;
- development of improved mechanisms for work-for-others and cooperative R&D agreements with industry; and
- establishment of an extramural R&D program to fund work in universities and industry.

Some U.S. GOGOs have taken similar steps. For example, in the 1980s and 1990s, the National Institute of Standards and Technology undertook three steps:

- It received legal authority from Congress to hire researchers more quickly and pay them more flexibly than was allowed under earlier civil-service rules. Originally, the reforms were an experiment, called the "personnel demonstration project." But they proved so successful that Congress made the authority permanent.

- NIST also expanded an earlier program in which it hired, on a contract basis, promising post-doctoral fellows. Permanent jobs were then offered to many of these fellows.

- NIST also expanded the number of "visiting researchers" it accepted each year from industry. Companies pay the salaries of these visitors, but NIST provides them with laboratory space and NIST research partners. This program of visitors not only expands the staff and technical capabilities of NIST; it also strengthens ties to industry.

In addition, Congress also established at NIST the Advanced Technology Program (ATP) as an extramural program. The ATP co-funds industrial R&D projects that have the promise of significant and broad economic benefits. These projects run from three to five years. By funding short-lived projects instead of long-lived organizations (such as laboratories), the ATP program has great flexibility and its resources are not tied to the long-term support of specific groups.

Outsource Operations to a Contractor

A second option is to outsource operations to a contractor. In the U.S. experience, it is more common to use non-profit or universities as the managing organization, because it is preferable to have large public investment managed by an organization that has a public mission rather than one motivated by private profit. If there is not an existing non-profit organization that is suitable to manage a laboratory, in the United States it is possible to create one for that purpose. A typical structure for a non-profit organization would be to have a board of directors (with members of the board either providing expertise in areas that are important for the non-profit, or links to key stakeholders). In the case of Kyoto, for example, one might want the board of directors to have links to

universities and companies that would be collaborators and customers of the laboratories.

With the GOCO option, laboratory employees would be converted to non-governmental status and would be exempt from government personnel rules. This would provide flexibility with respect to hiring, firing and wages.

There are several advantages and disadvantages to converting the laboratories to GOCOs. One major advantage is greater flexibility with regard to hiring, firing, and rewarding the personnel (without requiring the changes or exemptions from government personnel rules that would be needed for a GOGO laboratory). The other major advantage is that the contractor can use private sector management practices and, relatedly, that there is competitive pressure on the manager. The contractor can be replaced if it is not managing well, and this provides a strong incentive for the contractor to do its best to manage well.

The disadvantages are that:

- converting existing laboratories to a GOCO will take more effort, and cause more disruption to the laboratory operations than leaving them as GOGO laboratories;
- it requires new management skills that may not be readily available, both on the government side to manage the contractor, and on the contractor side to manage a public laboratory needed;
- it can lead to a more complicated management structure, especially if the government believes that it needs to monitor the contractor closely.

Privatize Ownership and Operation of Labs

The third option is to give or sell the laboratories to a non-profit organization or university. In this case, the government would continue to be

the main source of funding; the facilities and equipment would be transferred to the contractor, and the staff would become employees of the contractor.

The advantages of turning the laboratory over to contractor are that it would:

- provide the greatest degree of flexibility;;
- create the most competitive environment; and
- unlike a GOCO management system, would use a single, private sector, management system.

The disadvantages are that:

- It would be the most disruptive in that it would involve transferring both people and equipment to the contractor.
- The government would lose ownership and control of the investment in facilities and equipment. This may raise questions about whether or not it is in the public interest to make government investments in these private facilities.

Best Option for Kyoto

The best option for Kyoto depends on degree of change that is desired and possible within the Kyoto institutional and political environment. As mentioned previously, the United States tends to use a COCO approach when creating new laboratories to provide services similar to those currently provided by the Kyoto laboratories. In U.S. experience, operation by non-profit organization with public mission provides the most flexibility. Alternatively, reforms could be achieved under the present GOGO structure. The reforms that are necessary, however, such as changing personnel rules for government employees, may be difficult to implement. The GOCO option is a compromise between stability of a GOGO system and the flexibility of COCO system. The

optimum choice for Kyoto depends in part on which reform path is most institutionally and politically feasible.

U.S. Procedures Relevant to GOCO Laboratories

The following section provides more detail on several aspects of operating a GOCO system. In particular, it discusses:

- the responsibilities of the government and the contractor under a GOCO arrangement;
- the process of selecting a contractor;
- the personnel system of GOCOs;
- the skills need to operated a GOCO;
- handling of intellectual property; and
- evaluation of GOCOs.

