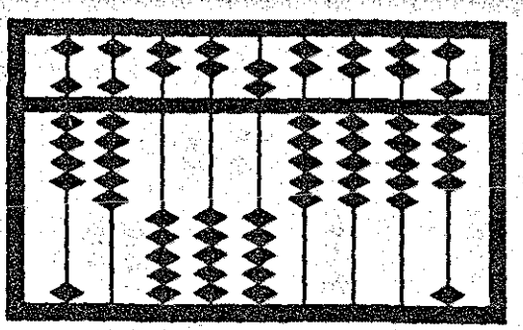
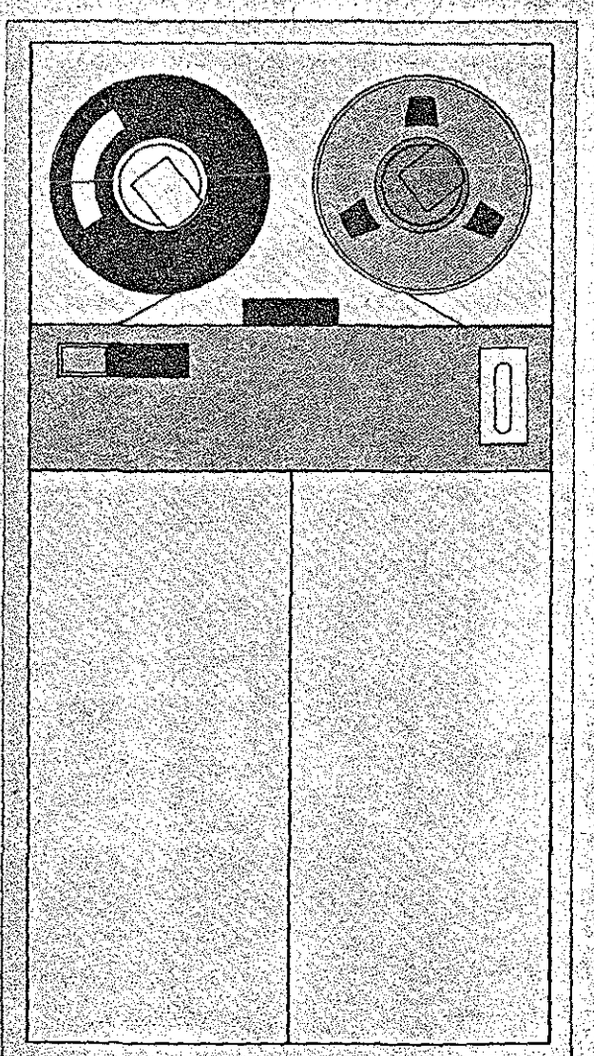
TECHNOLOGICAL INNOVATION

Its Environment and Management





U.S. DEPARTMENT OF COMMERCE

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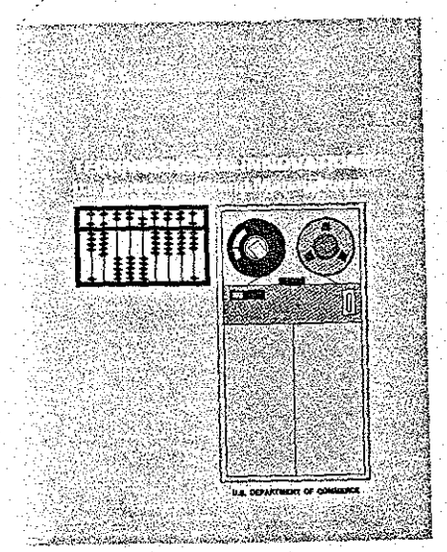

Early forms of the abacus, a manually operated biquinary computer, were introduced as early as 3,000 B.C. The electronic digital computer, capable of vastly more complex and speedy computations, was introduced in the early 1950s.

TECHNOLOGICAL INNOVATION:
Its Environment and Management

This report represents the views of the panel on invention and innovation, an advisory committee of private citizens convened by and reporting to the Secretary of Commerce. The views of the panel do not necessarily represent those of the Department of Commerce or of any other agency of the federal government.

January 1967

U.S. DEPARTMENT OF COMMERCE
John T. Connor, Secretary

J. Herbert Hollomon, Assistant Secretary
for Science and Technology

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SUMMARY

In accordance with its charter, the Panel considered three main factors affecting invention and innovation: taxation, finance, and competition. On the basis of its analysis, the Panel concluded that there was no need to recommend any major changes in the present laws governing these three areas. However, it did make a number of specific proposals * aimed at improving the environment for invention and innovation.

With respect to the field of taxation, the Panel made several specific recommendations which it felt could provide justifiable encouragement to inventors and innovators. Among these recommendations are proposals providing for a more equitable treatment of innovation losses, an improvement of the stock option to make it a more effective instrument for attracting critically important management personnel to fledgling firms, and a reasoned approach to tax-deduction problems posed by several other areas of the tax laws.

The Panel found no reason for proposing any new federally supported programs to furnish venture capital for the financing of new, technologically based enterprises. It did, however, make recommendations concerning the communication of venture-capital opportunities and the establishment of an effective Federal spokesman for such enterprises.

The Panel's review of the interaction between competition and innovation showed a need for greater understanding of this interaction and improvements in the coordination of antitrust and regulatory policies affecting both competition and innovation. No new antitrust or regulatory legislation was recommended, but the Panel did recommend, among other proposals, the establishment of a group to serve as an advisory resource to the antitrust and regulatory agencies, as well as a strengthening of the professional staffs of these agencies.

Throughout its review, the Panel was impressed by the need for promoting a basic understanding of the innovative process in all sectors of our society. The Panel felt that it would be highly desirable to encourage educational programs, studies, and regional seminars to further this understanding. Accordingly, the Panel's concluding recommendation proposes a White House conference on technological innovation, to dramatize the importance of this vital process, and urges that this conference be followed by a nationwide program for broadening recognition, understanding, and appreciation of the problems and opportunities associated with technological change.

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* *The complete list of the Panel's recommendations is set forth in Appendix E, page 79.*

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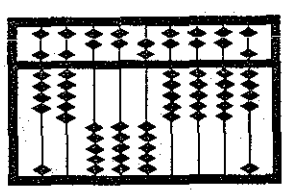
* *The recommendations are recapitulated, in full, in Appendix E, page 79.*



INTRODUCTION AND SETTING

In 1964 the President of the United States directed the Department of Commerce to explore new ways for "speeding the development and spread of new technology." [1] Because one of the ways in which a government can accomplish this end is to improve the *climate* for technological change, the Secretary of Commerce created an ad hoc *Panel on Invention and Innovation* and asked it to explore the opportunities for improving such climate-setting policy areas as antitrust, taxation and the regulation of industry. What follows is the report of the Panel.

[1] *Economic Report of the President to the Congress of the United States, 1964.*

We began our investigation by asking ourselves some very basic questions. The climate for invention and innovation could be improved by providing reasonable incentives to these processes of technological change and by removing or lessening unreasonable barriers that impede or stifle them. But what is reasonable or unreasonable? The reasonableness of our proposals would depend upon an appreciation of other national goals upon which these proposals might impinge—for example, the preservation of competition and fiscal integrity. And incentives and barriers to what? What is the anatomy of invention and innovation in the American economy? We had to analyze illustrative cases, demonstrating some of the problems and characteristics associated with the processes of invention and innovation, before we could rationally weigh incentives and barriers. Our analysis had to tell us something about the people who power invention and innovation, for these are largely "people" processes.

We shall develop illustrative cases as we get to the specific recommendations of this report. In the meantime, however, we need to make some initial distinctions between the processes of invention and innovation, for incentives and barriers to one may not be to the other.

Very simply, the difference between the processes of invention and innovation is the difference between the verbs "to conceive" and "to use."

CHART 1

WHAT IS INVENTION? INNOVATION?

Invention . . . TO CONCEIVE . . . The idea.

Innovation . . . TO USE . . . The process by which an invention or idea is translated into the economy.

To be sure, innovation is not limited to technological products and processes in the business world. But that is the principal sense in which we were asked to be concerned with innovation. Much of what is said in these pages, however, applies as well to fields where non-technological innovation is of great importance—for example, social institutions and relationships. For invention and innovation encompass the totality of processes by which new ideas are conceived, nurtured, developed and finally introduced into the economy as new products and processes; or into an organization to change its internal and external relationships; or into a society to provide for its social needs and to adapt itself to the world or the world to itself.

INNOVATION AND ECONOMIC PROGRESS

The next basic question we asked ourselves was: Why should the government have an interest in invention and innovation?

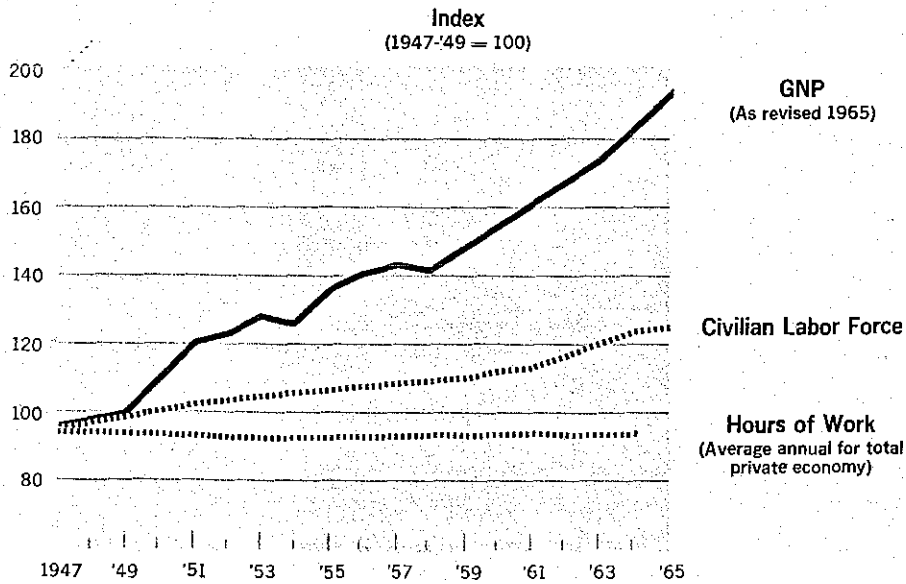
The answer is that invention and innovation lie at the heart of the process by which America has grown and renewed itself.

Let us expand upon this simple truth and explore more specifically some of the reasons why the Federal Government must be concerned about the climate for invention and innovation.

First, there is a very significant relationship between innovation and economic growth. Although estimates of the contribution of technological progress to increases in the Gross National Product (GNP) are imprecise, economists agree that the contribution is substantial.[2] For example, if we compare the change in the labor input ("Hours of Work" in Chart 2) with the change in GNP over the period 1947-1965, we see a marked difference between these two factors.

CHART 2

INDEXES OF GROSS NATIONAL PRODUCT, LABOR FORCE, ANNUAL HOURS WORKED, 1947-1965



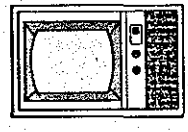
The average annual hours of work remained practically constant, while the GNP rose substantially during the period in question. Indeed, the GNP nearly doubled. Without presuming to say how much of this increase in GNP was attributable to technological innovation, we are confident that

[2] *See, for example, Denison, E.,* The Sources of Economic Growth in the United States, *Committee for Economic Development, 1962; Kendrick, J.,* Productivity Trends in the United States, *National Bureau of Economic Research, 1961; and Solo, R., "Technical Change and the Aggregate Production Function,"* Review of Economics and Statistics, *1957.*

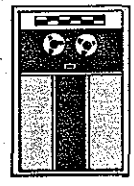
technological innovation played a major role. We realize that data such as the GNP are abstract statistical notions. By and large, they fail to excite the imagination, for they do not have the impact of specific examples. So we thought it would be instructive to look at the histories of three industries which were commercially non-existent in 1945, but over the past 20 years have contributed significantly to the nation's growth. We chose the television, jet aircraft, and digital computer industries.

CHART 3

ECONOMIC EFFECTS OF ONLY THREE TECHNOLOGICAL INDUSTRIES OUT OF MANY







In 1945, the TELEVISION, JET TRAVEL, and DIGITAL COMPUTER industries were commercially non-existent.

In 1965, these industries contributed more than $ 13 BILLION to our GNP and an estimated 900,000 jobs . . . and very important, affected the QUALITY of our lives.

We also thought it would be useful to compare the average annual growth of the Gross National Product over the period, 1945-1965, with that of some of the companies that have committed themselves to innovation as a way of life and have experienced most of their growth over the 20-year period (see Chart 4). We analyzed the growth histories of Polaroid, 3M, International Business Machines, Xerox, and Texas Instruments. While the average annual growth of the GNP over this period advanced at a rate of 2.5%, the average annual net-sales growth of these companies ranged from 13% to 29% and averaged, for the group, nearly 17%[3]. At the same time, the average yearly growth in jobs ranged from 7.5% to almost 18%.

Here we see some large, successful, innovative companies which grew from relatively small beginnings and have contributed very significantly to the GNP and employment opportunities. Many other companies have had similar experiences.

[3] *Texas Instruments, which had the highest growth rate and would have raised the over-all average, was nontheless excluded, since data for the company were not available for the year 1945.*

CHART 4

A FEW EXAMPLES OF TECHNOLOGICALLY INNOVATIVE COMPANIES THAT HAVE EXPERIENCED MUCH OF THEIR GROWTH IN THE LAST 20 YEARS (1945-1965)

AVG. % ANNUAL GROWTH (Compounded)

	Net Sales	Jobs
Polaroid	13.4%	7.5%
3M	14.9%	7.8%
IBM	17.5%	12.1%
Xerox (Haloid Co.)	22.5%	17.8%
Texas Instruments (1947-1965)	28.9%	10.0%

Average % annual sales growth of above companies*: 16.8%

Average % annual growth of GNP: 2.5%

*Excluding Texas Instruments for which data are available only for the past 18 years.

INTERNATIONAL TRADE

If we consider the effects of technological change on international trade, we can see another very persuasive reason why the Federal Government should be concerned about the promotion of invention and innovation.

An important element of our international balance of payments is what is called the "technological" balance of payments. This international account reflects payments for technical know-how, patent royalties, and the like. In a recent study of the technological balance of payments of various countries, the Organization for Economic Cooperation and Development (OECD) published data for the United States, which are depicted in Chart 5.

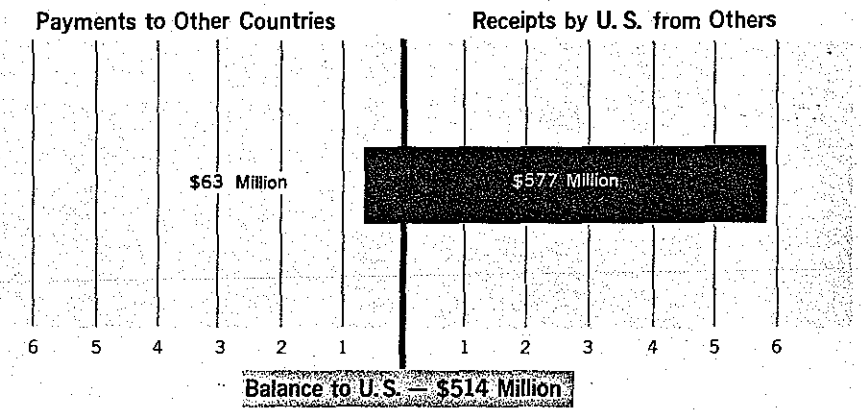
The OECD compliation shows the United States receiving roughly ten times as much in technological payments from abroad as goes out in payments to other nations. This is a very significant secondary effect of innovation in the American economy.

Technological change affects international trade in subtle ways. Let us consider, for example, the so-called "displacement" innovations. These do not have the dramatic result of a new company, such as the Xerox Corporation or an entirely new product or process for which no substitute existed before—the electronic computer is a good example. "Displacement" innovations displace existing products or processes. The effect of such innovations is illustrated by the invasion of the cotton and wool fiber market by synthetic fibers.

CHART 5

U. S. TECHNOLOGICAL BALANCE OF PAYMENTS

Payments for Technical Know-how, Patent Royalties, etc.



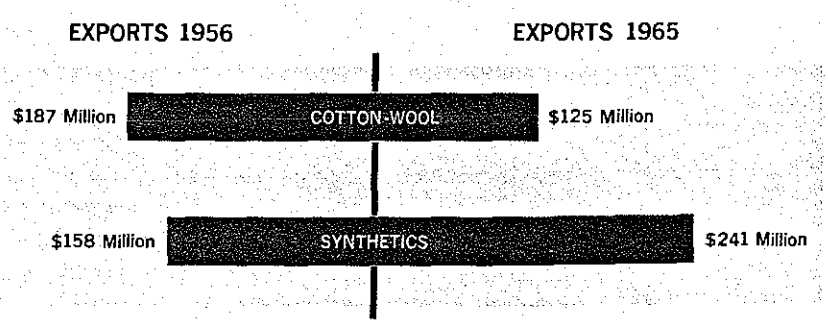
Source: OECD (1965) — Figures for 1961

It is very difficult to measure the full significance of "displacement" innovations in the United States, because such displacement is a *domestic* give and take. But if we look at the international picture, we can get a better feeling for the significance of these kinds of innovations. We chose as an example the yarns and fabrics industry and we compared synthetics with cotton and wool.

CHART 6

INNOVATION AND INTERNATIONAL TRADE

An Example: U.S. Exports of Yarns & Fabrics
Synthetics (High Technology)
Cotton & Wool (Low Technology)



Source: U.S. Department of Commerce.

We can see in Chart 6 that synthetics, which sprang from considerable innovative effort, have maintained our share of the international yarns and fabrics market. The total exports of cotton and wool yarns and fabrics have declined by about a third over the period 1956-1965, whereas the total exports of synthetic yarns and fabrics have increased by over 50%. The export of high-technology synthetic yarns and fabrics has therefore maintained the U.S. export of yarns and fabrics roughly at the level it was in 1956.

