Government Patent Policy Study

Final Report

Volume I

by
Harbridge House, Inc.
Boston, Massachusetts

For the
J.C.S.T. Committee on
Government Patent Policy

Contract No. 7-35807

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MICHAEL BERGNER
Vice President

17 May 1968

Assistant Commissioner of Patents O'Brien
Chairman, Committee on Government Patent Policy
U.S. Patent Office
Department of Commerce
Crystal Plaza
Arlington, Virginia 22202

Dear Mr. O'Brien:

Harbridge House is pleased to submit a final report on the government patent policy study in fulfillment of Contract No. 7-35087.

The final report consists of four volumes. This Volume I summarizes the results of research on the three study questions. Volumes II through IV are research reports which provide back up data to Volume I. Volume II is a more detailed report on the effect of patent policy on industry participation in government research programs. Volume III describes the efforts of eight government agencies to promote commercial utilization of government-sponsored inventions. And, Volume IV reports on the effect of government patent policy on commercial utilization and business competition.

Harbridge House has appreciated the opportunity to work with the Committee on Government Patent Policy in this important area of government policy. We wish to thank the Committee for their truly fine assistance and support over the eighteen months of the study effort.

Sincerely,

Michael Bergner

Michael Bergner
Vice President

MB/mh

PREFACE

In October 1963, after 18 months of intensive interagency deliberations, the President issued a Memorandum and Statement of Government Patent Policy. The Policy established, for the first time, basic criteria to guide all executive departments and agencies not otherwise governed by statute in allocating rights to inventions made under government grants and contracts. The Policy was viewed as a first attempt to establish a central rationale for allocating patent rights government-wide in accordance with the public interest.

Because of its newness and the great concern of government and industry over the subject, the President provided for continuing evaluation of the Policy to determine the need for revision. In December 1965, the Federal Council established the Committee on Government Patent Policy, to examine the principles established by the Policy and their effect on the public interest. The Committee, comprised of policy level officials from the R&D sponsoring agencies represented on the Federal Council and representatives of the Departments of State and Justice, first identified the basic policy questions underlying the President's Memorandum. It determined that three questions represented the fundamental policy issues:

(i) What effect does patent policy have on industry participation in government R&D programs?

(ii) What effect does patent policy have on the commercial utilization of government-sponsored inventions?

(iii) And what effect does patent policy have on business competition in commercial markets?

In considering a way to examine the questions, it concluded that a study contract would best collect and analyze the necessary data. In September 1966, the Committee commissioned Harbridge House to study the policy questions and to prepare reports which would: (i) help test the effects of alternative patent policies; (ii) lead to affirmation or revision of the President's Policy or assist in formulating useful legislation; and (iii) be useful to executive departments and agencies in administering government-wide policy, whether established by Congress or the Executive Branch.

The accompanying final report and three research reports describe the study findings. Volume I summarizes findings on the three policy questions. Volume II reports on Question One—the effect of patent policy on industry participation in government research and development programs. Volume III reports on one aspect of Question Two—the efforts of eight federal agencies to promote commercial utilization of government-sponsored inventions. And Volume IV reports on Questions Two and Three—the effect of patent policy on utilization of government-sponsored inventions and business competition.

Summary and Analysis of Findings

A. Study Objectives and Approach

The primary purpose of the Harbridge House study has been to provide government policy makers with data to evaluate the effectiveness of government patent policy in achieving policy objectives. The study sought answers to three basic questions which underlie the government's objectives concerning patents arising out of government contracts:

(i) How does patent policy affect commercial utilization of government-sponsored inventions?

(ii) How does patent policy affect business competition in commercial markets?

(iii) How does patent policy affect participation of contractors in the government's research and development programs?

A three-phase study effort was undertaken to answer these questions: In phase one, existing data was gathered to determine what relevant information was already available. Phase two consisted of a utilization questionnaire survey to gather a broad body of new data on a large sample of government-sponsored inventions. And, phase three involved case studies of inventions and contractors in the utilization survey to develop a fuller understanding of the effects of patent policy on them.

The first phase involved four separate tasks. A literature search was conducted to determine what existing data were available on the study questions. In addition, three research tasks were conducted within government activities to (i) determine the promotional programs of eight government agencies; (ii) review reported instances of industry hesitation or refusal to participate in programs of the Department of Interior and the National Institutes of Health (NIH) for reasons relating to patents; and (iii) examine 100 contractor NASA waiver requests to determine the basis for waivers of patent title granted by NASA. These tasks, useful in themselves, also provided background information in conducting phases two and three of the study.

In the second phase of the study, commercial utilization of all government-sponsored inventions patented in 1957 and 1962[1] were surveyed through questionnaires[2] to gather data on utilization and licensing of a large and statistically significant group of patents. A two-year sample was selected to ensure against bias in patents issued in a given year, and the years 1957 and 1962 were chosen to allow enough time for sample inventions to be applied commercially. Although the sample predates the current policy established by the Kennedy Memorandum of 1963, patent rights in sample inventions were allocated in different ways under various programs making it possible to project the results of the study in terms of current policy.

Questionnaires on each invention were sent to organizations which developed them regardless whether the contractor or the government retained title. Similar questionnaires were also sent to firms which requested licenses to government-owned inventions, whether developed under contracts on in government laboratories, to compare conditions under which inventions might be used with and without exclusive rights. Both included questions on the size and business orientation of the responder; the nature of the invention; the role it played in its commercial use; the speed with which it was applied; the type and amount of private funds invested in applying it; the sales attributable to the invention; the extent to which it was available for and resulted in licenses by patentee; and the reasons for nonutilization where it was not used commercially.

Questionnaire responses were received on about 60 percent of the sample inventions and were analyzed to determine the patterns of utilization, and the effect of patent rights and other factors on commercial use, licensing and business competition. The data were also used to select areas for case research in phase three of this study.

The case research in phase three gathered more detailed data on selected government contractors and inventions to understand better the factors which control decisions to utilize government-sponsored inventions, the utilization process, the effect of utilized inventions on business competition and the factors affecting willingness of contractors to participate in government-sponsored R&D programs. Five groups of case studies were conducted:

(i) Twenty-one high and low utilizers of sample inventions were interviewed to determine the reasons for their performance.

(ii) All sample inventions of TVA, and the Department of Agriculture and Interior were

[1] For government agencies other than DOD, AEC and NASA all patents issued from 1956 to 1966 were included because of the small number of patents issued on inventions of those agencies in 1957 and 1962.

[2] Copies of the questionnaires are included in an appendix to this report.

companies predominantly in either the commercial or the government markets.

1. Effect of Agency Mission and Commercial Potential of Sample Inventions on Utilization

The R&D mission of the sponsoring government agency was found to have a critical effect on the commercial applicability of the sample inventions. The Department of Defense, NASA and AEC accounted for some 90 percent of contracted research and more than 98 percent of the patents arising under contract in the years under study. Inventions covered by these patents were designed to meet operating requirements of these agencies rather than civilian needs in the great majority of cases. Their commercial applications, therefore, were essentially a by-product of governmental uses and depended largely on coincidental overlap between government and commercial requirements. Thus, over 70 percent of the reasons advanced by responders as most important to nonutilization of sample inventions relate to their limited commercial potential. This in no way measures their value for their intended use, but simply indicates the effect of differences between operating requirements of the government and civilian needs in commercial markets.

On the other hand, commercial inventions with significant utilization were among the patents of these agencies in the fields of transistors, vacuum tubes, numerical control devices, computers and gas turbine engines, where the necessary commercial overlap did exist.

The sample inventions of other agencies—such as the Department of Agriculture and Interior, and TVA—were highly oriented to civilian requirements reflecting the civilian orientation of their R&D missions. Since most of the Agriculture and TVA R&D programs are conducted in-house, the sample included few inventions developed by their contract programs. However, these were supplemented with in-house inventions for which the agencies granted licenses. All that were used commercially, were used without exclusive patent rights. This was largely attributable to three factors: the commercial orientation of the inventions, good potential demand for their use, and sufficient government development of the inventions to show their commercial feasibility. Notwithstanding the commercial potential of these government inventions, agency promotion within industry was important in achieving utilization of Agriculture and TVA patents because of the need to convince firms of their commercial value. In several instances, utilizing firms acquired some measure of patent protection by developing patentable improvement to the government inventions.

Two causes predominated in cases where the inventions of these agencies did not achieve commercial utilization. Lack of full technical development of the inventions was the most frequent and important. No market need due to the complexity of the invention, its high cost compared with other methods or the availability of more practical alternatives was second in importance. It is probable that some measure of exclusive rights might have encouraged private firms to complete technical development of some inventions not fully developed by the government where adequate demand existed to make them attractive investment opportunities.

The R&D programs of HEW and Interior illustrate still another effect of mission on utilization. The programs of these two agencies are oriented to civilian needs, but in many aspects, are directed toward basic rather than applied research. The sample inventions that have resulted from their work have not, for the most part, been sufficiently developed to prove their commercial value. However, should their inventions reach that stage in programs like water desalination, and medicinal chemistry, broad commercial utilization could reasonably be anticipated because of the strong potential demand for commercial innovations in these fields.

2. Private Development Costs

Information on private development costs required to apply sample inventions commercially was somewhat sketchy due to the age of the sample and the confidential nature of the data. But the information gathered showed significant differences in the types of costs incurred on DOD-oriented inventions (with exclusive rights owned by the contractor/utilizer in almost all cases), and civilian-oriented agency inventions (with nonexclusive licenses owned by the utilizers).

Private investment was heavily concentrated in technical development of DOD inventions. Fifty-six and eight tenths (56.8) percent of private dollars were spent for development compared with 22.7 percent for production facilities and 20.5 percent for marketing the product. In contrast, only 21.1 percent of private investment was required for technical development of civilian-agency inventions, while 52.2 percent was spent on production facilities and 26.7 percent on marketing.

The data confirms the relationships observed above between agency R&D mission and commercial potential of sample inventions. Civilian agency inventions, in general, are closer to commercial products when government development is complete than are DOD inventions.

policy from license rights to title rights would limit the government-sponsored R&D activity of firms in this category because of possible conflict with company-sponsored research activities. Contract opportunities would be examined on an individual basis and, in many cases, the government might be refused.

A fifth group of firms regard patent rights as essential to their business activities, and are careful to avoid government claims or conflicts over ownership of inventions. Their policies generally lead them into one of two business patterns. In the first pattern, firms will assure corporate ownership of patents before initiating work on a government contract. They may assure ownership either by negotiating contracts that permit them to acquire title to patents on inventions they may develop, or by developing and patenting basic inventions with limited private funds and then seeking contract work in order to develop additional technical competence, push the state of the art, explore a new technology, or determine if commercial applications may begin to be drawn off. In these situations, firms deliberately select areas of government research to match their commercial interests in order to generate product ideas with commercial possibilities. New research firms with strong technical abilities and limited capital typically follow this pattern, as do specialized firms that have concentrated their business in a limited area of technology.

In the second pattern, firms consciously isolate government work from their commercial operations and pursue these activities separately. The sample firms in this category did only a small percent of their business with the government and were quite independent of it. Frequently, inventions derived from government contract work by these firms will be assigned automatically to the government to avoid title conflicts or commingling with company-sponsored R&D. In other cases, government R&D will be undertaken only in areas where there is no potential conflict with corporate proprietary objectives and in order to enhance the corporate image. The technical value of government contracts to the commercial interests of these firms is rarely considered a valuable supplement to in-house research and development.

Many diversified companies follow different patent policies in their commercial and government markets. These firms may place a strong emphasis on maintaining proprietary positions in commercial markets and express a relative lack of interest in patents arising from government work. The primary purpose of securing patents on government-sponsored research discoveries as in the case of the wholly government-oriented firms, is to provide professional recognition for technical personnel.

Lastly, an important difference was observed between the research-oriented firms doing business with DOD, NASA and AEC, and the product-oriented firms whose interests are aligned with Agriculture and TVA. The former were much more aggressive in their search for useful innovations in the work they performed than the latter who tended to rely on the results of government laboratory programs for innovations in their fields. Thus, although the food, textile, and fertilizer industries are less patent-conscious, they are also more conservative in the risks they are willing to take in applying new inventions. This accounts for the frequent need for active government promotion of Agriculture and TVA inventions even when the inventions appear to have clear commercial applications.

4. Effect of Patent Policy

Notwithstanding the varying roles assigned patent rights by the firms described above, the key questions is whether permitting them to retain exclusive rights will, on balance, promote utilization better than acquisition of title by government.

The study data indicate that the answer is yes in at least the following circumstances:

(i) Where the inventions as developed under government contracts are not directly applicable to commercial uses and the inventing contractor has commercial experience in the field of the invention. This occurs most frequently with DOD, NASA and AEC inventions. In the case of DOD, the fact that it does not actively promote commercial use of its patents is an added factor. In these instances the inventing contractor with commercial experience appears to be the logical candidate to attempt utilization either directly or by licensing others; and

(ii) Where the invention is commercially oriented but requires substantial private development to perfect it, applies to a small market, or is in a field occupied by patent sensitive firms and its market potential is not alone sufficient to bring about utilization. Inventions in this category may arise with any agency and may have had only limited government development toward a commercial application.

utilized—either developed them in-house or took title to them when developed under contract.

(iii) And industrial owners of government-sponsored inventions have been willing to license them upon request or, where they were unwilling to license, alternative technologies were available to competitors in the great majority of cases.

Based on all observations of the sample inventions we have found little evidence of adverse effects on business competition by permitting contractors to retain title of government-sponsored inventions.

D. Effect of Government Patent Policy on Industry Participation in Government R&D Programs

The effect of government patent policy on industry participation in R&D programs was the most difficult factor to measure because of the difficulty of obtaining data on the question. However, a useful understanding of problems in this area was obtained by studying the medicinal chemistry program of the National Institutes of Health (HEW) and various contracts of the Department of the Interior. This aspect of the study attempted to answer such questions as:

(i) Do competent business organizations refuse to undertake government R&D work—either entirely or in selected areas—because of government patent policy?

(ii) What effect does policy have on application of a contractor's most advanced private technology to government programs?

(iii) Does patent policy have any influence on the flow of information concerning new developments between a contractor's government and privately sponsored work?

The data available to us only allows us to define some first-order effects of the policy in this area.

Industry's main concern about participating in government research has been the compromise of private investment in research and invention. Frequent objection was made to the "peephole" effect of government programs, whereby the government receives rights in the accumulated results of private work. The "peephole" effect has its counterpart in patent matters where an invention has been conceived at private expense, but reduced to practice under a government program. The traditional patent provisions classify this as a government invention and dispose of its rights under the terms of the contract.

The reach of the contract has been extended in some program to background patents owned by the contractor at the time of contracting. This practice causes the sharpest industry reaction of all because firms feel caught between their wish to participate in government programs and the need to protect their private investment and competitive position.

The major adverse effects of patent policy on participation are program delay, loss of participants, diversion of private funds from government lines of research, and refusal to use government inventions and research when questions regarding a company's proprietary position are raised. These adverse effects occur selectively, but they have occurred at important points in government programs observed in the study.

The key to the participation questions, however, lies in the attitude of prospective contractors toward the role of patents in their activities. As noted in connection with utilization, patents have varying importance to organizations doing business with the government. Industrial firms whose major business objective is participation in government work and systems-oriented companies in the study sample were at one end of the scale and were found to assign patents a secondary role compared with technical and management competence. Patents typically were used by the former to provide recognitition to technical personnel and to project the creative quality of their work to their government customers. Systems firms, on the other hand, were found to rely on patents to ensure design freedom, provide material for cross licensing agreements as well as to recognize creativity in their technical personnel. The data indicates that firms in these two categories are not likely to refuse to participate in government R&D for patent reasons. However, systems firms may encounter participation problems at the subcontract level if the government acquires title to all inventions developed under its program.

On the other hand, firms which place a high value on patents for defensive purposes tend to choose among the areas in which they are willing to undertake government research and may decline to participate in programs which impair their operational flexibility. And, firms in research-intensive industries like electronics and new technically-oriented firms seeking to develop a proprietary product-line through government research were found to rely on patents to establish proprietary positions. These firms tend to be selective in their government-sponsored research and may decline to participate in programs which conflict with their privately sponsored research and development or which do not promote their growth objectives for proprietary lines.

Firms which follow this policy even more fully try to assure corporate ownership of patents before initiating work on a government contract or may consciously

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PART I. The Study Task

The goal of the Harbridge House study has been to determine the effects of government patent policy on the objectives it is designed to achieve. Essentially, these objectives are three:

(i) Encourage participation in government research and development programs;

(ii) Promote commercial utilization of government-sponsored inventions; and

(iii) Foster business competition.

While it is easy to agree on the policy objectives, it is hard to agree on how best to achieve them. Lack of information on the economic effects of the policy has been a major obstacle in this respect. There have been no ready answers to such questions as:

(i) Is commercial utilization of government inventions achieved best under government or contractor ownership?

(ii) Is substantial investment over and above that supplied by the government necessary to achieve utilization: If yes, are exclusive rights necessary or useful in attracting private capital for further development, or will such investment be made when everyone is free to use the invention?

(iii) Do competent firms refuse to undertake government R&D work because of government patent policy? Does the policy affect application of the contractor's most advanced privately developed technology to government projects? Does it affect assignments of personnel to government contracts? And, does it affect the flow of information between the contractor's government and privately sponsored work?

(iv) What are the effects on competition of the acquisition of exclusive commercial rights to government-sponsored inventions? Do they increase or decrease concentration in commercial industries; cement or dilute positions of leadership in industry; create or eliminate significant areas of market power?

A major objective of the study has been to acquire and analyze information which would help answer these questions. As described in the Summary and Analysis of Findings the study was accomplished in three phases and the data were gathered through several related tasks, which were researched for 18 months within government, industry, and educational and nonprofit institutions. Since the research data are a significant source of new information on the role of patents within government, industry, and nonprofit institutions, they are reported in some detail in the research reports which comprise Volumes II, III, and IV of the final report. Names of organizations and other information received in confidence are disguised throughout the study.

TABLE 1

CONCENTRATION OF R&D FUNDS (1965) IN RELATION TO AGENCY AND GOVERNING POLICY CRITERIA AND PATENTS ISSUED (1957, 1962, 1965)

($ in Millions)

Policy Criteria	Agencies	R&D Obligations FY 1965 ($ in Millions)		Patents Issued: Contract Work					
				1957		1962		1965	
		Extramural	Intramural	Title	License	Title	License	Title	License
I. Principal Rights in Government	A. Public Service								
1(a)(1)- End item intended for commercial use by general public.	Agriculture	$ 61.7	$155.7	0	0	1	1	2	0
	Interior	38.5	84.4	1	0	1	0	0	0
	HEW	682.7	174.8	2	1	4	2	3	0
	VA	.8	36.9	0	0	0	0	1	0
1(a)(2)- Purpose of contract to explore fields concerned with public health or welfare.	TVA	.3	5.5	0	0	0	0	0	0
	NSF	183.2	14.5	0	0	0	0	0	1
		$967.2 (9%)	$471.8 (16%)	3	1	6	3	6	1
	B. Public Service and Mission-Oriented								
1(a)(3)- Contract pertains to new fields with Government as sole or principal developer.	Commerce	19.4	48.5	8	2	7	0	0	0
	FAA	$ 41.7	$ 34.5	0	0	0	8	1	2
1(a)(4)- Contract requires operation of Government research or production facility or coordination and direction of work of others.	NASA	3,999.9	871.0	0	4	4	7	19	4
	AEC	1,233.6	32.8	266	33*	289	98*	250	65*
	[1(a)(1), (2) and 1(b) also applicable]	$5,294.6 (48%)	$986.8 (33%)	274	39	300	113	270	71
II. Principal Rights in Contractor	C. Mission-Oriented								
1(b)- Contract builds upon existing knowledge and contractor has technical competence and established nongovernmental commercial position.	DOD	$4,805.6 (43%)	$1,542.9 (51%)	206	958	221	1,501	407	NA
	[1(a)(2), (3) and (4) also applicable]								

* AEC rights in these inventions vary. In some it holds a nonexclusive license only. In others it holds a general license with exclusive rights in field of atomic energy.

Source: Annual Report on Government Patent Policy, Federal Council for Science and Technology, June 1966, and study data.

Public-service agencies, on the other hand, have had few patents from R&D contracts (see Table 1) because their contract programs are small, more oriented toward basic research, and conducted predominantly with educational and nonprofit institutions. In fiscal 1965, they obligated $986.6 million for extramural work, or 8.9 percent of the total obligated for work outside of government agencies (see Table 1), and $864 million—87.7 percent (see Table 2)—was spent with educational and nonprofit institutions. Specific agencies exceeded that mark, with over 99 percent of Agriculture's, all of TVA's, and more than 92 percent of HEW's share obligated with those institutions.

The net result of these operational patterns is that the Section 1(a) "government title" criteria will apply to very few government-sponsored inventions, while the Section 1(b) "government license" criteria will apply to the great majority. The contract inventions of the mission-oriented and mixed-activity agencies come largely from applied research in the industrial sector, while those of public-service agencies come from basic research at educational and nonprofit institutions. And the great majority of government-sponsored contract inventions come from military-oriented programs of the Department of Defense which bear little relation to consumer uses.

TABLE 3
SALES AND DEVELOPMENT COSTS ASSOCIATED WITH COMMERCIAL UTILIZATION OF INVENTIONS BY CONTRACTORS (1957 AND 1962)
($ in millions)

	Amount[1] of Actual Domestic Sales From:		Amount[1] of Actual Foreign Sales From:		Development Costs:				Number of Licenses in Use for Inventions With:	
	Critically Important Inventions	Inventions With a Supporting Role	Critically Important Inventions	Inventions With a Supporting Role	Amount[1] ($)	Average[2] Percent in Technical Development	Average[2] Percent in Production Facilities	Average[2] Percent in Marketing	Critical Role	Supporting Role
Total Sample	193.63	117.07	47.28	47.65	26.33	56.8	22.7	20.5	31	40
DOD	193.48	117.05	47.18	47.65	25.88	56.8	21.9	21.3	29	38
AEC	0	.021	0	0	.201	52.5	45	2.5	1	2
Other Agencies	.15	0	.10	0	.25	70	20	10	1	0
1957 DOD	100.85	103.37	45.80	40.32	3.59	58.3	20	21.7	12	13
1962 DOD	92.63	13.68	1.38	7.33	22.29	56.2	22.7	21.1	17	25

[1] To date of response to questionnaire.
[2] Average for those responding to this question only.

totaled only $29 million in sales. This amounts to annual[5] sales of $20 million for the five inventions with high sales and about $659,090 for the other inventions in that class.

In relating sales to the concentration of patent holdings, it was found that not one of the top ten patent owners has a sample invention with cumulative sales of more than $2 million, even though the group holds 52 percent of all the patents. Only one firm, ranked in the 11 to 25 group, had a patent with significant utilization—$70 million to the date of the survey.

When private development costs were compared with utilization, it was found that firms spent at least $26 million in bringing the inventions into commercial use. It is difficult to generalize on these data because many firms provided no information. However, the data available does indicate that about 56 percent of private funds were spent in technical development and the balance was divided about equally between production facilities and marketing.

[5] Computed from the date of patent application to the date of the survey. Three years were allowed for filing an application prior to issuance of patent. On this basis, the availability of 1957 inventions is 13 years; and of 1962 inventions, eight years. The average availability is 10.5 years for inventions in both sample years.

2. Licensee Sales and Development Costs

Table 4 shows comparable sales and development costs associated with licensed government-owned inventions. The government issued 342 licenses on 126 survey inventions, ten of which were used by 50 licensees.[6] These inventions are concentrated in agencies other than the Department of Defense.[7] The AEC and the Department of Agriculture account for the largest number, owning 65 percent of these patents and issuing 55 percent of the licenses.

Domestic and foreign sales to the date of the survey were $210.3 million, compared to $405 million for contractor inventions. All but $7.03 million of this is attributable to inventions which play a critical role in their commercial use.

Unlike contractor inventions where sales related primarily to DOD inventions, DOD-related sales here account for only .4 percent ($75,000) of the total.

[6] Since it is common knowledge that government-owned inventions may be used without a formal license, it is probable that more inventions are being used than are noted in government records, although no data were available as to the exact number.

[7] DOD owns only 19 percent of the inventions and issued only 9 percent of the licenses.

organizations interviewed that actually receives annual royalty income of six figures, still regards patent administration as marginal from a purely financial point of view. The average net annual royalty income of the three institutions of higher learning with the most active programs in the study was $100,000. Several institutions were currently enjoying higher incomes attributable to a single invention or the settlement of a law suit, but in no case did royalty income approach that of an industrial scale.

As reported by *The Patent, Trademark and Copyright Journal*,[8] the average annual gain for each utilized patent is about $70,000. This figure seems high to us, since our study revealed that firms frequently overstate the value of a patent by equating revenue accruing from the invention with end-product sales. In addition, the figure of $70,000 does not resemble the return on inventions to nonprofit institutions.

Overall, only 10 percent of the survey inventions from nonprofit institutions reached commercial utilization. One of the patent development firms interviewed in our study estimates that 10 to 15 percent of the disclosures it receives result in patents three to four years after submission; 25 percent of these patents are eventually licensed, with 3 percent profitable. As for dollar value, once every three years a university invention is likely to result in an annual royalty of $50,000 or more.