The discussion here is based primarily on the experience of U.S. Department of Energy (DOE) laboratories, because the DOE is the largest user of the GOCO mechanism for laboratories, and because it has been more active than other agencies in running competitions for the management of these laboratories.

It is important to note, however, that the DOE laboratories are in general much larger than the Kyoto laboratories, and have some special characteristics, such as involvement with secret technology or nuclear materials, that require many special regulations. It should also be noted that the over the 60 year history of these laboratories, the number of regulations that apply to the laboratories has grown, and that this is often criticized as leading to inefficiencies. For these reasons, Kyoto prefecture should be selective about which aspects of the DOE system it adopts. It may be able to adopt a somewhat simpler management system.

Government and Contractor Roles in a GOCO System

Table 2 shows some of the responsibilities and roles of the government and the contractor under a GOCO management system. In general, many of the responsibilities go to the contractor, but the government needs to retain the ability to oversee the contractor.

Table 2. Government and Contractor Responsibilities in a GOCO System

Category	Government Responsibility	Contractor Responsibility
Personnel	Set guidelines. Advise/approve key personnel	Determine compensation and incentives, hire and (rarely) fire
Contract Competition	Decide on terms of contract, run competition (if competitive)	Prepare proposal, negotiate terms
Evaluation	Assess overall performance of contractor	Evaluate personnel and projects
Management	Oversee contractor	Use best private sector management practices
Environment Safety and Health	Oversee contractor; government may have liability	Manage day to day ES&H at the laboratory
Research Priorities and Funding	Decide on research priorities, provide funding	Make proposals for research and funding
Work for Others & Cooperative R&D	Oversight to make sure non-governmental work does not cause conflict of interest	Solicit and conduct work for non-government clients
Intellectual Property	Set policy, oversight to make sure policies are followed	Own and manage intellectual property
Financial Management	Provide oversight	Conduct financial management, use outside auditors to ensure commercial standard met
Facilities	Make decisions on investment in equipment and facilities	Propose investments in equipment and facilities
Property Management	Oversight to make sure government property is properly managed	Have property management procedures
Strategic and institutional planning	Jointly plan with contractor	Jointly plan with government

Skills Needed to Operated a GOCO

Related to these roles and responsibilities, specific skills area needed by the government and the contractor. Some of the skills that the government needs to manage GOCO laboratories are:

- The ability to select a contractor. Although many of the original U.S.. GOCO contractors were selected on a non-competitive basis, contractors are currently selected in a competitive bidding process.
- The ability to decide on research priorities and funding. While the contractor may propose research directions and priorities, the government needs to retain overall direction and control of the research direction of the laboratory to make sure that it fulfills its public mission.
- The ability to provide some level of oversight and evaluation of GOCO's management of finances, human resources, facilities, intellectual property to ensure that the contractor is conducting these activities in a way that is consistent with the contract.
- The ability to evaluate the contractor's performance.

Some of the skills that the contractor needs for operating a GOCO laboratory include:

- The ability to identify and hire laboratory director and senior staff, and evaluate their performance (Board of Directors role).
- The ability to connect laboratory to resources (identify and maintain good relations with funding organizations), identify useful collaborations (Board of Directors Role).
- The ability to hire and evaluate senior R&D leaders and Administrative staff. (CEO role).
- Staff skills, including planning/evaluation, budget, contracts, marketing, human resources, technology transfer.

The key person in the contractor's team is generally the laboratory director. The laboratory director is generally a person with technical expertise

and R&D management experience. The director also needs to be able to manage the administrative staff of the laboratory. The director should be experienced and well-known, and also should be energetic. The laboratory director needs to have the respect of the scientists and engineers at the laboratory and the confidence of the funding agency. For the DOE laboratories, they are typically 45 to 65 years old.

The contractor needs to have a mechanism to be able to identify and hire the laboratory director and senior staff, and be able to evaluate their performance. This is often done with the aid of the board of directors or an advisory committee. The contractor usually has an executive to manage this process. The board of directors is also useful to help maintain good relations with funding organizations and to identify useful collaborations. The board of directors should consist of senior people of high reputation with a broad mix of experience in government, industry, and academia.

The key staff positions (planning/evaluation; budget/financial management; contracts management/legal; human resources; intellectual property management/technology transfer/industrial partnerships; and communications/government relations) are generally less critical, and are easier to fill, than the laboratory director position. They can generally be filled by competent mid-level people with appropriate private sector or government experience. For a small laboratory, several of these staff functions might be combined in one person.