We could give other examples of the secondary effects of innovation. We are satisfied that the international stature of a nation with respect to trade—and, it is important to note, assistance to under-developed countries—becomes increasingly dependent upon its innovative performance.

INNOVATION AND COMPETITION

There are other reasons why the Federal Government should be interested in promoting invention and innovation, among which is the close and complementary interaction between innovation and competition.

Competition has traditionally involved rivalry among manufacturers of like products, as well as the stimulating effect of innovators who introduce new products and reduce costs through new methods of production and distribution. For example, the advent of the airplane had a powerful influence on competition in public transportation, and the automobile brought entirely new forces into the private transportation sector. To take more recent examples, the introduction of the transistor and integrated circuits has stimulated competition in the electronics industry.

The influence of innovation on competition has become stronger and clearer with the accelerated pace of technological change. Competition has developed between entirely new types of products that perform old functions better or make possible entirely new functions. To give just three examples, consider electrostatic copying ("xerography"), synthetic wash and wear fabrics, and instant photography.

The importance of innovation has become so strong that no longer may we look only to the conventional limits of a given industry to examine competition. Increasingly, innovations of importance are coming from companies that do not fit within the conventional classifications of individual industries. For example, synthetic fibers came from the chemical industry, not the textile industry. High-speed ground transportation is now as much the domain of the aerospace and electrical manufacturing industries as it is that of the automotive and railroad industries. Instant photography (the Polaroid camera) was not developed by the photographic industry. And electrostatic copying came from outside the conventional office equipment industry.

It is easy to see, therefore, that innovation from the outside (across conventional industry boundaries) is a powerful force influencing competition. Consequently, a climate conducive to technological progress is important not only with respect to economic growth and international stature, but is also essential to the maintenance of a vigorous, competitive, economic climate.

II

INNOVATION IN CONTEXT

We have already noted that technological innovation, in the sense we have been asked to be concerned with it, is a complex process by which an invention is brought to commercial reality. It is our thesis that if we are interested in increasing our rate of economic growth and the vigor of competitive forces in our society, we need to remember that these goals cannot be satisfactorily achieved in the absence of technological progress—i.e., the bringing of new products, processes and services to market.

We need also to bear in mind that the path between an invention (or idea) and the market place is a hazardous venture, replete with obstacles and substantial risks. It is ordinarily a very costly, time-consuming, and difficult task that the innovator faces.

INNOVATION IS NOT SIMPLY R&D

Continuing the series of basic questions we put to ourselves, we asked what it is the Government should seek to promote. Should attention be focused on the total process of innovation or merely on the research and development phase of the total process?

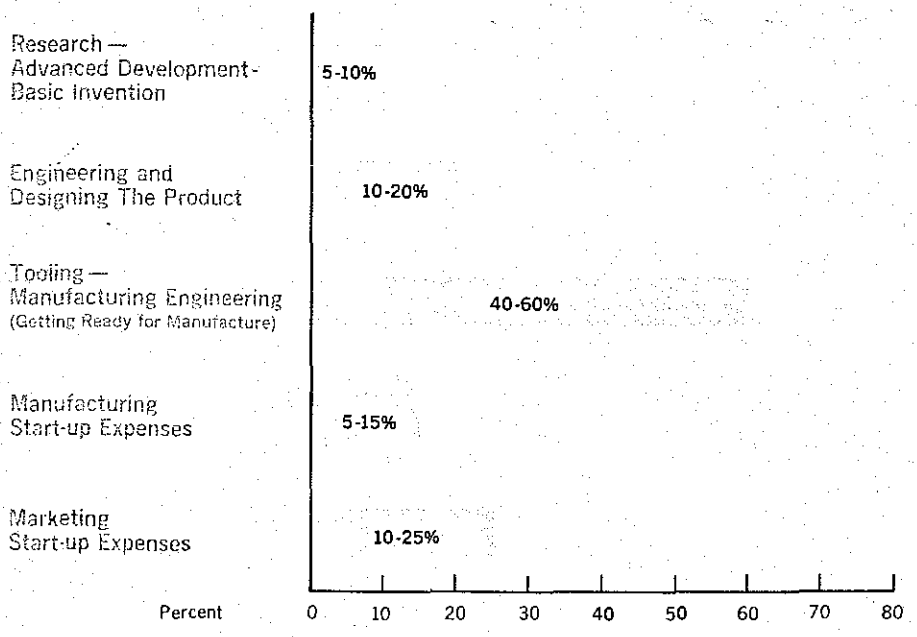
We came to realize early in our analysis how very little statistical evidence there is on the innovative process. Such data as are available primarily concern research and development, not the *total* innovation process, of which R&D is only a part. These data give us a reasonable indication of the investment in R&D, who is performing it and to what extent. But they are not reliable indications of *innovative* performance. They do not tell us, for example, what the total investment in innovation is in the United States. Such information would be very useful to have. Indeed, it would be highly desirable to encourage systematic studies of the innovative process in order to clarify the strategic elements which stimulate and further innovation.

We wish to make quite clear, therefore, that our analysis could not be based upon empirical data on the innovative process. Rather, we have had to rely on personal experience and knowledge and, where appropriate, data concerning R&D.

Accordingly, in order to arrive at a reasonable indication of the distribution of costs in successful product innovations and, particularly, to examine the role of research and development in the total process of bringing a new product to market, we pooled the knowledge of experienced members of the Panel. On this basis, we tried to discern a representative pattern in the distribution of costs in successful product innovations. There was sufficient similarity in the experiences we covered to convince us that it would be desirable to present the following "rule of thumb" figures as the basis for our discussion.

CHART 7

TYPICAL DISTRIBUTION OF COSTS IN SUCCESSFUL PRODUCT INNOVATIONS



This breakdown of cost and effort indicates that the step we commonly call research, advanced development or basic invention, accounts, typically, for less than 10% of the total innovative effort. The other components, which we do not usually associate with the innovative process, account for something like 90% of the total effort and cost. Engineering and designing the product, tooling and manufacturing-engineering, manufacturing start-up expenses, and marketing start-up expenses, are all essential to the total process. It is obvious, therefore, that research and development is by no means synonymous with innovation.

The above analysis concerns successful product innovations. We tried to

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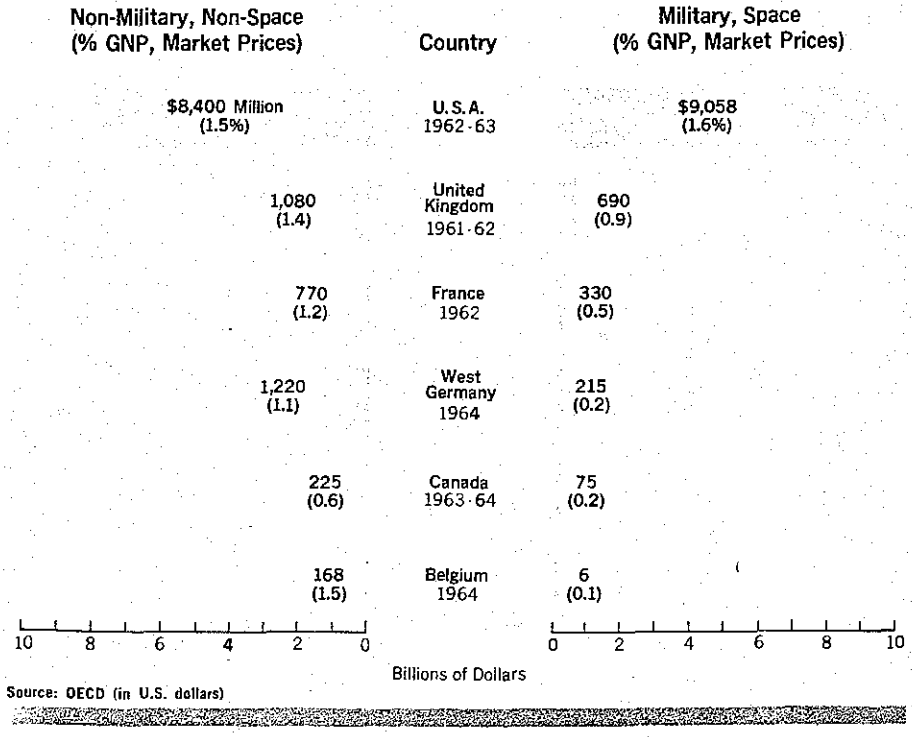
get some indication of the ratio of R&D costs to the total costs of innovative activities, both successful and unsuccessful. As a very rough measure of this, we compared total company expenditures on R&D in the manufacturing sector with the total net sales of these companies.[1] The latest year for which such data are available is 1964. We make no pretense about the adequacy or relevancy of these data. The total net sales for 1964 amounted to $293 billion; company-financed R&D expenditures totaled $5.7 billion. The ratio of R&D costs to net sales was therefore approximately two per cent, which would indicate that R&D costs are a small part of the total effort in the manufacturing sector.

Another illustration of the need for careful study of the innovative process is the indiscriminate use of statistical aggregates purporting to show the comparative innovative performance of various countries—in particular, statistics comparing research and development expenditures as a percentage of gross national product. As a measure of our innovative performance as a nation, data such as in the following tabulation are occasionally cited. We believe such data to be an inappropriate index of innovative performance.

CHART 8

TOTAL EXPENDITURES ON RESEARCH AND DEVELOPMENT, SELECTED COUNTRIES.



Source: OECD (in U.S. dollars)

[1] *"Basic Research, Applied Research, and Development in American Industry, 1964,"* Reviews of Data on Science Resources, *No. 7, January 1966, National Science Foundation, Washington, D. C.*

If R&D percentages of GNP were an appropriate measure of innovative performance, the above data, compiled by the Organization for Economic Cooperation and Development (OECD), would imply that innovation is as significant a factor in the non-military, non-space sectors of the United Kingdom (1.4%) and Belgium (1.5%) as it is in the United States (1.5%). However, it is clear that these countries are not running a close race with respect to innovative successes and economic growth. Such R&D data are obviously misleading when they are relied upon as indexes of innovative capability or accomplishment.

It is important to bear in mind, therefore, that an oversimplified assumption is probably made whenever it is assumed that more money spent on research and development automatically has some kind of multiplier effect on innovation into the market place. Those who equate R&D expenditures with innovative accomplishment are not looking at the innovative process the way businessmen must. For the main concern of businessmen is the total cost and the total profitability or loss of the *entire* venture.

This is not to say that R&D is unimportant. It should be understood that we appreciate the vital role of R&D and that our discussion is not meant to imply that there are not important sectors of the economy in which additional R&D effort would be desirable. For we believe that there are several sectors of the economy which should be given special attention in any analysis of the innovative process, including the role of R&D.

SOCIAL INNOVATION IN THE PUBLIC SECTOR

There are many pressing, public-sector problems that require innovative solutions. By way of illustration, we have listed a few examples of some of the problems that call for social innovation.

CHART 9

SOME PROBLEMS REQUIRING SOCIAL INNOVATION

Environmental Pollution	Urban Redevelopment
Fresh Water	Poverty
Crime Prevention	Highway Safety
International Organization	Urban Transportation
Arms Control and Disarmament	

Any consideration of the total innovative process should include analysis of the interrelations between social and private innovation. Private innovation in the industrial sector has produced conditions which call for social innovation in the public sector. Moreover, advances in private innovation are dependent upon the climate provided by social innovation.

For example, the development of the automotive industry and the introduction of various forms of chemical processing have created conditions leading to the pollution of water and air. In this respect, private innovation has created environmental conditions which call for social innovation. New industrial innovations requiring additional supplies of fresh water and a substantial number of well-educated workers will depend, in turn, on social innovation. For without improvements in water supply and in our educational system, it would seem that future industrial innovation will be limited. On the other hand, improvements in the educational system are at least partially dependent upon innovation in teaching aids such as audio-visual instrumentation. There is a mutual interdependence between social and private innovation.

We have considered the possible sources of social innovation and the roles of government and industry with respect to its performance. Social innovation in the public sector must depend upon private as well as public resources. As an illustration, improvements in the control of water and air pollution must stem from private innovations producing changes in automobiles and in industrial processes such that the polluting elements which are discharged into the environment will be reduced or eliminated.

We believe it is incumbent upon government, both local and national, to provide the essential framework for social innovation. As a general principle, moreover, government should encourage the use of private resources for social innovation whenever possible. In this effort we conceive of governmental functions along the following lines:

a. Defining the social problems and the priorities for their solutions.
b. Intensifying the planning for such solutions.
c. Encouraging private enterprise to seek profit-making opportunities in the development of such solutions.
d. Developing regulatory and other mechanisms, such as government purchasing policies, to compel or encourage industries to modify productive processes and products in such ways that they will contribute to the betterment of the social sector (for example, regulations regarding water and air pollution).
e. Carrying on the necessary technological developments, when it is clear that private resources cannot be depended upon to undertake them satisfactorily.

The prosecution of this program on the part of the government would call for careful, intensive analyses of each of the areas requiring social innovation. No pat formulas can indicate which paths would be more productive. Social problems may arise which are not susceptible to solution via the private sector of the economy, in which case the government would have to accept the primary or exclusive burden of performance. Again, however, we believe the only reasonable generalization which can be made in tackling these problems of social innovation is that the government should give careful consideration to the utilization of private industry for this purpose before it undertakes investment of public funds and resources.

REGIONAL DIFFERENCES

Cities and regions appear to vary markedly with respect to successful generation of new technologically based enterprises. Unfortunately, there are no statistical data to show this. But our personal experiences—and we claim no more proof than that—tell us that cities and regions do vary widely in their propensity to exploit their innovative potential. We surmise that important factors exist which go beyond such indexes as the total number of scientists in the area, or the total R&D expenditures, or the availability of capital.

CHART 10

VARIATIONS — CITY TO CITY IN THE PROPENSITY TO GENERATE NEW TECHNOLOGICALLY BASED COMPANIES

e. g., Many Such Companies	e. g., Few Such Companies
Boston	Philadelphia
Palo Alto	Chicago
Washington, D.C.	Kansas City
Pittsburgh	Atlanta

We tried to analyze—again, of necessity, largely on the basis of our personal experiences—what differentiates cities with respect to their propensity to generate new technological enterprises. As we have indicated, Boston is an area which generates many new technological enterprises, whereas Philadelphia, by comparison, apparently generates few. We asked ourselves, first of all, whether the difference between these two areas is due to the existence of greater potential venture capital in one over the other—whether this factor is a major barrier to the creation of new technological enterprises. We are unaware of any evidence to this effect.

There is abundant potential venture capital available in the Philadelphia area. What we are led to believe is that in the Philadelphia area there is poor linkage, poor communication, between potential venture capital sources and technological entrepreneurs. There are also other factors that bear on this problem. We shall explore them, but at this time it would be well to analyze the one piece of evidence we have that compares the attitudes of technological entrepreneurs in the Philadelphia and Boston areas with respect to the climate for generating new technological enterprises in these localities. This evidence was developed by the Federal Reserve Bank of Philadelphia.[2] It is a report based on interviews with scientist-businessmen regarding the problems of seeding science-based industry.

[2] *Elizabeth P. Deutermann, "Seeding Science-Based Industry,"* Business Review, *Federal Reserve Bank of Philadelphia (May 1966).*

The author carefully and objectively selected several research-oriented firms in the Delaware Valley area and in the Boston area and asked the founders of these companies several questions, among which the following two are of greatest interest: (1) "Do local universities play any role in stimulating new science-based firms?" (2) "What is the attitude of local banks toward financing for the small, science-based firm?" The Boston entrepreneurs, in response to the first question, replied to a man that the universities play an important role. In striking contradistinction, the Philadelphia entrepreneurs were of the unanimous view that universities play a small role.

In response to the second question, the Boston entrepreneurs replied unanimously that the attitude of local banks to the financing of small science-based firms was "good" or "excellent." Again, in marked contrast, the Philadelphia entrepreneurs said, without exception, that the attitude of their local banks was "unreceptive," "poor," or "bad."

It is true that the number of firms interviewed by the author was small (there were 13 all together), but the likelihood of getting these completely disparate views with respect to the attitudes of banks and the importance of universities is so remote that the results are significant. There is at least some reason to believe that the apparent difference in attitudes among venture capital sources, technological entrepreneurs, and universities in these two areas bears upon their propensity to generate new technological enterprises.

THE TOTAL ENVIRONMENT

In our over-all deliberations, we came to some general conclusions about the kind of *total* environment that seems to encourage the creation of new technological enterprises. Included in this environment are:

a. Institutional and individual venture capital sources that are (i) "at home" with technologically oriented innovators and (ii) have the rare business appraisal capabilities necessary to diagnose the prospects of translating a technical idea into a profitable business.

b. Technologically oriented universities, located in an area with a business climate that encourages staff, faculty, and students to study and themselves generate technological ventures.

c. Entrepreneurs, who have been influenced by examples of entrepreneurship (for it is our contention that entrepreneurship *breeds* entrepreneurship).

d. Close, frequent consultations among technical people, entrepreneurs, universities, venture capital sources, and others essential to the innovative process.

Professor Cole has drawn an analogy between the elements of an entrepreneurial environment and the charges in an electric field. A beneficial environment requires, he has said, "a sympathetic alignment of institutions . . . pointing in the same direction, or charged with the same brand of electricity." [3]

[3] *Arthur H. Cole,* Business Enterprise and Its Social Setting, *Harvard University Press, 1959, p. 245.*

Viewed in this sense, unsympathetic bankers, inattentive educational institutions, overzealous tax authorities, and other environmental barriers, are negative charges that work against the entrepreneur.

VARIATIONS AMONG INDUSTRIES

Many industries are apparently under-spending on innovation. (Again, we must emphasize that we lack adequate empirical data to substantiate this feeling.) A number of factors bear on this problem, the most important of which would be the absence of adequate managerial and technological skills in an industry. We often see companies with an abundance of these skills enter such an industry for the first time and make significant contributions. The invasion of the textile industry by the chemical industry (Nylon, Acrilan, etc.) is a case in point.