Expectation of large returns, which appears to be a principal motivation behind the upsurge in patent interest among nonprofit organizations, is not likely to be fulfilled for many of them. At best, a well-organized patent program, using the personnel required to meet reporting commitments under government contracts, may expect to reap a modest return for a nonprofit organization.

C. Concentration of Patent Holdings and Utilizations

1. Contractor-Owned Inventions

Both utilization and patent holdings of survey inventions are heavily concentrated in a few firms. Table 5 shows the levels of concentration among the top 50 responders. Consistent with the concentration of R&D funds in industry generally, the top five hold rights in 31.2 percent of the inventions and account for 27.2 percent of the inventions utilized. The top 25 hold 70.7 percent of the inventions and 67.6 percent of the utilizations.

[8] "The Economic Impact of Patents," 2:340-362, 1958.

Concentration slows markedly with the next 25 firms, the top 50 holding rights in 82.9 percent of the inventions and achieving 81 percent of the utilizations. Although the overall rate of utilization is 10.4 percent, the record of the top 50 firms is consistently below that mark. Only 65 of 192 responders reported any commercial utilization at all.

2. Invention Holdings and Utilization by Firm and Percent Government Business

Table 6A shows the percent distribution of holdings and utilization of sample patents by size of firm and percent government business. Both patent rights and utilization of inventions are heavily concentrated in large companies. Firms with annual sales over $200 million account for about 37 percent of the responders but hold rights (title and license) in 80 percent of the inventions and account for 72 percent of the utilization. Table 6A indicates that these same firms (annual sales over $200 million) have the following characteristics:

(i) Firms in the 0 to 20 percent government business category include 20 percent of the responders, have title in 33.9 percent of the inventions, and account for 19 percent of the inventions utilized;

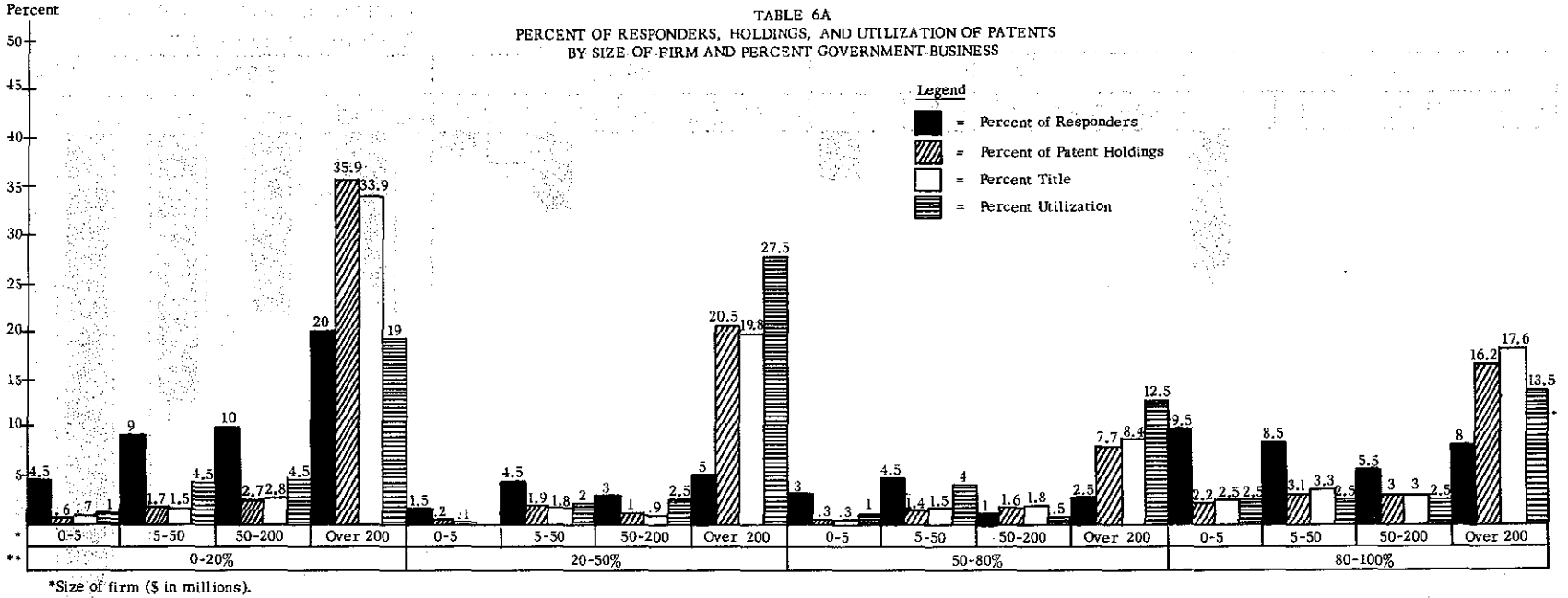
(ii) Firms in the 20 to 50 percent government business category comprise 5 percent of the responders, have title in 19.8 percent of the inventions, and account for 27.5 percent of the inventions utilized;

(iii) Firms in the 50 to 80 percent category include 2.5 percent of the responders, have title in 8.4 percent of the inventions, and account for 12.5 percent of the inventions utilized; and

(iv) Firms in the 80 to 100 percent government business category make up 8 percent of the responders, have title in 17.6 percent of the inventions, and account for 13.5 percent of the inventions utilized.

Highlighting the record of this group of firms with sales over $200 million is the heavy concentration—20 percent of all responders—of firms doing 20 percent or less of their business with the government. These firms own a larger share of inventions (33.9 percent) than they have utilized (19 percent). In contrast, large firms in the 20 to 50 percent category constitute a much smaller percentage of the responders (5 percent) but proportionately own (19.8 percent) and use (27.5 percent) many more inventions than any other class of firms in the sample. Large firms doing 80 to 100 percent of their business with the government comprised only 8 percent of the responders, but they owned (17.6 percent) and

TABLE 6A
PERCENT OF RESPONDERS, HOLDINGS, AND UTILIZATION OF PATENTS
BY SIZE OF FIRM AND PERCENT GOVERNMENT BUSINESS



*Size of firm ($ in millions).
**Percent Government business.

TABLE 7.–
NUMBER OF USES PER GOVERNMENT-OWNED INVENTION

	Total	DOD	AEC	TVA	Agriculture	Other
Inventions in Use	10	2	1	2	4	1
Number of Users	50	2	2	36	9	1
Number of Inventions Used						
Most Frequent Use	1 @ 32			1 @ 32		
Second Most Frequent Use	1 @ 3				1 @ 3	
Third Most Frequent Use	1 @ 2		1 @ 2			
Once	7 @ 1	2 @ 1		1 @ 1	3 @ 1	1 @ 1
Number Not Specified By Invention	6			3	3	

heavily oriented to civilian needs, and they normally develop their inventions fully for consumer use and actively promote utilization by manufacturers and the ultimate consumer.[9] This combination of factors is largely responsible for their high record of utilization while retaining title.

D. Factors Affecting Utilization

1. Contractor-Owned Inventions

With the patterns of patent activity in the survey identified, the data were analyzed as to the major factors affecting utilization. Contractor rights, prior experience, percent government business, size of firm, field of technology, form of invention, kind of agency, and year of patents were all tested for their effect on commercial use.

a. *Patent Rights, Prior Experience, and Year of Patent.* Of all the factors, patent rights and prior experience show the strongest association with commercial utilization. Table 8 correlates these factors and the year of patent with the rate of utilization. The year of the patent issue appears to have little effect on utilization, but utilization drops from 23.8 to 13.3 percent when exclusive rights are not available[10] and from 23.8 to 6.6 percent when prior experience is not present.

[9] Volume III describes the promotional programs of Agriculture, TVA, and six other agencies.

10 It is not possible to state categorically that exclusive rights in themselves are responsible for the shift in utilization since contractors had the option to acquire or waive title to most of these inventions under DOD contracts, and presumably waived title only when the invention clearly was of no use to them.

TABLE 8
CORRELATION OF PATENT RIGHTS, PRIOR EXPERIENCE, YEAR OF PATENT, AND COMMERCIAL UTILIZATION

Characteristics of Invention	Rate of Commercial Utilization (percent[1])	Observations (No. Utilized/ Total No. Observations)
Year of Patent		
1. 1962 patent, contractor has title and prior experience	22.8	78/341
2. 1957 patent, contractor has title and prior experience	25.6	50/195
Title (both years)		
1. Contractor has title and prior experience	23.8	128/536
2. Contractor has no title, but has prior experience	13.3	8/60
Prior Experience (both years)		
1. Contractor has prior experience, but no title	13.3	8/60
2. Contractor has no prior experience, but has title	6.6	63/948
3. Contractor has no prior experience and no title	2.2	4/176

[1] Computed by dividing the number utilized by the total number of observations.

TABLE 9
INTERNAL PATENT MANAGEMENT
TEN HIGH UTILIZERS

Company	Size of Firm ($ in millions)	% Government Business	Number of Applications Filed Per Year (Approx.)	% Government-Sponsored Applications*	% Company-Sponsored Applications*
Q	over 1,000	65-80	Not Available	20	80
S	over 1,000	40	960	12	88
A	200 -1,000	40	75	33 1/3	66 2/3
G	200 -1,000	30-40	150	15	85
R	200 -1,000	10	500	10	90
E	50 - 200	85	125	14	86
H	50 - 200	75	75	25-30	70-75
N	50 - 200	70	140	25	75
M	5 - 50	10-40	25-30	25	75
J	under 5	20-50	Not Available	Not Available	Not Available

*Percentages are approximate.

TABLE 10
INTERNAL PATENT MANAGEMENT
ELEVEN LOW UTILIZERS

Company	Size of Firm ($ in millions)	% Government Business	Number of Applications Filed Per Year (Approx.)	% Government-Sponsored Applications*	% Company-Sponsored Applications*
B	over 1,000	80	1,000-2,000	2-5	95-98
C	over 1,000	2	510	1 (-)	99+
I	over 1,000	75	300- 350	33 1/3	66 2/3
O	over 1,000	50-90	70	25	75
P	over 1,000	95	175- 200	50	50
T	over 1,000	30	600	10-15	85-90
D	200- 1,000	10	1,000	0 (since 1962)	100 (since 1962)
U	200- 1,000	55-70	250	20	80
F	5- 50	85	Not Available	Not Available	Not Available
K	5- 50	90	5-6	100	0
L	under 5	Not Available	30	65	35

*Percentages are approximate.

TABLE 11
EFFECT OF FIELD OF TECHNOLOGY ON UTILIZATION

	Commercial Use with Title and Prior Experience		Commercial Use with Title but No Prior Experience	
	Percent	Observations	Percent	Observations
Mechanical Inventions	33.3	40/120	11.0	25/227
Inventions in Other Fields of Technology	20.6	89/431	5.2	38/725

FIGURE 1-2

DOMINANT INDUSTRIAL ATTITUDES TOWARD PATENTS
AMONG TEN HIGH AND ELEVEN LOW UTILIZERS
(CONTRACTOR INVENTIONS)

1. Patents have no importance

Company F - $5-50 million * - Industry 4 ** - 85% ***
Company K - $50-200 million - Industry 6 - 90%
Company A - $200 - 1 billion - Industry 3 - 40%

2. Patents are of little value, compared with technical know-how

Company E - $200 M - 1 billion - Industry 4 - 85%
Company B - Over $1 billion - Industry 5 - 80%
Company O - Over $1 billion - Industry 1 - 50-90%
Company P - Over $1 billion - Industry 1 - 95%
Company Q - Over $1 billion - Industry 2 - 65-80%
Company U - $200 M - 1 billion - Industry 3 - 55-70%
Company R - $200 M - 1 billion - Industry 2 - 10%

3. Patents are valuable for defensive purposes

Company B - Over $1 billion - Industry 5 - 80%
Company G - $200 M - 1 billion - Industry 5 - 30-40%
Company H - $50 - 200 million - Industry 5 - 75%
Company I - Over $1 billion - Industry 5 - 75%
Company O - Over $1 billion - Industry 1 - 50-90%
Company P - Over $1 billion - Industry 1 - 95%

4. Patents are important in establishing proprietary positions

Company C - Over $1 billion - Industry 7 - 2%
Company J - Under $5 million - Industry 6 - 20-50%
Company L - Under $5 million - Industry 6 - N/A ****
Company T - Over $1 billion - Industry 3 - 30%

5. Patents are essential to business activities

Company L - Under $5 million - Industry 6 - N/A
Company M - $5-50 million - Industry 7 - 10-40%
Company N - $50-200 million - Industry 4 - 70%
} Pattern 1

Company C - Over $1 billion - Industry 7 - 2%
Company D - Over $1 billion - Industry 7 - 10%
} Pattern 2

6. Patents are judged differently in commercial and government work

Company C - Over $1 billion - Industry 7 - 2%
Company D - Over $1 billion - Industry 7 - 10%
Company S - Over $1 billion - Industry 3 - 40%

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* Indicates range of annual sales at time survey patents were issued.

** Industry Key:
1 Military & Space Systems & Airframe Manufacturers
2 Aircraft Engines & Components Manufacturers
3 Diversified Products & Service Firms (military & commercial)
4 Instruments, Components & Subsystems Manufacturers
5 Electronic & Communications Equipment Manufacturers
6 R & D Firms
7 Commercial Product Firms

*** Indicates approximate percent government business during sample years.

**** Not available

TABLE 13
INVENTION UTILIZATION
ELEVEN LOW UTILIZERS
(CONTRACTOR INVENTIONS)

Company	Rank in Patent Holdings	Patent Holdings				Number Utilized	Number Utilized With Commercial Sales Over $1 Million	Total Commercial Sales Million-Dollar Inventions
		Title	License	Number	% of Sample			
Company I	2	84	47	131	6.5	5	0	0.0
Company B	4	118	1	119	5.8	5	1	22.0
Company T	5	67	50	117	5.7	3	0	0.0
Company P	7	75	7	82	4.0	5	0	0.0
Company C	9	57	5	62	3.0	0	0	0.0
Company U	12	39	3	42	2.0	3	2	50.0
Company O	16	30	0	30	1.4	4	0	0.0
Company L	19	26	0	26	1.2	0	0	0.0
Company D	21	13	9	22	1.0	3	0	0.0
Company F	35	11	0	11	.5	0	0	0.0
Company K	39	8	1	9	.4	0	0	0.0
TOTAL				651	31.5	28	3	72.0

more carefully the areas in which they are willing to undertake government research. Faced with the possibility of being unable to obtain title to patents they develop, these firms may refuse to contract in research areas that would impair their operational flexibility.

(5) *Patents Are Important in Establishing Proprietary Positions.* Firms having this attitude actively seek ownership of patents to establish and maintain proprietary positions in new technologies as well as in established product areas. Invariably, however, estimates of market potential and corporate investment requirements determine which product areas are developed. The makeup of the patent portfolio of these firms may indicate the direction for product development in order to strengthen proprietary positions, but development is rarely, if ever, undertaken solely because patent protection is available.

Of the four firms showing this attitude, two (J and L) are small (less than $5 million sales) and two (C and T) are large (more than $1 billion in sales). One of the small firms is a high utilizer; the other small firm and the two large firms are low utilizers. The large firms hold 8.8 percent of the patents and about 2.3 percent of the utilizations. The small firms hold 2.1 percent of the patents and 1.5 percent of the utilizations. The low record of utilization by the small firms in this group masks their importance as potential commercializers of government inventions. They actively seek new product ideas in the R&D work they perform and, consequently, they have very different outlooks from the firms described under (2) above. That their utilization is low is partially due to the fact that they often participate in advanced R&D government programs where the chances for immediate commercial spillover are small.

A change in government policy from license rights to title rights would limit the government-sponsored R&D activity of firms in this category because of possible conflict with company-sponsored research activities. These companies would examine contract opportunities on an individual basis and, in many cases, might refuse to contract with the government.

(6) *Patents Are Essential to Business Activities.* Firms in this category regard patent rights as essential to their business activities, and are careful to avoid

substantial private development to perfect it, applies to a small market, or is in a field occupied by patent sensitive firms and its market potential is not alone sufficient to bring about utilization. Inventions in this category may arise with any agency and may have had only limited development toward a commercial application by the government itself.

2. Public-Service Agency Inventions

The public-service agency inventions all achieved utilization without exclusive rights. Utilization was achieved primarily because the inventions were highly commercial in nature and because they were extensively developed and promoted by the sponsor agencies.

a. *Commercial Nature of the Inventions.* The consumer orientations of the public-service agency inventions makes them more attractive to prospective users than inventions—such as those of DOD—which are not originally intended for public use. (The utilized inventions of public-service agencies are identified in Table 14.)[12] The inventions that achieved the greatest success—potato flakes developed by the Department of Agriculture and the fertilizer inventions of TVA—all are used in products having broad consumer demand. The sugar beet extraction process, another important Agriculture invention, provides the sugar beet extraction industry with a cheaper and more convenient process for extracting water in the manufacture of beet sugar. The dialdehyde starch inventions (Agriculture) have applications as wet-strength paper additives; the foam-mat process (Agriculture) provides one of the most inexpensive ways of dehydrating foods; the cotton opener provides a more efficient method for opening, cleaning, and blending cotton; and synthetic mica has a wide range of uses as a superinsulator in the electrical and electronic industries.

Even the inventions that have not been used are commercially oriented (Table 15). Among these are two processes for desalination of water, a mechanical crab-picker, a method for preserving walnuts, a process for flameproofing fabrics, a textile fiber cleaning machine, and a process for extracting oil from shale. As shown in Table 15, the reasons for their nonutilization are largely technical and relate to the invention's state of development.

b. *Role of Agency Mission—Development and Promotion.* It is not coincidental that these inventions originate with the public-service agencies since the missions and R&D programs of these agencies are oriented toward the civilian economy. To the extent that they select their research to fulfill civilian needs, these agencies function—with one essential difference—like industrial firms looking for new markets: Since they are not required to earn a profit, they are freer than most industrial organizations to sponsor high-risk research with future, rather than imminent, utilization prospects. This pattern is particularly significant with Agriculture and TVA since their programs benefit conservative industries, such as food, textile, or fertilizer, which perform little of their own research or development. These agencies have become, to a large extent, the research arm of these particular industries. This relationship is noted in a number of the cases in Volume IV where the companies involved attribute lack of utilization to the government's failure to carry development of the invention far enough.

The extent of development undertaken by these agencies is a second major factor in achieving utilization of these inventions without exclusive rights. Research shows that the agencies have to develop the inventions extensively for commercial use before firms will attempt application without patent protection.

The Department of the Interior experience illustrates the importance of full development. Much of its research—particularly in water desalination, coal, and oil—is basic in nature and parallels work being performed by research- and development-oriented firms that are sensitive to patent rights. And although Interior's research has great commercial potential, the technology involved is speculative and commercially feasible inventions are still in the development stage. Industry has hesitated, in many instances, to undertake private commercial development of these inventions without patent protection. Here, nonexclusive rights have not been as effective as with Agriculture and TVA inventions. When research is performed under contracts, patent rights are often an issue (see Volume II, Part IV) and resulting inventions, because they are not yet economically feasible, do not spark wide interest in industry. Similar reactions are found in the government's health programs, discussed in Volume II, where drug firms will not use the results of HEW research if these results appear to conflict with their patent position.

Development alone, however, may not insure commercialization of public-service agency inventions without exclusive rights. Often intensive promotion is needed to convince potential users of the invention's commercial value. For example, the Department of Agriculture market tested potato flakes in supermarkets before food processors picked up the invention. TVA has had similar experiences with fertilizers it developed.

[12] Case studies of these inventions are presented in Volume IV, Part III.

TABLE 15
NONUTILIZED INVENTIONS
(PUBLIC-SERVICE AGENCIES)

	Case	Sponsor Agency	Patents Involved	Licensees	Reasons for Nonutilization	Private Investment
11.	Solar Still	Interior	1	1	Only technical feasibility demonstrated; government now funding alternative methods	None
12.	Electrolytic Process for Desalination of Water	Interior	1	1	Development work not finished	None
13.	Hydrate Process for Desalination of Water[1]	Interior	5	1	Development work not finished; patent rights issue with firm	$495,000
14.	Centrifugal Compression Distillation	Interior	1	1	Utilization tried but servere technical problems encountered	Some[3]
15.	Shale Oil	Interior	1	1	No market need yet, although thought to have promise; patent rights problems	Some[3]
16.	A Calcium Carrying Agent for Medicinal Applications	Agriculture	1	1	Research not yet complete; thought to have promise	$100,000
17.	Gelsoy (Manufacture of Sausages)	Agriculture	1	1	Lack of availability of raw material; no USDA follow through	Some[3]
18.	Textile Fiber Cleaning Machine	Agriculture	1	4	Utilization tried but severe technical problems encountered	$20,000
19.	Flameproofing of Fabrics	Agriculture	5	5	Chemical and raw material problems	About $80,000[4]
20.	Coumarone Derivatives	Agriculture	1	1	Technical problems; reorganization of firm	None?
21.	Preservation of Walnuts	Agriculture	1	1	More practical alternative method developed concurrently	Some[2]
22.	Vinyl 9, 10-Epoxystearate	Agriculture	1	1	Chemical limitations and high cost relative to other methods	None
23.	Honeycomb (Uncapping Apparatus)	Agriculture	1	25	No market need; too complex for commercial application	None
24.	Deamidized Gliadin	Agriculture	1	1	No market need; licensee not in business related to potential use	
25.	Mechanical Crabpicker	Interior	1	2	Development unsuccessful to date	None

[1] This case also documented in Volume II.
[2] Development undertaken on cooperative basis with USDA (amounts not available).
[3] Records not available.
[4] Amount spent by only one of several commercial firms attempting to utilize.

b. *Characteristics of Inventions of Nonprofit Institutions.* Inventions arising out of nonprofit research have a distinctly different character than the patentable ideas arising from R&D contracts with industry. In nonprofit research, the end product is normally "software"–scientific findings–and patentable ideas take the form of concepts rather than hardware. In industry R&D, on the other hand, the result is usually "hardware"–a product, process, or component–and a working model, at least, will have been developed.

The task of a nonprofit organization is over and the contract has been fulfilled when the organization submits a research report. Funds are rarely available to reduce the discovery to any practical application, and interest and motivation to seek utilization are often also absent. The idea of following an invention through development and production to a marketable product is alien to the academic and nonprofit environment. For this reason, the patent licensing profession refers to academic invention as a "bare bones patent." Industry must take it from there.

In contrast, under comparable government research contracts, the industry contractor normally seeks to promote follow-on work that will further develop his findings–ultimately, into a product. Should contract research result in an invention with commercial possibilities, in-house funds may be assigned to develop and exploit it.

Nonprofit research inventions usually require a larger investment for commercialization than industry discoveries because nonprofit inventions are frequently at an earlier stage of development. In our investigation, the nonprofit institutions repeatedly emphasized the additional investment industry has made to develop products based on nonprofit discoveries. In Case 1, for example, the industrial licensee invested a quarter of a million dollars in the tomato harvester after eleven years of university research developed a patentable prototype. The patent development firm in Case 16 has already made a comparable investment in seeking applications of holography, and still the patented disclosures relate only to the mathematical theory of wavefront reconstruction, rather than to any marketable three-dimensional imaging device.

The institute in Case 3 has been extremely critical of development firms that license university patents to companies which are not prepared to invest the necessary development capital. In short, inventions from nonprofit concerns are grains of sand about which a pearl may be formed only if industrial development is undertaken.

Another characteristic of nonprofit inventions is that they stand alone. Their isolation is a major obstacle to utilization, since most inventions are not marketable products in themselves. (In only 55 inventions investigated by Harbridge House was the patented discovery regarded as critical to the product.) The industrial product is often protected by a cordon of patents, as illustrated by the list of patents on a packet of Polaroid film. A university invention, on the other hand, is a one-shot patent. Even if the patent specification discloses an ingenious invention, the patent claims which define the scope of the monopoly are likely to be narrowly drawn. Whereas industry will add to its patent arsenal as a product is improved, a university patent, if it is to be licensed at all, must be licensed on the initial effort. Thus, the patent development firm in Case 16 did not begin to see a return on an invention which revolutionized an industry until the basic patent had run for thirteen years. By then, however, the industrial developer had patented a line of industrial improvements over the basic invention.

Industry can profitably keep an innovation "on the shelf" until the time is right to market it. Furthermore, cross-licensing agreements between firms extend the economic utility of the industrial patent. Nonprofit inventions, on the other hand, remote from the market to begin with, are perishable if unlicensed, since the nonprofit organizations do not have manufacturing operations. All the above characteristics of inventions developed by nonprofit institutions make them high-risk commercialization ventures.

c. *Patenting Versus Publishing Research Results.* Another major factor which affects invention utilization by academic institutions is the drive to publish research results. This drive produces a dilemma where utilization of inventions is concerned, since patents are the only protection for the inventions of nonprofit institutions. In the nonprofit environment, there is no economically useful equivalent of "proprietary data" or industrial trade secrets. While industry may benefit from these alternatives to patenting, the secrecy involved is counter to the tradition in university and nonprofit research.