The Process of Selecting a Contractor

While many of the initial U.S. GOCO contractors were selected on a non-competitive basis, in recent years, the contractors have been selected competitively. The general process is similar to that for other large government contracts. After the government decides to compete a contract, it generally announces this decision. The government generally publishes a "presolicitation" notice that describes the goals, scope, and timing of the upcoming competition. The government typically invites "expression of interests" from possible contractors, to determine who is interested in bidding. The government also may hold one or more information sessions, to provide background information and answer questions about the upcoming competition. It may also provide an opportunity to meet individually with possible bidders, in order to answer specific questions.

The government often issues a draft request for proposals (RFP). This draft provides potential contractors with the details of the RFP, but still allows the contractors to make further questions or comments. If there are substantial questions about part of the draft RFP, the government may modify the draft before issuing the final RFP. An example of a draft RFP for the Idaho National Laboratory is online at http://www.id.doe.gov/DOEID/RFP-NE&NSD/ID14517.htm. The government then publishes the final RFP, and potential contractors prepare and submit their proposals by the deadline in the RFP.

After the potential contractors submit their proposals, the proposals are reviewed by a selection committee. This committee is typically composed of government officials with expertise in the various aspects (technical, managerial,

etc.) of the RFP. They collectively will score each proposal on all of the criteria in the RFP. The committee will make a recommendation to the "selection official," who will make the final decision to select the contractor.

The Personnel System of GOCOs;

A key purpose of the GOCO mechanism is to use the contractor's, rather than the government's, personnel system. The general approach is that government's Request for Proposal (RFP) requires the potential contractors to describe their personnel system in their proposal, and this becomes one of the factors upon which the government decides which contractor to select. In their proposal, potential contractors need to say how they will provide the scientific, technical and administrative leadership, management and skills to sustain and enhance the laboratory. The RFP also requires the potential contractors to identify the key personnel (the laboratory director and senior staff) that they will use, and this also is a major factor in selecting a contractor.

The RFP language typically recognizes that the quality of any research organization is based upon its people, and the emphasis is on the contractor's ability to attract and keep top people. Regarding compensation, it is expected that the contractor should adopt wage, salary, and employee benefit practices that will provide a technically competent, productive and efficient workforce. The contractor should base these on a consideration of the conditions in the various labor markets -- local, national, and international -- from which it competes for its employees. Some aspects of wages, hours, and working conditions are left to negotiations between the Contractor and organized groups of employees (e.g., labor unions).

There are a variety of other Federal regulations related to personnel that are imposed on contractors. Contractors are typically required to make efforts towards having a diverse workforce (regarding employment of women and underrepresented minorities); to allow collective bargaining; to maintain personnel records; to give preference to employing personnel from the previous contractor when the contract changes; and a variety of other requirements. Contractors also have to comply with government security regulations regarding personnel.

DOE reviews the contractor's policies and procedures affecting human resources, and these are part of the periodic reviews of the contractor's performance that affect decisions about the award fee on the contract and decisions about whether to renew or recompete the contract. DOE will also review proposed changes in the key personnel for the laboratory, such as changes in the laboratory director. DOE can directly intervene in personnel decisions of the laboratories if it chooses to, by telling the contractor to fire someone in case of misbehavior or incompetence, but it does so rarely.

Evaluation of GOCOs.

In the Department of Energy GOCOs, the contractor is evaluated based on:

- the quality and relevance of the technical work;
- the contractor's management performance regarding human resources; financial management; environment, safety, and health management, security, etc.; and
- their management of facilities (especially construction of new facilities.)

Performance measures for all three categories are typically decided upon jointly between DOE and the contractor. The contractor proposes performance measures, and these are negotiated with DOE. The contractor is encouraged to propose multi-year performance measures with long-term benefits for the lab, where appropriate. DOE has the right to unilaterally decide on performance measures if DOE and the contractor can not reach agreement.

Evaluation of the technical work is provided by peer review for scientific work, reviews by laboratory management, reviews by advisory committees, and reviews by the DOE program staff that funds the work.

Evaluation of the management performance is done by DOE officials with responsibility for the specific areas (such environmental, safety, and health) for specific laboratories. In DOE, many of these people are located at site offices close to the laboratories, rather than in DOE headquarters. There is typically an annual review of the contractor's performance that evaluates how the laboratory performed based upon the performance measures that were previously agreed to. The contracting officer, usually at the site office, takes all views into a consideration and makes a decision on the performance rating of the labs. This affects the award fee that the contractor receives, and ultimately, whether or not DOE decides to extend or recompete the contract.