We looked at variations among selected "big sales" industries. Since empirical data on *innovation* were unavailable, we resorted again to R&D percentages. In particular, we selected the steel, transportation, chemical, and drug industries—and noted the variation in the ratio of company-financed R&D to net sales.

CHART 11

VARIATIONS IN COMPANY-FINANCED R & D AS A PER CENT OF NET SALES, BY INDUSTRY

	Net Sales (Billions)	R & D (Billions)	R & D Net Sales
Steel (Primary ferrous products)	17.8	0.111	0.6%
Transportation Equipment (Excluding aircraft)	34.3	0.865	2.5%
Chemicals	25.6	0.830	3.2%
Drugs	5.03	0.224	4.5%

Source: NSF (1966) — Figures are for 1964.

The above tabulation shows the steel industry (primary ferrous products) spending, in 1964, a mere 0.6% of its $17,800,000,000 in net sales on R&D. In contrast, the drug industry was spending 4.5% of its $5,400,000,000 in net sales on R&D, a percentage almost eight times that of the steel industry.

We asked ourselves several questions about the differences between highly innovative industries and those which are relatively uninnovative.

Are the highly innovative industries progressive because of the manner in which they respond to technological opportunities? Are they primarily this way because their managements have extraordinary capabilities for grasping

and managing technological change? What characterizes the relatively uninnovative industries? Are they this way because they failed to exploit innovative opportunities? Because they possess excessive built-in barriers to technological change? Is it that their managements have not learned the importance of utilizing technological opportunities and innovative skills?

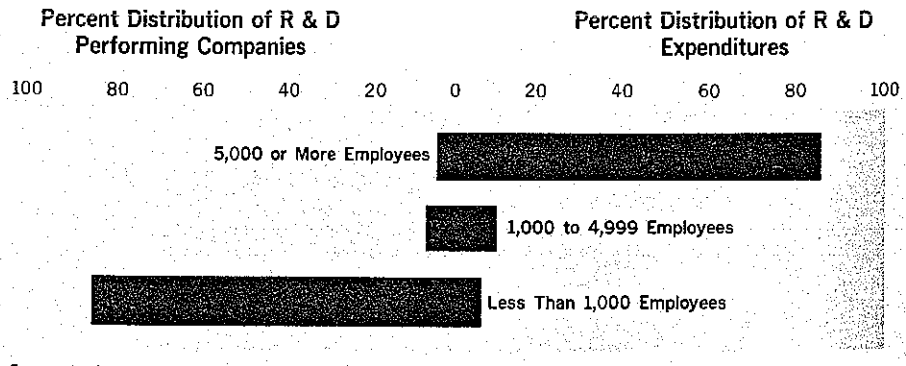
We find that we must answer each of these questions affirmatively. The major barrier is one of attitude and environment. It is primarily a problem of *education*—not of antitrust, taxation, or capital availability.

THE SIGNIFICANCE OF SIZE

We have examined variations in innovative performance between the public and private sectors, different regions, and different industries. We turn now to a consideration of innovative performance as a function of company size. Again, however—because we have no choice in the matter—we have been forced to resort to data concerning R&D, *not* the total innovative process.

CHART 12

VARIATIONS IN R & D, BY SIZE OF COMPANY



Source: Basic research, applied research, and development in industry, 1962, NSF 65-18, 1965.

The above data show that a handful of large companies (having 5000 or more employees) perform almost all of the R&D, although, as we have illustrated, this is not necessarily indicative of *innovative* performance.

It is important to distinguish between large and small sources of invention and innovation, for the resources available to them are different and, not surprisingly, the riskiness of a venture and the manner in which it is undertaken are generally a function of the available resources. We therefore analyzed several studies on the sources of invention and innovation. These studies were unusually consistent in indicating that independent inventors (including inventor-entrepreneurs) and small technologically-based companies are responsible for a remarkable percentage of the important inventions and innovations of this century—a much larger percentage than their relative investment in these activities would suggest.

—Professor John Jewkes, et al, showed that out of 61 important inventions

and innovations of the 20th century, which the authors selected for analysis, over half of them stemmed from independent inventors or small firms.[4]

—Professor Daniel Hamberg of the University of Maryland studied major inventions made during the decade 1946-55 and found that over two-thirds of them resulted from the work of independent inventors and small companies.[5]

—Professor Merton Peck of Harvard studied 149 inventions in aluminum welding, fabricating techniques and aluminum finishing. Major producers accounted for only one of seven important inventions.[6]

—Professor Hamberg also studied 13 major innovations in the American steel industry—four came from inventions in European companies, seven from independent inventors, and none from inventions by the American steel companies.[7]

—Professor John Enos of the Massachusetts Institute of Technology studied what were considered seven major inventions in the refining and cracking of petroleum—all seven were made by independent inventors. The contributions of large companies were largely in the area of improvement inventions.[8]

Chart 13, which is based on the above studies, illustrates some of the important inventive contributions made by independent inventors and small companies in this century. One finds the range and diversity of these inventions impressive. Indeed, the mercury dry cells in our electronic watches, the air conditioners in our homes, the power steering in our automobiles, the FM circuits and vacuum tubes in our Hi-Fi and television sets, the electrostatic-copying machines in our offices, the penicillin and streptomycin in our medicine cabinets, and the list goes on—all of these inventions, which are generally taken for granted, take a new meaning when one identifies them with their sources. The point to be made is that independent inventors and small firms are responsible for an important part of our inventive progress, a larger percentage than their relatively small investment in R&D would suggest.

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[4] *J. Jewkes, D. Sawers, and R. Stillerman,* The Sources of Invention, *St. Martin's Press, 1958, particularly pp. 72-88, and Part II.*

[5] *D. Hamberg, "Invention in the Industrial Research Laboratory,"* Journal of Political Economy, *April 1963, p. 96. See also,* Concentration, Invention, and Innovation, *U. S. Senate Antitrust Subcommittee, 89th Cong., Part III (Government Printing Office, 1965), p. 1286.*

[6] *M. J. Peck, "Inventions in the Post-War American Aluminum Industry," in* The Rate and Direction of Inventive Activity: Economic and Social Factors, *National Bureau of Economic Research, (Princeton, New Jersey, 1962), pp. 279-92. See also, U. S. Senate Antitrust Subcommittee, op. cit., p. 1296 and 1438-1457.*

[7] *Hamberg, op. cit., p. 98. See also U. S. Senate Antitrust Subcommittee, op. cit., p. 1287.*

[8] *J. L. Enos, "Invention and Innovation in the Petroleum Refining Industry," in* Rate and Direction of Inventive Activity, *op. cit., pp. 299-304. See also, U. S. Senate Antitrust Subcommittee, op. cit., p. 1287 and pp. 1481-1503.*

CHART 13

SOME IMPORTANT INVENTIVE CONTRIBUTIONS OF INDEPENDENT INVENTORS AND SMALL ORGANIZATIONS IN THE TWENTIETH CENTURY

Xerography
Chester Carlson

DDT
J. R. Geigy & Co.

Insulin
Frederick Banting

Vacuum Tube
Lee De Forest

Rockets
Robert Goddard

Streptomycin
Selman Waksman

Penicillin
Alexander Fleming

Titanium
W. J. Kroll

Shell Molding
Johannes Croning

Cyclotron
Ernest O. Lawrence

Cotton Picker
John & Mack Rust

Shrink-proof Knitted Wear
Richard Walton

Dacron Polyester Fiber "Terylene"
J. R. Whinfield/J. T. Dickson

Catalytic Cracking of Petroleum
Eugene Houdry

Zipper
Whitcomb Judson/Gideon Sundback

Automatic Transmissions
H. F. Hobbs

Gyrocompass
A. Kaempfe/E. A. Sperry/S. G. Brown

Jet Engine
Frank Whittle/Hans Von Ohain

Frequency Modulation Radio
Edwin Armstrong

Self-Winding Wristwatch
John Harwood

Continuous Hot-Strip Rolling of Steel
John B. Tytus

Helicopter
Juan De La Cierva/Heinrich Focke/
Igor Sikorsky

Mercury Dry Cell
Samuel Ruben

Power Steering
Francis Davis

Kodachrome
L. Mannes & L. Godowsky Jr.

Air Conditioning
Willis Carrier

Polaroid Camera
Edwin Land

Heterodyne Radio
Reginald Fessenden

Ball-Point Pen
Ladislao & Georg Biro

Cellophane
Jacques Brandenberger

Tungsten Carbide
Karl Schroeter

Bakelite
Leo Baekeland

Oxygen Steelmaking Process
C. V. Schwarz/J. Miles/
R. Durrer

It goes without saying that the United States could not depend solely on the innovative contributions of small firms. The large firms are indispensable to technological and economic progress. From a number of different points of view, however, we are persuaded that a unique cost-benefit opportunity exists in the provision of incentives aimed at encouraging independent inventors, inventor-entrepreneurs, and small technologically based businesses. The cost of special incentives to them is likely to be low. The benefits are likely to be high.

III

THE SMALL COMPANY ENVIRONMENT

We turn now to an analysis of the environment for innovation at the company level. We will do this first for an illustrative small company, then for a large company. We will analyze these large and small company environments by describing their growth cycles and some of the characteristics and problems encountered in each case. Our recommendations will then be made in reference to these factors.

We analyzed the growth cycle of an illustrative technologically based small company and divided the cycle into what we perceived for our purposes to be the key stages of growth. These are shown in Chart 14.

Let us discuss each of the stages of the growth process in detail.[1]

THE IDEA STAGE

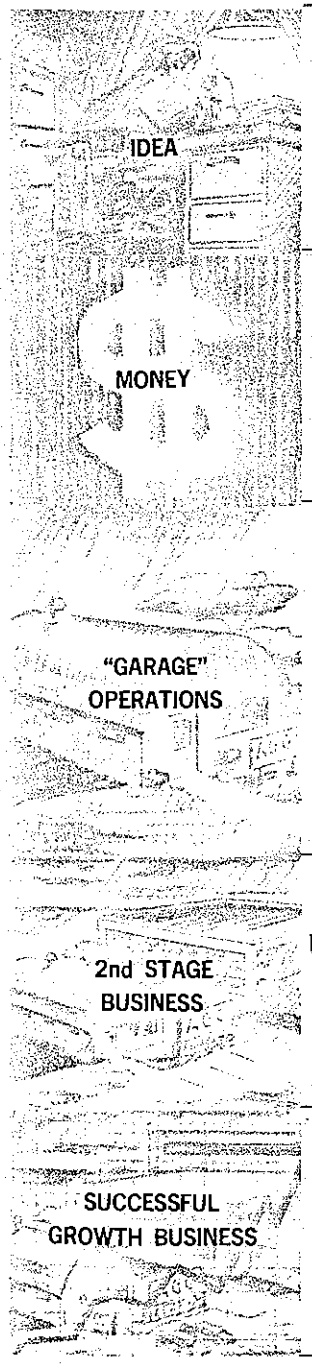
We begin with the idea stage. An inventor, or an inventor-entrepreneur, has an idea to which he is committed. Typically, the product or process which underpins the idea is the subject of a patent application. The people we are talking about are *individualists,* who usually have voluntarily "spun-off" from another organization. Their educational backgrounds are usually in science or engineering.

[1] *Italicized words in the text correspond to terms appearing in Chart 14.*

CHART 14

MANAGING TECHNOLOGICAL INNOVATION

SMALL COMPANY ENVIRONMENT



	CHARACTERISTICS	PROBLEMS
IDEA	**Individualists** Technical **Uncertainty** No business experience **Total commitment**	**Capital?** In business?
MONEY	**High risk requires high potential return** Relatively small $ **No technical experience**	**Appraisal** Lack of understanding • Banks • Industry • Government • Universities
"GARAGE" OPERATIONS	**Losing money** Less than • 100 employees • $1 million capital • 5 years old **Technology oriented** High ratio technical men **Government contracts** Fast reaction time **One or few customers** Custom manufacture **High return on investment** High value added	**Key management** incentives **Fringe benefits** Government procurement **Total commitment**
2nd STAGE BUSINESS	**New kind of financing** Dilution of equity **Many impersonal customers** Product oriented **High volume manufacture** More than • 100 employees • $1 million capital • 5 years old	**Key functional staff** Control techniques **Market analysis** World wide marketing **Costs** Competition
SUCCESSFUL GROWTH BUSINESS	**Growth** Jobs **Products**	**Escape** Merger **Sell out** Antitrust **Timing**

UNDERSTANDING

As we have noted, the path between an invention and the market place is a very tortuous obstacle course and, therefore, in this first stage of the cycle, there is a high degree of *uncertainty* as to the ultimate outcome of the venture.

Typically, these individualistic, technical people have little or *no business experience,* but are *totally committed* and prepared to risk their livelihoods and their future security in order to champion their idea.

We turn now to the problems the inventor and the entrepreneur have in this stage of their venture. We have listed two which are pertinent to some of the recommendations that we shall make. First of all, they need *capital.* As a rule they have none, and nothing will happen to their idea until they get some financial backing. It is not just any kind of money they are seeking. What they require is venture capital, and they must know something about the intricacies of venture capital acquisition or find somebody who does.

Secondly, they are faced with a legal issue of whether or not they are *"in business."* As we shall see, this question is important from the standpoint of the tax laws, for the deductibility of expenses that they incur at this stage in the growth cycle of their hoped-for company will depend upon, first of all, their tax acumen and, secondly, whether or not they are in business. Although we shall explore this question in detail later, it may be helpful to note at this point that even if the Internal Revenue Service regards them as being in business at this stage, they probably have no personal income against which to deduct the expenses in excess of income which the "business" is incurring.

THE MONEY STAGE

Venture capital is very *high risk* money. High risk money requires *high potential return.* It is important to note the very *high risk* that venture capital sources assume in underwriting the formation of new technologically based enterprises; and governments, the universities, and society need to understand this risk. There must be opportunities for large gains from a few successful ventures to offset the risk of losses from the many failures. Notwithstanding the risk element, venture capital *is* available (to those who know where and how to get it) precisely because there are extraordinarily high potential returns for the successful undertakings. We need only recall the histories of the ventures listed in Chart 4, Chapter I.

The money needs of a fledgling technological venture in its first two years are *comparatively small,* typically under $500,000. These costs, however, are much greater now than they were only twenty years ago.

By and large, the technical people, who have the idea and want to build a company on it, have little if any business experience and know nothing about the venture capital market. On the other hand, the sources of capital —banks, wealthy individuals, underwriters, investment trusts, and others— usually have *no technical background* and only rarely have available to them adequate staffs to perform the complex investment appraisals required to measure the merit of any single entrepreneurial proposal. We are dealing here with ideas that have high technical content. The venture capitalist needs to weigh their prospects. He may have a great many new ideas presented to him. He must pick winners some of the time and make educated gambles

all of the time; and to do this he has to have adequate appraisal resources at hand. One cannot overstate the pivotal importance of adequate appraisals. There truly are very few capital sources who understand equally well the nuances of convertible debentures and the intricacies of gas laser technology.

The "appraisal gap" is a rather specific example of our principal theme, that if any problem can be singled out as the central obstacle to the small technologically based enterprise, it is the need for *understanding*. Too few leaders in industry, government, the universities, and the financial community truly understand the business and human dynamics of the innovation process.

THE "GARAGE" OPERATION

The Company obtained the needed capital. It is now in business, but it is *losing money*. Let us put some rough dimensions on the firm at this stage. It is small, lean, proud, hard working. It is quartered, we may say, in a "garage"—in any case, very modest facilities. During this "garage" stage, it is typically less than five years old, has less than one hundred employees and less than $1 million in capital. Some of these firms may have one tenth of these resources.

The company is *technology oriented* and has a high ratio of technical to non-technical staff. Often, it is seeking government research and development contracts.

This kind of company has a *fast reaction time;* it is quick on its feet. It has to be: the distance from the front to the back of the garage or from smooth sailing to bankruptcy is very short, indeed. Each adversity is a major crisis for the fledgling enterprise.

It has limited marketing problems, because it typically has only a *few customers.* One dissatisfied customer, and the firm may face disaster, so it naturally tries a little harder to please. Because its market is limited, it often produces on a custom basis.

All of the above characteristics—high ratio of technical people, emphasis on know-how, a high-technology product or service, and so on—indicate that the firm's output probably has a *high value added.* This, in turn, means that if the company matures to a successful growth business, there will be a very high return on the *initial* investment.

But let us turn now to some of the problems. Management problems are foremost. They present the greatest frustrations. The typical inventor, prime mover, man with the idea, lacks managerial skills. The firm needs these skills, but how does it get them? The salaries, pensions, and other fringe benefits used by successful large firms to lure and hold key people cannot be offered by a struggling small company which is fighting for its survival. Other incentives must be found. To lure *key managers,* who are willing to share the *total commitment* of the company founders, the company must be able to point to a high return if the high risks are overcome. Our recommendation concerning stock options (Recommendation 2) is directed to this end.

Government procurement procedures may pose a problem to our new firm. Procurement regulations and policies do not take the peculiar problems of small, technological firms into account. For example, the summary cancellation of one government contract may be disastrous to a small firm. A large

firm, on the other hand, can probably survive such a cancellation, although we appreciate that such a cancellation is always a shock to any organization.

THE SECOND STAGE BUSINESS

Our company is maturing. It is now maybe as much as five years old, has annual sales in the millions of dollars, and is in business in every sense of the word. The loss of a single customer is no longer decisive. It now has many impersonal customers.

The company is no longer solely dependent on technology. Its central problems are now related to product manufacturing—to improving product quality and lowering manufacturing costs.

It needs a *new kind of financing.* But this new money will not be exclusively high-risk, high-return, venture-type capital. The earlier risks and uncertainties have been reduced and, therefore, obtaining secondary financing is usually easier than was the acquisition of venture capital. This time the company can look to conventional sources of capital—through public stock offerings, for example. After additional financing has been acquired, the equity of the original owners of the company has probably been significantly diluted in terms of the degree of ownership control they can exercise.

What are some of the new problems? To get to this stage, a company has to solve the key management problem we discussed with respect to the previous stage of its life. But now *key functional staff* are probably missing. Research, development, marketing, and production are new problem areas, and skilled personnel are needed to handle them. *Control techniques* are now needed to keep the business on course and operating effectively and efficiently. Costs have taken a new meaning and complexity.