This tradition reflects the relative values academic institutions place on publishing and patenting the results of their work. Publications are central to scholarly pursuit. Invariably, the results of research, except those limited by the terms of a grant or contract, are fully disclosed through articles in scientific and technical journals. Patents, on the other hand, have traditionally been regarded as irrelevant at best and, at worst, as an indication of unworthy commercial motives. All but one of the educational institutions interviewed declared that publication of research results is preferred even if, by doing so, patentability of an invention is

TABLE 16
TIME LAG FROM PATENT APPLICATION TO FIRST COMMERCIAL UTILIZATION
CONTRACTOR ACTIVITY FOR SAMPLE YEARS 1957 AND 1962

Independent Variables	≤0 Years	1-3 Years	4-8 Years	≥9 Years	9* Years	Total
Sales of Firm						
Less than $5 million	3	4	2	0	3	9
$5 - $50 million	8	6	7	0	1	21
$50 - $200 million	5	11	3	3	6	22
Over $200 million	37	33	22	0	14	92
TOTAL	53	54	34	3	24	144
Prior Activity						
Yes	41	36	13	2	8	92
No	12	19	21	1	16	53
						145
Percent Government Business						
0-20	16	14	20	2	2	52
20-50	16	10	3	0	2	29
50-80	10	11	1	0	7	22
80-100	11	20	10	1	13	42
						145
Field of Technology						
Mechanical	14	22	12	1	6	49
Other	39	33	22	2	18	96
						145
Form of Invention						
Material	12	10	6	0	2	28
Process	2	4	0	0	3	6
Component	22	17	7	1	10	47
End Product	17	24	21	2	9	64
						145
Kind of Agency						
DOD	50	53	31	3	24	137
AEC	2	1	3	0	0	6
Other	1	1	0	0	0	2
						145

*Years between filing and first expected commercial utilization. This column is not included in the row totals.

F. Reasons for Nonutilization

The survey questionnaire asked contractors and licensees to enumerate reasons for nonuse of government inventions in which they had rights. In each case, responders were asked to rank 10 different reasons according to their importance in the decision not to utilize. Significant differences which appeared in the answers of contractors and licensees are summarized in Tables 17 and 18.[17]

1. Contractor Inventions

Contractors indicated that the low commercial potential of their government inventions is the greatest barrier to utilization. Over 70 percent of the first-ranked reasons in Table 17 are in this category.[18] These inventions are derived mainly from defense programs and most are too far removed from consumer needs to be truly useful commercially. Developed under hardware programs in many instances, they represent applied

[17] In Tables 17 and 18, the first row indicates the number of times a reason was ranked first, the second row, the number of times a reason was ranked second, and so forth.

[18] These reasons include no commercial potential seen (420), technology too sophisticated (171), expected market failed to materialize (208), and invention became obsolete (236).

TABLE 18

REASONS FOR NONUTILIZATION OF INVENTIONS
(NONINVENTOR LICENSEES OF GOVERNMENT-OWNED PATENTS, 1957 AND 1962)

Frequency
Percent

Reason for No Commercial Utilization		No Reason Given	Development Costs Too High	Development Revealed Serious Flaws	Development Personnel Not Available	Invention Became Obsolete	Expected Market Failed to Materialize	Technology Too Sophisticated	Too Much Competition	Channels of Distribution Lacking	Invention Falls Outside of Company Product Line	No Commercial Potential Seen	All Other	Total Reasons Given
Rank of Reason	1	23	9 (13.1)*	16 (23.2)	0 (0)	8 (11.6)	5 (7.3)	3 (4.3)	0 (0)	0 (0)	19 (27.6)	2 (2.9)	7 (10.1)	69
	2	53	6 (15.4)	2 (5.1)	2 (5.1)	2 (5.1)	4 (10.3)	1 (2.6)	0 (0)	1 (2.6)	5 (12.8)	3 (7.7)	13 (33.3)	39
	3	74	1 (5.5)	2 (11.1)	0 (0)	2 (11.1)	2 (11.1)	6 (33.3)	0 (0)	1 (5.5)	1 (5.5)	0 (0)	3 (16.7)	18
	4	80	0 (0)	1 (8.3)	0 (0)	1 (8.3)	7 (58.3)	1 (8.3)	0 (0)	1 (8.3)	1 (8.3)	0 (0)	0 (0)	12
	5	82	1 (10.0)	0 (0)	1 (10.0)	6 (60.0)	1 (10.0)	0 (0)	0 (0)	0 (0)	1 (10.0)	0 (0)	0 (0)	10

*Percentage is the total responses for a reason, divided by the total responses given for that row.

TABLE 19
FACTORS AFFECTING REASONS FOR NONUTILIZATION OF INVENTIONS

Utilization Factor	Technical Reasons for Nonutilization (percent)	Marketing Reasons for Nonutilization (percent)	Number of Observations
Contractor has prior experience.	39.7	60.2	405
Contractor has no prior experience.	31.6	68.3	958
Contractor has title.	35.9	64.0	1,187
Contractor has no title.	21.0	78.0	176
Contractor does more than 50% of his business with the government.	29.7	70.2	841
Contractor does less than 50% of his business with the government.	40.9	59.0	522
Contractor has annual sales over $50 million.	33.8	66.1	1,177
Contractor has annual sales under $50 million.	34.0	65.9	186

TABLE 20
EFFECT OF PRIOR EXPERIENCE ON REASONS FOR NONUTILIZATION
(GOVERNMENT-OWNED INVENTIONS)

	Technical Reasons (percent)	Marketing Reasons (percent)	Number of Observations
Prior Experience	76.4	23.6	17
No Prior Experience	50.0	50.0	44

program of developing inventions to the point of commercial feasibility. Potato flakes and frozen orange juice are two of its well-known successes. That agency, in promoting potato flakes, sponsored pilot production of the product and performed a market study in supermarkets in a major city to determine the product's consumer appeal. The study was then made available to the food industry to stimulate interest in the product.

Notwithstanding the utilization programs employed by government agencies, none except AEC has an express statutory mission to increase business competition in commercial markets for its own sake. When it does occur, however, it is an indirect result of their efforts to accomplish their basic mission. From our observations of the study inventions and insofar as the effect of patent policy is involved, competition does not appear to have been adversely affected by this lack of direct concern, for three reasons:

(i) The rate of utilization of government inventions has been low.

(ii) The agencies—such as TVA and Agriculture, whose inventions are most likely to be utilized—either developed them in-house or took title to them when developed under contract.

(iii) And industrial owners of government-sponsored inventions have been willing to license them upon request or, where they were unwilling to license, alternative technologies were available to competitors in the great majority of cases.[1]

The sections below present additional findings which support these conclusions. Section B reports on the licensing of survey inventions and Section C discusses the survey patents involved in infringement suits.

B. Licensing of Inventions in the Utilization Sample

1. Licensing of Sample Inventions

The utilization survey indicated that responding industrial firms held exclusive rights on 1,618 patents in the utilization sample. Ninety-five percent—or 1,539 of the inventions—were reported to be available for license. The sample inventions generated 175 requests for license which resulted in 138 licensing agreements.[2] Industrial firms reported use of inventions by 77 licensees. Only 26 licenses covered inventions also used by the patentee and only eight were critically important in the patentees' use of them.

The small amount of licensing reported by patentees is consistent with the low level of commercial utilization among the survey inventions. The low levels of activity reflect, for the most part, the limited commercial value of most government-sponsored inventions. In comparison, one of TVA's fertilizer patents is used by at least 32 licensees, reflecting both its high commercial potential and the effectiveness of TVA promotional efforts. And, a DOD process patent for growing synthetic quartz is used by every firm in the synthetic quartz crystal industry.

Several utilization trends are apparent from the licensing data: The utilization rate for licenses is 5 percent of the inventions available for license[3]—about half the rate experienced through direct use of survey inventions. Measured against the number of license agreements, utilization is about 56 percent of the total,[4] reflecting the positive interest of licensees in inventions they wish to license.

Table 21 compares major aspects of contractor licensing activity. Although large firms (over $200 million) account for the major share of inventions available for license (79.9 percent), they account for a much smaller share of license requests (56 percent), license agreements (52.2 percent), and licenses in use (46.8 percent). This is due to the tendency of large firms to patent inventions more broadly for reasons such as to recognize employee inventions, to protect against infringement suits, to obtain patents with which to negotiate cross licenses in addition to patenting them for direct commercial utilization (see Volume IV, Part II). Thus, large firms have a larger share of inventions with speculative utility than do smaller firms.

This pattern is particularly pronounced for large firms doing 20 percent or less of their business with the government. This group accounts for 31.4 percent of the patents available for license, but it received only 5.7 percent of the license requests, and entered 3.4 percent of the licensing agreements. All that these firms did license, however, were used.

Large firms doing 80-100 percent of their business with the government show a contrasting pattern: Accounting for 18.5 percent of the inventions available for license, this group received 26.9 percent of the license requests, entered into 28.7 percent of the licenses, but accounted for only 14.3 percent of the licenses in use. However, 10 of their 11 licenses in use covered

[1] Except for several case studies which investigated the field of the sample patents involved, studies were not conducted on the effect of a series or cluster of related government-sponsored inventions developed over a period of years.

[2] These agreements were individually negotiated and were not the result of automatic cross-licensing arrangements. No estimates were provided for the extent to which sample inventions were used under cross-licensing agreements.

[3] 1,539 inventions available for license; 77 licenses in use.

[4] 138 license agreements; 77 in use.

inventions which the licensor was also using. Their performance clearly shows a willingness to license even where they use the inventions themselves.

By far the best licensing performance is achieved by firms with sales of $5 to $50 million doing 50 to 80 percent of their business with the government. They account for only 1.5 percent of the inventions available for license, but received 19.4 percent of the license requests, entered into 21.9 percent of the licenses, account for 33.8 percent of the licenses in use, and utilized directly five of the 26 inventions used by licensees. This group—which itself uses only 4.3 percent of the patents in commercial use—made its greatest contribution to utilization through licensing.

A consistent record of utilization both directly and through licenses is shown by large firms doing 20 to 50 percent of their business with the government: Accounting for 20.9 percent of the inventions available for license, they received 20 percent of the license requests, entered into 15.9 percent of the licensing agreements, and accounted for 22.1 percent of the licenses in use. This matches closely their *direct* utilization—27.5 percent of the survey inventions used.

2. Speed in Licensing

Speed in licensing contractor-owned inventions closely matches the speed with which contractors use the inventions themselves. The time lags between applications for patents and the dates of first license, as set forth in Table 22, show that 58 percent of the licensed inventions were licensed within three years of the application for a patent. This compares very favorably with the 68 percent used by patentees within that same period (see Table 16 above).

An even more meaningful test of diligence in licensing is the time it takes to reach agreement once a license request is received. A check of 13 respondents who reported a time lag of one year or more between first commercial use of an invention and issuance of license showed that all but one had issued licenses within one year of the request. In the latter case—involving a high-speed printer—we found no effort to delay licensing. The initial request was an informal inquiry for information. The requester then decided to purchase printers over the next year. When he did finally request a license, it was quickly granted.

3. Refusal to License

The utilization questionnaires were analyzed to determine the frequency and character of refusals to license survey inventions. A high rate of refusals would indicate

TABLE 22
TIME LAG BETWEEN PATENT APPLICATION AND FIRST LICENSE AGREEMENT MADE: CONTRACTOR ACTIVITY FOR SAMPLE YEARS 1957 AND 1962

Independent Variables	0-3 Years	4-8 Years	>9 Years
Size of Firm			
Less than $5 million	5	3	0
$5 - $50 million	12	2	0
$50 - $200 million	4	1	0
Over $200 million	26	23	4
TOTAL	47	29	4
Prior Experience			
Yes	21	6	0
No	26	25	3
Percent Government Business			
0 - 20	3	3	0
20 - 50	9	6	0
50 - 80	9	2	0
80 - 100	26	18	4
Field of Technology			
Mechanical	12	8	0
Other	35	21	4
Form of Invention			
Material	3	3	0
Process	1	1	0
Component	21	17	1
End Product	22	8	3
Kind of Agency			
DOD	45	27	4
AEC	0	0	0
Other	2	2	0

that industry ownership of patents might have an adverse effect on competition. Initial analyses of the data identified 35 inventions as unavailable for license. All were investigated to determine the reasons for refusal.

Interviews revealed that 20 of the 35 inventions did not really involve refusals to license:

- —Nine had either been sold outright or were involved in exclusive license agreements.
- —Four were developed by companies which held only a license to the invention from the government.
- —Seven involved questionnaires which were answered incorrectly and, consequently, were dropped from this aspect of the study.

against industrial giants or attempting to retain its market share through product superiority.

Nine of the 15 were used commercially (inventions 1 through 9, Table 23). Only three played a critical role in their commercial use. The most successful of these was a gas turbine motor scroll structure (invention 5, Table 23) which was critical to a gas turbine motor involving commercial sales of $60 million to date. The patentee has several active competitors in the gas turbine field and there are alternative ways of performing the function involved in this patent. Given the competitive conditions in this market, the company does not wish to make its design expertise available through license of the patent.

The other two critical inventions involved very modest sales. The first--a device which breaks a tire bead away from the wheel rim on an aircraft landing gear (invention 7, Table 23)--was developed under Navy contract and was an outgrowth of a smaller model which the contractor had invented, patented, and produced for many years. The invention played a critical role in expanding the commercial application of the bead-breaker and was directly responsible for sales of about $66,000. Nominal development costs of $2,000 were required to commercialize the device. Since the device is specialized and has a limited market, the patentee has no interest in encouraging entry of a competitor into the market by licensing the invention. The second--a reagent for analysis of carbon dioxide (invention 9, Table 23)--generated sales of only $11,000, both commercially and to the government.

The six other inventions which were commercially used played supporting roles in their commercial products. Three, relating to various design aspects of jet fuel flow-meters (inventions 1 to 3, Table 23), represent improvements in a basic patent already owned by the company. The patentee did not wish to license the inventions because it was trying to penetrate a market with a new product. The company invested $1.45 million to commercialize the product, and since 1962 when the invention was first put on the market, commercial sales have been $1.8 million.

This same company owns the fourth invention which played a supporting role--a process for the manufacture of formed metal of uniform density and pore size (invention 4, Table 23). It has been trying to commercialize the invention since 1950 at a cost of $300,000. The company refused a request for license in 1963 because it wished to develop the market from a protected position. But since it has been over five years since receipt of the patent and very little commercial utilization has been achieved--to date, commercial sales have amounted to $13,000--the company expects to turn the invention over to its licensing group for licensing to other manufacturers.

The fifth invention relates to an apparatus for cutting microfilm strips and matting them on aperture cards (invention 6, Table 23), and is part of microfilm processing equipment manufactured by the patentee. The company considers the machine to be highly specialized with only a limited market. Since commercial sales during the past 10 years have only amounted to some $500,000, the company feels quite capable of handling the entire future demand for the equipment and is not interested in licensing competitors. The company has invested some $30,000 in the invention to commercialize it. The sixth invention--a safety helmet with eye shield (invention 10, Table 23)--has had negligible sales.

The last company interviewed showed a somewhat different pattern than the companies discussed above. It refuses to license patents in any new or existing markets in which it is interested. Thus, none of the eight inventions it owns in the sample are available for license. Only three of these (inventions 8, 9, and 10, Table 23, described above) had any commercial sales. The company anticipates no commercial sales of the remaining five patents, which include a shift seal for liquid metal pumps, contaminant liquid metals, an apparatus to maintain low oxygen atmosphere, gas detection techniques, and a head positioner for a helmet.

Table 24 shows the effect of the size of the firm on these refusals to license. Only 1 percent of the inventions of larger firms (over $50 million) were unavailable for licenses compared with 7.6 percent for smaller firms. With respect to utilized inventions, smaller firms again kept a larger percentage for their own use (13.0 percent) than did larger firms (3.8 percent).

TABLE 24
EFFECT OF SIZE OF FIRM ON REFUSAL TO LICENSE

	License Available (Percent)	License Not Available (Percent)
Size of Firm		
Under $50 million	92.4	7.6
Over $50 million	99.0	1.0
Size of Firm Where Invention Is in Use		
Under $50 million	87.0	13.0
Over $50 million	96.2	3.8

sophisticated device has not yet developed to the extent the patentee expected. The company has licensed three domestic firms to use the invention, including its major competitor.

c. *The Impressive Patent Case.* The invention in "The Impressive Patent Case" is the most important patent of the ten studied. The invention is basic to a product line of capital equipment that has total annual industry sales of $22 million to $30 million. About 70 percent of this market is now government, but commercial sales are increasing. No alternative technology to the invention appears available.

The patentee does not manufacture the invention itself, but has entered into an exclusive license with a large diversified manufacturer, who is estimated to account for about 50 percent of the market. The exclusive licensee has negotiated two sublicenses with its major competitors and another two are close to agreement.

The exclusive licensee also manufactures a less sophisticated device in the same general product line covered by another basic government-sponsored patent not included in the sample. The two products compete in the market. Some 10 manufacturers produce the less sophisticated device, one of which has the major share of the market and was the first to sublicense the more sophisticated device.

d. *The Ninety-Percent Government Business Case.* "The Ninety-Percent Government Business Case" involves three patents owned by a patentee who is among the 50 largest defense contractors and does no commercial work in the field of the patent. Two of these, improvement patents issued in 1957 for which there is a significant amount of alternative technology, are available for licensing and are part of a broad cross-licensing agreement.

The third patent—issued in 1960—is the second most important one studied. It has been basic to important and expensive commercial applications involving sales to date of some $20 million. The patentee has licensed six manufacturers and one user; one manufacturer was included under a broad cross-licensing agreement.

e. *The Declining Business Case.* The patentee in "The Declining Business Case" has had declining commercial and military sales in the field covered by the two improvement patents involved in the study, even though it owns basic patents in the product line. The company's overall sales have also declined over the last several years.

Although the two improvement patents are available for licensing, there have been no requests from interested firms. The patentee's three basic patents and others in this field, however, have been licensed to its major competitor under a broad cross-licensing agreement. The two improvement patents were issued after the cutoff date of that agreement and were, therefore, excluded from it. An infringement suit is in process in a foreign country to collect royalties on the improvement patents.

f. *The Commercial Company Case.* The patentee in "The Commercial Company Case" applied its knowledge in a commercial field to develop a device for an entirely different application for the Department of Defense. It then applied the resulting invention—along with some other basic patents it owned—to a system used by one of its major commercial activities. Every competitor in the industry except one uses the patented equipment under license from the patentee.

g. *The Nonprofit Institution Case.* The patentee in "The Nonprofit Institution Case," is a nonprofit institution connected with a university. The organization does no manufacturing. The invention is critical to a device having modest market potential. When companies began using the invention commercially, the patentee made the decision to collect royalties under license, if possible, rather than dedicate the invention to the public and has licensed the invention to four companies.

h. *The Critical Process Patent Case.* The patentee in the "Critical Process Patent Case" does not practice the invention commercially, but has granted an exclusive license instead. The invention is critical in synthesizing an important mineral used in the electronic industry. The process makes the synthetic mineral produceable at a cost which is competitive with the natural product and, as such, has been instrumental in creating a small, but growing industry. The exclusive licensee is willing to license others, but at a royalty which may make their operations unprofitable. The validity of the patent is currently being tested in a suit involving an infringing user.

3. The Effect of Litigated Patents on Competition

a. *General Conclusions.* Each situation studied is unique but the general conclusion is that healthy competition exists in all of the cases involving litigated patents. There appears, at first blush, only one situation—"The Impressive Patent Case"—in which there might be enough economic leverage to raise concern over concentration. But even there the total dollar amount of industry sales in an increasing market is relatively small

Another firm stated that royalty rates in its existing licenses are 3 percent to 5 percent and that the method of computing the royalty is based on a customary industry formula. In "The Critical Patent Process Case" a 10 percent royalty is requested by the exclusive licensee and some firms in the industry indicated that such a rate could make their work unprofitable.

Representatives of other firms made more general statements about royalty patterns and rates. In "The Impressive Invention Case," the patentee stated, "we license all comers at reasonable rates." The sublicense agreements are fixed-sum agreements payable over a period of years, and the exclusive licensee pays a certain royalty to the patent owner on each item it manufactures as well as a share of the sublicense royalty payments it receives.

With regard to licensing policy, all firms represented that licenses were available for licensing or—perhaps more realistically—that, "If it comes to our attention that someone is using or wants to use the patent, we will do something about it." This remark appears to reflect industrial patent situations more accurately than the statement that a patent is available for licensing. Often a patent owner is in the frustrating position of having to find out who is infringing on his patent in order to attempt to obtain royalties. This certainly was the case in "The Ninety-Percent Government Business Case" and in "The Nonprofit Institution Case" and "The Small Business Case" as well.

Several factors contribute to this situation. A number of firms take the attitude, "Why not use a patent, as necessary, before negotiating a license, since most patent suits are settled out of court and preliminary injunctions are rarely granted?" and the ideal corporation in which engineers and patent attorneys review all corporate actions for infringement of the patent rights of others does not widely exist. This situation changes the competitive environment from one in which the patentee may limit use of the invention to one in which he may have to aggressively seek out potential infringers.

On the other hand, the tendency to go sailing into infringement situations is certainly not universal. In connection with the two most important patents in our cases, for example, the same large firm was the first to be licensed because it expressed awareness of the patent to the patentee and initiated negotiations for a license. The licensee is widely known to have a patent policy based on deliberate action and advance planning.

Research showed that license negotiations can be very complex. To establish the proper royalty base and to decide what patents are to be included in the license, large companies having numerous divisions or subsidiaries may engage in protracted bargaining. Such bargaining did occur in a number of the selections considered. In one case, delay was encountered in arriving at a proper royalty base and, in another, in working out arrangements suitable for various divisions of the licensee. In a third case, a pending merger of the licensee caused delay. Moreover, in some of the cases, lengthy negotiations were terminated, and resulted in a lawsuit.

c. *Extent of Private Development to Commercialize the Inventions.* Four of the cases involved are inventions used in capital equipment sold in both commercial and military markets.[7] In all four of these cases the commercial application of the invention could have been anticipated at the time of invention disclosure. In this respect, these cases run contrary to assumptions often made about commercial use of items developed under military contracts. A fifth case[8] also involves general purpose capital equipment that has wide use in many industries, but the military use is specialized and does not have major commercial possibilities.

One would expect that only a small amount of private investment would be necessary to commercialize an invention whenever it can be used in the same basic configurations for both the government and commercial markets. The small business and declining business firms indicated that this expectation is correct; however, the exclusive licensee in "The Impressive Patent Case" reported that each firm that entered the field spent substantial amounts of private funds to bring the invention to market.

Another way of looking at the question of private investment is to ask, "Would the invention have been commercialized to the same extent once it was patented if the government had retained title?" It appears that in all but "The Sophisticated Devices Case" this would have been so, but this does not answer the question of whether the licensees under those circumstances would promote the invention as aggressively as when they had title. Also, the lack of patent protection may have its greatest adverse effect on small firms; the inventor in "The Small Business Case" would have been in a precarious position if he had not had the protection of the patent and its royalty income to support his entry into a market of much bigger competitors. Based on all observations of the sample inventions, little evidence was found that permitting contractors to retain title to government-sponsored inventions had an adverse effect on business competition.

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[7] "The Small Business Case," "The Impressive Patent Case," "The Declining Business Case," and "The Nonprofit Institution Case."

[8] "The Ninety-Percent Government Business Case."

loss of relevant technical experience and applications to the government work.

Lastly, large diversified firms often follow different patent policies in different divisions of the organization. Accordingly, they may be willing to participate in government programs with small concern for patents in some areas but with great concern for patent rights in others. It is difficult to generalize about these firms except to notice that their policies tend to follow the patterns of the industries in which their divisions participate. Their behavior may, therefore, resemble any of the categories of firms described above if their divisions have similar business profiles.

With respect to educational and nonprofit institutions refusal to participate for patent reasons is not normally a problem. However, instances were found in Department of Interior programs where patent problems were encountered because of conflicting institutional obligations arising from joint support of a research program or where rights in background patents were sought as a condition of the project. With the rising interest in nonprofit institutions in patents as a source of revenue, greater concern over patent rights can be expected from institutions with large research programs as financial pressures on these organizations continue to increase.

Viewing the participation problem from the standpoint of individual government agencies, the effect of patent policy varies with the nature of their R&D programs and the contractors that participate in them. Participation problems are not a concern to TVA which performs virtually all its research and development itself and, therefore, has little or no contractual interface with industry. They are also minimal in Agriculture programs since that agency contracts almost all its extramural research and development with educational and nonprofit institutions. In addition, the firms that do participate in its programs do relatively little research and development on their own and tend to be less patent conscious than those participating in defense/aerospace work.

The direct effect of policy on NSF and HEW programs also appears to be small because most of their contract research is either basic in nature, offering limited opportunities to develop patentable inventions, or is performed by nonprofit institutions who, for the most part, are interested in the research for itself. However, some problems may be encountered in instances of joint or overlapping research at nonprofit institutions where the rights of other parties may be involved. And, a significant indirect effect has been noted in an important HEW health program where voluntary noncontractual participation by a patent sensitive industry was curtailed because of patent considerations.

The Department of Interior, like HEW and NSF, has a number of programs—such as water desalination—which are oriented toward basic research. The Agency contracts in these areas with research-oriented industrial firms (many of whom are patent conscious), as well as educational and nonprofit institutions, and acquires title to patents arising under its programs. Under some programs, statutes on which they are based have been interpreted to require the agency to acquire rights in existing patents owned by contractors because of their relevance to the contract effort and future utilization of contract results. These factors—patent conscious organizations and acquisition of rights to contract inventions and existing patents—have resulted in several instances of hesitation or refusal to participate in the government program. Insufficient data was available to establish how widespread the reaction was or its overall effect on Interior programs.