Market analysis is also a new problem. In this stage of its life the firm may find that its product is not just a domestic item, but has international possibilities.

The company has become successful and, thus, has attracted other companies to its field. The competition intensifies.

A SUCCESSFUL GROWTH BUSINESS

The company, in its wisdom, persistence and good fortune, has solved its initial problems. It has become a successful growth business. Its contribution to the gross national product is growing, its products are filling many additional demands, and it is employing many more people.

It has new problems. The founders—the entrepreneur and the inventor—are not the central figures they used to be. They may want to escape. They championed their idea into a success story and the challenge may not be there any more. The time for taking a high return on their total commitment over the years may have come. They might want to do this by selling their interest in the company. Or they might want to sell the company or merge it with another corporation. For the first time, a new word appears in their vocabulary: "Antitrust." To them it may appear as an unwarranted governmental restriction that prevents them from realizing the maximum possible return on their personal investment and commitment; and yet, in larger perspective, the restriction may be required to safeguard the public interest.

IV

THE LARGE COMPANY ENVIRONMENT

The innovation process in a large company is, in many respects, similar to that in a small company. But the risk of any single venture to the future of a large company is nowhere near as great, for the large technologically based company can spread its risks by undertaking several innovation projects at once. Moreover, because a large company normally has profits against which it can offset costs, the government, in effect (through the corporate income tax), shares in 48% of the innovation project losses of the company. As we have seen, this is not true of a typical small company in its early stages.

THE PROBLEMS OF GROWTH

To illustrate the basic problem of the large company with growth objectives, let us consider the following hypothetical case.

CHART 15

GROWTH PROBLEM IN A SUCCESSFUL LARGE COMPANY

(Hypothetical Case)

Annual Sales	$1,000,000,000	
Sales Decline (Oldest Products)	5% Per Year	$70,000,000
Price Erosion	2% Per Year	
Typical Market Penetration	25%	
Growth Target	10% Per Year	$100,000,000
		$170,000,000

Such a company needs $170,000,000 of new sales from a combination of

(a) established products
(b) new products in established businesses
(c) new businesses

Ultimately this company must seek to enter completely new businesses or abandon its growth objective

The company has annual sales of one billion dollars, derived from established products, in a series of markets which it has penetrated, on the average, to the extent of 25%. The total demand for the oldest of these products is falling at a rate of 5% per year ($50 million). Moreover, the price erosion of its whole range of products is 2% per year ($20 million).

This company is well-managed and has substantial resources. It is not content to deteriorate by $70,000,000 each year. Nor will it be satisfied merely to remain static. On the contrary, it wishes to grow at a fairly high rate—say, 10% per year ($100 million). Adding these figures up, then, this company finds that it needs $170 million of added sales in the first year of its growth program.

The new sales can only come from a combination of (a) increased sales of its established products through greater market penetration or the invasion of new markets, (b) development of new products in its current businesses, or (c) entry into completely new businesses.

With the demand for some of its established products declining, an increase in the sales of its better performing products (amounting to a 17% year-to-year rise) will be hard to achieve, particularly in view of the substantial market penetration the company already has. Ultimately, therefore, the company will have to enter new business fields or abandon its growth objective. The important point to bear in mind, as we proceed now to discuss briefly an example of the large company environment, is that this requirement for growth leads a large company to launch innovative business ventures. The small, fledgling firm is therefore not alone in this respect. Whatever the differences between the small and large firm, the goal in each case is a successful new growth business.

For purposes of discussion, we have divided the management of technological innovation in a large company into four stages, as shown in Chart 16.

We identify the first phase as the business planning stage. Next comes the period of experimental appraisal. Out of this, if all goes well, an embryo business appears. And if everything falls into place, the result is a successful growth business. Let us consider each of these stages in turn.

BUSINESS PLANNING

In almost every detail the large company environment for innovation is different from the small company situation we have discussed. In one crucial respect, however, they are identical. At the *very* beginning of a new "business innovation project" there is an individual who has an idea on how to solve a problem, or how to create a novel product, or how to fill a need which he believes will be manifested in the market place.

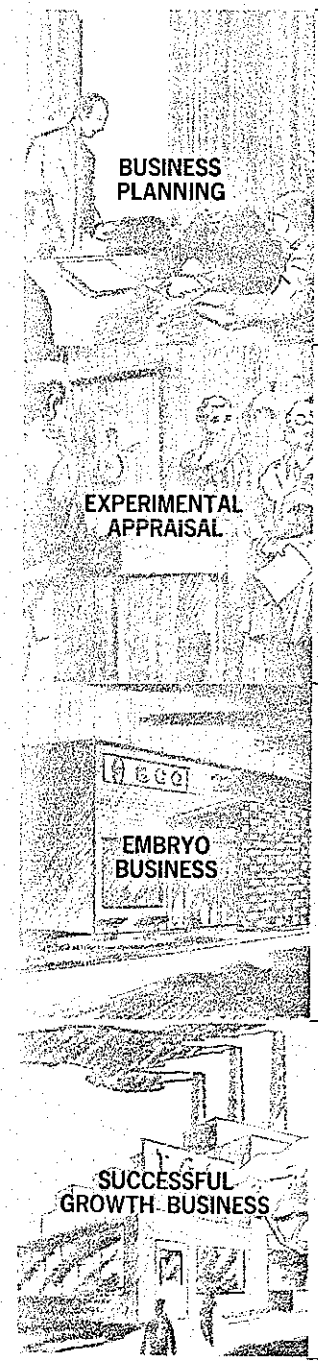
Because the company is committed to innovation, this individual has an opportunity to perform some experiments to develop his concept; he then has a chance to present his idea for consideration by management.

We come now to an important difference between new and established companies. In the large company the merit of the idea is judged by analyzing the totality of the proposed new business venture as an alternative investment opportunity. This analysis in the most sophisticated companies can be used to establish a "best guess" for the net present value of the new venture con-

CHART 16

MANAGING TECHNOLOGICAL INNOVATION

LARGE COMPANY ENVIRONMENT



	CHARACTERISTICS	PROBLEMS
BUSINESS PLANNING	**Venture analysis** Directional planning **Business objectives control**	**Not invented here** Time value of money **Inbreeding** Lack of specific market experience often kills good projects
EXPERIMENTAL APPRAISAL	Complex enterprise **Has R/D organization** May lack certain technical skills	**Entrepreneurs missing** Know-it-alls **Risk vs. Cost emphasized** Extend present businesses
EMBRYO BUSINESS	**Outside imputs needed** Incentives available **Continuing R&D effort**	**Failure to meet return on investment criteria in early years** Antitrust **Key management**
SUCCESSFUL GROWTH BUSINESS	**Growth** Jobs **Products**	**Assimilation** Antitrust

UNDERSTANDING

cept, taking into account the risk of failure, the time value of money, and the company's performance in its established businesses. The new idea is thus judged as an alternative to other investment opportunities available to the company. Such alternatives are not available to a new company of the kind we explored in Chapter III.

As part of its *venture analysis* [1] the company also engages in directional planning, based on the realities of the market place and aspirations and capabilities of the organization. Directional planning involves questions such as: "Where are we?" "Where are we going?" "How will we get there?" "How did we get to where we are?" "What business are we in?" "What should we be in?" "How does the idea we're considering fit in with what we are or should be?"

Despite the logic and helpfulness of the planning process, it cannot cope with certain internal barriers to the new idea being considered. If it has come from outside the company, the new idea may undergo a fatal battering because of the *"not invented here"* syndrome. As Charles Kettering once put it, "The greatest obstacle course in the world is trying to get a new idea *into* a factory." [2]

A large company has greater concern for the *time value of money*. Unlike a small company beginner, a large established company has the option of applying its money to a number of alternatives. An investment that will not yield returns for several years is made less attractive because it is discounted substantially. As a consequence, the company may choose less ambitious shorter-run opportunities.

A large company tends to be *inbred;* in extreme cases the company may thereby actively resist any change. More important, however, is the problem that a new market represents to the large company's established marketing staff. Indeed, there is no question that good innovative opportunities often are not exploited because the company lacks the requisite *market familiarity*. The irony, as we have seen, is that new markets are the key to the kind of new growth businesses that the large company needs to develop.

EXPERIMENTAL APPRAISAL

In those cases, however, where the large company management elects to try to develop a new business opportunity, it proceeds next to an experimental appraisal of the key elements of the new business. This often involves a research effort for which the company has an *institutionalized research* and development activity.

However, the company may be missing some of the technical skills needed in the new field it is exploring. If, for example, its traditional business is in electronics, but the new venture has to do with washing machines, its technical people may not possess the required mechanical skills for the new business. But a large company has the resources to acquire these skills.

The large company is a complex social organization. The fast reaction

[1] *Italicized words in this chapter correspond to terms appearing in Chart 16.*
[2] *See* Concentration, Invention and Innovation, *U. S. Senate Antitrust Subcommittee (Government Printing Office, 1965), pp. 1099, 1115.*

time we discussed in reference to the small company environment is not easily attainable here. The distance from the chief executive's office to the maintenance shop may be a long way. He is, in fact, often removed from the operational details of his company; surely, he is not familiar in detail with each new venture early in its lifetime. The complexity of the organization itself leads to certain problems.

There are the *"know-it-alls."* They explain that they have thought about similar new ideas many times before, and have concluded that there are many, many reasons why each new concept cannot succeed. Or, it will not work because it has never been done before. There are many other reasons why, in this experimental appraisal stage, prior experiences and predispositions rise up to block innovation. Often these take the form of an overly conservative estimate of *risk-versus-probable cost* for new ventures. It is easy to make such decisions because there is always the choice of *extending the present business* rather than taking the organization into unknown territory. As we have noted, the beginning small business has no analogous option.

These are different kinds of problems from those we discussed in reference to the small company environment. There, when the problem was to obtain initial financing for the incipient firm, the problems were largely external ("Can we get the capital?"). Here, we are concerned with what may be a lack of entrepreneurial spirit and commitment within a well-established, well-financed organization. In a complex organization the overriding problem often is maintaining an adequate commitment to a new idea in the face of internal obstacles to change. There is an understandable reluctance to depart from what has been a successful pattern of business. So we come back again to the need for *understanding,* within and outside the company, of the special problems of managing and exploiting technological change. These problems are no less formidable in a large organization than they are in a small firm. They are just different.

THE EMBRYO BUSINESS

The experimental appraisal is over and the idea has proved itself. An embryo business is formed within the framework of the corporation. Because of its ancestry, the business needs no major effort to establish a long-range R&D program. It has the tradition and the backing to fill in gaps in the R&D sector.

But the embryo business usually does *need outside inputs*—in the marketing area, for instance. Key management is also important. The established company can get these inputs more easily than can the small firm, for it can offer the *incentives* of high salaries, security, and other inducements already mentioned.

But sometimes the most effective strategy is to purchase the needed elements by acquiring assets from another company or merging with it. Here, again, *antitrust* considerations play an important role in limiting the company's course of action.

At an equivalent point in its growth pattern, a small company is in a "do or die" situation. The large company, however, may still elect to abandon the venture if it fails to show signs of measuring up. For example if, in the early

years, the embryo business fails to meet the established criteria for *return on investment,* the large company may drop the venture altogether.

A SUCCESSFUL GROWTH BUSINESS

Just as the desired final stage of the small-company cycle was a successful growth business, so it is for the new business development within a large technologically based company. Here, too, the characteristics of the firm include growth contributing to the gross national product, jobs to provide new employment opportunities, and products to fulfill needs and to diffuse technology.

Antitrust can be a problem if, for example, the corporation seeks to enhance its new business by acquiring other companies that are capable of complementing it. It should also be noted that if, in the first instance, the large corporation, instead of developing a new business venture completely internally (as in our illustrative example), had preferred to add a new business through *external* acquisition or merger, antitrust questions could have arisen then.

As a further observation on the large-company example discussed in this chapter, we should mention the difficult problem of *assimilating* the new growth business into the parent corporation. Adjustments and dislocations are inevitable; disharmonies will occur. This is a painful but absolutely necessary step, since the full value of the new business cannot be realized if it operates separately from the supportive strength of the entire company, to which it can also add strength and skill.

It is apparent, therefore, that small and large technologically based companies have similar goals and problems, though different environments. Both wish to develop successful growth businesses, but they go about the task in very different ways.

No attempt has been made to construct a *generic* model of the innovation process as it occurs in "the" small firm or in "the" large firm. We chose instead two illustrative examples of the process. Much more could have been said about the problems and characteristics of large and small technologically based companies. We believe, however, that we have identified an adequate number of problems and characteristics of the innovation process in large and small firms to enable us to explore, in a more reasoned approach, possible ways to improve the environment for technological change.

Moreover, what we have noted regarding the *respective* characteristics and problems of large and small technologically based firms suggests an important challenge to the business world. The challenge is to explore new ways for large companies to work with small technologically based companies, while maintaining the creative qualities of each—or, alternatively, for large companies to develop, *within* themselves, sub-environments that foster the enthusiasm and entrepreneurial spirit of the small firm, while benefitting from the over-all resources of the total corporate environment.

V

PROBLEMS AND RECOMMENDATIONS

Having explored various aspects of incentives and barriers to technological change and having analyzed some of the salient features of small and large companies in the management of technological innovation, we are in a position now to present our recommendations. For reasons already stated, and which will be supplemented, they are aimed primarily at the problems encountered in the small company environment.

A. TAXATION [1]

1. THE PROCESS OF SELECTION

We have reviewed many tax proposals aimed at either (1) encouraging innovation in a positive way, or (2) eliminating disincentives or barriers to innovation. We are recommending only a few, having rejected most of the proposals we considered. It would please us to be able to say that our evaluation was made on the basis of clear, statistical evidence of the prevalence and importance of a given barrier to innovation, or on the basis of a sophisticated cost-benefit study of the impact of a given tax change on the amount of innovation or even on the level of tax revenues.

Unfortunately, there are few such data available. In fact, the lack of objective data, in or out of government, on the innovation process, in general, and the technologically based firm, in particular, is symptomatic of a very serious deficiency in our thinking regarding technological innovation. As we have said earlier, too few people in government, in industry, in banks, and in universities understand the special forces at work in the conception, appraisal and nurturing of the innovative, technological enterprise. Yet, even a casual reading of the business history of this country makes it clear these innovative

[1] *See Appendix D for provisions of the Internal Revenue Code discussed in this chapter.*

enterprises are an important part of the process that differentiates our rate of progress from that of the rest of the world.

How, then, have we decided to recommend some tax proposals while rejecting so many others? We have tried to give adequate consideration to tax incentives that operate across the total process of innovation, and have avoided recommendations which, in our view, would result in unreasonable or unjustified economic distortions. We are wary of proposals that would lead one to believe that a tax incentive for R&D alone would automatically lead to major increases in innovation.

In this vein, a common proposal is a 75% tax credit on all R&D expenditures. Let us review our reasoning in *rejecting* this proposal. Its cost in lost tax revenues would fall in the range of *1.25 to 1.5 billion dollars a year,* for between 5 and 6 billion dollars per year is now being spent on industry-supported research. It should be understood that a 75% tax *credit* means the government would, in effect, be bearing three-fourths of the cost of industry-supported R&D. At the present corporate tax rate of 48%, it bears roughly half the cost. An additional 25% of the burden would therefore be a very costly tax change.

This recommendation generally flows from an assumption that what our society really needs to get more innovation is simply more research and development. We have indicated earlier that we are unable to conclude that our country is lacking in this regard. Also, and more important, we believe we must look increasingly at the innovative process the way businessmen do—that is, at the *total* new venture, the *total* cost, the *total* profitability or loss, not just the R&D portion, which is usually only a small segment of this total.

It is very likely that an across-the-board (and therefore costly) tax credit would be enjoyed largely by the very large and already technologically-oriented companies. As recently as 1960, only 300 companies accounted for 90% of the R&D expenditures. As we have already noted, to many of these companies, research and development is increasingly a way of life.

We should seek to provide incentives that will increase the nation's total innovative potential and should aim our efforts at companies where the extra incentives are genuinely needed, or will provide the maximum innovative response per dollar spent. We do not believe an across-the-board 75% tax credit for R&D expenditures meets these criteria.

In looking for unique cost-benefit relationships, we were impressed, as we have already noted, by the apparent leverage of small companies and individual inventors and entrepreneurs in the whole process of invention and innovation. We were also impressed by the great difficulty that apparently exists in communicating the availability of tax benefits to small companies and individuals.

It is not enough to say that a given tax change will produce dramatic results. Even if the economic theory is sound, this assumes people will know about the tax change and grasp its implications. The Sloan School at the Massachusetts Institute of Technology recently conducted a study of the impact of tax benefits on small technologically based companies.[2] It would

[2] *Baty, Gordon,* Initial Financing of the New Research-Based Enterprise in New England, *Report to Federal Reserve Bank of Boston No. 25 (1964), Master's Thesis, M.I.T., pp. 72-73.*

appear from the study that Section 1244 (which allows an ordinary deduction, instead of a capital loss, for losses incurred in the stock transactions of certain small business corporations) did not have a substantial influence on many of these companies. Because a tax provision of such potential benefit is still apparently not widely appreciated and used, one is led to conclude that not enough is being done to provide better education for administrators, businesses, and individuals on the availability and meaning of *existing* tax provisions. One needs to ask, moreover, whether a given tax problem, such as that to which Section 1244 was directed, while noticed by sophisticated tax experts, really affects only a very small percentage of the potential innovators.

To propose that far-reaching, across-the-board tax benefits are the major requirement for higher levels of innovation requires an explanation of why, with existing tax benefits, some areas like Boston, Palo Alto, Pittsburgh, and northern New Jersey have produced many more technologically based innovative companies than have other major areas with equivalent or greater numbers of scientists. A study we have already alluded to suggests that other factors—attitudes of universities and banks, for example—play a major role.[3]

Thus, where we were not impressed that a *pervasive* and *important* need existed for a tax proposal, we were not persuaded to recommend it, however technically elegant the proposal may have been. On this basis, we eliminated a large number of specific, technical tax recommendations that may have made sense in their own terms, but which, in our view, were likely to have limited impact. In this process of selection, we have focused on the special problems of the inventor, the entrepreneur and the small technological enterprise. We turn now to our specific proposals.

2. MORE TIME FOR SMALL BUSINESS DEDUCTIONS

A large corporation engaged in research, development and innovation projects generally has profits against which losses incurred on these projects may be deducted. As a result, it may be said that the Government shares in the cost of these innovation losses to the extent of 48% of the cost. On the other hand, a small corporation that has no profits from which it may deduct R&D expenditures bears the entire cost of that expenditure. While those losses may be carried forward against profits of the succeeding five years, this places the unprofitable corporation in a disadvantageous position as compared with the large corporation, because (1) the Government's contribution is deferred until profits are realized, and (2) if profitable operations are postponed beyond the fifth year after the loss is incurred, the Government is never called upon to "contribute" its share of the loss. A similar result obtains in the case of the individually operated business, except that here the time limitation on the loss carry-over provisions also wipes out the deductions for personal exemptions and non-business income. Our review of several successful, technologically based companies indicates that it is not uncommon for even the successful ones to have lost money for at least five years. To recapitulate:

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[3] *Deutermann, Elizabeth P., "Seeding-Science Based Industry,"* Business Review, *Federal Reserve Bank of Philadelphia (May 1966), pp. 3-10.*

CHART 17

LARGE vs. SMALL COMPANY IMPACT OF CURRENT 5 YEAR LOSS CARRY FORWARD

(1) Large companies generally have other profits against which innovation project losses can be written off immediately...therefore,

Government shares currently in 48% of these losses.

(2) Small companies often do not make profits for five years or longer...therefore,

The government either defers its contribution until profits are realized, or if losses persist for longer than five years, the government is never called upon to share in these losses.

Our task is to look for ways to remove tax disincentives or provide incentives for innovation. Tax changes that have little effect on *innovation* are not within the scope of our mission. Thus, if we are to favor extension of the period of loss carry-forward, as we do, we feel it desirable to limit the applicability of this extension to companies or activities that involve innovation.

We have struggled with this question. To allow such an extension for *all* companies would be to often allow benefits for incompetence rather than risky innovation. On the other hand, to allow such benefits only for *projects* that are "innovative" would be to require advance *certification* procedures which would likely be cumbersome at best and destructive of the innovation process, at worst.

We have therefore decided that the approach most likely to strike the right balance in defining the right targets for tax incentives, without imposing anti-innovative certification procedures, is to describe the kinds of companies that are most likely to produce the desired kind of innovation.

As we indicated in our analysis of the small company environment (Chapter III), small, technologically based companies, which in the past have generated so much effective innovation, would probably have

1. A product or know-how that can be sold or licensed.
2. A high ratio of technical people to the total number of employees.
3. A high value added as percentage of sales.
4. A small size in terms of (1) number of people, (2) dollar sales, and (3) net worth.
5. No affiliations with other companies (e.g., as a subsidiary).

These are illustrative criteria. A more refined and definitive list should be based on a detailed, empirical study of the characteristics of such firms.

RECOMMENDATION 1

We recommend that losses of small, technologically based companies, meeting criteria along the lines we have suggested, be allowed as a carry-forward against profits of the succeeding ten years instead of only five years.

This would assure those businesses which contemplate a longer than five year period of development that the Government would bear an equitable share of the losses, as it does in the case of the large profitable enterprises. Such an extension of the loss carry-forward period for small technologically-based companies would certainly help to equalize their treatment with that of the larger profitable organizations.

And yet, conceptually, it is clear that our recommendation is really only a *partial* equalization of treatment. The large corporation is often a conglomerate of a number of different businesses, some profitable and others not. In particular, the new and innovative businesses are often not profitable, at least for some time. The Government shares *currently* these losses of large profitable companies.

On the other hand, the small, technologically based company, as we have seen, often has its total commitment in one or a very limited number of product lines. Thus, its losses from its new product lines may often be unaccompanied by offsetting profits from profitable product lines.

We have explored the concept of suggesting that the Government share *annually* in the losses of these small, technologically based companies through a *tax credit*—a negative tax, as it were. It has been suggested that the concept of the Government's sharing in the losses (they share in the gains) makes good economic sense—particularly since this kind of firm contributes significantly to invention and innovation. Nevertheless, we are aware of the political and philosophical objections to such a proposal. We are not inclined to favor a tax recommendation as far-reaching as this at a time when even the most "conservative" and "modest" proposals for tax incentives are likely to be viewed with great caution, both by the makers of fiscal policy and respected commentators in the field.[4] However, we would be remiss if we did not point out that we seriously debated the merits of such a proposal, and there is something to be said for it conceptually.

3. A LIBERALIZED STOCK OPTION FOR THE SMALL FIRM

There are few subjects less popular and perhaps less likely to receive favorable consideration than any proposal for the liberalization of stock options.[5] And yet, our study of small technologically based companies indicates they and the pace of their innovation have probably been affected adversely by the tightened provisions of the 1964 tax revisions. We note in the following chart three of the major stock option revisions that were enacted in 1964.

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[4] *See, for example, Peckman,* Federal Tax Policy, *Brookings Institution, 1966.*
[5] *See, for example, Eisenstein,* The Ideologies of Taxation, *Ronald Press, 1961.*

CHART 18

SOME OF THE MAJOR 1964 REVISIONS OF STOCK OPTION PLANS ENTITLED TO CAPITAL GAINS TREATMENT

	Before 1964	After 1964
Minimum Purchase Price of Stock	85% of Market Value	100% of Market Value
Maximum Time to Exercise Option	10 Years	5 Years
Minimum Holding Time Between Purchase and Disposition of Stock	6 Months	3 Years

The latter two changes pose, we believe, especially significant problems for the small company. We believe that at the time of the change, the major thrust of Congress' intent was to minimize certain abuses of *large company* option holders. We question whether there was adequate understanding, at the time, of the special impact of this change on the small company. But first, let us consider the small technically based company's need to attract and motivate experienced managerial talent.

As we noted in the discussion of these small companies (Chapter III), they tend to go through a growth cycle where, in the early stages, technical know-how is the dominant skill required. Then, commercial products are developed from this know-how. Initially, the number of customers is very limited. Later, as markets grow, new requirements develop: how to manufacture and market products on a broader scale and how to control increasingly complex operations. This stage requires managerial talents that are more likely to be found in larger companies than in the small companies.

The problem, of course, is how to attract these men from the larger companies. Stock options in the small companies are, relatively speaking, substantially less desirable than they were, and less desirable than many large-company options. There are at least two reasons for this:

—First, the absence of a broadly based public market for the stock of many small, technologically based companies increases substantially the borrowing difficulties of the sought-after employee (the stock can be offered as security on loans), especially over a three-year period.

—Second, the employee of a large company can limit his downside risks, in the event the stock market declines, by selling his stock *immediately* should the stock fall below a given point. The very limited market for the stocks of many small companies makes the downside hazard of the stock option of such companies much greater than that of a large company.

For reasons we have already expressed, it is our belief that there would be

a net, national gain in industrial innovation if these small technologically based companies could attract more skilled, *managerial* talent from the *larger* companies. Liberalized stock options for these small companies could be an important incentive.

RECOMMENDATION 2

We recommend a liberalization of the stock option rules for small technologically based companies by (1) extending the permissible option period from a maximum of five years to ten years, and (2) reducing the holding period required to receive capital gains treatment to less than three years, preferably to six months.

4. CRITERIA FOR R&D DEDUCTIBILITY

a. Casual Inventors and Innovators Judicial decisions under Section 174, relating to the allowance of a current deduction for research and development expenses, *disallow* such a deduction to "casual" inventors and innovators who are not engaged in a trade or business at the time the expenditure is incurred. We cite, for example, the following cases:

—T. R. Ewart, Tax court Memo (1966) (deduction disallowed to a public relations executive who sought to promote a novel candy-dispensing toy);
—John F. Koons, 35 T.C. 1092 (1961) (deduction disallowed to advertising executive for payments to develop an invention unrelated to his advertising business);
—Charles H. Schafer, P–H T.C. Memo P64, 156 (1964) (deduction denied lumber salesman on the ground that his invention did not constitute a separate going trade or business);
—William S. Scull II, P–H T.C. Memo P64, 224 (1964) (deduction denied president of instant coffee corporation on the ground that he was not personally engaged in the coffee business).

We recognize that appropriate safeguards are necessary to protect against deductions for "hobby" expenditures, and feel that such safeguards can be erected without denying a deduction to bona fide inventors and innovators who incur out-of-pocket expenses for the *purpose of ultimately producing income*. Among the safeguarding factors which, in various combinations, may tend to show bona fide inventive activity, are the filing of an application for patent; diligent prosecution of the application; the borrowing of capital to finance the inventive activity in question; a contingent fee arrangement with the inventor's attorney; efforts to license, assign or otherwise exploit the patent or prospective patent.

We are aware of the Treasury Department's reluctance to draw a more generous line between the "casual inventor" and the "inventor-businessman," and are also aware that it is not easy to differentiate between a hobbyist and an inventor who intends to go into business. But the answer to this difficulty is not to draw the line at the point where the inventor is already in business before these expenses can qualify as deductible expenses, for to do so is to

fail to take adequately into account the realities of the innovative process, with its very uncertain initial stages. Accordingly, we make the following recommendation.

RECOMMENDATION 3

The Internal Revenue Code should be amended so that a casual inventor or innovator can deduct out-of-pocket expenses legitimately incurred for the purpose of ultimately producing income.

Also, we see cases where the inventor-entrepreneur was indeed seriously intent upon going into business by the fact that he is *now* in business. At the time he was doing his research and development, he may not have declared his costs as a deduction. We need only recall the great uncertainty in the first (the "idea") stage of our small company example (see Chapter III). This failure to declare deductions frequently happens because the inventor-entrepreneur is usually not a sophisticated person in the tax aspects of his work and does not get adequate counsel *until he has an established business.* Accordingly, we make the following proposal.

RECOMMENDATION 4

The successful inventor who has a going business but did not declare his earlier development costs should receive a "generous backward look" by the Internal Revenue Service and be permitted to reconstruct his development costs and write them off over a period of five years.

b. New Lines of Business In a recent case before the United States Tax Court,[6] the Commissioner of Internal Revenue unsuccessfully argued that Section 174, allowing a current deduction for research and development expenditures, is not available in the case of such expenditures incurred to develop new products unrelated to the taxpayer's current products. This contention has an obviously adverse impact on a business that seeks to develop a new product. Accordingly, we urge the Internal Revenue Service to issue a ruling that it will no longer make this contention in litigation.

The Internal Revenue Service has indicated it will review this case and consider whether it needs to clarify the treatment of R&D outlays directed toward launching a new product line. That such a position was ever taken in litigation is in itself evidence of a point of view that, at least occasionally, puts the innovation process on the defensive. Almost by definition, the more significant the innovation, the more likely it is to be a "new produet line." Accordingly, we make the following recommendation.

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[6] Best Universal Lock Co., Inc. *45 T.C. No. 1 (1965).*

RECOMMENDATION 5

Research and development expenditures incurred to develop new products or processes should not be disallowed as a business deduction merely because they are unrelated to a taxpayer company's current products or processes.

5. THE PROFESSIONAL INVENTOR

Under present law, an individual patent owner receiving compensation for the sale or use of his patent may be entitled to capital gains treatment under two separate but overlapping provisions of the Internal Revenue Code. If he is an *"amateur"* inventor, he may be entitled to capital gains treatment under the general provisions of the Law (Internal Revenue Code Section 1222). These provisions are applicable to capital transactions in general and not just to patents. He is an "amateur" if he is not holding the patent for sale to customers in the ordinary course of his business. If he is a "professional" inventor, however, he must look to Section 1235 of the Internal Revenue Code, which permits the capital gains treatment to an inventor if he transfers substantially all of his rights in the patent.

Under the Treasury Regulations,[7] the requirements to qualify under Section 1235 are more stringent than the requirements developed by some courts with respect to the general provisions of the Code.[8] Thus, under these general provisions, an amateur inventor may realize a capital gain on a grant of rights in a patent limited to a specific field of use (for example, the field of radio and television), while retaining the rights to other fields (for example, computers or telephone equipment). Or he may limit a patent license to a particular geographical area of a country (for example, the West Coast), while retaining all rights in the remainder of the country. But a professional inventor loses his capital gains advantage if he imposes either of these limitations in a license of his patent, for Section 1235, as interpreted, does not permit such limitations.

These more stringent requirements imposed under Section 1235 can operate as a disincentive to the diffusion of technology. Requiring a professional inventor who seeks to comply with Section 1235 to forego, in affect, all possible applications of his invention is, it seems to us, against the public interest. For there arc inventions which have diverse applications, and in these instances no *single* licensee or purchaser may be able to pursue all of the invention's possibilities.

In effect, we ask the inventor to make a complete commitment to a given company or person who will presumably exploit the invention. Because it is a complete commitment, it is no surprise the inventor's asking price is high. It is high because (1) he realizes that this is "his only chance" to receive the capital gains treatment and (2) he tries at the outset to be assured of a substantial

[7] *Treas. Reg. Sec. 1.1235–2(b)(1)(1965); Treas. Reg. Sec. 1.1235–2(c)(1957).*

[8] *See, for example,* Dairy Queen, Inc. v Commissioner, *250 F.2d 503(10th Cir. 1957);* Thornton G. Graham, *26 T.C. 730(1956);* Gowdey v. Commissioner, *307 F.2d 816(4th Cir. 1962);* Molberg v. Commissioner, *305 F.2d 800 (5th Cir. 1962).*

minimum advance payment, for he is uncertain as to how aggressively a given company will exploit his patent. In other words, he negotiates a final contract in an early atmosphere of very imperfect knowledge as to whom he is dealing with and the extent to which the other party will tap the potential uses of his invention.

From the *company's* standpoint, the value of the patent is not clear, because it often does not know its value until further development work is pursued, practical production or engineering problems solved, and market explorations conducted.

Thus, at this early point of *maximum ignorance* on both sides of the negotiation, the inventor and the company must make a commitment for "all substantial rights," if the inventor is to receive capital gains treatment. Several panel members have had personal experience on both sides of this kind of negotiation and are convinced it substantially deters the process of getting patents translated into commercial products.

For this reason, we believe that the two provisions of the Code should be reconciled to permit qualification under Section 1235 in the case of a transfer of substantially all the rights in a patent limited to a particular field of use, or to a particular geographical area within a country. This would afford to the professional inventor the same capital gains advantage available under present law to the amateur inventor. We believe there is ample evidence that much effective invention is done by inventors who are prolific—i.e., professionals. If we want to encourage these individuals who, by any study of history, have contributed so much to the innovative status of this country, we feel a positive incentive is warranted.

RECOMMENDATION 6

Professional inventors should be placed on the same tax footing as amateur inventors by interpreting or amending Section 1235 of the Internal Revenue Code so that a patent license qualifies as a transfer of "substantially all rights," even though the grant is legally limited to a particular field-of-use or a particular geographical area.

We recommend that the Treasury first consider whether it would be feasible to accomplish this by amendment of its Regulations, without legislation. If this cannot be accomplished, we recommend that appropriate legislation be sought.

6. TAXABLE PURCHASES OF TECHNOLOGICAL ASSETS

The Treasury Regulations issued under Section 174 of the Internal Revenue Code draw a distinction between research and experimental expenditures incurred by a business in its development of an invention or innovation and the cost of acquiring another's invention or innovation. While expenditures incurred for internal development are deductible against *current* income, the cost of acquiring another's patent or process must be *capitalized*. (U. S. Treasury Regulations, Section 1.174–2(a)(1)).

In the case of any capitalized expenditure, a deduction for the cost is written off over the estimated useful life of the asset acquired, provided that its useful life is determinable with reasonable accuracy. For example, in the case of a secret formula, generally no deduction is allowable for its cost against the income earned therefrom, until such time as the process becomes completely worthless. This result is premised on the assumption that a secret process has an indefinite life, an assumption made doubtful in many cases by the rapid changes in modern technology. Moreover, the advantage of the current deduction for self-developed innovations over purchased innovations tends to discourage the acquisition by purchase rather than development, especially in light of uncertainty as to the proper write-off period, and this may operate to the disadvantage of the small innovator seeking to sell his innovation.

The Treasury Department's concern over any step that might tend to erode the principle of no tax write-offs for "good will" is understandable. Yet, the equally legitimate concern over the rate of technological diffusion suggests serious consideration be given to that portion of "good will" that can logically be attributed to technological assets. The ability to write off patents but not technology creates a distinction that is neither logical nor meaningful.

We do not propose that a general assault be made on the "good will" principle. Rather, we seek to encourage the spread of innovation by permitting the depreciation of purchased technological assets in certain limited cases. Accordingly, we make the following recommendation.

RECOMMENDATION 7

Companies making taxable purchases of technological assets should be permitted some depreciation and tax write-off of these assets in excess of the value of tangible assets.

Such treatment could be limited in the following ways:

(1) Only taxable purchases (for example, in cash) would qualify; tax-free acquisitions in exchange for stock would not be entitled to such treatment.

(2) Purchasers would be required to distinguish the technological components of the intangible assets—e.g., know-how—from "good will" elements, such as trade names and marks.

(3) To remove some of the ambiguity, the purchaser of such qualifying technological assets could be assured that he could write off a certain minimum portion (say, 50%) of the excess of the purchase price over the value of the tangible assets (including cash and accounts receivable).

(4) The burden of proof would be on the purchaser to validate the values of technological assets above the level of tangible assets—for example, by estimating costs of duplicating know-how, if the company had developed it internally.

(5) Such values of technological assets could be written off over an interval of 17 years, which corresponds to the period over which the cost of an acquired patent can be amortized.