The largest number of opportunities for participation problems occur, of course, in DOD, NASA and AEC programs because of the size and scope of their contract effort. Only a limited amount of data was available on this question for these agencies but a few general observations may be made. At least as to the majority of DOD inventions, to which contractors are normally permitted to retain title, no problem arises. In addition, NASA's policy of waiving title to inventions to promote utilization under appropriate circumstances provides a method for resolving competing government and industry objectives with regard to patents arising under contract. Lastly, interviews with industrial firms in the survey sample indicate that—except where a large investment in related private research, know-how, inventions and/or patents considered to be important in commercial markets exist—acquisition or improvement of technical skills is sufficiently important to them in most cases to justify participating in government programs in their areas of interest even though patent provisions are not completely suitable to them.

However, this does not mean that either a title or license policy will equally serve the government's interests under all the above circumstances, since the policy selected may also affect industrial decisions to use contract inventions commercially. Here again, a balancing of government objectives appears necessary to ensure that the net effect of the patent policy promotes the government's overall goals.

(c) Where the new use is within the field of research work supported by the grant.[1]

(iv) The government shall receive a nonexclusive, irrevocable, royalty-free license to any new use patent and shall also have the power to sublicense others for all governmental purposes.

The drug firms almost unanimously rejected the amended patent agreement from the beginning for several reasons:

(i) They refused to accept the loss of prospective proprietary rights.

(ii) They feared the contamination[2] of in-house research that would result from taking in compounds arising from NIH-sponsored research.

(iii) They thought that they might lose control over the testing and the reporting of results.

The immediate effect of the drug firms' refusal to sign the amended patent agreement was their almost complete withdrawal from screening compounds resulting from NIH-sponsored research. However, the overall effects of the policy on the interactions necessary for successful completion of the drug development process are much broader.

The nearly complete blockage of testing—an essential step in the utilization of compounds conceived or developed under NIH sponsorship—is an obvious major effect of HEW patent policy in effect prior to late 1966. The almost total refusal of drug firms to screen (and subsequently develop) these compounds created an insurmountable obstacle to their ultimate utilization, except possibly in those areas (cancer and malaria) where the government operates its own screening services.[3]

What is not so obvious but equally important is the second major effect of patent policy in this area: The crippling limitations on the necessary flow of ideas among the groups that must participate in the drug development process if it is to be successful. This interference occurs even earlier in the drug development process and has even broader impact than the blockage that results from the refusal of the drug firms to screen NIH-sponsored compounds.

2. The Two Major Effects

Before the promulgation in 1962 of the new procedures for HEW patent policy administration, the interplay between the academic community and the drug industry was concrete and specific. A drug firm could actually work, in pursuit of its own interests, with a professor's compound; the professor received, in return, not only the kind of testing appropriate to his specific intentions and test data sufficient for publication, but also, in many cases, practical suggestions about continuation of his research, new avenues of investigation, and, sometimes, the opportunity to pursue further work under specific industrial research grants. The free pharmacological advice and counsel to which the academic medicinal chemist often had access was of the most practical and experienced type available anywhere. At the same time, the relationship between the academic investigator and the drug firm allowed for recycling—based upon test results—of the research. Positive test results from the drug firm could be incorporated readily into the investigator's research design for further work, and he was almost always assured of the availability of additional testing.

When the drug firms stopped testing compounds conceived or developed under NIH sponsorship, the investigators developing these compounds had to turn to other sources of testing—government, university, and independent testing laboratories. The advantages and disadvantages of these respective sources of testing can be summarized as follows:

- *Government Testing Laboratories*

  Although some attempt may be made by the two government laboratories—Cancer Chemotherapy National Service Center (CCNSC) and Walter Reed Army Institute of Research (WRAIR)—to accommodate the specific intentions of the academic investigator who developed the compound being screened, the high volume of tests usually precludes all but the most standardized screening for activity against the two disease systems, cancer and malaria. For example, although potentially analgesic, antihistaminic, or other compounds may be submitted to CCNSC or to WRAIR for testing on the outside chance that they may show activity (and often merely to allow the academic investigators to

[1] Agreement, as revised in December 1966, eliminates these criteria.

[2] As used by the drug industry and university investigators, "contamination" means the potential compromise of rights in proprietary research resulting from exposure of an individual or organization to ideas, compounds, and/or test results arising from government-sponsored research. For example, a compound developed under NIH-sponsored research comes into a drug firm for screening and is found to be useful in a therapeutic area in which the company has conducted prior research; the company incorporates into its research program some of the research findings from the screening of the NIH compound, and the company then develops a marketable product. The company is afraid that HEW is in a position to assert claims to that product. Figures issued by the Pharmaceutical Manufacturers Association show that the drug industry supports the greatest research and development effort per sales dollar (8.7 percent of sales in 1964) of any industry class.

[3] In 1967 approximately 55 agreements were signed by three firms under the revised patent agreement form adopted in December 1966.

of-the-art studies. Commercial testing organizations are less broadly focused than either the pharmacology department of a drug firm or the pharmacology department of a university. The operations of a nonprofit testing organization can resemble the operations of any of the other screening sources, depending on the specific circumstances of the nonprofit organization.

With regard to the second effect of patent policy—the limitation on productive interchange of research ideas—practically every scientist interviewed in this study was worried about the comparative isolation of academic and government investigators from their drug industry counterparts. Vital communications links have been weakened in large measure by the problem of "contamination." Drug firms are negative about government patent policy not so much because they may lose rights to the outside compounds that they test, but because the outside compounds, any related in-house items that they may already have, and any and all ideas submitted to them by academic investigators may become the subject of a claim of rights by the Surgeon General. Consequently, drug firms are quite concerned about keeping all ideas that may have come from NIH-sponsored research segregated from their own research. To accomplish this segregation, they have minimized those professional contacts and meetings that could later be construed as having contributed to their own research.

The issue of contamination of ideas arises with regard to several other sources of ideas in addition to the NIH idea itself. Was the research that the journal article described performed under an NIH grant? Did the colleague communicate ideas developed under NIH sponsorship? Because of the investigator's intimate knowledge of NIH-projects, can virtually anything he does be considered contaminated? The implications of these questions are worrying the drug industry.

The implications of government patent policy do not end with the proposal preparation phase—the typical investigator is continually confronted with patent questions while pursuing his projects. For example, consider the case of an investigator with an industry-sponsored project, a foundation-sponsored project, and an NIH-sponsored project. He reads professional literature, attends meetings, and keeps up his contacts in his search for new ideas and approaches. In addition, his own analysis and experimentation on each project yield data that may have application to his other projects and to projects of his professional associates within his organization. He must continually live with the question of the extent to which he must recognize proprietary and government patent rights—and with the adverse effects that appropriate recognition of these rights necessarily has upon what would otherwise be relatively free research communications. For the diligent respecter of rights, current government patent policy tends to inhibit contacts among associates and the concomitant idea flow between projects and to prevent the results of work sponsored by NIH from being used in further drug research.

Evidence that the effects observed in the medicinal chemistry program were not just an isolated occurrence in one industry was found in cases relating to development of two biomedical inventions. In both instances, companies with investments in private research and portfolios of background patents to products similar to those the government was proposing to develop, hesitated to deal with NIH if they had to forego title to inventions developed under government contract or give up rights to related background patents. Similar experiences were encountered in Department of Interior programs, as reported in Volume II of the study. Although there was insufficient data to determine how broadly government programs are affected by nonparticipation of industry for patent reasons, it seems clear that some programs are. To deal with these problems as they surface, it may be desirable to establish a procedure that provides for reexamination of their treatment under the policy when a government agency finds that the policy is materially affecting accomplishment of a program.

APPENDIX A

Presidential Memorandum and Statement of Government Patent Policy Issued October 10, 1963

(Published Federal Register, Vol. 28 No. 200, October 12, 1963)

Memorandum for the Heads of Executive Departments and Agencies

Over the years, through Executive and Legislative actions, a variety of practices has developed within the Executive Branch affecting the disposition of rights to inventions made under contracts with outside organizations. It is not feasible to have complete uniformity of practice throughout the Government in view of the differing missions and statutory responsibilities of the several departments and agencies engaged in research and development. Nevertheless, there is need for greater consistency in agency practices in order to further the governmental and public interests in promoting the utilization of federally financed inventions and to avoid difficulties caused by different approaches by the agencies when dealing with the same class of organizations in comparable patent situations.

From the extensive and fruitful national discussions of government patent practices, significant common ground has come into view. First, a single presumption of ownership does not provide a satisfactory basis for government-wide policy on the allocation of rights to inventions. Another common ground of understanding is that the Government has a responsibility to foster the fullest exploitation of the inventions for the public benefit.

Attached for your guidance is a statement of government patent policy, which I have approved, identifying common objectives and criteria and setting forth the minimum rights that government agencies should acquire with regard to inventions made under their grants and contracts. This statement of policy seeks to protect the public interest by encouraging the Government to acquire the principal rights to inventions in situations where the nature of the work to be undertaken or the Government's past investment in the field of work favors full public access to resulting inventions. On the other hand, the policy recognizes that the public interest might also be served by according exclusive commercial rights to the contractor in situations where the contractor has an established nongovernmental commercial position and where there is greater likelihood that the invention would be worked and put into civilian use than would be the case if the invention were made more freely available.

Wherever the contractor retains more than a nonexclusive license, the policy would guard against failure to practice the invention by requiring that the contractor take effective steps within three years after the patent issues to bring the invention to the point of practical application or to make it available for licensing on reasonable terms. The Government would also have the right to insist on the granting of a license to others to the extent that the invention is required for public use by governmental regulations or to fulfill a health need, irrespective of the purpose of the contract.

The attached statement of policy will be reviewed after a reasonable period of trial in the light of the facts and experience accumulated. Accordingly, there should be continuing efforts to monitor, record, and evaluate the practices of the agencies pursuant to the policy guidelines.

This memorandum and the statement of policy shall be published in the Federal Register.

John F. Kennedy

STATEMENT OF GOVERNMENT PATENT POLICY

Basic Considerations

A. The government expends large sums for the conduct of research and development which results in a considerable number of inventions and discoveries.

B. The inventions in scientific and technological fields resulting from work performed under government contracts constitute a valuable national resource.

C. The use and practice of these inventions and discoveries should stimulate inventors, meet the needs of

(d) In the situation specified in Sections 1(b) and 1(c), when two or more potential contractors are judged to have presented proposals of equivalent merit, willingness to grant the government principal or exclusive rights in resulting inventions will be an additional factor in the evaluation of the proposals.

(e) Where the principal or exclusive (except as against the government) rights in an invention remain in the contractor, he should agree to provide written reports at reasonable intervals, when requested by the government, on the commercial use that is being made or is intended to be made of inventions made under government contracts.

(f) Where the principal or exclusive (except as against the government) rights in an invention remain in the contractor, unless the contractor, his licensee, or his assignee has taken effective steps within three years after a patent issues on the invention to bring the invention to the point of practical application or has made the invention available for licensing royalty free or on terms that are reasonable in the circumstances, or can show cause why he should retain the principal or exclusive rights for a further period of time, the government shall have the right to require the granting of a license to an applicant on a non-exclusive royalty free basis.

(g) Where the principal or exclusive (except as against the government) rights to an invention are acquired by the contractor, the government shall have the right to require the granting of a license to an applicant royalty free or on terms that are reasonable in the circumstances to the extent that the invention is required for public use by governmental regulations or as may be necessary to fulfill health needs, or for other public purposes stipulated in the contract.

(h) Where the government may acquire the principal rights and does not elect to secure a patent in a foreign country, the contractor may file and retain the principal or exclusive foreign rights subject to retention by the government of at least a royalty free license for governmental purposes and on behalf of any foreign government pursuant to any existing or future treaty or agreement with the United States.

SECTION 2. Government-owned patents shall be made available and the technological advances covered thereby brought into being in the shortest time possible through dedication or licensing and shall be listed in official government publications or otherwise.

SECTION 3. The Federal Council for Science and Technology in consultation with the Department of Justice shall prepare at least annually a report concerning the effectiveness of this policy, including recommendations for revision or modification as necessary in light of the practices and determinations of the agencies in the disposition of patent rights under their contracts. A patent advisory panel is to be established under the Federal Council for Science and Technology to

(a) develop by mutual consultation and coordination with the agencies common guidelines for the implementation of this policy, consistent with existing statutes, and to provide overall guidance as to disposition of inventions and patents in which the government has any right or interest; and

(b) encourage the acquisition of data by government agencies on the disposition of patent rights to inventions resulting from federally-financed research and development and on the use and practice of such inventions, to serve as basis for policy review and development; and

(c) make recommendations for advancing the use and exploitation of government-owned domestic and foreign patents.

SECTION 4. Definitions: As used in this policy statement, the stated terms in singular and plural are defined as follows for the purposes hereof:

(a) *Government agency*—includes any Executive department, independent commission, board, office, agency, administration, authority, or other government establishment of the Executive Branch of the Government of the United States of America.

(b) *Invention* or *Invention or discovery*—includes any art, machine, manufacture, design, or composition of matter, or any new and useful improvement thereof, or any variety of plant, which is or may be patentable under the Patent Laws of the United States of America or any foreign country.

(c) *Contractor*—means any individual, partnership, public or private corporation, association, institution, or other entity which is a party to the contract.

(d) *Contract*—means any actual or proposed contract, agreement, grant, or other arrangement, or subcontract entered into with or for the benefit of the government where a purpose of the contract is the conduct of experimental, developmental, or research work.

(e) *Made*—when used in relation to any invention or discovery means the conception or first actual reduction to practice of such invention in the course of or under the contract.

APPENDIX B

PATENT POLICY STUDY
FOR THE
COMMITTEE ON GOVERNMENT PATENT POLICY
OF THE
FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY

INVENTION UTILIZATION QUESTIONNAIRE
FOR
CONTRACTORS WITH RIGHTS IN INVENTIONS

1. Title of Invention _____
2. U.S. Patent No. _____
3. Patent Application No. _____ Filing Date _____
4. Contracting Government Agency _____
5. Contractor Rights in Invention _____ Title _____
   License _____
6. Name of Company _____
7. Address _____
8. Person Completing
   Questionnaire _____ Title _____
   Telephone No. _____
   Area Code _____
9. Contract Number _____
   (government contract under which invention was made)

PART I

BACKGROUND INFORMATION

1. Please briefly describe the invention _____
_____
_____
_____
_____

2. Please briefly describe the scope of work of the contract under which the invention was made. _____
_____
_____
_____
_____

3. Prior to the contract, did you sell goods or services closely related to the invention:
   ☐ a. To the U.S. government ☐ b. Commercially

PART II

COMMERCIAL USE OF THE INVENTION

1. Please state briefly how the invention is used commercially.
   (For example, "as a component of the x product," or "in manufacturing y products," and so forth)
   _____
   _____
2. What role did the invention play in such use?
   ☐ critically important role ☐ supporting role
3. When was the invention first used commercially? 19____
4. If the invention is incorporated in a product(s) please estimate:
   a. Sales of such products to date in each of the following markets:
      (1) Domestic commercial _____
      (2) U.S. government _____
      (3) Foreign _____
   b. Anticipated total sales of such products over the next five years.
      _____
5. Please indicate the approximate total cost of company-financed efforts that were required after completion of government work to develop the invention for commercial use:
   a. $_____ ☐ b. None
6. Please estimate what percent of the costs specified in question 5 were incurred for:
   a. Technical development ___% b. Production facilities ___%
   c. Marketing and sales promotion ___%

PART III

INVENTION WITH EXPECTED FUTURE USE

1. Please state briefly how your company intends to use the invention commercially.
   (For example, "as a component of the x product"; or "in manufacturing y products," and so forth)
   _____
   _____
2. What role is the invention expected to play in such use?
   ☐ a. critically important role ☐ b. supporting role
3. Please estimate when the invention will first be used commercially. 19____
4. If the invention is expected to be incorporated in a product(s), please estimate the anticipated sales volume of such products. _____
5. Please indicate the approximate total cost of company-financed efforts that will be required after completion of government work to develop the invention for commercial use:
   a. $_____ ☐ b. None
6. Please estimate what percent of the costs specified in question 5 will be incurred for:
   a. Technical development ___% b. Production facilities ___%
   c. Marketing and sales promotion ___%

PART I

BACKGROUND INFORMATION

1. Please briefly describe the invention. _____

2. How did your company learn that the invention was available for licensing?

3. Prior to the license, did you sell goods or services closely related to the invention:
   ☐ a. To the U.S. Government ☐ b. Commercially
4. Please indicate the annual sales volume of your company at the time the license was obtained:
   ☐ a. Less than $5 million ☐ b. $5 - $50 million
   ☐ c. $50 - $200 million ☐ d. Over $200 million
5. Approximately what percent of company sales was made in connection with government contracts and subcontracts at the time the license was obtained?
   ☐ 0-20% ☐ 20-50% ☐ 50-80% ☐ 80-100%
6. Has your company used the invention in sales to the government?
   ☐ Yes ☐ No
   If yes, please give brief statement about the nature of government use.

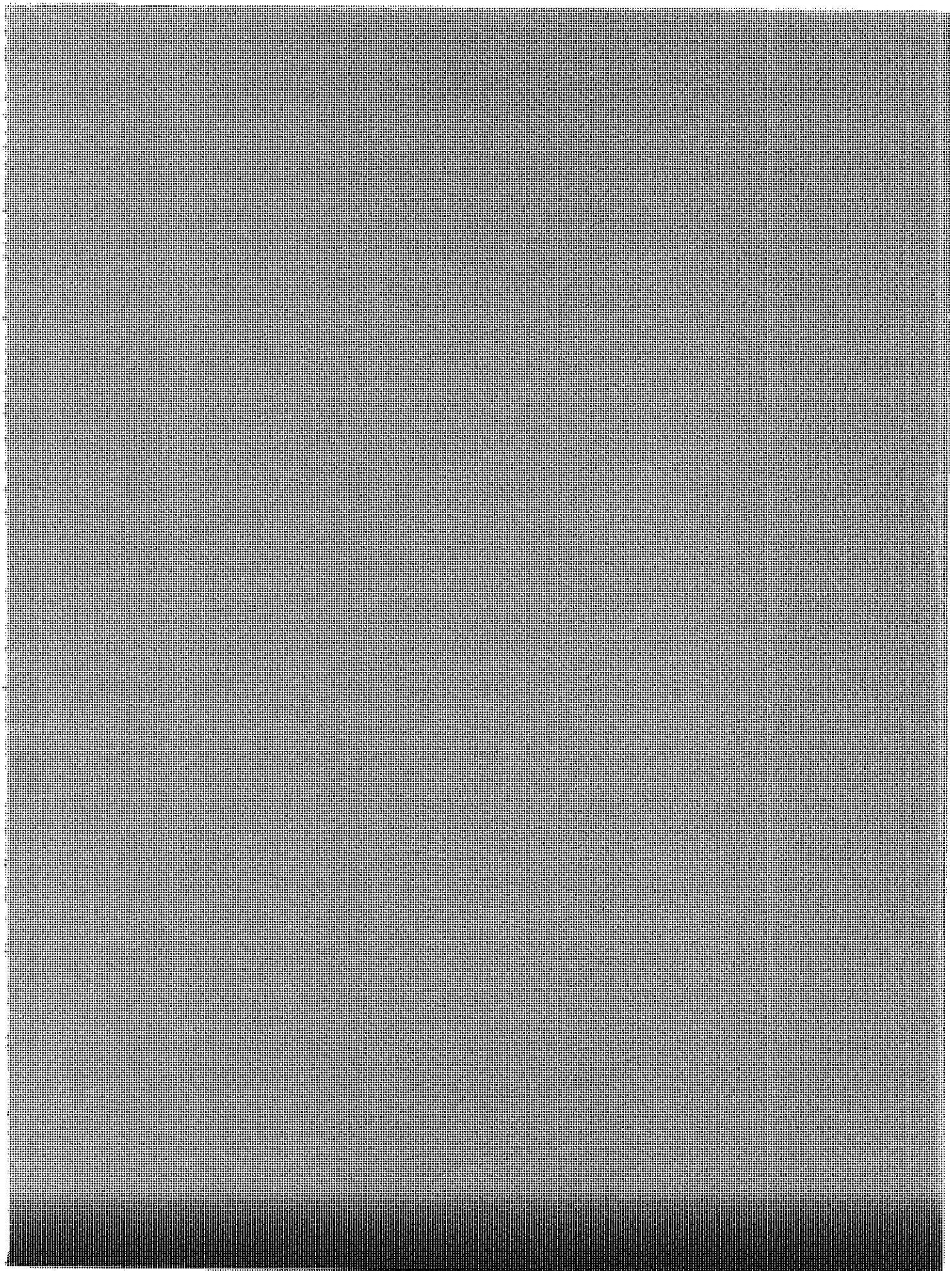
7. Please check whether the invention:
   ☐ a. Is or has been in commercial use by your company.
   If question 7a is checked, please answer Part II, below.
   ☐ b. Is expected to be used commercially by your company in the future, even though it has not yet been used.
   If question 7b is checked, please answer Part III, below.
   ☐ c. Is not expected to be used commercially.
   If question 7c is checked, please answer only question 8, immediately below.
8. If you do not intend to use the invention commercially, please rank the applicable reasons for lack of commercial potential numerically by assigning the most important reason the rank of (1) and grading the others in numerical order.
   ____a. Development cost too high.
   ____b. Development showed serious flaws.
   ____c. Development personnel not available.
   ____d. Invention became obsolete.
   ____e. Expected market failed to materialize.
   ____f. Technology too sophisticated for commercial use.
   ____g. Channels of distribution lacking.
   ____h. Invention falls outside of company product line.
   ____i. Other (please specify). _____

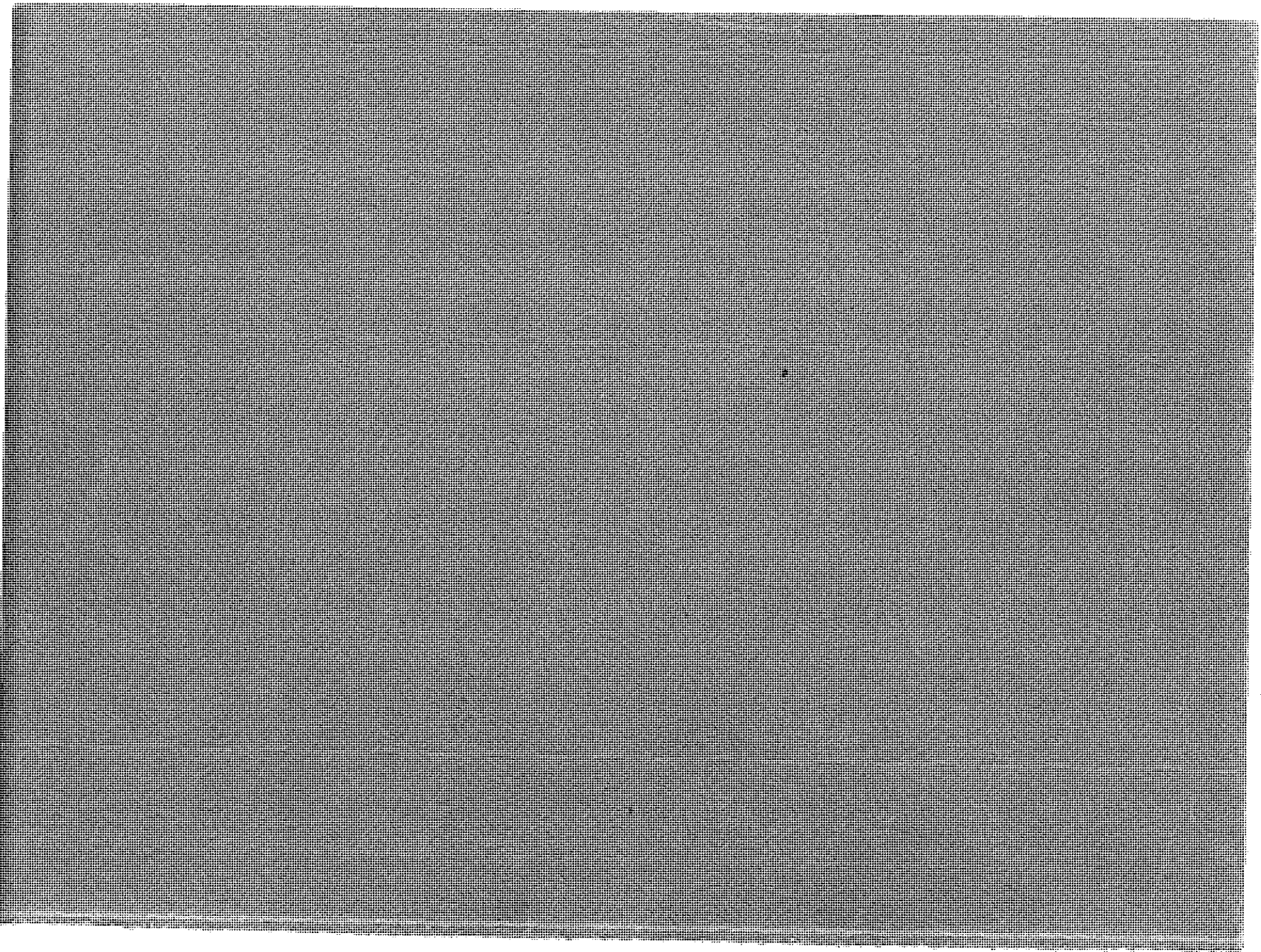
PART II

COMMERCIAL USE OF THE INVENTION

1. Please state briefly how the invention is used commercially.
   (For example, "as a component of the x product," or "in manufacturing y products," and so forth.)