To further narrow the scope of the above recommendation, it may be desired to limit its applicability to purchases *from* individuals or companies that qualify as "small technologically based companies." [9] It should be noted, however, that the illogicality of retaining the tax distinction between internally developed technological assets and those externally acquired is not dissipated where the seller is a *large* company. The distinction is illogical and improper irrespective of the size and wherewithal of the seller.

A FINAL WORD ABOUT TAXES

Considerable effort and time will be required to review and act on the tax recommendations discussed here. *In the meantime,* while these tax recommendations are being considered, we urge an intensive effort:

(1) To acquaint responsible employees of such agencies as the Internal Revenue Service, the Small Business Administration, and the Department of Commerce with the importance and unique problems of small technological enterprises; and

(2) To apprise such firms of the *existing* governmental aids and incentives directed to them. There is good reason to believe that important, *existing* tax incentives are having far less than their maximum potential impact on the encouragement of innovation in this country.

B. THE FINANCING OF INNOVATION

We turn now to the role of venture capital in the innovation process, its sources, some rough estimates as to the amount potentially available, and its significance with respect to the creation of jobs. We could summarize this subject by saying we have found an abundance of ignorance—in government, in business, and in the universities—on what the venture capital business is about. It should be apparent by now that the lack of knowledge, understanding and appreciation of the innovative process is the central theme of our report.

1. THE AVAILABILITY OF VENTURE CAPITAL

Quantitative information on the availability of venture capital is not readily obtained. We were unable to find any published data to support the widely stated notion that there is a lack of adequate *potential* venture capital in this country. Accordingly, we tried to develop our own rough estimates of potentially available venture capital through discussions with experienced individuals in the business and financial communities. Extensive conversations

[9] *See Page 33.*

were had with a number of Small Business Investment Companies (SBIC's), investment trust firms, wealthy individuals, and investment bankers engaged in organized venture capital investment activities. We heard testimony from a number of successful entrepreneurs and individual inventors who depend upon securing venture capital in their present business operations.

On the basis of these discussions we have made some rough estimates of the amounts of potentially available venture capital from various sources. Our estimates indicate that more than $3 billion of potentially available capital exists in this country. This by no means indicates that all of the holders of such capital are actively seeking investment opportunities or that the techniques and communication mechanisms for approaching capital sources are necessarily known to individuals with worthwhile projects requiring financial support. The potential availability of such an amount of money, however, indicates that factors other than money alone determine the rate of new-enterprise funding.

Let us discuss, for a moment, some of the sources of venture capital in the United States.

a. Personal Wealth—This country now has over 65,000 individuals each with a net worth in excess of $1,000,000. In addition, there are a large number of family fortunes which, in the aggregate, exceed several billions of dollars. We have also identified as a separate category, successful entrepreneurs who have prior experience in the field, and are in a position to assume the role of venture capitalists. For example, some twenty experienced and successful technical entrepreneurs in the Boston Route 128 complex alone, currently have a total *personal* net worth in excess of $500,000,000.

b. Insurance Companies, Investment Funds, Trusts—A number of less conservative insurance companies are engaged in financing speculative ventures—at least the "Second Stage" businesses we identified in our discussion of the small company environment (See Chapter III). In addition, publicly owned investment funds, such as American Research and Development, and organized, family-owned venture capital operations, represent a sizeable source of venture capital. These organizations have a high degree of sophistication and appraisal experience with respect to technological opportunities.

c. Corporate Sources—Within the past few years a number of large corporations have entered the venture capital business and have initiated the financing of new technological ventures. Although it is too early to appraise the impact of this development, the potential capital availability is obviously large. An important factor with respect to corporate sources of funds is that they may also provide knowledge of markets, management skills, and other aids that are, as we saw, essential to the success of a beginning firm. On the other hand, conflicts of interest and the frequent lack of knowledge on the part of the large corporation of the unique problems of small companies may present major difficulties.

d. Investment Bankers and Underwriters—The investing public becomes, through underwriters, a source of venture capital. For example, we found that in 1961 it was common to finance a wide variety of highly speculative electronic ventures through this public source of financing. Increased public interest in such schemes occurs from time to time, depending upon investment

attitudes. A large number of investment banking groups also operate in the venture capital field.

e. Small Business Investment Companies—Although less than 10% of the total amount of available SBIC capital is currently invested in technologically oriented businesses, the SBIC as an institution has undoubtedly created interest in the venture capital business, and some $500,000,000 is *potentially* available from this source.[10] Because of its relatively small size, however, the typical SBIC has had difficulty in developing a competent staff to tackle the formidable project appraisal problem and in carrying the necessary overhead to administer a complicated portfolio of new technical enterprise investments. It is doubtful, in our view, that an SBIC can be successful in a diversified program of financing technologically oriented ventures, if its size is less than 15 to 20 million dollars. Only a few SBIC's are currently of this size. Much can be learned from the developing experience of these few.

It is important to re-emphasize the project-appraisal problem which faces all sources of venture capital. Entrepreneurship is at best a risky business. Markets are rapidly changing, and the success of any venture is closely coupled to management ability. Capital requirements for new businesses are almost always in excess of initial estimates. The time required, particularly today, to reach the stage of profitability is usually several years longer than originally anticipated.

The more experienced and sophisticated venture capital sources compete with each other for the most attractive investment opportunities. Their decisions to invest are keyed to their judgments of the quality of the management, the quality and proprietary character of the product, and the timing with respect to the market. Experience shows that investments fail, primarily, because of *management* problems—the inadequacy of the key individual as a manager of people, or his lack of sensitivity to external conditions, which prevents him from developing a realistic time schedule for achieving goals with available capital.

In view of the above considerations, and our feeling that the alleged absence of potentially available venture capital is not really the problem, we see no basis for the establishment of any new federally supported programs for the furnishing of venture capital. Accordingly, we make the following recommendation.

RECOMMENDATION 8

In view of present information on the availability of venture capital, the Federal Government should take no action with respect to the establishment of new federally supported programs for the furnishing of venture capital. However, appropriate mechanisms should be developed to provide information on capital availability and the problems of new enterprise development at the regional level.

[10] *It is interesting to note that some 40% of the SBIC's (on a dollar basis) are located in three states, which already have large, well-organized and long-established venture capital sources.*

2. VENTURE CAPITAL AND JOBS

A recent study conducted by the Sloan School of Management at the Massachusetts Institute of Technology, examined the job-creating power of venture capital. We have tabulated the data developed in that study in the following chart.

CHART 19

VENTURE CAPITAL DOLLARS PER JOB: AN ILLUSTRATION

No. of Companies	21
Average Time Period	4.2 Years
Increase in Sales - Average	$ 3,657,000
Increase in Sales - Total	$76,806,000
Increase in Employment - Average	147
Increase in Employment - Total	3,096
Initial Venture Capital - Average	$ 225,000
Initial Venture Capital - Total	$ 4,720,000
Initial Venture Capital Requirement	$ 1,525 Per Job

This does not take into account the additional, derivative employment resulting from these primary jobs.

Source: Sloan School, Massachusetts Institute of Technology.

There were twenty-one companies in the survey. All were private, technological ventures. In an average period of a little over four years, the average increase in sales for these companies was approximately $3½ million; the total increase in sales was roughly $75 million. The average increase in employment over that period was 147 jobs; the total increase for all of the companies was 3,096 jobs. The average venture capital investment in these companies was $225,000, the total venture capital investment having been almost $5 million.

We note from the above data that roughly $1500 of venture-capital investment resulted in one primary job. We realize that there may be objections with respect to the adequacy of these data—for example, the sample was limited to the Boston area. Nevertheless, despite the deficiencies that purists may find in these data, they do illustrate the significant contribution of technological ventures to employment. For whether the amount of venture capital per job was $1500 or $2500 or, indeed, $3500 (which allows for a substantial margin of error), this still represents a very powerful job-creating capacity per risk-dollar utilized. Moreover, it should be understood that the data in Chart

19 concern primary employment only and do not account for the much greater secondary employment (in the food and service industries, etc.) that usually builds on the primary job base.

C. SOME ASPECTS OF FEDERAL RESPONSIBILITY

There are several areas in which the government bears a special responsibility with respect to various aspects of technological innovation, but in which, through action or inaction, this responsibility is being either ignored or frustrated. Perhaps this is because the areas in question are relatively less important than other, more noteworthy fields, such as antitrust and taxation. We considered three areas which have been neglected: studies of the innovation process, the adverse impact of government contracting on small technologically based firms, and the absence of an effective federal spokesman for such firms.

1. STUDIES OF THE INNOVATION PROCESS

This nation spends tens of billions of dollars every year on innovation—twenty billion on the research and development component of innovation alone. Yet we know very little about the processes of technological change and growth. As we have noted time and again throughout our analysis, insufficient effort is being devoted to the development and expansion of our knowledge of these processes. Until adequate data and better insights are developed, we will have to continue to rely on inappropriate information, educated guesses and, unwittingly at times, on lore. It is inexcusable that decisions, both in and out of government, as to the probable impact of proposed policy changes on technological innovation, have to be made on the basis of such information.

Additional research on the processes of technological change is therefore badly needed. The initial studies being worked on in the Commerce Department's National Bureau of Standards, should be expanded and made more comprehensive. These studies, concerning the processes of invention and innovation and the social, economic and legal forces with which they interact, should be undertaken in close cooperation with the universities, industry, and other students of the subject.

Accordingly, we make the following recommendation.

RECOMMENDATION 9

The Department of Commerce should broaden and complement its studies of the innovative and entrepreneurial processes by initiating an integrated program, in cooperation with the universities, including the preparation of empirical data and case materials on these processes, studies of the venture capital system, and experimentation with teaching methods to develop innovative and entrepreneurial talents.

2. GOVERNMENT CONTRACTING AND THE SMALL FIRM

In the past, government contracts have been one of the most important sources of business for the initiation of new technologically based enterprises. Nevertheless, the small business "set-aside" program, which purports to set aside contracting opportunities for small businesses, does not provide them with any real hope for success in the highly competitive research and development business associated with today's defense and space programs. It should be noted, also, that the total percentage of Federal work performed by small companies has decreased in the last five years.

Current Department of Defense (DOD) and National Aeronautics and Space Administration (NASA) contracting trends, the rapidly increasing costs of doing R&D, and the increased critical size required for a successful business operation, all work against the interests of small technologically oriented ventures. In addition, increasing competition from in-house government laboratories and "nonprofit" firms that are DOD and NASA captives, and the greatly increased costs of preparing proposals for government R&D contracts and of private representation in Washington, have all substantially reduced the prospects for success by the small company.

The large technologically based company (which, as we have noted, probably had small beginnings itself) can bid a fixed price under the current fixed-price R&D contracting procedures that may clearly be a losing proposition—in the short term. In the long term, however, the bid may be a winner in terms of lodgement in the technological field involved. For example, assume a large company bids $300,000 below the estimated cost of a contract. Generally, a small firm cannot compete in this way. If it loses $300,000, it has probably committed suicide; it is out of business. As Professor Corwin Edwards of the University of Oregon expresses the problem, a large economically powerful firm ". . . can outbid, outspend, and *outlose* a small firm. . . . If it overdoes its expenditures, it can absorb losses that would bankrupt a small rival." [11]

As an important first step in bringing these problems to the attention of government contracting agencies, we make the following recommendation.

RECOMMENDATION 10

An interdepartmental ad hoc review of current contracting policies and procedures of such agencies as the Department of Defense, the National Aeronautics and Space Administration, the Atomic Energy Commission, and the National Institutes of Health, to ensure that these policies are conducive to the long-range growth of small enterprises.

[11] *Testimony in hearings on Economic Concentration before U.S. Senate Antitrust Subcommittee, 88th Cong., Part I* Overall and Conglomerate Aspects *(Government Printing Office, 1964), p. 42.*

3. A FEDERAL SPOKESMAN

The above recommendation can at best be only a palliative. For it does not go to the heart of the problem. It merely treats one of the symptoms. The basic problem is that the small technologically based companies, despite all they have contributed to American progress, really have no effective representation in Washington.

There is *no Federal spokesman* for them. Within the Federal Government there is no single place which is specifically concerned with the generation of new technological enterprises and the problems of these unique organizations.

The Small Business Administration cannot deal effectively with these inherently *high-risk* enterprises because its enabling statute prevents it from doing so. In any event, there is very little understanding in the SBA or elsewhere in the government (indeed, as we have noted, in society at large) of the special problems and needs of these businesses. We therefore make the following recommendation.

RECOMMENDATION 11

The Department of Commerce should serve as the Federal spokesman representing the interests of new technologically based enterprises and should develop the necessary competence and organization to deal effectively with problems associated with venture capital availability and the generation of such enterprises.

This recommendation is closely related to the program of studies proposed in Recommendation 9. For only through greater understanding of the processes of invention and innovation will the Department of Commerce be able to perform the role we urge.

D. ANTITRUST AND THE REGULATION OF INDUSTRY

It is probably fair to say that most well-informed individuals, who are not directly concerned with the fields of antitrust and regulation, are unaware of the numerous Federal agencies that are active in these fields.[12]

Chart 20 is a partial tabulation, not intended to be comprehensive, which illustrates the magnitude of the government's involvement in what we loosely call a "free enterprise economy." Of course, our economic system is not literally free; it is much too complex for that.[13]

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[12] *An excellent discussion of government activities in these fields appears in* Massel, Competition and Monopoly, *Brookings Institution, 1962.*

[13] *See Appendix B for some of the relevant statutory provisions affecting competition in the American economy.*

CHART 20



The purpose of this chapter is to examine an important facet of this complex system. What we hope to do is clarify some of the issues concerning the interfaces between competition, antitrust, regulation and technological innovation.

1. THE NEED FOR CLARIFICATION

The necessity for our examination is perhaps obvious: Our central concern is innovation and its stimulus and promotion. Such promotion requires appropriate attention and adjustment to *other* public policies—among them, antitrust and regulatory policies, which we lump, for convenience, into what we call "competitive policy." Hence, it becomes necessary to examine the interrelationship between innovation and competition, understand their interaction, lay bare the apparent or hidden conflicts between them, and suggest means for resolving or minimizing these conflicts.

We subscribe to both of the public policies involved here: (1) the preservation of a satisfactorily balanced, competitive enterprise system, and (2) the promotion of invention and innovation. The former is reflected in our laws on restraint of trade, monopolization, regulation and unfair methods of competition. The latter includes both technological and commercial activities, and both private and governmental actions.

Sometimes, a given practice furthers both of these objectives. Sometimes it does not. If it does, problems of concern to us are unlikely to arise. Practices that promote both competitive and innovative objectives or that promote one and are neutral as to the other, are acceptable in terms of our mission. Practices that impede both or impede one without promoting the other, are unacceptable. A practice that promotes one of the objectives and impedes the other, however, is another matter. In this event, we must try to find an accommodation that minimizes the conflict between the two, and decide which objective shall prevail in those circumstances where the conflict cannot be resolved or reduced.

Past judicial, legislative or administrative efforts to resolve this conflict disclose no clear-cut, uniform pattern. *Nor do we have satisfactory empirical analyses of actual situations to serve as the basis for such resolution.* Sometimes, competitive objectives seem to be the dominant concern in the consideration of competitive problems; sometimes, innovative objectives prevail. Often, the objective fastened upon is pursued without apparent concern for the possible adverse effects upon other objectives.

Neither objective can safely be disregarded in our present social, economic and political circumstances. The support and furtherance of *both* are too important in terms of public interest for either to be heedlessly pushed aside in the interests of promoting the other. Fortunately, only minimal conflicts seem likely to arise in the areas under discussion, since it appears that *on the whole, a well-balanced and healthful, competitive economy stimulates, rather than frustrates, innovation.*

Let us turn now to an examination of those areas in which *conflicts* are most likely to arise—since it is conflict, not complementary action, that poses the problems we are concerned about.

2. AREAS OF POSSIBLE CONFLICT

The thrust of the antitrust laws is against (1) commercial or industrial combinations which prevent or limit the competition upon which our free enterprise system depends, (2) the creation of monopolies that destroy or impede such competition, and (3) unfair competitive and business practices that hinder competition and contribute to monopoly. Our concern, therefore, is directed to those structural characteristics of the innovative process and specific practices involving innovation that may result in monopoly, restraint of trade, or unfair trade practices of the kind mentioned.[14]

Technological innovation may be undertaken by (1) individuals or other single entities, or (2) two or more entities (of an industrial, governmental, educational or other nature) acting cooperatively. Neither of these ordinarily need give us concern, *as such,* in dealing with the competitive-innovative relationship.

The conduct of innovation by individual, independent entities is not only

[14] *See Appendix C for some hypothetical situations that illustrate possible conflicts between Federal policies on competition and various practices involving innovation.*

condoned, but affirmatively encouraged in the public interest. Such activity poses no antitrust problem in the restraint-of-trade sense. Monopoly problems can arise, but they rarely do. Even if they do, both judicial and statutory law tend to accept this in the interests of encouraging individual effort. The policy seems to have worked reasonably well.

Similarly, there is no problem with respect to cooperative innovative activities, *as such*. The attack upon a given problem by two or more minds, instead of one, or through two or more sets of resources (know-how, assets, managerial skills, equipment, and the like) instead of one, seems as likely in most instances to produce beneficial results in this as it does in other fields of cooperative endeavor. The same is generally true of cooperation in removing legal and other impediments to innovation through the licensing of patents, the release of secret processes and know-how, and other transfers of technological property.

Restrictive agreements involving the use or non-use of technological property are more of a problem. Here, conflicts between our innovative and competitive goals do arise. Such agreements may restrain trade, create monopolies or otherwise distort the competitive balance.

These restrictive agreements may take various forms:

—Parties may agree not to compete with each other or with third parties. They may do this directly by means of patent licenses and other agreements containing price, geographic, field-of-use or other restrictions, or indirectly by royalty arrangements that impede or discourage competition.

—They may boycott or otherwise injure third persons, or obstruct channels of distribution, and at the same time adversely affect innovation by means of closed pools, tie-in arrangements, discriminatory conditions as between different licensees, and so on.

—They may lessen the incentive to engage in competitive innovation by imposing limitations upon the use of new technology developed or acquired by the licensee or upon methods of distribution.