2. What role did the invention play in such use?
   ☐ critically important role ☐ supporting role





3. When was the invention first used commercially? 19____
4. If the invention is incorporated in a product(s) please estimate:
   a. Sales of such products to date in each of the following markets:
      (1) Domestic commercial _____
      (2) U.S. Government _____
      (3) Foreign _____
   b. Anticipated total sales of such products over the next five years.
      _____
5. Please indicate the approximate total cost of company-financed efforts that were required to develop the invention for commercial use:
   a. $_____ ☐ b. None
6. Please estimate what percent of the costs specified in question 5 were incurred for:
   a. Technical development ___% b. Production facilities ___%
   c. Marketing and sales promotion ___%

PART III

INVENTION WITH EXPECTED FUTURE USE

1. Please state briefly how your company intends to use the invention commercially.
   (For example, "as a component of the x product," or "in manufacturing y products," and so forth.)
   _____
   _____
2. What role is the invention expected to play in such use?
   ☐ a. critically important role ☐ b. supporting role
3. Please estimate when the invention will first be used commercially. 19____
4. If the invention is expected to be incorporated in a product(s), please estimate the anticipated volume of product sales. _____
5. Please indicate the approximate total cost of company-financed efforts that will be required to develop the invention for commercial use:
   a. $_____ ☐ b. None
6. Please estimate what percent of the costs specified in question 5 will be incurred for:
   a. Technical development ___% b. Production facilities ___%
   c. Marketing and sales promotion ___%

PART IV

LICENSING

(To be completed only by contractors having exclusive rights to the invention)

1. Is the invention available for licensing?
   ☐ Yes ☐ No
2. If the answer to question 1 is "yes," please briefly identify the methods used to make the invention available for licensing. _____

   _____

3. Have there been specific requests to license the invention (apart from automatic cross licensing)?
   ☐ Yes ☐ No
4. If the answer to question 3 is "yes":
   a. Approximately how many requests have been received to date? _____
   b. In what year was the earliest request made? _____
   c. How many licensing agreements were made? _____
   d. In what year was the earliest agreement made? _____
5. Do you know if any licensees are using the invention?
   ☐ Yes ☐ No
   If yes, how many: _____

PATENT POLICY STUDY
FOR THE
COMMITTEE ON GOVERNMENT PATENT POLICY
OF THE
FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY

INVENTION UTILIZATION QUESTIONNAIRE
FOR
LICENSEES OF GOVERNMENT-OWNED PATENTS

1. Title of Invention _____
2. U.S. Patent No. _____
3. License Agreement No. _____ Date of License _____
4. Licensing Government Agency _____
5. Name of Company _____
6. Address _____
7. Person Completing Questionnaire _____ Title _____
   Telephone No. _____
   Area Code _____

December 1966

4. Please identify the division or other major organizational element of your company (referred to hereafter as the *inventing division*) that made the invention.

_____

5. Please indicate the sales volume of your company in the year the patent application was filed:
   ☐ Less than $5 million ☐ $5 - $50 million
   ☐ $50 - $200 million ☐ Over $200 million
6. Approximately what percent of *company* sales was made in connection with government contracts and subcontracts in the year the patent application was filed?
   ☐ 0-20% ☐ 20-50% ☐ 50-80% ☐ 80-100%
7. Approximately what percent of the *inventing division* sales was made in connection with government contracts and subcontracts in the year the patent application was filed?
   ☐ 0-20% ☐ 20-50% ☐ 50-80% ☐ 80-100%
8. In what product line(s) did the inventing division or company specialize at the time the patent application was filed?
   (Please answer in terms of the *inventing division* if the group was responsible for developing inventions to the point of a marketable product or commercially useful process. In all other cases, please answer in terms of the *company*.)
   a. Inventing division

   _____
   _____
   _____

   b. Company

   _____
   _____
   _____

9. Has the invention ever been used by or for the government?
   ☐ Yes ☐ No ☐ Don't know
   If yes, please give brief statement about the nature of government use.

   _____
   _____

10. Please check whether the invention:
   ☐ a. Is or has been in commercial use.
   If question 10a is checked, please answer Part II, below. If you have exclusive rights to the invention, please also answer Part IV.
   ☐ b. Is expected to be used commercially in the future, even though it has not yet been used.
   If question 10b is checked, please answer Part III, below. If you have exclusive rights to the invention, please also answer Part IV.
   ☐ c. Is not expected to be used commercially.
   If question 10c is checked, please answer question 11 immediately below. If you have exclusive rights to the invention, please also answer Part IV.
11. If the invention is not expected to be used commercially, please rank the applicable reasons for lack of commercial potential, giving the most important reason the rank of 1 and grading the others in numerical order.
   ___ a. Development cost too high.
   ___ b. Development revealed serious flaws.
   ___ c. Development personnel not available.
   ___ d. Invention became obsolete.
   ___ e. Expected market failed to materialize.
   ___ f. Technology too sophisticated.
   ___ g. Too much competition.
   ___ h. Channels of distribution lacking.
   ___ i. Invention falls outside of company product line.
   ___ j. Other (please specify). _____

   _____

(f) *Governmental purpose*—means the right of the Government of the United States (including any agency thereof, state, or domestic municipal government) to practice and have practiced (made or have made, used or have used, sold or have sold) throughout the world by or on behalf of the Government of the United States.

(g) *To the point of practical application*—means to manufacture in the case of a composition or product, to practice in the case of a process, or to operate in the case of a machine and under such conditions as to establish that the invention is being worked and that its benefits are reasonably accessible to the public.

the government, recognize the equities of the contractor, and serve the public interest.

D. The public interest in a dynamic and efficient economy requires that efforts be made to encourage the expeditious development and civilian use of these inventions. Both the need for incentives to draw forth private initiatives to this end, and the need to promote healthy competition in industry must be weighed in the disposition of patent rights under government contracts. Where exclusive rights are acquired by the contractor, he remains subject to the provisions of the antitrust laws.

E. The public interest is also served by sharing of benefits of government-financed research and development with foreign countries to a degree consistent with our international programs and with the objectives of U.S. foreign policy.

F. There is growing importance attaching to the acquisition of foreign patent rights in furtherance of the interests of U.S. industry and the government.

G. The prudent administration of government research and development calls for a government-wide policy on the disposition of inventions made under government contracts reflecting common principles and objectives, to the extent consistent with the missions of the respective agencies. The policy must recognize the need for flexibility to accommodate special situations.

Policy

SECTION 1. The following basic policy is established for all government agencies with respect to inventions or discoveries made in the course of or under any contract of any government agency, subject to specific statutes governing the disposition of patent rights of certain government agencies.

(a) Where

(1) a principal purpose of the contract is to create, develop or improve products, processes, or methods which are intended for commercial use (or which are otherwise intended to be made available for use) by the general public at home or abroad, or which will be required for such use by governmental regulations; or

(2) a principal purpose of the contract is for exploration into fields which directly concern the public health or public welfare; or

(3) the contract is in a field of science or technology in which there has been little significant experience outside of work funded by the government, or where the government has been the principal developer of the field, and the acquisition of exclusive rights at the time of contracting might confer on the contractor a preferred or dominant position; or

(4) the services of the contractor are

(i) for the operation of a government-owned research or production facility; or

(ii) for coordinating and directing the work of others,

the government shall normally acquire or reserve the right to acquire the principal or exclusive rights throughout the world in and to any inventions made in the course of or under the contract. In exceptional circumstances the contractor may acquire greater rights than a non-exclusive license at the time of contracting, where the head of the department or agency certifies that such action will best serve the public interest. Greater rights may also be acquired by the contractor after the invention has been identified, where the invention when made in the course of or under the contract is not a primary object of the contract, provided the acquisition of such greater rights is consistent with the intent of this Section 1(a) and is a necessary incentive to call forth private risk capital and expense to bring the invention to the point of practical application.

(b) In other situations, where the purpose of the contract is to build upon existing knowledge or technology, to develop information, products, processes, or methods for use by the government, and the work called for by the contract is in a field of technology in which the contractor has acquired technical competence (demonstrated by factors such as know-how, experience, and patent position) directly related to an area in which the contractor has an established nongovernmental commercial position, the contractor shall normally acquire the principal or exclusive rights throughout the world in and to any resulting inventions, subject to the government acquiring at least an irrevocable non-exclusive royalty-free license throughout the world for governmental purposes.

(c) Where the commercial interests of the contractor are not sufficiently established to be covered by the criteria specified in Section 1(b), above, the determination of rights shall be made by the agency after the invention has been identified, in a manner deemed most likely to serve the public interest as expressed in this policy statement, taking particularly into account the intentions of the contractor to bring the invention to the point of commercial application and the guidelines of Section 1(a) hereof, provided that the agency may prescribe by regulation special situations where the public interest in the availability of the inventions would best be served by permitting the contractor to acquire at the time of contracting greater rights than a non-exclusive license. In any case the government shall acquire at least a non-exclusive royalty-free license throughout the world for governmental purposes.

publish that the compounds have at least been tested for something), the compounds most likely will not be tested for their intended–and potentially most effective–uses.

- *University Testing Laboratories*
  University-run laboratories have only limited capability to carry out pharmacological evaluation beyond the first gross qualitative steps. In most cases, they have limited access to professional pharmacologists, no experience with FDA requirements and procedures, and little interest in active compounds beyond finding out why they are active.
- *Independent Testing Laboratories*
  Both types of independent testing laboratories–commercial and nonprofit–that evaluate academically prepared compounds must charge for their services so that their testing is self-supporting.[4] Although some of the independent testing laboratories can offer a rather complete line of pharmacological testing capabilities, costs tend to be beyond the scope of the academic investigators' grant budgets. Representatives of one independent testing laboratory, an organization capable of performing a fairly complete range of services for academic investigators, said that there have been only a handful of tests performed for principal investigators in the 15 or so years of the organization's experience, and that the total value of all of this work would not exceed $10,000. They attributed the low volume to the costs that they had to charge in order to earn a profit from testing. In some cases, nonprofit organizations may have grants that allow them to run specific screens; however, this is not true in all medically interesting areas.

It does not seem to matter much which screening source other than drug firms is used to test the NIH-sponsored compounds–the result is the same (except in the case of a compound that proves useful in treating cancer or malaria.)[5] Having to do without the drug firms' screening services–which in their total range include specific screening, extensive test results, and concomitant development work–means to the academic investigator that the work on his compound that is necessary for ultimate utilization is cut off, in most cases, at the development stage.

The second major effect of current government patent policy is the serious weakening of the communications links vital for the productive interchange of research ideas. Prior to 1962, the interchange of ideas among the NIH, university investigators, professional journals, and drug firms was accomplished through consulting relationships, work on compounds, test data, and papers. Since 1962, two of these media for interchange of ideas–the flow of compounds and investigators–have been virtually eliminated. The other two media–consulting relationships and papers–have been diluted by the lack of drug industry screening services for NIH-sponsored compounds. Drug firms currently seem to screen their consultants carefully; a criterion for an acceptable consultant seems to be noninvolvement with government research related to the drug firm's interests. With regard to papers, the lack of extensive–or even, in many cases, specific–test results has led to decreased publication of results of medicinal chemistry research. In addition, two media contacts through scientific seminars and personal friendships have been affected to some extent.

In summary, many extremely important contacts among academic, industrial, and government researchers in areas outside of cancer and malaria have been either eliminated or seriously decreased because of the current patent policy and the consequent threat of "contamination" of industrial research. In contrast, when the compound originates under a drug industry grant, the working relationship between the academic investigator and the drug firm screening his compound is very close, and research can be recycled or replanned as necessary to meet specific goals.

From their respective testing services outlined above, the roles and operating patterns of the various screening sources can be summarized as follows. The pharmacology department of a drug firm acts as a sort of sophisticated broker between an inventory of tens of thousands of compounds (some generated by academic investigators and some generated through in-house efforts) and the clinical requirements of the medical profession. Since it is specifically oriented to cancer and malaria, the pharmacology work done by CCNSC and WRAIR also falls in this category. The pharmacology department of a university probably functions more as a scientific knowledge-gathering organization operating with an inventory of compounds and producing state-

[4] In contrast, testing by a pharmaceutical firm is essentially a by-product of its need for research, testing by government agencies is funded because of important national goals, and testing within universities is squeezed out of operating budgets by interested faculty members.

[5] Because of the large amounts of money available for cancer research and malaria research, the availability of testing facilities in these fields, and the fact that compounds in these fields seem to have the greatest chance for utilization, cancer research and malaria research are attracting great interest and effort on the part of university investigators in medicinal chemistry. Compounds found, through government screening, to be useful in treating cancer or malaria are developed by the government and can be carried through the remainder of the drug development process to the consumer.

B. Effects of Government Patent Policy on a Major Government Program

1. Lack of Collaboration in the National Institutes of Health (NIH) Medicinal Chemistry Program

The NIH medicinal chemistry program was studied by Harbridge House as an example of a major government program in which patent considerations were known to have a noticeable adverse industry-wide affect. Through this study it was possible to define the range of effects patent policy can have when the government either takes title to government-sponsored inventions or reserves the right to do so in programs involving a highly patent-sensitive industry.

The two key factors shaping industry reaction to the medicinal chemistry program are heavy private investment in civilian-oriented research which parallels government work, and application of that research to commercial products in which patents are important in establishing and maintaining a market position. When both these factors are present, patent policy may have a significant effect on participation in government programs and utilization of their patentable research results. A third factor—the extent of invention development by the government for commercial use—will also influence industry reaction even when the other two factors are present since it conditions the financial risks and potential rewards of using an invention without exclusive rights. In this respect, new compounds developed under the medicinal chemistry program are typically far removed from commercial products even when they show useful biological activity, and require substantial additional development beyond the work sponsored by the government. The sections below describe the effects of patent policy on both participation by the pharmaceutical industry in the medicinal chemistry program and its utilization of program results. Even though industry participation, prior to 1962, was provided at no cost to the government, we believe the effects of patent policy described below would have been the same if the government had attempted to acquire these services from industry under contract.

The NIH conducts extensive work in medicinal chemistry as part of its program in medical and health-related research. Normally 500 to 800 medicinal chemistry grants are in operation at any given time, and they annually account for about $8 million of the NIH grant program. Under these grants, new compounds believed to have potential medical value are developed; chemical synthesis techniques are studied; the relationship of chemical structure to biological activity is investigated; and research opportunities to promote professional development of medicinal chemists are provided. The typical grant is conducted by personnel associated with universities or hospitals and may cover a period of several years. Frequently, many related compounds are synthesized and tested under a single grant.

Prior to 1962 pharmaceutical firms had routinely made tests for biological activity—at no charge—on compounds developed by grantees. Such screening, required to establish the usefulness of the compounds, is the first step in developing new drugs. According to estimates furnished NIH by the pharmaceutical firms, screening a compound to the point where sufficient data are available to support a Federal Drug Administration application may cost $200,000 to $500,000. Most compounds do not survive the initial broad screening, which may only cost several hundred dollars or less depending on the tests performed.

Since many significant discoveries in medicinal chemistry have occurred by accident rather than by plan, the practice is to screen large numbers of compounds for a wide range of possible uses. The NIH medicinal chemistry program thus provides a fertile source of new and potentially useful compounds for pharmaceutical firms to explore. HEW patent policy has required that all rights in inventions arising out of NIH-sponsored research shall be determined by HEW. Prior to 1962, however, drug firms were never required to sign agreements with the grantee of NIH regarding rights to inventions discovered in screening.

In 1962 NIH began requiring pharmaceutical firms to sign a patent agreement before being permitted to screen compounds developed under NIH funds. The agreement imposed four conditions on the screener:

(i) It shall not disclose the results of testing for 12 months, except with the consent of all parties concerned.

(ii) It shall promptly report the results of testing to the investigator and will furnish him the information demonstrating any utility or new use of the compound for use by the PHS in connection with any application for patent that organization may file.

(iii) It shall be permitted to obtain patent rights to new uses of the compounds developed at its own expense *except* under three circumstances:

(a) Where the grantee contributed or participated in the conception or reduction to practice of such new use;

(b) Where the patent would hamper, impede, or infringe on the intended use of the invention;[1]

[1] Agreement, as revised in December 1966, eliminates these criteria.

PART V. Effect of Government Patent Policy on Industry Participation in Government R&D Programs

A. Introduction

The effect of government patent policy on industry participation in R&D programs was the most difficult factor to measure because of the difficulty of obtaining data on the question. However, a useful understanding of problems in this area was obtained by studying the medicinal chemistry program of the National Institutes of Health (HEW) and various contracts of the Department of the Interior. This aspect of the study attempted to answer such questions as:

(i) Do competent business organizations refuse to undertake government R&D work—either entirely or in selected areas—because of government patent policy?

(ii) What effect does policy have on application of a contractor's most advanced private technology to government programs?

(iii) Does patent policy have any influence on the flow of information concerning new developments between a contractor's government and privately sponsored work?

The data available to us only allows us to define some first-order effects of the policy in this area.

Industry's main concern about participating in government research has been the compromise of private investment in research and invention. Frequent objection was made to the "peephole" effect of government programs, whereby the government receives rights in the accumulated results of private work. The "peephole" effect has its counterpart in patent matters where an invention has been conceived at private expense, but reduced to practice under a government program. The traditional patent provisions classify this as a government invention and dispose of its rights under the terms of the contract.

The reach of the contract has been extended in some programs to background patents owned by the contractor at the time of contracting. This practice causes the sharpest industry reaction of all because firms feel caught between their wish to participate in government programs and the need to protect their private investment and competitive position.

The major adverse effects of patent policy on participation are program delay, loss of participants, diversion of private funds from government lines of research, and refusal to use government inventions and research when questions regarding a company's proprietary position are raised. These adverse effects occur selectively, but they have occurred at important points in government programs observed in the study.

The key to the participation question, however, lies in the attitude of prospective contractors toward the role of patents in their activities. As noted in connection with utilization, patents have varying importance to organizations doing business with the government. Industrial firms whose major business objective is participation in government work and systems-oriented companies in the study sample were at one end of the scale and were found to assign patents a secondary role compared with technical and management competence. Patents typically were used by the former to provide recognition to technical personnel and to project the creative quality of their work to their government customers. Systems firms, on the other hand, were found to rely on patents to ensure design freedom, provide material for cross licensing agreements as well as to recognize creativity in their technical personnel. The data indicates that firms in these two categories are not likely to refuse to participate in government R&D for patent reasons. However, systems firms may encounter participation problems at the subcontract level if the government acquires title to all inventions developed under its program.

On the other hand, firms which place a high value on patents for defensive purposes tend to choose among the areas in which they are willing to undertake government research and may decline to participate in programs which impair their operational flexibility. And, firms in research-intensive industries like electronics and new technically-oriented firms seeking to develop a proprietary product-line through government research were found to rely on patents to establish proprietary positions. These firms tend to be selective in their government-sponsored research and may decline to participate in programs which conflict with their privately sponsored research and development or which do not promote their growth objectives for proprietary lines.

Firms which follow this policy even more fully try to assure corporate ownership of patents before initiating work on a government contract or may consciously isolate government work from their commercial operations. In the latter case, there is usually little interchange of technical innovations between the government and commercial activities of the firm and there may be some

in comparison with the dollar volume of sales in other major industry product lines. As noted previously in "The Impressive Patent Case," five companies occupy the market for the equipment, and the exclusive licensee has at least one half of the market. We believe that the current degree of concentration arose from circumstances other than the fact that patent title was retained by the original R&D contractor:

- The exclusive licensee obtained an early start in the technology. Even before it began negotiations for the exclusive license, it was working on a machine which performed many of the functions of the patented equipment to be used in its own internal manufacturing operations. The exclusive licensee, after receiving its license, completed the first production application of equipment embodying the invention and gained further momentum when it received a substantial government order for the equipment.
- The combination of technological and marketing talents required to produce and market the equipment limited the attractiveness of producing the equipment to a few firms.
- The stated licensing policy of the exclusive licensee is to license all comers on reasonable terms.
- Government business still occupies about 70 percent of the market.
- Improvement patents in the field are held by various companies.
- The wide market for less sophisticated equipment not covered by the subject patent is part of the competitive environment of the sophisticated equipment because buyers may choose between these two types of equipments for many applications and among the 10 or so manufacturers of the less sophisticated equipment. The exclusive licensee does not have the major share of that market for the less sophisticated device.

In the "Critical Process Patent Case," the invention appears to give the exclusive licensee sufficient leverage to control the industry. We believe it is untypical of government inventions in this respect. But, provision for government "march-in-rights" to require licensing at reasonable rates would appear to provide the necessary safeguard to protect against the occurrence of such cases.

Similarly, the effect on competition of the other cases studied can be summarized as follows:

(i) *"The Small Business Case."* The activities of the small business in this case have increased competition and lessened concentration within its business area. The company's licenses have involved a full-scale transfer of technology.

(ii) *"The Sophisticated Devices Case."* The commercial market in this case is small, sophisticated, and, in large part, experimental; and government sales are four times commercial sales. Whereas the patentee has the major share of the government and commercial markets, the potential economic leverage of the invention is small since the patentee has licensed its major competitor and two others at low royalty rates.

(iii) *"The Ninety-Percent Government Business Case."* The patentee of this invention does not manufacture it and would like to see as many other firms as possible use the invention. Therefore, it has licensed six manufacturers and one user, and would license others. In addition, firms have used the invention rather freely without obtaining a license.

(iv) *"The Declining Business Case."* Since new companies have been entering this market during the life of the patent and the company's business in the market has declined, it is clear that the patent ownership has not had an adverse effect on competition or concentration.

(v) *"The Commercial Company Case."* Competition was not adversely affected in this case since the entire industry is licensed and the other commercial patents that the patentee developed were equally basic to the system.

(vi) *"The Nonprofit Institution Case."* The patentee here does no manufacturing and would like to see as many companies as possible use the invention. Over the life of the patent, four firms have desired to develop the equipment and have received licenses.

b. *Licensing Terms.* Licensing, of course, is a very important factor in the conclusions outlined above. Although many aspects of existing licenses, licensing policies, and royalties were discussed in the research at the various companies, copies of licenses were not available for examination. Much of this information is considered confidential by the companies interviewed.

Some firms did, however, reveal royalty rates. In "The Small Business Case," one license included a 5 percent royalty, based on the net selling price of the equipment. Another license, now inactive, required a 3 percent royalty on manufacturing and sale of the invention and 1 percent on the entire device embodying the invention. Licensees had strong bargaining positions here and were able to negotiate low royalty rates.

However, the total number of refusals in the survey is negligible, and with the exception of the gas turbine motor scroll structure, none of the inventions described above made any appreciable impact on a commercial market. Even the turbine motor scroll was competing with alternative methods of performing the same function. There is little evidence in the survey inventions that refusals to license have had a material effect on business competition in commercial markets.

C. Sample Patents Involved in Lawsuits

1. Research Approach

Anticipating that patents involved in court proceedings were likely to be important and have a significant commercial impact, sample patents involved in law suits were investigated to identify inventions which have a significant effect on competition. The purpose, however, was not to study the law suits in themselves, but to determine the effect of the patents on competition.

Working from the listing of contractor-owned patents issued in 1957 and 1962 and from the patent sections of *Shepard's Citations* (including current supplements through July 1967[5]), we identified patents which had been involved in lawsuits between private parties regarding infringement or validity. The search of *Shepard's Citations* disclosed 16 private suits involving 11 patentees or assignees.

Next, the court files of these lawsuits were examined to determine the nature of the dispute and to decide whether the cases were relevant to the study.[6] In this step, four patents and six suits were eliminated because the main issues did not involve the patents, but were primarily claims for appropriation of trade secrets—one involved use of a patented invention under a government contract rather than commercial utilization. The remaining nine patents involving seven patentees or assignees were selected for further study. In addition, a tenth patent was added during the course of our research. Issued in 1960 to a firm already under study, it had far greater importance than the two related 1957 patents which were the starting point for the research. In each case, interviews were conducted with patentees or assignees to obtain information about the inventions, their commercial development, their licensing and use, and their effect on business competition.

Much of the data provided to us by the companies interviewed were given in confidence. We have, therefore, disguised both the inventions and the companies involved and reported them only in summary fashion. For identification, we give the following titles to the cases:

(i) Case 1 – The Small Business Case
(ii) Case 2 – The Sophisticated Devices Case
(iii) Case 3 – The Impressive Patent Case
(iv) Case 4 – The Ninety-Percent Government Business Case
(v) Case 5 – The Declining Business Case
(vi) Case 6 – The Commercial Company Case
(vii) Case 7 – The Nonprofit Institution Case
(viii) Case 8 – The Critical Process Patent Case

2. The Patents Involved in Lawsuits

a. *The Small Business Case.* The invention involved in "The Small Business Case" is a critical component of a capital equipment item which sells for from $25,000 to $35,000 and which is the primary product of the company. The patentee is an individual inventor—a type who is sometimes thought to no longer exist in this era of group research by large companies—who owns a small business. His company has about 65 employees and has an expected sales volume for fiscal year 1967 of between $700,000 and $1 million, a record for the firm.

The patentee has licensed two domestic firms and the patent is available for license to others. The licenses include a complete transfer of technology. An infringement suit to collect royalties is in process against the largest firm in the industry. There is a widely used alternative technology to the invention and there are other more inexpensive ways of accomplishing its functions that have advantages in some applications.

b. *The Sophisticated Devices Case.* The invention in "The Sophisticated Devices Case" is a critical component of a specialty device which has its main use on government work, but which also has some sophisticated commercial applications that contribute annual sales of about $200,000 to the patentee. The firm has been trying to promote utilization of the invention commercially, a major factor in deciding to form a small subsidiary company to manufacture it and other less sophisticated devices (amounting to about 80 percent of the commercial market in the total product line) that are in the same product line. The commercial market for the

[5] The patent law requires that when a patent is the subject of a court suit, the Clerk of Courts must notify the Commissioner of Patents, who, in turn, publishes this information in "The Official Gazette." *Shepard's Citations* picks up these listings from "The Patent Gazette" and publishes a complete listing of the patents with citations to the court suits.

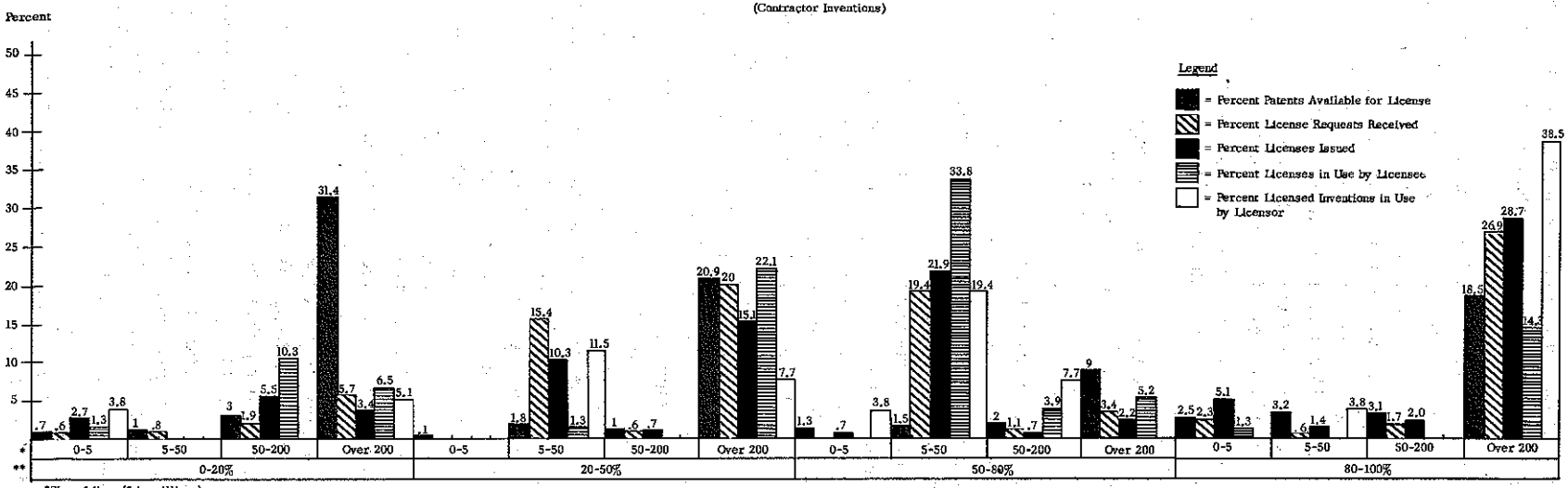
[6] No patent was adjudicated in any of these proceedings. While there were some interlocutory opinions and hearings on such matters as change of venue, all the proceedings, except those still continuing at the date of our research, were settled by the parties through stipulation of settlement, withdrawal, or voluntary dismissal.

The remaining 15 patents, involving five companies, reflected explicit management decisions to withhold licensing as part of their business strategy. (Table 23 lists pertinent information on these inventions.) Licenses were refused for two basic reasons: (i) to establish new markets for the company and (ii) to protect existing markets from competitors. One company, (Company 5), holding 8 of the 15 patents, categorically refused to license competitors when either of the above situations existed. The remaining four companies refused licenses selectively, depending upon their evaluation of the patents and specific market conditions. The first reason—establishment of new markets—was usually associated with specialized new products of limited applicability or with attempts to penetrate markets of well-entrenched competitors. The second reason—protection of existing markets—was a position generally adopted when the company was either competing

TABLE 23
REFUSALS TO LICENSE

	Invention	Company	Commercial Sales	Private Development Cost	Role of Invention	Reason for Refusal to License	Sponsoring Government Agency
(1)	Turbine drive mechanism for miniaturized jet fuel flowmeter	1	$1 million	$450,000	Supporting	Establish market position with new product	DOD
(2) & (3)	Design features and fluid seals for jet fuel flowmeter (two related inventions)	1	$800,000	$1 million	Supporting	Establish market position with new product	DOD
(4)	Porous metal and process for manufacture	1	$13,000	$300,000	Supporting	Establish market position with new product	DOD
(5)	Gas turbine motor scroll structure	2	$60 million	Not Available	Critical	Avoid direct competition	DOD
(6)	Punch guide for microfilm mounting	3	$500,000	$30,000	Supporting	Avoid direct competition	DOD
(7)	Bead breaker for tire mounting machine	4	$66,000	$2,000	Critical	Avoid direct competition	DOD
(8)	Electromagnetic pump for liquid metals	5	$1.25 million (commercial and government)		Supporting	Avoid direct competition	DOD
(9)	Reagent for carbon dioxide analysis	5	$11,000 (commercial and government)	Not Available	Critical	Avoid direct competition	DOD
(10)	Safety helmet with eye shield	5	Negligible	Not Available	Supporting	Avoid direct competition	DOD
(11)	Gas detection techniques	5	No commercial sales anticipated	Not Applicable	Not Applicable	Avoid direct competition	DOD
(12)	Shaft seal for liquid metal pumps	5	No commercial sales anticipated	Not Applicable	Not Applicable	Avoid direct competition	DOD
(13)	Contaminant analysis for liquid metals	5	No commercial sales anticipated	Not Applicable	Not Applicable	Avoid direct competition	DOD
(14)	Apparatus to maintain low oxygen atmosphere	5	No commercial sales anticipated	Not Applicable	Not Applicable	Avoid direct competition	DOD
(15)	Head positioner for helmet	5	No commercial sales anticipated	Not Applicable	Not Applicable	Avoid direct competition	DOD

TABLE 21
CONTRACTOR LICENSING ACTIVITY
BY SIZE OF FIRM AND PERCENT GOVERNMENT BUSINESS
(Contractor Inventions)



*Size of firm ($ in millions).
**Percent Government business.

PART IV. Effect of Government Patent Policy on Business Competition

A. Introduction

Reflecting the government's concern with maintaining a competitive economy, the patent study included tasks to determine whether government patent policy promotes or restricts business competition. Data on this question were gathered from four sources.

(i) Questions on licensing were included in the utilization survey questionnaire to provide a data base for statistical analysis and case studies;

(ii) A pilot study was conducted within the synthetic quartz crystal industry to determine the feasibility of using case studies to explain the effect of patent policy on competition;

(iii) Case studies were conducted on sample patents involved in infringement suits to determine the effect on competition of inventions important enough to involve litigation; and

(iv) Interviews were conducted with patentees who reported inventions unavailable for license to determine the importance of the inventions and their effect on competition.

In evaluating the impact of government patent policy on competition, it is important to distinguish the effects of patent policy from other effects which may result from industry participation in government programs. Competitive advantages in commercial markets may well accrue to government contractors through knowledge gained in new technologies, through sharpening of technical skills, and through government funding of R&D work, which has parallel commercial areas of interest. But these are quite separate from the advantages of owning patents to specific inventions. This study has tried to measure only the latter. And, it has tried to measure it in terms of the inventions included in the survey sample. While a broader study of the cumulative effect of government-sponsored inventions patented over several years might have provided more definitive data, we believe that the study data provides a representative and useful picture of the effects of patent policy on competition.

The study indicates that both in number of inventions utilized and in sales volume, the patents sampled appear to have had small impact on commercial markets. Although over 80 percent of both sample inventions and utilization were concentrated in 50 firms, only 55 inventions owned by contractors–2.7 percent of the sample–played a critical role in their commercial use, and five were responsible for $201 million out of the $406 million in cumulative sales attributable to contractor inventions. This utilization of critical-role contractor-owned inventions is low compared with the total sales of these firms and the industries in which they participate. Of equal importance is the fact that very few instances were reported where owners of government-sponsored inventions refused to license their patents. Only 15 inventions–less than 1 percent of the sample–involved such refusals, and these 15 refusals involved just five companies.

These statistics suggest that government patent policy has a very limited effect on business competition, a conclusion that is corroborated by the case data. None of the infringement suits investigated involved attempts by the patent owner to limit use of the patent to himself. On the contrary, the evidence is that the patent owner, despite a general willingness to license, may find his competitors using the patent first and negotiating a license only when he claims infringement.

The study did show that government retention of title, when coupled with full development and active government promotion of inventions having high commercial potential, has promoted competition. A striking example of this is the fertilizer industry where TVA developed high-concentrate fertilizers, patented them, proved their effectiveness on pilot farms and their commercial feasibility in pilot production, and aggressively promoted their use among farmers and fertilizer manufacturers. Industry sales have increased greatly through the manufacture of these fertilizers by many small regional producers. In circumstances like these, government retention of title can be an effective spur to competition because licenses are available to all comers. But several additional factors must be present for patent policy to have this effect. It must be evident to licensees that the invention has good commercial potential. The invention must be producible in commercial quantities and marketable at a cost that is competitive with alternative product. And the risks of recouping development costs must be no greater than similar investment opportunities available to the licensee.

In most cases, government agencies have to go far beyond discovery of an invention to create these conditions. Some agencies do–as described in the Volume III report on government efforts to promote utilization of government-sponsored inventions. The Department of Agriculture, for example, has an active

engineering to meet a specific requirement and, thus, their application to other products is limited. Developed under more basic research in other cases, they are still too speculative to find quick commercial application. There are notable exceptions with high potential—transistors, vacuum tubes, numerical control devices, computers and gas turbine engines—as noted earlier in connection with sales, but the exceptions prove the rule since these inventions have commercial applications which closely parallel their government uses.

Table 19 which groups the reasons and responses in the two categories of technical and marketing shows the effect of prior experience, patent rights, percent government business, and size of firm on nonutilization. Of the four factors, patent rights have the greatest effect on whether nonutilization was attributed to technical or marketing reasons. Technical reasons for nonutilization rate 15 percent higher when the contractor has title than when he does not. Interviews with firms in the survey indicate that this is caused by contractors' normally not taking title when the inventions clearly appear to have no utility. Thus a marketing reason is inherent in the decision not to take title. Even where contractors own the patents, however, marketing reasons still predominate since contractors often take title when utilization is only a speculative possibility, resulting in ownership of many inventions with low commercial potential.

Table 19 also shows the parallel effect of prior experience and percent government business. With both factors, greater contact with commercial markets appears to increase the percentage of patents acquired that have commercial potential, resulting in a smaller number of inventions eliminated for marketing reasons.

2. Government-Owned Inventions

In contrast with contractors, licensees of government-owned inventions found development costs and development flaws rather than low commercial potential an important barrier to utilization. Those two reasons were ranked first in 35 percent of the responses (Table 18) compared with 2.8 percent for the contractor group (Table 17). The market orientation of the firm is also a more important factor with licensees than with contractors: That the invention was outside company product lines was ranked first in 27 percent of the licensee responses (Table 18), compared with 16 percent for contractors (Table 17).

Table 20 measures the effect of prior experience on licensees' reasons for nonutilization of inventions. Both with and without prior experience, technical reasons are more important to licensees (76.4 percent with experience and 50 percent without) than to contractors (39.7 percent with experience and 31.9 percent without—see Table 19). Licensees with prior experience, however, rate technical reasons more important than those without it. Interviews indicate that licensees without prior experience often inquire about an invention to determine if it is of commercial interest to them, normally receive a license in response to the inquiry, and, then upon closer examination of the invention, often conclude they do not wish to pursue it. Licensees with prior experience, on the other hand, tend to screen inventions in their field more carefully before inquiring about them, resulting in a higher proportion of marketing reasons for licensees without prior experience than for those who have it.

TABLE 17
REASONS FOR NONUTILIZATION OF INVENTIONS
(CONTRACTOR INVENTIONS, 1957 AND 1962)

Frequency
Percent

Reason for No. Commercial Utilization		No Reason Given	Development Costs Too High	Development Revealed Serious Flaws	Development Personnel Not Available	Invention Became Obsolete	Expected Market Failed to Materialize	Technology too Sophisticated	Too Much Competition	Channels of Distribution Lacking	Invention Falls Outside of Company Product Line	No Commercial Potential Seen	All Other	Total Reasons Given
Rank of Reason	1	244	20 (1.4)*	21 (1.4)	6 (.4)	236 (16.2)	208 (14.3)	171 (11.7)	10 (.7)	26 (1.8)	234 (16.1)	420 (28.9)	102 (7.0)	1,454
	2	1,116	80 (13.7	23 (4.0)	4 (.7)	76 (13.1)	78 (13.4)	62 (10.7)	26 (4.5)	43 (7.4)	67 (11.5)	86 (14.8)	37 (6.3)	582
	3	1,470	22 (9.6)	15 (6.6)	5 (2.2)	22 (9.6)	34 (14.9)	17 (7.5)	28 (12.3)	17 (7.5)	48 (21.0)	10 (4.4)	10 (4.4)	228
	4	1,611	3 (3.4)	7 (8.1)	3 (3.4)	35 (40.3)	6 (6.9)	5 (5.8)	8 (9.2)	6 (6.9)	12 (12.7)	1 (1.5)	1 (1.5)	87
	5	1,635	1 (1.6)	1 (1.6)	7 (11.1)	10 (15.9)	34 (54.0)	3 (4.8)	1 (1.6)	3 (4.8)	2 (3.2)	0 (0)	1 (1.6)	63

*Percentage is the total responses for a reason, divided by the total reasons given for that row.

endangered.[15] Thus, we found that perhaps the single most difficult task of a university patent administrator was the solicitation of invention disclosures. Even if the inventor was willing to cooperate in the utilization process, it was a familiar story that the university patent office only learned of the invention eight months after publication in a scientific or technical journal.

Since, under the present law, patent applications must be filed within one year of public disclosure of the invention or the patent will be banned, patentable ideas are frequently lost to an institution's portfolio. The universities, however, have never considered the industrial alternative of delaying publication until a patent is filed, resting on the comfort of one year within which to file an application. The college officials in Case 10 proposed that the government agencies retain an option to prohibit publication during a contractual evaluation period rather than require clearance prior to publication.

While nonprofit institutions actively disseminate technology through publication, promoting utilization of a specific invention is another matter. Given the academic preference for publication of research results over patenting them, a major problem exists in mounting an effective patent promotion program. As the cases illustrate, except for a few universities and technical schools, there is today little active promotion of patents by academic institutions.

Notwithstanding the low-key promotion of inventions by academic institutions, the critical question concerning utilization is whether patents would be promoted more effectively through government ownership, given their speculative utility. Research indicates that the mission-oriented and mixed-activity government agencies—DOD, NASA, and AEC—would promote patents largely through publicity. These agencies would not, as a rule, develop inventions beyond the agency mission expressed in the contract. A chance overlap in government and commercial requirements then, determines the applicability of the inventions in the commercial market. In most cases, substantial private development is required to commercialize patents, and the nonexclusive license the above agencies would offer may not compensate for the development risks involved. Allowing academic and nonprofit institutions to keep title, under these circumstances, offers greater flexibility in providing patent protection to interested developers, when that is necessary to achieve utilization. Title also motivates the inventor to assist in developing the invention for commercial use, because of its potential rewards to him.

[15] Case 1 is a qualified exception to this rule.

Inventions of public service agencies—such as TVA, HEW, and the Departments of Agriculture and the Interior—may differ from the inventions discussed above in two important respects: their close alignment with commercial needs, and their greater agency development and promotion for public use. Review of public service agencies[16] and their promotional programs suggests that TVA and Department of Agriculture inventions have a good chance of utilization if these agencies retain title, and invest in invention development and promotion. HEW and Department of the Interior inventions, on the other hand, require strong patent incentives for industry because of high product development costs and minimum agency development and promotion. For these inventions commercial utilization would appear to be better promoted by allowing academic and nonprofit institutions to retain title.

E. Speed of Utilization

Survey inventions that were utilized, for the most part, found quick application. Table 16 shows the time lag between patent application and first commercial utilization of contractor inventions. About a third of the inventions had been used commercially by the time a patent application was filed, and assuming three years for patent issue, about two-thirds had been used by the time a patent was received.

Prior experience plays an important role in the speed with which inventions are used. If rapid utilization is defined as occurring in three years or less from the date of application, inventions developed by firms with prior commercial experience achieved a ratio of 77 rapid to 15 slow utilizations (see Table 16). In contrast, firms without prior commercial experience had a ratio of only 31 to 22.

The mix of government and commercial business is a second major factor which affects speed of utilization. Firms in the middle range of government activity (20 to 80 percent government business) use inventions much more quickly than companies who are predominantly in the commercial or the government market. These middle range firms have a ratio of 47 rapid to 4 slow utilizations compared with 61 rapid to 33 slow for the other companies, due, at least in part, to the fact that firms with both low and high proportions of government activity separate their government and commercial work to a greater extent than do the firms in the medium range of government activity.

[16] See Volume III, on government efforts to promote utilization.

new products based on the original patents. As shown in Table 14, these firms often gain protection by patenting improvements to the original invention or by trade and processing secrets growing out of their own research. Here, government patents, although not utilized in their original form, have stimulated private research that led to commercial products. The utilization achieved by this method is not readily measurable, but it is significant.

3. Transfer of Technology in the Nonprofit Environment

a. *Licensing Programs.* Inventions arising out of nonprofit research do not travel the same route to commercial utilization as inventions arising out of industrial research. While there is much variation in the policies and practices of educational and nonprofit research institutions, we found more similarities than differences among them when contrasted with industrial commercialization practices. The nonprofit institutions do not make or sell the products and processes embodying their inventions and must license these inventions in order to have them used. Therefore, these institutions have evolved a variety of licensing techniques to transfer technology from nonprofit research programs to the marketplace.

Some colleges and universities, such as those discussed in Volume IV, Part IV, Cases 1, 3, and 6 have their own licensing programs. These programs call for processing patents through special administrative units that are responsible directly to the administration of the senior policy-making group in the institution.

Other colleges and universities administer patents as a part of the routine duties of established offices and faculty committees. At the state university discussed in Case 2, for example, the dean of the graduate school is chairman of the patent committee. An office of research services, which is responsible for administration of sponsored research, provides the necessary administrative support. Here, as in other institutions which lack formal licensing programs, the administrative arm of the school ensures that pertinent institutional regulations are observed, that there is compliance with invention-reporting requirements of government contracts, and that the rights of the parties involved are guarded in the rare case of a decision to patent an invention.

Many educational institutions administer patent programs through independent foundations, for various legal, financial, and policy reasons that are only occasionally related to invention utilization. In these instances, the invention is assigned to the foundation either by the institution or by the inventor hemself. The technical institute in Case 6 and the liberal arts college in Case 9 administer their patent programs in this way. The reasons for establishing such foundations include:

- Insulating patent funds from use by the state agency, or even by the university itself, for purposes other than financing scientific research;
- Creating a buffer between the nonprofit institution and industrial licensees in the event of litigation;
- Limiting contractual and tax liabilities;
- Providing a degree of flexibility in relationships between the nonprofits and industry not possible with the nonprofit institution alone;
- Facilitating a continuing relationship between the inventor and the licensee in order to develop the invention.

In many instances, a patent administration foundation was created to relieve the institutional administrative staff of the complicated and time-consuming technical and commercial problems of patent management. However, as additional duties were delegated, a number of the 50 to 60 such foundations retained patent development firms like those discussed in Cases 15 and 16, below, to manage their patent portfolios.

The principal agent for the transfer of the patentable products of nonprofit research to industry is the patent development firm. Of the 349 institutions described by Palmer,[14] 212 have contracts with patent development firms; in our investigation, all but three of the institutions having patent programs were also found to have contracts with such firms. Some patent development firms serve a restricted clientele or a limited technological market. Only three firms offer their services in invention marketing to all educational institutions, foundations, and nonprofit research corporations. The services of patent development firms include:

- Evaluation of disclosures.
- Assistance in preparation of patent applications.
- Negotiation of licenses.
- Distribution of royalties.
- Policing the patent.

The firms act as a clearinghouse for the nonprofits and as a marketplace for industry. Patents are typically assigned to the patent development firm on a royalty-sharing basis. Patent applications are filed on approximately 10 to 15 percent of the disclosures submitted and, if present circumstances continue, only one-quarter of these patents will ever be licensed.

[14] A comprehensive survey of the patent policies, practices, and procedures of universities, technological institutions, and nonprofit organizations was commissioned by the Patent Policy Survey of the National Research Council (National Academy of Sciences) in 1946. Dr. Archie M. Palmer published five monographs between 1952 and 1962 depicting the patent activities of the 945 institutions, with a description of the situation at each of the 349 institutions which conduct scientific and technological research and have invention policies.

TABLE 14
UTILIZED INVENTIONS
(PUBLIC-SERVICE AGENCIES)

	Case	Sponsor Agency	Number of Government Patents Involved	Additional Inventions (Trade Secrets/Patents)	Licensees/ Utilizers	Investment[4]	Annual Market[5]
1.	Dialdehyde Starch	Agriculture	8	Secrets and patents	1/1	About $2.5 million	About $750,000
2.	Synthetic Mica	Interior	1	Secrets	2[1]/2	About $2 million	About $600,000
3&4.	Liquid and Mixed Fertilizer Process	TVA	4	None	130/many[1]	About $40,000	About $3 million
5.	Cotton Opener	Agriculture	1	Secrets and patents	13/3[1]	About $40,000	About $140,000
6.	Superphosphoric Acid	TVA	1	None	3/1	N/A[8]	N/A[8]
7.	Sugar Beet Extraction	Agriculture	2	None	1/more than 1[2]	N/A[6]	N/A[6]
8.	Foam-mat Process for Drying Foods	Agriculture	3	Patents	4/1	About $300,000	N/A[7]
9.	Low-Temperature Phase Equilibria Cell[3]	Interior	1	Unknown	1/more than 1[2]	N/A[9]	N/A[9]
10.	Potato Flakes	Agriculture	3	Patents	6 or more	Unknown	$8 million

[1] Case research on all licensees was not performed for the study. Number of licensees reflects licensees under most "popular" of patents involved in the product.
[2] Firms other than those licensed are believed to practice the invention.
[3] Government sources believe this invention to be in use although single licensee declined to be interviewed.
[4] Investment of "most successful" utilizers in case where more than one attempt took place.
[5] Current annual market of "most successful" utilizer.
[6] A process improvement invention used by a company with $40 million sales. No breakout of investment or contribution of invention available.
[7] Current market is only in pilot plant design and installation.
[8] A process for turning out an existing product–acid manufactured by new process probably amounts to several million dollars; investment estimates were not available.
[9] Only known utilizer declined to be interviewed.

Both agencies employ a variety of techniques to promote the use of new products which make industry aware of valuable innovations developed by the government and which stimulate demand.[13] Thus, it appears that, in most cases, three factors contributed to commercial utilization of these inventions without exclusive rights: The inventions were commercially oriented and there were a clear need and market demand for them; the government undertook extensive development of the invention in its commercial form; and the government promoted industry interest in the invention.

Several firms studied did achieve utilization of government-sponsored inventions without these three factors. These companies picked up inventions in various stages of government development and went on to devise

[13] Promotional approaches by government agencies are, discussed in Volume III.

government claims or conflicts over ownership of inventions. Their policies generally lead them into one of two business patterns. In the first pattern, firms will assure corporate ownership of patents before initiating work on a government contract, either by negotiating contracts that permit them to acquire title to patents on inventions they may develop, or by developing and patenting basic inventions with limited private funds and then seeking contract work in order to develop additional technical competence, push the state of the art, explore a new technology, or determine if commercial applications may begin to be drawn off. In these situations, firms deliberately select areas of government research to match their commercial interests in order to generate product ideas with commercial possibilities. New research firms with strong technical abilities and limited capital typically follow this pattern, as do specialized firms that have concentrated their business in a limited area of technology. The three firms in the first pattern (L, M, and N) are small to medium-sized companies, ranging from less than $5 million in sales to $50 to $200 million. One of these (Company L) is included under (5) above; the other two hold .9 percent of the inventions and account for about 6 percent of the utilizations. Though these holdings are small, one of the two (N) has three inventions which account for $22.2 million, or about 12 percent of the total sales of inventions by high and low utilizers.

In the second pattern, firms isolate government work from their commercial operations and pursue these activities separately. Frequently, inventions derived from government contract work will be assigned automatically to the government to avoid title conflicts or commingling with company-sponsored R&D. In other cases, government R&D will be undertaken only in areas where there is no potential conflict with corporate proprietary objectives and in order to enhance the corporate image. The technical value of government contracts to the commercial interests of these firms is rarely considered a valuable supplement to in-house research and development.