—They may cause competitive imbalance through excessive acquisition of technological property by purchase, merger or grant-back.

Arrangements such as those we have noted above may be quite ambivalent from the standpoint of both innovation and competition. They may stimulate innovation or they may retard it. They may strengthen competition or weaken it. It may be extraordinarily difficult, in short, to reach firm conclusions as to the extent to which a given practice promotes or retards innovation, on the one hand, and competition on the other.

It may be even more difficult to assess the *relative* merits or demerits of such arrangements in terms of the respective objectives, or to determine where, on balance, the public interest lies. In the formulation of policy, the difficulties in defining and measuring the nature and extent of benefit or detriment in terms of innovative and competitive effects are compounded when one attempts to balance the one against the other. This is so whether the

policy in question is determined at the legislative, administrative or judicial level.[15]

Beyond this, in the vast area of *private* action and policy making—where the businesman, the entrepreneur, the inventor and the innovator operate—decision and conduct, and the effect thereof, may be even less well defined and more haphazard. Here, it not only becomes increasingly difficult for the decision-makers to evaluate and properly balance the effects flowing from their conduct and the public policy considerations involved, but they may also be influenced by *mistaken notions* of what the law permits and what it prohibits.[16]

In terms of influencing their conduct, it is not what the law really is that matters. It is what the decision-makers *think* it is.

We want to emphasize that what we are saying is not limited to *technological* innovation. The problems go deeper, and so must our inquiry into them. Innovation occurs in finance, marketing, methods of distribution, business structure, business administration, labor relations—indeed, in virtually every area of activity that the processes of business touch upon.

In methods of distribution, for example, it may show up in brand selling, introduction of new products, price discounts, offer of side inducements and collateral attractions, advertising, dealer relationships and development, service and advisory activities, extension of credit, and so on. Here, as in technological innovation, the activities may run afoul of the antitrust laws, including the Robinson-Patman Act. They may also come into conflict with other trade regulation laws, such as fair trade laws, trademark laws, labeling laws, the Shipping Act, the Food, Drug and Cosmetic Act. These interrelationships have been a part of our inquiry.

The problems, described generally in the foregoing discussion, may be summarized as follows:

(1) Long-standing and settled public policy supports and demands the promotion of competitive objectives.
(2) Public policy also supports and demands the promotion of innovation.
(3) These two public policies, while usually compatible, may at times comes into conflict with each other.
(4) It is often difficult to detect, define and evaluate these conflicts. We have not, on the whole, developed satisfactory procedures for achieving an understanding of their relationship and their accommodation to each other. This is true at all levels of decision and policy-making: private, legislative, administrative and judicial.

3. RESOLUTION OF CONFLICTS

Our investigation has helped us to see what some of the problems are. It has not enlightened us on how to solve them. We must promote *both* com-

[15] *See, for example, a current study by the Office of Invention and Innovation, National Bureau of Standards, entitled* Judicial Consideration of Technological Factors in Antitrust Actions. *The study will be published in early 1967.*

[16] *For a lucid discussion, aimed at providing a better understanding of the field of antitrust to business executives and others who are not expert in the field, see Kintner,* An Antitrust Primer, *MacMillan, 1964.*

petition and innovation to the extent that this can be done, by minimizing or eliminating the conflicts to the extent possible. Where this cannot be done, we must decide under what circumstances the one or the other shall prevail.

The formulation of procedures in this area poses a dilemma: The desirability, and hence the ultimate legality, of a given restriction may turn upon the nature of the transaction, its subject matter and the economic and technological status of the parties affected. This suggests a case-by-case, *rule-of-reason* approach, guided by the sometimes conflicting objectives of promoting innovation and of preserving a satisfactory competitive structure. At the same time, it is important to formulate relatively *certain* rules in order to tell businessmen what they can and cannot do and to preserve the effectiveness and administrability of the antitrust and related laws. This suggests the development of *per se* doctrines, trade regulation rules, and the like.

We cannot have it both ways. It may, however, be possible to resolve the dilemma, partially at least, by two means. First, by defining those circumstances and practices that push so *predominantly* toward a given result as to justify a conclusion that they should be deemed, at least presumptively, permissible or prohibited. Second, by suggesting criteria and procedures (within existing procedural frameworks, to the extent possible) for resolving the more uncertain and debatable issues in a manner that promotes the public interest and is reasonably satisfactory to the affected parties.

The achievement of these goals will be no easy task. In few, if any, of the gray areas under discussion does our present knowledge and understanding provide a basis for firm answers. *To suggest significant judgmentive changes of policy in the absence of the empirical data and analysis needed to support such changes, would therefore be irresponsible.*

RECOMMENDATION 12

We recommend, at this time, no legislative changes in the antitrust and regulatory laws. However, we do recommend that in the interpretation and administration of these laws, the effect on innovation, as well as on competition, be taken into account.

4. AN ANALYTICAL AND ADVISORY RESOURCE FOR THE ANTITRUST AND REGULATORY AGENCIES

We need empirical data. How are we to get them? How are we then to arrive at sound interpretations of the facts? While there can be no assurances of certain success, we suggest certain premises and considerations for the satisfactory performance of these tasks:

(1) To avoid unnecessary injury to either competition or innovation, those responsible for making and carrying out policy in these fields must have

access to information concerning the effect of their policies upon both competition and innovation, and should be in a position to evaluate such information in order to achieve a proper balance and coordination between these policies. In today's fast-evolving economy, both the necessary information and the means for evaluating it are often seriously lacking.

(2) While the ultimate formulation of specific "black-and-white" rules or guidelines for determining the legality or illegality of given practice seems desirable, this cannot be done, except in a few small areas, until more extensive studies have been made of the many ramifications of the relationships between competition and innovation.

(3) Antitrust, regulation and innovation have all demanded increasing attention in recent years. As a result, agencies operating in all three areas have proliferated. Inevitably, conflict and lack of mutual assistance among them have resulted. This condition is a matter of concern to many, including the agencies themselves. Unfortunately, the independent and separate status of those affected has made it difficult to resolve or lessen this conflict. Moreover, the formulation of the rules and guides referred to in the preceding paragraph becomes the most difficult at the very time that their need becomes the greatest.

In these circumstances, we believe that the ultimate development of such rules and guides, as well as the day-to-day administration of policies concerning competition and innovation, would be furthered if a group existed, *independent of the agencies charged with the administration and enforcement* of the antitrust and regulatory laws, to whom these agencies could turn for expert and unbiased advice and assistance. The creation of such a group, we emphasize, is a response to recognized needs for coordination and mutual accommodation. It does not infer any unreasonableness or known remediable deficiencies in existing policies and administration.

Hence, the function of such a group would be to offer advice and assistance rather than exercise authority of any sort over its "clients." It should be a continuing staff, designed to service the administering agencies and the policymakers by conducting studies and providing information, data, and suggestions for modifying policy and procedure.

Greater understanding and judgment should also accrue to the affected public, thus lessening the likelihood of conduct based upon misunderstanding and misinformation. The group could, for example, provide information, analysis and advice concerning the competitive and innovative aspects of various types of joint R&D programs, foreign trade and technology transactions, patent pools, mergers and acquisitions, restrictive or limited licenses relating to patents or know-how, government policies in awarding and framing R&D contracts, and so on.

Such a group should operate subject to the following conditions:

—It should concentrate on empirical analyses.

—It should be an advisory rather than a supervisory unit, maintaining continuous communication with the pertinent agencies and departments and with the Congress.

—Since the conditions to which it addresses itself are dynamic, not static, and also massive and complex, it should be a permanent entity.

—It should give appropriate attention to the need for clarity and administrability and to the importance of accommodation, insofar as possible, to existing procedures and structures of authority.

—Although its responsibilities should be primarily to the appropriate governmental agencies, its operations should be conducted with full attention to the need for informing and generally advising interested parties and the public, as well.

With these considerations in mind, we urge that such a group be formed.

RECOMMENDATION 13

A group should be established within the Federal Government to aid and advise the regulatory and antitrust agencies by performing such activities as:

(1) Developing criteria for helping these agencies judge the impact of antitrust and regulatory policies on invention and innovation.

(2) Systematically analyzing the consequences of past antitrust and regulatory activities in light of these criteria.

(3) Advising the responsible agencies on the probable consequences of proposed policy changes affecting invention and innovation.

(4) Providing technological forecasts as an additional factor for antitrust and regulatory planners to weigh in their policy formulations.

We would be remiss if we did not point out that we had much difficulty on the question of where this group should be located in the Federal Government. We have already explained that the objectivity it must rigorously pursue requires that it not be a part of any of the agencies responsible for *administering and enforcing* the antitrust and regulatory laws.

If we consider again the large number of independent agencies affecting competition (See Chart 20), it is not difficult to understand the need for some *central* location of the group we propose. The issues with which it would deal stretch from one end of Washington to the other. The most logical housing for such a group would therefore be in the Executive Office of the President, but we are aware of the reluctance to add "appendages" to that Office.

In any event, we have chosen *not* to make any specific recommendation as to the location of the proposed group. We would only urge that its initial

structure and operation be kept as *flexible* as possible in order to permit experimentation and adjustment in the light of experience.

Pending the establishment of the central group we urge be formed, we believe that much could be done in the legislative, executive and judicial branches to broaden understanding of the problems under discussion. In particular, we make the following recommendations.

RECOMMENDATION 14

To enable the antitrust and regulatory agencies to give greater attention to questions concerning technological innovation, their staffs should be strengthened by increasing the number of personnel who have a deep understanding of economic and technological development.

RECOMMENDATION 15

In the legislative and judicial processes involving antitrust and regulation, more consideration should be given to the interaction of technological change and competition.

We should note in this regard the continuing efforts of the Senate Antitrust and Monopoly Subcommittee to explore the interrelationships between competition, invention and innovation. We have referred to their work elsewhere in this report.

RECOMMENDATION 16

(a) The antitrust and regulatory agencies should provide guidelines clarifying the legality or illegality of business conduct affecting competition and technological innovation.

(b) The agencies should also devote more attention to the effect of remedies, orders, and decrees on innovation in relation to competition.

During the past year, the Antitrust Division of the Department of Justice, with whom we have had a very rewarding relationship, has been developing guidelines to help clear away some of the inevitable uncertainties that emerge as antitrust policies evolve. We are hopeful that these guidelines will help resolve some of the issues we have discussed in our analysis of the policies affecting competition *and* innovation.

VI

CONCLUSIONS AND OVER-ALL RECOMMENDATION

One more recommendation remains and it is, in our view, of key importance. We have stressed the reason for it throughout this report. It has to do with the abundance of ignorance about the processes of invention, innovation and entrepreneurship.

For whether we talk about the problems and contributions of a large or small company, a regulated or unregulated industry, or an individual inventor or entrepreneur, there is too little appreciation and understanding of the process of technological change in too many crucial sectors:

—Throughout much of the Federal Government.

—In some industries.

—In many banks.

—In many universities.

—In many cities and regions.

More important, therefore, than any specific recommendation concerning antitrust, taxation, the regulation of industry, or venture capital, is one central proposal:

> The major effort should be placed on getting more managers, executives, and other key individuals—both in and out of government—to *learn, feel, understand* and *appreciate* how technological innovation is spawned, nurtured, financed, and managed into new technological businesses that grow, provide jobs, and satisfy people.

We therefore propose a high-level conference on technological innovation, to dramatize the importance of this vital process, and urge that this conference be followed by a nationwide program for broadening recognition,

understanding and appreciation of the problems and opportunities associated with technological change.

RECOMMENDATION 17

(a) A White House conference on "Understanding and Improving the Environment for Technological Innovation."

(b) Soon thereafter, a series of regional innovation conferences, composed of governors, mayors, bankers, academicians, scientists, engineers, entrepreneurs, and others—aimed at removing barriers to the development of new technological enterprises, jobs, and community prosperity in the respective regions.

Summing up, we find that the concepts, uncertainties, and other realities of technological innovation are like a foreign language, indeed a strange world, to too many of us. Because of this, we believe the most important initial task before us is to become more widely acquainted with the "language" and "world" of innovation.

Understanding, as Alexander Pope might have put it, is the key to a drawer wherein lie other keys. When we come to appreciate and understand the problems and the opportunities associated with innovation, we can more effectively act on programs that will best encourage beneficial change and the continued renewal of our society.

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Appendix A

PANEL MEMBERS AND THEIR ASSOCIATES

The Panel

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Paul W. McGann is Assistant Administrator for Industrial Analysis, Business and Defense Services Administration.

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Appendix B

MAJOR FEDERAL POLICIES THAT REGULATE COMPETITIVE ACTIVITIES AND PRACTICES

Name of Agency	Nature and Scope of Regulation	Statute
A. *General Provisions* (NOT LIMITED TO A SPECIFIC AGENCY)	Declares unlawful (1) contracts, combinations, and conspiracies in restraint of trade, and (2) the monopolization or attempt to monopolize trade.	Sherman Act, 26 Stat. 209; 15 U.S.C. 1–7; Public Law No. 190, 51st Cong. (1890).
	Declares unlawful, price discrimination, exclusive dealing arrangements, and mergers and acquisitions by corporations that may lessen competition or tend to create a monopoly. It also places restrictions on interlocking directorates among banks and among corporations.	Clayton Act, 38 Stat. 730; I5 U.S.C. 12ff.; P.L. 212, 63rd Cong. (1940).
	Declares unlawful, any contracts, combinations and conspiracies by persons or corporations engaged in importing articles from a foreign country into the U.S. which restrain trade or are intended to increase the price of articles imported into the U.S.	Wilson Tariff Act, 28 Stat. 570; 150 U.S.C. 8–11; P.L. 227, 53rd Cong. (1894).
	Declares unlawful, the importation and sale, by persons engaged in importing articles from a foreign country into the U.S., of articles within the U.S. at a price substantially less than the actual market value or wholesale price of such articles in the principle markets of the country of their production, or other foreign countries where they are exported, after allowance for freight, duty, and similar expense.	Revenue Act, 1916, 39 Stat. 798; 15 U.S.C. 71–77; P.L. 271, 64th Cong. (1916).
	Declares unlawful, the disclosure of the amount or terms of a bid, or any combination or agreement that would deprive the U.S. of the benefit of full, free and secret compctition in the awarding of a contract or charter under the Merchant Marine Act of 1936. It declares unlawful any agreement or concerted action by any contractor or charterer of vessels under the Act which is unjustly discriminatory or unfair to any citizen who operates a common carrier by water.	Merchant Marine Act, 1936; 49 Stat. 2014; 46 U.S.C. 1224, 1227 and 1228; P.L. 835, 74th Cong.

Name of Agency	Nature and Scope of Regulation	Statute
	Prohibits any vessel engaged in foreign trade of the U.S. from entering or passing through the Panama Canal if such vessel is owned, chartered, operated or controlled by a person or corporation doing business in violation of the antitrust laws.	Panama Canal Act, 37 Stat. 567; 15 U.S.C. 31; P.L. 337; 62nd Cong.
	Prohibits contracting with any person who has entered or proposed to enter into a combination to fix the price of bids, or to induce others not to bid, for postal supply contracts.	62 Stat. 704; 18 U.S.C. 44l (1948).
B. *Supplemental Enforcement of the Antitrust Laws*		
Federal Trade Commission	Created the Federal Trade Commission (FTC) and declared unfair methods of competition and unfair or deceptive acts or practices in commerce unlawful, including the dissemination of false advertisement. The FTC was also given the power to investigate and require annual reports providing information on organization, business conduct and practices.	Federal Trade Commission Act, 38 Stat. 717; 15 U.S.C. 41ff; P.L. 203; 62nd Cong. (1914).
Federal Trade Commission	Declares the manufacture for sale and sale of any wool product, which is misbranded, unlawful and a violation of the Federal Trade Commission Act (FTCA).	Wool Products Labeling Act of 1939, 54 Stat. 1129; 15 U.S.C. 68a; P.L. 850; 76th Cong. (1940).
Federal Trade Commission	Declares the manufacture for sale, sale, or advertising of any fur product, which is misbranded or falsely or deceptively advertised or invoiced, unlawful and a violation of the FTCA.	Fur Products Labeling Act, 65 Stat. 175; P.L. 110; 82nd Cong. (1951).
Federal Trade Commission	Declares the manufacture for sale, sale, importation into the U.S., or transportation in commerce of any article of wearing apparel which is defined under the Act as highly inflammable, as to be dangerous when worn by individuals, unlawful and a violation of the FTCA.	Flammable Fabrics Act, 67 Stat. 111; 15 U.S.C. 1191–1200; P.L. 88, 83rd Cong. (1953).
Federal Trade Commission	Declares the manufacture for sale, sale, advertising, transportation in commerce, or importation into the U.S. of any textile fiber product, which is misbranded or false or deceptively advertised, unlawful and a violation of the FTCA.	Textile Fiber Products Identification Act, 72 Stat. 1718; 15 U.S.C. 70a; P.L. 85–897 (1958).