The two firms in the second pattern (C and D) are large firms with more than $1 billion in sales. They hold 4 percent of the inventions and account for 2.2 percent of the utilizations. Those firms following the second business pattern have no proprietary expectations from government contracts. Any change in government patent policy with respect to license and title rights would have little effect on them since they have already divorced their main corporate interest from government contract work and do not regard government-sponsored R&D as a source of commercial ideas.

Firms following the first pattern, however, would be severely affected by a change in policy since their business activity is based largely on government-sponsored research that may develop commercial applications. Corporate ownership of patents is, therefore, an essential feature of the growth strategy of such firms. If title to inventions arising from government-sponsored research were to become unavailable, such firms would have to either change their mode of business or refuse to contract with the government.

(7) *Patents Are Judged Differently in Commercial and Government Work.* Many diversified companies follow different patent policies in their commercial and government markets. These firms may place a strong emphasis on maintaining proprietary positions in commercial markets and express a relative lack of interest in patents arising from government work. It is difficult to generalize about these firms except to note that their policies tend to follow the patterns of the industries in which their divisions participate. Their behavior may, therefore, resemble any of the categories of firms described above if their divisions have similar business profiles.

All three firms in this category (Companies C, D, and S) are large companies with more than $1 billion in sales. Two (C and D) are included under (6) above. The third firm holds 7.8 percent of the patents and accounts for about 32 percent of the utilizations. Though it has used a large number of its government inventions, these inventions generally have played a supporting role. Only three represent significent sales, amounting to $3.0 million at the date of the survey.

(8) *Overall Effect of Policy on Utilization.* Notwithstanding the varing roles assigned patent rights by the firms described above, the key question is whether permitting them to retain exclusive rights will, on balance, promote utilization better than acquisition of title by government. The study data indicate that the answer is yes where the inventions as developed under government contracts are not directly applicable to commercial uses and the inventing contractor has commercial experience in the field of the invention. This occurs most frequently with DOD, NASA and AEC inventions. In the case of DOD, the fact that it does not actively promote commercial use of its patents is an added factor. In these instances the inventing contractor with commercial experience appears to be the logical candidate to attempt utilization either directly or by licensing others. The answer is also yes where the invention is commercially oriented but requires

TABLE 12
INVENTION UTILIZATION
TEN HIGH UTILIZERS
(CONTRACTOR INVENTIONS)

Company	Rank in Patent Holdings[1]	Patent Holdings				Number Utilized	Number Utilized With Commercial Sales Over $1 Million	Total Commercial Sales Million-Dollar Inventions
		Title	License	Number	% of Sample			
Company S	1	153	21	174	7.8	43	3	3.0
Company R	6	110	0	110	5.4	13	2	7.2
Company Q	10	52	4	56	2.7	13	1	1.0
Company E	14	36	0	36	1.7	5	1	1.0
Company H	20	22	0	22	1.0	7	0	0.0
Company A	22	20	0	20	.9	7	1	2.0
Company G	24	15	4	19	.9	4	2	70.0
Company J	25	18	1	19	.9	3	0	0.0
Company N	31	13	0	13	.6	5	3	22.2
Company M	45	8	0	8	.3	3	1	1.25
TOTAL				477	22.2	103	14	107.65

[1] Rank based on holdings of both title and license to inventions in the survey sample.

directly to the government, these firms frequently sell similar products to commercial markets. Inventions developed during the course of R&D activities tend to be auxiliary components and subsystems or incremental improvements to the basic product, not as important in sustaining sales or selling new products as are the basic engineering management and production capability of the firm. New ideas and inventions are incorporated in product modifications or in new models and little consideration is given to the protection offered by patent rights. Using a new idea to enhance product performance is regarded as more important than assuring that the company owns the exclusive right to use it.

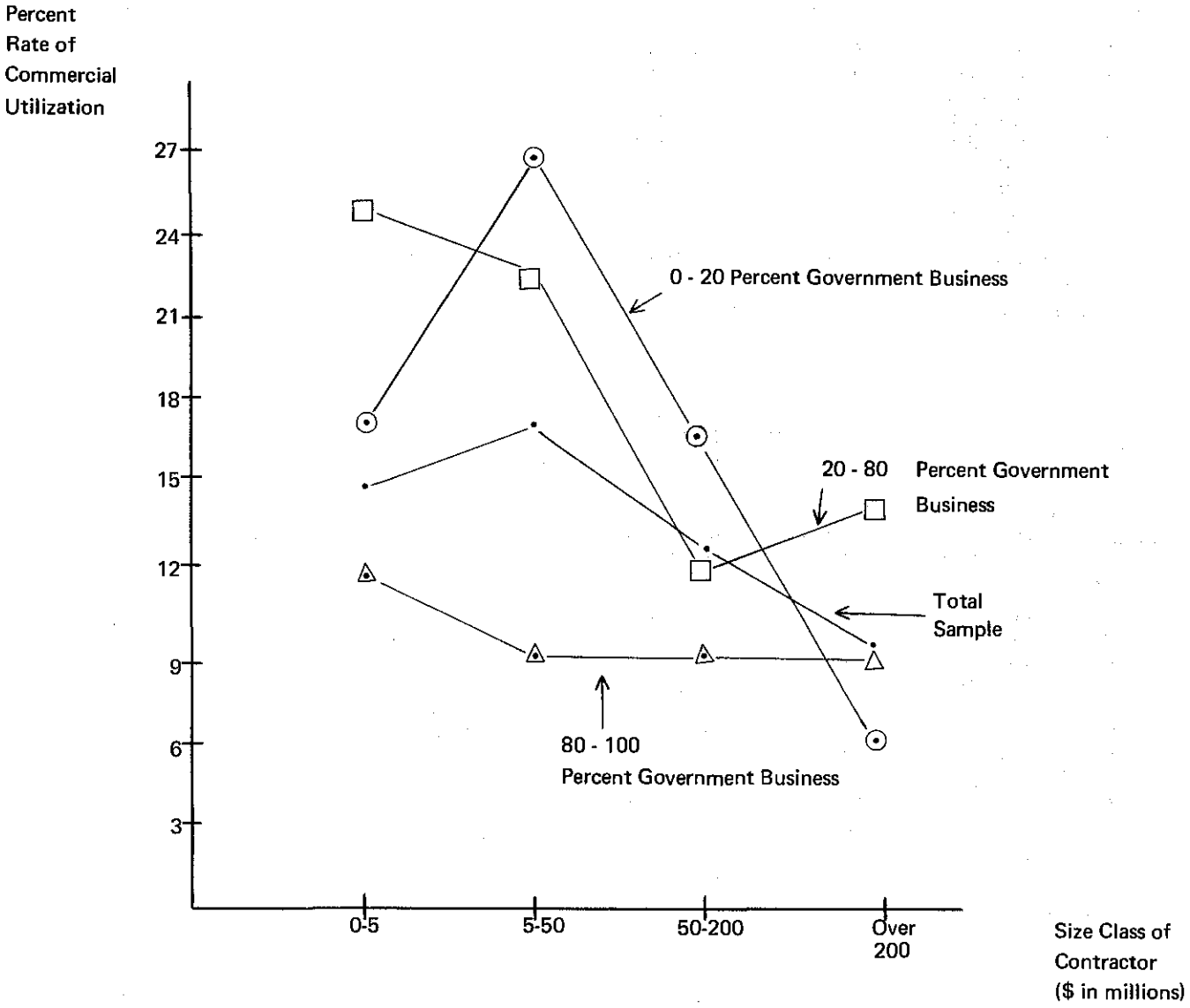
The seven firms with this attitude, three of whom are also listed under the attitude which follows, all have annual sales over $200 million (see Figure I-2). They include three high and four low utilizers, who as a group, hold 22.9 percent of both the survey patents and 36.6 percent of the utilized inventions. More importantly, however, these seven firms are responsible for $81.2 million, or almost half, of the sales of the entire group of high and low utilizers. Just three inventions, however, account for $79.2 million of that, showing again the "sweepstakes" effect in utilization of government-sponsored inventions.

(4) *Patents are Valuable for Defensive Purposes.* Some firms believe strongly that corporate ownership of patents is important to maintain flexibility in design, both in the United States and abroad (through ownership of corresponding foreign patent rights), and to provide trading material for cross-licenses with competitive firms. Ownership of a patent as a prerequisite for new product development, however, is a relatively minor factor with these firms compared with market and investment considerations associated with commercialization of the invention. Five of the six firms with this attitude are large companies with sales over $200 million. The sixth, Company H, has sales in the $50 to $200 million range (see Figure I-2). The three new firms, (Companies G, H, and I) included here hold about 8 percent of the patents and utilization, including one highly used invention, contributing $70 million in sales to its owner.

A change in government patent policy may affect some firms in this category by causing them to choose

FIGURE I - 1

RELATIONSHIP AMONG SIZE OF FIRM, PERCENT GOVERNMENT BUSINESS, AND THE RATE OF COMMERCIAL UTILIZATION[1]



[1] Defined as patents in commercial use/patents in response.

Significantly, prior experience has an even greater effect on utilization than does ownership of the patent, as the case studies in Volume IV, part II confirm. Interviews of 10 high and 11 low utilizers showed that, in most large firms, the decision to use a government invention is quite separate from the decision to patent. Most frequently the decision to patent is based on a desire to ensure freedom of design, to protect against infringement suits, to cross license, to recognize employee inventiveness, or to enhance the firm's image. In most instances, utilization counts only as a speculation that the invention may have some commercial use. Tables 9 and 10 provide some measure of the weight given the commercial value of government inventions by these firms. With the exception of three companies who do most of their business with the government, all file one-third or less of their patent applications on government-sponsored inventions.

b. *Field of Technology, Size of Firm, and Percent Government Business.* Three other factors—the field of technology, the size of the firm, and the percent government business—were found to affect the rate of commercial utilization statistically.

Table 11 shows that mechanical inventions have a higher rate of utilization than inventions in other fields of technology. Prior experience again strongly influences utilization, but apparently less for mechanical inventions than for those in other fields of technology.

The combined effect on utilization[11] of size of firm and percent government business is shown in Figure I-1. As we have already discussed, large firms in government markets tend to patent for reasons more than planned use of the invention, resulting in their lower rates of utilizations as shown in Figure I-1. Case studies show that some firms who do most of their work for the government do not try to apply the inventions commercially and, therefore, have low rates of utilization. Smaller firms and those more oriented to commercial markets achieve higher utilization because they patent more selectively and have the necessary experience to develop market innovations in their product lines.

Even for firms with the highest rates of utilization, however, the amount of utilization is very small when measured in sales. Thus, the factors affecting utilization, described above, affect it only within a narrow range of performance. The most basic factor, as noted in Volume IV, Part II, is the commercial potential of the sample inventions and all other factors make a difference only when inventions reach a minimum threshold of commercial utility. Not many of the inventions involved in the study have reached that point.

c. *Industry Attitudes Toward Patents on Government-Sponsored Inventions.*

(1) *Introduction.* Industry's attitudes toward patents on government-sponsored inventions are an important factor in utilization even though these attitudes cannot be evaluated statistically. The 21 high and low utilizers of contractor inventions interviewed in the survey were found to have six dominant attitudes toward patents, which condition their reaction to government patent policy and govern their actions in participating in, and using the inventions of, government programs. Firms were classed as high utilizers if they used more than 12 percent of their inventions commercially and as low utilizers if they utilized less than 7 percent.

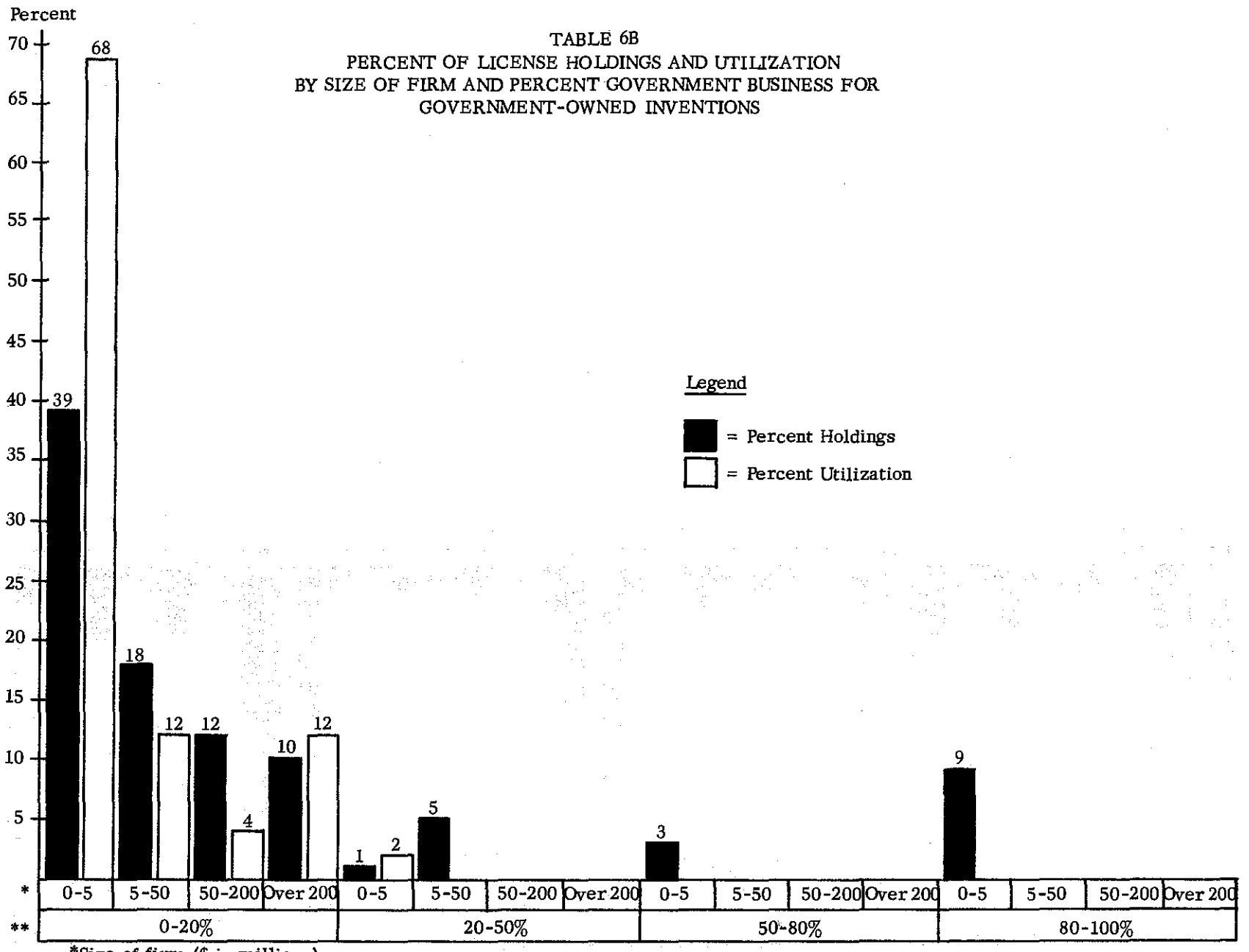
Figure I-2 categorizes the 21 companies according to dominant attitudes, size distribution, and industry. As shown in Tables 12 and 13, these firms account for 53.7 percent of the survey inventions, 131 of the 210 utilized inventions, and, at least, $179 million of the $406 million in sales reported for contractor inventions.

(2) *Patents Have No Importance.* A lack of interest in patents was characteristic of some research-oriented and manufacturing firms that do either a preponderance or a large percentage of their business in the government aerospace and defense markets. Three such firms—Companies A, F, and K, ranging in size from the $5 to $50 million category to over $200 million in annual sales (see Figure I-2)—indicated no desire to expand into commercial markets and no mechanism for the commercialization of inventions. These three firms account for only 1.8 percent of the inventions of the companies interviewed. Although Company A is shown as a high utilizer in Table 12, its attitude toward patents has changed since the early sixties, and it no longer pursues commercial utilization of inventions developed by its government divisions. When these firms (A, K, and F) obtain patents under government contracts, their sole purpose is recognition of technical competence within the company.

(3) *Patents Are of Little Value, Compared with Technical Know-How.* Firms expressing this attitude toward patents generally are manufacturers of such complex systems and technical products as aircraft, jet engines, computers, or communications equipment. Although as much as 75 percent of their sales may be

[11] The rate of commercial utilization is computed differently in Figure I-1 than in the Table 6 above. Utilization percentages in Table 6 represent a group's share in all inventions used. Utilization rates in Figure I-1 represent the percent of a group's holdings that it has been able to utilize.

TABLE 6B
PERCENT OF LICENSE HOLDINGS AND UTILIZATION
BY SIZE OF FIRM AND PERCENT GOVERNMENT BUSINESS FOR
GOVERNMENT-OWNED INVENTIONS



*Size of firm ($ in millions).
**Percent government business.

TABLE 5
CONCENTRATION OF CONTRACTOR PATENT HOLDINGS IN THE SAMPLE, RESPONSE RATE, AND RATE OF COMMERCIAL UTILIZATION: ALL AGENCIES BOTH SAMPLE YEARS[1]

Number of Firms	Number of Patents in			Percent[5] of Total Patents in			% Average Utilization Percent[6]
	Sample[2]	Response[3]	C. U.[4]	Sample	Response	C. U.	
Top Five[7]	721	662	57	31.2	32.6	27.2	8.6
10	1,150	1,047	92	49.7	51.6	43.8	8.8
25	1,635	1,479	142	70.7	73.0	67.6	9.6
50	1,919	1,735	170	82.9	85.6	81.0	9.8
Total	2,316	2,024	210	100.0	100.0	100.0	10.4
In Sample, No Response	1,082						

Number of Firms:
(1) Responding 192
(2) Not Responding 271
(3) Total 463
(4) With At Least One C.U. 65

[1] Total sample includes all patents developed by contractors and issued in 1957 and 1962, except those developed under NASA contracts and 415 AEC inventions.
[2] "Sample" means the total population of patents as defined in footnote 1.
[3] "Response" indicates the number of patents for which questionnaires were returned.
[4] "C. U." indicates that commercial utilization has been achieved for this patent, by the inventing contractor.
[5] Percent in each case is the percent of the total patents of responding firms in the sample, the response, and in commercial utilization. For example, a total of 210 patents in C. U. and the top five firms held 57 or 27.2 percent of these patents in C. U.
[6] Calculated by taking the sum of patents in C. U. over the sum of patents in the response for each size class.
[7] Ranking is by order of number of questionnaires in the response.

used (13.5 percent) a larger share of inventions than their share of responses.

Grouping firms by percent government business rather than by size, Table 6A shows that firms with 20 percent or less in government work have the most patent activity but not the most utilizations. Comprising 43.5 percent of the responders, this group owns 38.9 percent of the inventions and accounts for 29.0 percent of the utilization. Firms in the 80 to 100 percent category are second in level of activity, comprising 31.5 percent of the responders, 26.4 percent of the titles, and 21 percent of the utilization. Firms in the 20 to 50 category, however, show a better record of utilization than any other group. Constituting 23.6 percent of the inventions, they account for 32 percent of the utilization. The high utilization is due primarily to the large firms (over $200 million) in the group. Firms in the 50 to 80 percent category show fairly low levels of activity; comprising 11 percent of the responders, they own 12 percent of the patents and account for 18 percent of the utilization.

3. Government-Owned Inventions

Concentration of license holdings and utilization of government-owned inventions presents a very different picture from contractor inventions. As Table 6B shows, holdings and utilization are very heavily concentrated in small firms with less than $5 million in sales who do 20 percent or less of their business with the government. These firms account for 68 percent of the utilization of government-owned patents. Large firms with over $200 million in sales utilized almost no inventions they did not develop except for a small segment doing 20 percent or less of their business with the government. Thus the pattern of holdings and utilization is exactly the reverse of the pattern for contractor inventions.

Significantly, utilization of licenses is concentrated among inventions developed by TVA and Agriculture, as shown in Table 7. These agencies account for 45 of the 50 users among licensees and six of the 10 utilized inventions. The R&D programs of these agencies are

TABLE 4
SALES AND PRIVATE DEVELOPMENT COSTS ASSOCIATED WITH COMMERCIAL UTILIZATION OF GOVERNMENT-OWNED PATENTS BY NON-INVENTOR LICENSEES
($ in millions)

	Amount[1] of Actual Domestic Sales From:		Amount[1] of Actual Foreign Sales From:		Development Costs[2]			
	Critically Important Inventions	Inventions with a Supporting Role	Critically Important Inventions	Inventions with a Supporting Role	Amount[1]	Average Percent in Technical Development	Average Percent in Production Facilities	Average Percent in Marketing
Total Sample	201.12	6.945	2.2	.085	5.389	21.1	52.2	26.7
DOD	.02	.055	0	0	.040	70	30	0
AEC	.40	0	0	0	.020	50	25	25
Agriculture	196.5	.025	2.2	.085	3.118	17.1	47.9	35
TVA	4.20	5.34	0	0	2.211	16.9	58.9	24.2
Other Agencies	0	1.525	0	0	0	0	0	0

[1] To date of response to questionnaire.
[2] Average for those responding to this question only.

Agriculture and TVA are the largest contributors of commercial inventions, and, here again, the extreme variability in commercial potential of government patents, seen first in connection with contractor inventions, is evident. Three patents involved in the manufacture of potato flakes account for about half the sales from Agriculture inventions.

As with contractor inventions, reports on private development costs were sketchy. Licensees reported $5,389 million in development expense, with a much smaller share–21.1 percent–going toward technical development of the invention and a much larger share–52.2 percent–going toward production facilities than was the case with contractor inventions. The shift in emphasis, we believe, is because the public service agencies sponsor inventions with greater commercial orientation and, in addition, carry development of their inventions further toward a commercially useful form. Table 4 shows the high percentage of costs going to technical development for DOD and AEC inventions (matching the pattern of contractor inventions in Table 3) as compared to the costs for Agriculture and TVA patents.

3. Utilization of Inventions from the Institutional Environment

Commercialization of institutional patents is increasingly contemplated by private and public institutions of higher education, in need of funds as educational costs outrun traditional sources of revenue. Patent activity in nonprofit research corporations has also been increasing, as a means of financing independent research and development programs.

The rise of interest in patents among nonprofit institutions has been fanned by reports in the press and popular periodicals about the "gold mine" of patentable research findings. Scarcely a month goes by without a report or a feature article on a cigarette filter and Columbia University, ammoniated dentifrice at Indiana University, Wisconsin's vitamins, or a super-juice called "Gator Ade" at the University of Florida. These reports are invariably sprinkled with seven-digit royalty income figures–$14 million from Vitamin D at Wisconsin, $7 million from streptomycin at Rutgers, and so on. Finally, there are allusions to the profit potential in the ocean outside of the Scripps Institute of Oceanography, in the sky above the California Institute of Technology, and in the black boxes of M.I.T.

The facts, however, do not support the thesis that the average nonprofit research organization can expect to realize any substantial income from patent royalties. The liberal arts college in Volume IV, Part IV, Case 10, which has enjoyed an unexpected and large return on a pre-World War II invention, acknowledges it as a windfall and deemphasizes patents accordingly. The technical institution in Volume IV, Part IV, Case 5, one of the five

PART III. Effect of Patent Policy on Commercial Utilization

A. The Utilization Survey

The effect of patent policy on commercial utilization was studied through a survey of government-sponsored inventions reported in Volume IV.[1] The histories of some 2,100 inventions were examined to determine the role of patent policy in their use.[2]

In addition, other factors that affect utilization—such as prior experience, size of firm, mix of government and commercial work, government promotion of inventions, and amount of private investment required to ready inventions for market—were analyzed to estimate the importance of government patent policy as a business incentive.

Interviews and case studies were conducted of contractors and licensees, the two major users of government-sponsored inventions, to determine the reasons for basic differences in their patterns of utilization: except for two inventions, utilization with title occurred entirely among contractors of the Department of Defense, while utilization under license occurred almost entirely among licensees of the AEC and the public-service agencies.

The role of educational and nonprofit institutions in utilization was a third aspect of the survey. Inventors of more than 10 percent of the inventions studied, these institutions participate in the R&D programs of almost all government agencies. While they do not use these inventions directly because their activities are essentially noncommercial, they do license them for use by others. The survey was concerned with the effect of their licensing activities on utilization.[3] Findings on these three groups of users are summarized below and reported at length in Volume IV, Parts II, III, and IV.

B. Extent of Commercial Utilization

The survey showed that commercial utilization of government-sponsored inventions is very low. Contractors and licensees reported only 251, or 12.4 percent, of all inventions in the survey response in use. Only 55, or 2.7 percent, played a critical role in the commercial products in which they were used, as compared to utilization rates of 50 percent or more estimated for inventions developed under private research. Measured in sales, utilization amounted to $616 million through 1966—$406 million of which was attributable to contractors and $210 million to licensees.

1. Contractor Sales and Development Costs

Table 3 shows the sales and private development costs associated with the 200 inventions used by contractors. Of the 200, DOD sponsored 198, to credit it with the major impact on utilization. Of the $406 million in sales, all but $271,000 are also attributable to DOD inventions.

Sales of critically important contractor inventions are a little over half the total—$193.6 million from domestic sales and $47.3 million from sales abroad; $241 million in all.[4] *Five inventions*, accounting for approximately *88 percent* of the sales in the group, involve the following technologies: *transistors, vacuum tubes, numerical control devices, computers, and gas turbine engines.* The remaining 44 critically important contractor inventions

[1] Invention utilization questionnaires were sent to contractors who made government-sponsored inventions patented in 1957 and 1962, and for agencies other than DOD and AEC—patented from 1956 to 1966. Questionnaires were also sent to organizations that received licenses of government-owned inventions they did not develop. These inventions included a group developed by government employees. NASA inventions were not included in the survey to avoid duplicating a recent report on that agency, but the findings of that report have been considered in preparing this study.

[2] When the questionnaire responses had been analyzed (see Volume IV, Part I), four additional tasks were performed to complete the information on the sample:

(i) A group of invention utilizers, deemed high and low (which rationale is set forth in Part II of Volume IV, with the results of the task), were interviewed to determine what business factors have the greatest effect on utilization.

(ii) The inventions of three public-service oriented agencies—Agriculture, Interior, and TVA—were researched to determine what effect agency mission has on utilization. The results of this task are reported in Part III of Volume IV.

(iii) A representative group of educational nonprofit institutions were interviewed to determine what role they play in utilization. The results of this task are reported in Part IV of Volume IV.

(iv) All firms reporting refusals to license sample inventions were interviewed and all inventions involved in infringement suits were investigated to determine the effect of patent policy on business competition. The results of this task are reported in Part V of Volume IV.

Responses were received on about 65 percent of the approximately 4,000 questionnaires sent to organization in the utilization survey.

[3] This task is reported in full in Volume IV, Part IV.

[4] In grouping the data, sales involving critically important inventions (those which were clearly responsible for commercial sales) were separated from those involving supporting inventions which played an incidental role in sales of commercial products.

TABLE 2
ALLOCATIONS OF DOMESTIC R&D OBLIGATIONS AMONG
PROFIT - MAKING, EDUCATIONAL, AND NONPROFIT ORGANIZATIONS FOR
FY 1965
($ in Millions)

R&D Obligations	A. Public-Service Agencies								B. Public-Service and Mission-Oriented				C. Mission-Oriented
	Agric.	Interior	Commerce	HEW	VA	TVA	NSF	Total (Percent)	FAA	AEC	NASA	Total (Percent)	DOD
1. Profit-Making Organizations	2.2	13.5	13.3	27.1	.2	0.	27.4	83.7 (8.5)	39.4	743.3	3766.2	4548.9 (86.0)	4274.5 (89.0)
2. Educational Institutions	57.2	10.7	4.3	475.7	.4	.3	130.9	679.5 (68.9)	.8	402.9	208.4	612.1 (11.9)	326.9 (6.8)
3. Other Nonprofit Organizations	2.3	2.4	1.8	153.5	.2	0.	24.8	185.0 (18.8)	1.5	87.2	17.4	106.1 (2.0)	203.9 (4.2)
4. Other	0.	11.9	0.	26.4	0.	0.	.1	38.4 (3.8)	0.	.2	7.9	8.1 (0.1)	.3 (0.)
TOTAL	61.7	38.5	19.4	682.7	.8	.3	183.2	986.6 (100)	41.7	1233.6	3999.9	5275.2 (100)	4805.6 (100)

PART II. The Policy Criteria and the Sources of Government Invention

The President's statement of policy[1] establishes several criteria for allocating patent rights between the government and its contractors. The criteria tend to align with the R&D programs of specific agencies, resulting in relationships among R&D programs, inventive output and patent rights which help explain the economic effects of government patent policy.

Section 1(a) of the policy provides for the government to retain principal rights when:

(i) The end item is intended for commercial use by the general public or government regulations will require it for public use [Section 1 (a)(1)].

(ii) The principal purpose of the contract is to explore fields concerned with public health or welfare [Section 1(a)(2)].

(iii) The contract pertains to new fields of science and technology in which the government has been the sole or principal developer, and the acquisition of title by a contractor might give him a dominant or preferred commercial position [Section 1(a)(3)].

(iv) The contract requires the operation of a government research or production facility or the coordination and direction of the work of others [Section 1(a)(4)].

Section 1(b) provides for principal rights to the contractor when the purpose of the contract is to "build upon existing knowledge or technology" to develop end items for use by the government, and "the contractor has technical competence directly related to an area in which he has an established nongovernmental commercial position." The party that does not receive principal rights normally receives a royalty-free license to use the invention.

Table 1 relates the policy criteria to the agencies whose programs broadly match them. The agencies are grouped into three categories, depending on the main objectives of their programs: (i) public-service agencies, who conduct R&D programs to benefit the public directly; (ii) mission-oriented agencies, who conduct R&D programs for the agencies' own internal use; and (iii) agencies with mixed activities, who conduct both public-service and internally oriented R&D programs.

The contracts of the public-service agencies (like Agriculture, Interior and HEW) if not governed by statute fall largely under Section 1(a)(1) and 1(a)(2) with title in the government, because of their civilian-orientation.

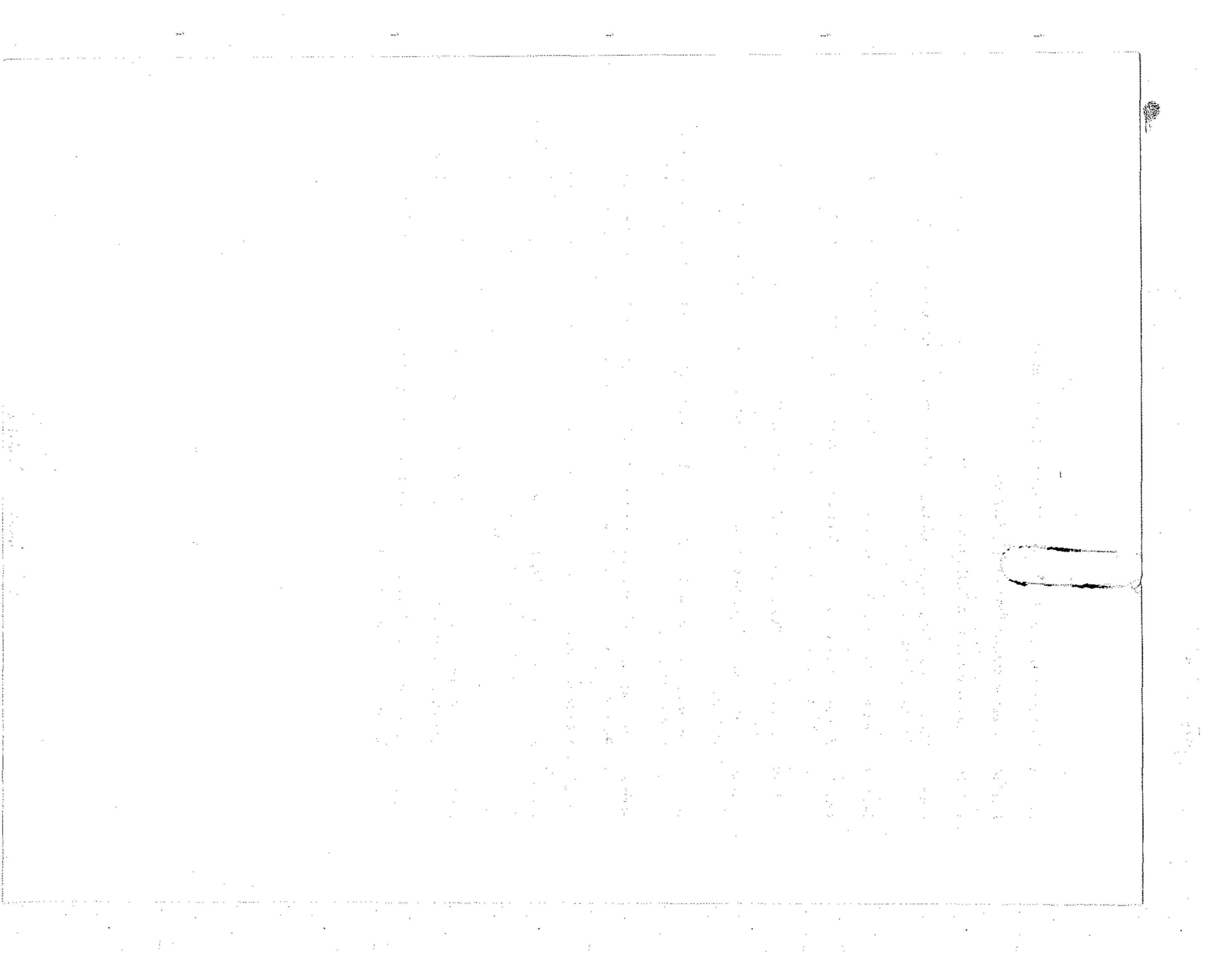
The contracts of DOD, a mission-oriented agency, are interpreted to fall largely within Section 1(b), with title in the contractor because they are not civilian-oriented and they draw heavily on the existing technical competence of industry. To a lesser extent they also come within Sections 1(a)(2), (3) and (4) with title in the government when inventions are in fields concerned with public health or welfare, DOD is the sole or principal developer in the field, or the contractor operates a government facility or directs the work of others. Lastly, the inventions of agencies with mixed activities (such as FAA, AEC, and NASA) may fall under any criteria depending on the purpose of the specific project and the circumstances under which the invention is made.[2] Generally, inventions arising out of public service activities—such as AEC's research on power sources for an artificial heart—would fall within Sections 1(a)(1) and (2). And, inventions from mission activities would come within one of the other three criteria.

Structural differences within the research and development program have a major effect on the number of inventions produced under the various policy criteria. Patents arising out of government contracts are heavily concentrated in the mission-oriented and mixed-activity agencies. There are several reasons for this. Since they perform most of the R&D contracting—91.1 percent in fiscal 1965 (see Table 1)—these agencies provide a far greater number of opportunities for inventions than public-service agencies. In addition, they contract predominantly with profit-making organizations[3]—over 87 percent in fiscal 1965 (see Table 2)—who attach greater importance to patents than educational and nonprofit institutions, the other major participants in federal R&D programs. And a great portion of their funds are spent in applied research and development, which is a greater source of patentable inventions than tasks in basic research.

[1] The President's Memorandum and Statement of Government Patent Policy is set forth in full in Appendix A.

[2] Here again, statutory patent policies exist and govern NASA and AEC. Both those agencies are matched with the President's Policy to evaluate its probable effect on them.

[3] Industrial firms and educational and nonprofit institutions as sources of government-sponsored inventions are described in detail in Volume IV, Part I. The importance of patents and government-sponsored inventions to these organizations and their utilization of them are discussed at length in Volume IV, Parts II, III, and IV.



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isolate government work from their commercial operations. In the latter case, there is usually little interchange of technical innovations between the government and commercial activities of the firm and there may be some loss of relevant technical experience and applications to the government work.

Lastly, large diversified firms often follow different patent policies in different divisions of the organization. Accordingly, they may be willing to participate in government programs with small concern for patents in some areas but with great concern for patent rights in others. It is difficult to generalize about these firms except to notice that their policies tend to follow the patterns of the industries in which their divisions participate. Their behavior may, therefore, resemble any of the categories of firms described above if their divisions have similar business profiles.

With respect to educational and nonprofit institutions refusal to participate for patent reasons is not normally a problem. However, instances were found in Department of Interior programs where patent problems were encountered because of conflicting institutional obligations arising from joint support of a research program or where rights in background patents were sought as a condition of the project. With the rising interest in nonprofit institutions in patents as a source of revenue, greater concern over patent rights can be expected from institutions with large research programs as financial pressures on these organizations continue to increase.

Viewing the participation problem from the standpoint of individual government agencies, the effect of patent policy varies with the nature of their R&D programs and the contractors that participate in them. Participation problems are not a concern to TVA which performs virtually all its research and development itself and, therefore, has little or no contractual interface with industry. They are also minimal in Agriculture programs since that agency contracts almost all its extramural research and development with educational and nonprofit institutions. In addition, the firms that do participate in its programs do relatively little research and development on their own and tend to be less patent conscious than those participating in defense/aerospace work.

The direct effect of policy on NSF and HEW programs also appears to be small because most of their contract research is either basic in nature, offering limited opportunities to develop patentable inventions, or is performed by nonprofit institutions who, for the most part, are interested in the research for itself. However, some problems may be encountered in instances of joint or overlapping research at nonprofit institutions where the rights of other parties may be involved. And, a significant indirect effect has been noted in an important HEW health program where voluntary noncontractual participation by a patent sensitive industry was curtailed because of patent considerations.

The Department of Interior, like HEW and NSF, has a number of programs--such as water desalination-- which are oriented toward developing basic technologies. The Agency contracts in these areas with research-oriented industrial firms (many of whom are patent conscious), as well as educational and nonprofit institutions, and acquires title to patents arising under its programs. Under some programs, statutes on which they are based have been interpreted to require the agency to acquire rights in existing patents owned by contractors because of their relevance to the contract effort and future utilization of contract results. These factors--patent conscious organizations and acquisition of rights to contract inventions and existing patents--have resulted in several instances of hesitation or refusal to participate in the government program. Insufficient data was available to establish how widespread the reaction was or its overall effect on Interior programs.

The largest number of opportunities for participation problems occur, of course, in DOD, NASA, and AEC programs because of the size and scope of their contract effort. Only a limited amount of data was available on this question for these agencies but a few general observations may be made. At least as to the majority of DOD inventions, to which contractors are normally permitted to retain title, no problem arises. In addition, NASA's policy of waiving title to inventions to promote utilization under appropriate circumstances provides a method for resolving competing government and industry objectives with regard to patents arising under contract. Lastly, interviews with industrial firms in the survey sample indicate that--except where a large investment in private research, know-how, inventions and/or patents considered to be valuable in commercial markets exist--acquisition or improvement of technical skills is sufficiently important to them in most cases to justify participating in government programs in their areas of interest even though patent provisions are not completely suitable to them.

However, this does not mean that either a title or license policy will equally serve the government's interests under all the above circumstances, since the policy selected may also affect industrial decisions to use contract inventions commercially. Here again, a balancing of government objectives appears necessary to ensure that the net effect of the patent policy promotes the government's overall goals.

C. Effect of Government Patent Policy on Business Competition

To evaluate the effects of government patent policy on business competition, the study tried to answer three questions:

(i) What are the effects on competition of the acquisition of exclusive commercial rights to government-sponsored inventions?

(ii) Do they increase or decrease concentration in commercial industries?

(iii) Do they create or eliminate significant areas of market power?

In evaluating the impact of government patent policy on competition, it is important to distinguish the effects of patent policy from other effects which may result from industry participation in government programs. Competitive advantages in commercial markets may well accrue to government contractors through knowledge gained in new technologies, through sharpening of technical skills, and through government funding of R&D work, which has parallel commercial areas of interest. But these are quite separate from the advantages of owning patents to specific inventions. This study has tried to measure only the latter. And, it has tried to measure it in terms of the inventions included in the survey sample. While a broader study of the cumulative effect of government-sponsored inventions patented over several years might have provided more definitive data, we believe that the study data provides a representative and useful picture of the effects of patent policy on competition.

The study indicates that both in number of inventions utilized and in sales volume, the patents sampled appear to have had small impact on commercial markets. Although over 80 percent of both sample inventions and utilization were concentrated in 50 firms, only 55 inventions owned by contractors–2.7 percent of the sample–played a critical role in their commercial use, and five were responsible for $201 million out of the $406 million in cumulative sales attributable to contractor inventions. This utilization of critical-role contractor-owned inventions is low compared with the total sales of these firms and the industries in which they participate. Of equal importance is the fact that very few instances were reported where owners of government-sponsored inventions refused to license their patents. Only 15 inventions–less than 1 percent of the sample–involved such refusals, and these 15 refusals involved just five companies.

The study did show that government retention of title, when coupled with full development and active government promotion of inventions having high commercial potential, has promoted competition. A striking example of this is the fertilizer industry where TVA developed high-concentrate fertilizers, patented them, proved their effectiveness on pilot farms and their commercial feasibility in pilot production, and aggressively promoted their use among farmers and fertilizer manufacturers. Industry sales have increased greatly through the manufacture of these fertilizers by many small regional producers. In circumstances like these, government retention of title can be an effective spur to competition because licenses are available to all comers. But several additional factors must be present for patent policy to have this effect. It must be evident to licensees that the invention has good commercial potential. The invention must be producible in commercial quantities and marketable at a cost that is competitive with alternative product. And the risks of recouping development costs must be no greater than similar investment opportunities available to the licensee.

In most cases, government agencies have to go far beyond discovery of an invention to create these conditions. Some agencies do–as described in the Volume III report on government efforts to promote utilization of government-sponsored inventions. The Department of Agriculture, for example, has an active program of developing inventions to the point of commercial feasibility. Potato flakes and frozen orange juice are two of its well-known successes. That agency, in promoting potato flakes, sponsored pilot production of the product and performed a market study in supermakets in a major city to determine the product's consumer appeal. The study was then made available to the food industry to stimulate interest in the product.

In other cases, allowing industry to retain title to inventions has promoted competition. The clearest example of this is the small firm which penetrates a market of large competitors on the strength of a patent on a government sponsored invention. Just such a case is described in Volume IV, Part V, Section C.

Notwithstanding the utilization programs employed by government agencies, none except AEC has an express statutory mission to increase business competition in commercial markets for its own sake. When it does occur, however, it is an indirect result of their efforts to accomplish their basic mission. From our observations of the study inventions and insofar as the effect of patent policy is involved, competition does not appear to have been adversely affected by this lack of direct concern, for three reasons:

(i) The rate of utilization of government inventions has been low.

(ii) The agencies–such as TVA and Agriculture, whose inventions are most likely to be

Thus, users of civilian agency inventions assume less financial risks in applying them than users of DOD inventions. This has a bearing on the degree of patent protection that may be needed as an incentive to utilization. All other factors being equal, more protection is required where the technical costs and financial risks are greater than where they are not.

3. Patent Rights as Incentives to Commercial Utilization

The study data show that patent rights play widely different roles in the business affairs of organizations in the sample. The sharpest distinction occurs between educational and nonprofit institutions, on the one hand, who can only achieve utilization of their inventions by licensing others, and industrial firms, on the other, who can promote utilization through direct use and licensing.

Educational institutions in the past have been much more concerned with publishing the results of their research than with promoting patents that may arise from it. Today, however, schools with large government research programs are taking greater interest in their patent portfolios and are seeking through a variety of means to promote them through licenses with industry. Nonprofit research firms also view their patents as a potentially useful source of income and actively seek to license others. In both cases, the inventions must frequently arise from basic research and require substantial private development before reaching the stage where they are commercially useful. Some measure of exclusive rights appears necessary to motivate licensees to invest in the work necessary to commercialize these inventions. Where the institution has an active promotional program and the government has none, commercial utilization would appear to be promoted more effectively by permitting the institution to retain exclusive rights. Where this is not so, more individual analysis is needed to determine what allocation of rights would best foster utilization.

Industrial firms in the sample place differing weights on the need for exclusive rights in using government inventions. At one extreme were firms who rely heavily on patent rights to establish their proprietary position in commercial markets and would hesitate to invest in an invention in which they could not obtain exclusive rights. At the other, were firms so completely in the government market that they attach little or no importance to patent rights for commercial purposes. In between were firms for whom patents provide a variety of incentives. The nature and importance of these incentives to firms in the sample are outlined below.

A lack of interest in patents was characteristic of some research-oriented and manufacturing firms that do a preponderance of their business in the government aerospace and defense markets. No desire to expand into commercial markets and no mechanism for the commercialization of inventions were noted. When these firms obtain patents, their sole purpose is recognition within the company of technical competence.

In a second group of firms patents were secondary to broad technical and management competence in maintaining their position in commercial markets. Firms expressing this attitude toward patents were generally manufacturers of complex systems and technical products, such as aircrafts, jet engines, computers, or communications equipment. Although as much as 75 percent of their sales may be direct to the government, these firms frequently sell similar products to commercial markets. Inventions developed during the course of R&D activities tend to be auxiliary components and subsystems or incremental improvements to the basic product. These inventions are not as important to these companies in sustaining sales or selling new products as is the basic engineering management and production capability of the firm. New ideas and inventions are incorporated in product modifications or in new models with little consideration given to the protection offered by patent rights. Using a new idea to enhance product performance is regarded as more important than assuring that the company owns the exclusive right to use it.

A third group of firms believe that corporate ownership of patents offers flexibility in design, both in the United States and abroad (through ownership of corresponding foreign patent rights), and provides trading material for cross-licenses with competitive firms. Ownership of a patent, however, as a prerequisite for new product development is a relatively minor factor compared with market considerations and investment requirements associated with commercialization of the invention. A change in government patent policy may affect firms in this category by causing them to choose more carefully the areas in which they are willing to undertake government research. Faced with the possibility of being unable to obtain title to patents they develop, these firms may refuse to contract in research areas that would impair their operational flexibility.

A fourth group of firms actively seek ownership of patents, to establish and maintain proprietary positions in new technologies, as well as in established product areas. Invariably, however, estimates of market potential and corporate investment requirements determine which product areas are developed. The makeup of the patent portfolio may indicate the direction for product development in order to strengthen proprietary positions, but development is rarely, if ever, undertaken solely because patent protection is available. A change in government

investigated to determine the effect of agency mission on invention utilization.

(iii) Sixteen educational and nonprofit institutions representing a cross section of all types and sizes of organization were interviewed to determine what role they play in promoting utilization of government-sponsored inventions.

(iv) All sample inventions involved in infringement suits were investigated to identify what effect they have on business competition.

(v) An industry study involving the medicinal chemistry program of NIH was performed to determine the effect of patent policy on voluntary industry participation in, and utilization of the results of the government program.

B. Effect of Government Patent Policy on Commercial Utilization

The study sought answers to several key questions concerning commercial utilization of government-sponsored inventions. Among these were:

(i) Under what circumstances have government inventions been utilized?

(ii) How important have exclusive patent rights been in promoting their use compared with other factors such as market potential, prior experience and amount of private investment required?

(iii) Under what conditions has utilization been optimized by government ownership of patents? By contractor ownership of patents?

(iv) Has substantial private investment been required to develop government-sponsored inventions for commercial use?

(v) Has such investment been made when everyone has been free to use the invention?

Several factors were found to have an important bearing on the answers to these questions. The intended uses of the sample inventions were found to have a primary effect on their commercial potential. Their intended uses, in turn, were determined by the R&D missions of the sponsoring government agencies. Once the invention was developed, several factors were found to affect their actual use in commercial markets—the extent of market demand for products employing them, the degree of promotion by government agencies which sponsored them, the size of private investment required to apply them, the prior experience and attitude toward innovation of organizations that developed them, and the type of patent rights available to protect the user's investment in bringing the inventions to market.

These factors have had the following net effect on utilization of sample inventions:

Of 2,024 contractor inventions in the two sample years for which information was available, 251 were used commercially.

- Two hundred were utilized by industrial contractors and all but seven were owned by them. Twenty-six of these were utilized by their licensees.
- An additional 51 inventions not utilized by contractors were utilized by their licensees. Ten of these inventions were owned by educational and nonprofit institutions.
- Fifty-five played a critical role in the commercial products in which they were used.
- All but two resulted from DOD contracts.

The study also reviewed 126 government-owned inventions from all sources, in-house and contractor, patented in 1957 and 1962 for which a license was issued to firms other than the inventing contractor. Ten of 126 inventions were reported used by some 50 licensees. Utilization is concentrated in TVA and Agriculture inventions which account for 60 percent of the utilized patents and 90 percent of the commercial users.

Measured in sales, commercial utilization of the inventions studied amounted to $616 million through calendar year 1966:

- $406 million were sales by contractors who owned the inventions.
- $210 million were sales by nonexclusive government licensees.
- All but $271,000 of contractor sales were from DOD inventions.

Sales of inventions, both with and without exclusive rights, were heavily concentrated in a few patents:

- 88 percent of contractor sales where the invention played a critical role are attributable to five patents in the fields of transistors, vacuum tubes, numerical control devices, computers, and gas turbine engines.
- About half the sales of licensees are attributable to three patents on the manufacture of potato flakes.

Study inventions that were used commercially found quick application in their commercial use. About one-third were applied by the time a patent application was filed, and almost two-thirds were in use when a patent issued.

A factor instrumental in the speed of utilization is prior experience. If rapid utilization is defined as occurring within three years of application for a patent, then firms with experience achieved rapid utilization over 80 percent of the time compared with half that for firms without.

The mix of government and commercial work within a firm also has an important effect. Firms in the middle range of government activity (20 to 80 percent government business) use inventions much more quickly than

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COMMITTEE ON GOVERNMENT PATENT POLICY
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NOTICE

This volume is part of the final report submitted by Harbridge House, Inc. to the Committee on Government Patent Policy, Federal Council for Science and Technology, in compliance with Department of Commerce Contract No. [illegible]. This contract was sponsored by the Committee in order to acquire and analyze relevant data and information regarding the effects of government patent policy on the public interest. Volume I summarizes the results of the research conducted by Harbridge House, Inc. and Volumes II through IV provide backup data to Volume I.

This final report is published in the interest of making the results thereof available to the public at the earliest possible date. Publication is in no way intended to indicate concurrence in or approval of the findings or analysis of the data provided by the contractor.

Gerald D. O'Brien
Acting Chairman

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