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Name of Agency	Nature and Scope of Regulation	Statute
Federal Trade Commission	Amended Section 2 of the Clayton Act. In addition, it forbids the payment of a broker's commission in cases where an independent broker is not employed. It forbids sellers to provide supplementary services rendered them by buyers unless available to all buyers on proportionally equal terms. It forbids the establishment, in one locality of prices lower than those charged elsewhere, and prohibits the sale of goods at unreasonably low prices for the purpose of destroying or eliminating a competitor.	Robinson-Patman Act, 49 Stat. 1526; 15 U.S.C. 13, 13a, 13b, 21a; P.L. 692; 74th Cong. (1936).
Secretary of Treasury	Imposes a double duty on any article imported into the U.S. under an exclusive dealing or selling agreement, but does not apply to the establishment of an exclusive agency in the U.S. by the foreign producer.	Revenue Act 1916, 39 Stat. 798; 15 U.S.C. 71–77; P.L. 271; 64th Cong. (1916).
Secretary of Agriculture	Declares unlawful, the manipulation or attempt to manipulate the price of any commodity in commerce or for the future delivery on any board of trade. It also prohibits the cornering or attempt to corner any commodity, or knowingly or carelessly delivering or causing to be delivered for transmission through mails or otherwise in interstate commerce, false and misleading reports concerning crops or market information or conditions that affect the price of grain in commerce.	Commodity Exchange Act, as amended by 49 Stat. 1491; 7 U.S.C. 13; P.L. 675, 74th Cong. (1936).
Secretary of Agriculture	Authorizes the Secretary of Agriculture to require all contract markets to suspend all trading privileges and to suspend or revoke the registration, as a future merchant or floor broker, of any person who is found, after a hearing, to have violated any provision of the Commodity Exchange Act, rules and regulations issued pursuant thereto, or has manipulated or attempted to manipulate the market price of any commodity in interstate commerce.	Commodity Exchange Act, as amended by 49 Stat. 1498; 7 U.S.C. 9; P.L. 675, 74th Cong. (1936).
Secretary of Interior	Provides that any lease, option or permit used under the Mineral Leasing Act of February 25, 1920, shall be forfeited by appropriate court proceedings if any lands or deposits shall be subleased, trusteed, or controlled so that they form an unlawful	Mineral Leasing Act of Feb. 25, 1920, 41 Stat. 488; 30 U.S.C. 184; P.L. 1461, 66th Cong.; as amended, 74 Stat. 789; P.L. 86–704, Sec. 3(k).

Name of Agency	Nature and Scope of Regulation	Statute
	trust, or form the subject of any contract or conspiracy in restraint of trade in the mining or selling of specified minerals.	
Secretary of Agriculture	Declares unlawful, certain practices in the sale or transfer of meats, livestock, poultry or poultry products, such as apportioning their supply if it has the tendency or effect of restraining commerce or creating a monopoly, manipulating or controlling prices in commerce, creating a monopoly in the acquisition of any article in commerce, or conspiring or combining to apportion territories. It also prohibits any unfair, unjustly discriminatory, or deceptive practice or device in commerce.	Packers and Stockyard Act, 42 Stat. 159; 7 U.S.C. 181ff, P.L. 51, 67th Cong. (1921).
Securities Exchange Commission	Declares unlawful, unless approved by the Chairman of the SEC, the acquisition of any securities, utility assets, or any other interest in any business, or the acquisition of any security of any public utility by a registered holding company or its subsidiary. The Commission is authorized to examine and review the corporate structure of any registered holding company for purpose of simplifying the structure, eliminating complexities, distributing voting power among shareholders, and confining properties and business to the operations of an integrated public utility system.	Public Utility Act of 1935, 49 Stat. 817; 15 U.S.C. 791; P.L. 333, 74th Cong.
Secretary of the Treasury	Declares unlawful certain practices or conduct by persons engaged in business as a distiller, brewer, rectifer, blender or bottler of distilled spirits, wine or malt beverages. Such practices declared unlawful are exclusive retailing arrangements; acquiring an interest in any retailer's license or real or personal property; furnishing or renting equipment or fixtures, etc. to retailer; paying or crediting the retailer for advertising; guaranteeing or repayment of retailer's financial obligation or providing other similar benefits; inducing any trade buyer to purchase such products by commercial bribery or offering of a bonus or compensation to said buyer; and to sell or to purchase	Federal Alcohol Administration Act, 49 Stat. 977; 27 U.S.C. 202ff.; P.L. 401, 74th Cong. (1935).

Name of Agency	Nature and Scope of Regulation	Statute
	formal advertising were not independently reached in open competition. He is required to refer any bid he considers to be evidence of an antitrust violation to the Attorney General.	
Atomic Energy Commission	Declares that nothing contained in the Atomic Energy Act of 1954 shall relieve any person from the operation of the antitrust laws, and in the event a licensee is found by a court to have violated the antitrust laws in the conduct of the licensed activity, the AEC may suspend, revoke, or take such other action deemed necessary with respect to any license issued by the AEC. In addition, the Commission is required to report to the Attorney General any activity concerning nuclear material or atomic energy which appears to violate or tends toward the violation of the antitrust laws.	Atomic Energy Act of 1954, 68 Stat. 938; 42 U.S.C. 2135; P.L. 703, 83rd Cong. (1954).
Federal Power Commission	Provides that, in addition to bringing suits in the Federal Courts to enforce compliance with the Natural Gas Act and to enjoin acts or practices which constitute violations of this Act, the FPC may transmit evidence concerning apparent violations of the antitrust laws to the Attorney General who may institute the necessary criminal proceedings.	Natural Gas Act, 52 Stat. 832; 15 U.S.C. 717; P.L. 688, 75th Cong. (1938).
Federal Power Commission	Declares that combinations, agreements, arrangements, or understandings, expressed or implied, to limit the output of electrical energy, to restrain trade, or to fix, maintain, or increase prices for electrical energy or service are prohibited.	Federal Power Act, 41 Stat. 1070; 16 U.S.C. 803(h); P.L. 280, 66th Cong. (1920); as amended, 49 Stat. 844; 16 U.S.C. 803(h); P.L. 333, 74 Cong. (1935).
Board of Governors of the Federal Reserve System	Provides that corporations organized under the Federal Reserve Act may purchase or acquire stock in another corporation, and sets forth the conditions under which such mergers or acquisitions are permissible, including the consent of the Board of Governors. It prohibits any corporation or its agents and employees organized under the Act from directly or indirectly controlling or fixing the price of commodities in commerce which subjects the corporation's charter to forfeiture.	Federal Reserve Act, 41 Stat. 379, 380, 381, Sec. 25(a); 12 U.S.C. 615 and 617; P.L. 106; 66th Cong. (1919).

Name of Agency	Nature and Scope of Regulation	Statute
Federal Deposit Insurance Corporation Comptroller of the Currency Board of Governors of the Federal Reserve System	Prohibits the merger, acquisition, or consolidation of an insured bank with any other insured or non-insured bank without the consent of one of the listed agencies, depending upon whether the bank involved in the merger is a National Bank, State Bank (member of FRS), or a non-insured bank. The Act sets forth the criteria upon which the agency shall determine its approval or disapproval of a proposed merger.	Federal Deposit Insurance Act, 64 Stat. 873; 12 U.S.C. 1828(c), as amended by the Bank Merger Act; P.L. 89-356, 89 Cong. (1966).
Federal Communications Commission	Prohibits interlocking directorates between or among carriers subject to this Act, unless holding the position of director or officer in more than one carrier is authorized by the Commission upon the finding that neither public nor private interests will be adversely affected thereby.	Communications Act of 1934, 49 Stat. 1087; 47 U.S.C. 314; P.L. 416, 73rd Cong.; as amended, 70 Stat. 931, Sec. 1; 47 U.S.C. 212; P.L. 899, 81st Cong. (1956).
Federal Communications Commission	Provides that no person engaged in the business of transmitting and/or receiving for hire, energy, communications, or signals by radio shall purchase, lease, or otherwise acquire control or operate any cable or wire telegraph or telephone line system if the purpose or effect thereof may be to substantially lessen competition or restrain commerce, or unlawfully to create a monopoly in any line of commerce. The same prohibition applies to a telegraph or telephone line system acquiring or merging with a business engaged in transmitting and/or receiving communications by radio.	Communications Act of 1934, 41 Stat. 1087; 47 U.S.C. 314; P.L. 416, 73th Cong.
Federal Communications Commission	Specifically provides that Sherman Act prohibitions apply to the manufacture, sale of and trade in radio apparatus and devices affecting interstate commerce. In addition, a license issued under the provisions of this Act shall be revoked when any licensee is found guilty of violating the provisions of the antitrust laws.	Communications Act of 1934, as amended by 74 Stat. 893, Sec. 5(b); 47 U.S.C. 313; P.L. 86–752 (1960).
C. *Exemption from Antitrust Laws*		
Federal Trade Commission	Provides that an association, entered into for the sole purpose of engaging in export trade and actually engaged solely in export trade, is exempt from Sherman Act violations pro-	Webb-Pomerene Act, 40 Stat. 516; 15 U.S.C. 61–65; P.L. 126, 65th Cong. (1918).

Name of Agency	Nature and Scope of Regulation	Statute
	vided such association is not restraining trade within the U.S., or in restraint of a domestic competitor in export trade. In addition, mergers or acquisitions of corporations engaging solely in export trade are exempt, unless the effect of the acquisition substantially lessens competition within the U.S. Unfair methods of competition prohibited under the FTCA do apply to competition in export trade.	
Federal Maritime Commission	Prohibits certain anticompetitive practices on the part of a common carrier by water and gives the Commission the authority to refer any violation to the Commissioner of Customs who shall refuse a violating carrier entry in any port of the U.S. Notwithstanding these prohibitions, the Commission shall, upon application, permit the use, provided criteria is met by carriers, in foreign commerce of any contract, which is available to all shippers and consignees on equal terms and which provides lower rates to a shipper who agrees to give all or any fixed portion of his patronage to such carrier or conference of carriers.	Shipping Act, 1916, 39 Stat. 733; 46 U.S.C. 812; P.L. 260, 64th Cong. (1916).
Civil Aeronautics Board	Prohibits consolidations, mergers and certain interlocking relationships between common carriers by air without the approval of the CAB, and requires the CAB to disapprove agreements between carriers which are adverse to the public interest. However, any person or corporation affected by any order of the CAB, under the sections prohibiting the practices listed above, is relieved from the operations of the antitrust laws.	Federal Aviation Act of 1958, 72 Stat. 770; 49 U.S.C. 1384; P.L. 85–726 (1958).
Interstate Commerce Commission	Prohibits any common carrier subject to the provisions of the Act from pooling or dividing traffic unless the Commission finds that such practice will be in the interest of better service to the public or of economy in operation, and will not unduly restrain competition. It permits two or more carriers to consolidate or merge with the approval and authorization of the Commission upon its finding that such action will be consistent with the public interest after weighing certain stipulated factors.	Interstate Commerce Act, as amended, 63 Stat. 486; 49 U.S.C. 5; P.L. 197, 81st Cong. (1949).

Name of Agency	Nature and Scope of Regulation	Statute
Interstate Commerce Commission	Provides that the ICC shall approve any agreement between two or more carriers of the same class (except under certain situations) relating to rates, fares, classifications, divisions, allowances, or charges, if it finds such agreements will further the national transportation policy declared in the Act, and if so, the parties to the agreement shall be relieved from the operation of the antitrust laws.	Reed-Bulwinkle Act, amended the Interstate Commerce Act by adding this provision to it; 62 Stat. 472; 49 U.S.C. 5(b); P.L. 662, 80th Cong. (1948).
Federal Communications Commission	Permits telephone companies to consolidate or acquire the whole or any part of another telephone company and domestic telegraph carriers to consolidate or acquire all or any part of another domestic telegraph carrier, upon the approval of the FCC and its finding that such action will be of advantage to the persons to whom service is to be rendered and in the public interest. Upon such approval such consolidations or mergers shall be exempt from any laws making consolidations and mergers unlawful.	Communications Act of 1934, 48 Stat. 1064; 46 U.S.C. 151 ff; P.L. 416, 73rd Cong.; as amended, 70 Stat. 932, Sec. 3; 47 U.S.C. 221(a); P.L. 915, 84th Cong. (1956).
Secretary of Agriculture	Permits the Secretary to enter into agreements with manufacturers and others engaged in the handling of anti-hog-cholera serum and hog-cholera virus for the purpose of regulating the marketing of such serum and virus in order to maintain an adequate supply. Such agreements are specifically exempt from the antitrust laws.	Anti-Hog-Cholera Serum and Hog Cholera Virus Act, 49 Stat. 781; 7 U.S.C. 851 ff; P.L. 320, 74th Cong. (1935).
Secretary of Agriculture	Permits persons engaged in the production of agricultural products to act together in associations, corporate or otherwise, in collectively processing, preparing for market, handling, and marketing in commerce such products. The Secretary is authorized to issue a complaint and hold a hearing to determine whether any such association monopolizes or restrains trade to such an extent that the price of any agricultural product is unduly enhanced. He also has the authority to issue a cease and desist order.	Capper-Volstead Act, 42 Stat. 388; 70 U.S.C. 291 and 292; P.L. 146, 67th Cong. (1922).

Name of Agency	Nature and Scope of Regulation	Statute
Secretary of Agriculture	Permits original producers of agricultural products to acquire, exchange, and disseminate past, present, and prospective crop, market, statistical, economic and other similar information by direct exchange between such persons and/or such associations thereof.	Cooperative Marketing Act, 44 Stat. 802; 7 U.S.C. 451 ff. at 455; P.L. 450, 69th Cong. (1962).
Secretary of Agriculture	Secretary is authorized, after notice and hearing, to enter into marketing agreements with processors, producers, associations of producers, and others engaged in the handling of any agricultural commodity, only with respect to such handling which directly burdens, obstructs, or affects interstate commerce. Such agreements are exempt from the antitrust laws.	Agricultural Adjustment Act, as amended, 61 Stat. 208, Title II, Sec. 206(d); 7 U.S.C. 608(b); P.L. 132, 80th Cong. (1947).
Secretary of Agriculture	Exempts from the operation of the antitrust laws awards or agreements resulting from the arbitration of bona fide disputes between cooperative associations of milk producers and the purchasers, handlers, processors, or distributors of milk or its products, as to the terms and conditions of the sale of milk or its products.	Agricultural Marketing Agreement Act of 1938, 62 Stat. 1258; 7 U.S.C. 671 ff; P.L. 897, 80th Cong. (1948).
Secretary of Interior	Permits persons engaged in the fishing industry, as fishermen or as planters of aquatic products to act together in associations in collectively catching, producing, preparing for market, processing, and marketing in commerce, such products. The Secretary of the Interior is authorized to issue a complaint and an order to cease and desist any activity which he believes monopolizes or restrains trade to such an extent that the price of an aquatic product is unduly enhanced.	Fisherman's Collective Marketing Act, 48 Stat. 1213; 15 U.S.C. 521, 522; P.L. 464; 73rd Cong. (1934).
Securities and Exchange Commission	Provides that the provisions of this Act, permitting the association of brokers and dealers in securities, shall prevail where any provision conflicts with any law of the U.S.	Maloney Act, 52 Stat. 1070; 15 U.S.C. 780–3; P.L. 719; 75th Cong. (1938).
State Insurance Commission	Provides for the regulation by the states of companies in the insurance business. It provides that the antitrust laws shall not apply to the business of insurance or to acts in	McCarran Act, as amended; 61 Stat. 448; 15 U.S.C. 1011 ff; P.L. 238, 80th Cong. (1947).

Name of Agency	Nature and Scope of Regulation	Statute
	conduct thereof, except to the extent that such business is not regulated by state law. It does not exempt Sherman Act application to any agreement to boycott, coerce, or intimidate or act of boycott, coercion, or intimidation.	
Small Business Administration	Provides that no act or omission to act in the formation of corporations provided for in this Act, if approved and found by the SBA as contributing to the needs of small business, shall be within the prohibitions of the antitrust laws. It also exempts, from the operation of the antitrust laws, any act or omission to act pursuant to and within the scope of any joint program for research and development under any agreement approved by the Administrator.	Small Business Act, 72 Stat. 388; 15 U.S.C. 636(a)(6); P.L. 85–536 (1958).
The President	Authorizes the President to encourage the making by representatives of industry, business, finance, agriculture, labor and other interests, of voluntary agreements and programs to further the objectives of the Defense Production Act of 1950. It exempts from the operation of the antitrust laws any act or omission to act pursuant to this act, if requested by the President pursuant to a voluntary agreement or program approved under the provisions of the Act and found by the President to be in the public interest as contributing to the national defense.	Defense Production Act of 1950, as amended, 69 Stat. 581, Sec. 6; 50 U.S.C. App. 2158; P.L. 295 (1955).
	Exempts from the operation of the antitrust laws any joint agreement, by or among persons engaged in the organized professional team sports of football, baseball, basketball, or hockey, by which any league or clubs participating in these sports sells the rights of such league's member clubs in the sponsored telecasting of the games engaged in by such clubs. The exemption is limited to this specific type of agreement only.	Telecasting of Professional Sports Contests, 75 Stat. 732, Sec. 1; 15 U.S.C. 1291–95; P.L. 87–331, 87th Cong. (1961).
	Provides that nothing in the antitrust laws shall be construed to forbid the existence and operation of labor, agricultural, or hor-	Clayton Act, 38 Stat. 731; 15 U.S.C. 17; P.L. 212, 63rd Cong. (1914).

Name of Agency	Nature and Scope of Regulation	Statute
	ticultural organizations, instituted for purposes of mutual help, and not having capital stock or conducted for profit . . . ; nor shall such organizations or their members be held or construed to be illegal combinations or conspiracies in restrain of trade under the antitrust laws.	
	Exempts from the operation of the antitrust laws an association entered into by marine insurance companies to transact a marine insurance and reinsurance business in the U.S. and in foreign countries.	Ship Mortgage Act, 1920; 41 Stat. 1000; 46 U.S.C. 885; P.L. 261; 66th Cong. (1920).
	Provides that the Robinson-Patman Act shall not apply to purchase of supplies for their own use by schools, colleges, universities, public libraries, churches, hospitals, and charitable institutions not operated for profit.	Exemption of Nonprofit Institution from Price Discrimination Provisions, 52 U.S.C. 13C; P.L. 550; 75th Cong. (1938).
	Exempts from the operation of the antitrust laws any agreements or contracts prescribing minimum or stipulated prices for the resale of a commodity which bears the trademark or trade name of the producer or distributor, when such contracts or agreements are lawful as applied to intrastate transactions under any *state law*. It does not exempt contracts or agreements providing for minimum resale price on any commodity, between manufacturers, or between producers, or between wholesalers, or between brokers, or between retailers, or between persons or corporations in competition with each other.	Miller-Tydings Act, 50 Stat. 693; 15 U.S.C. 1; P.L. 314; 75th Cong. (1937). Amended the Sherman Act.
	Cooperative associations or method or act thereof which comply with and are bound by the District of Columbia Cooperative Association Act are not deemed a conspiracy or combination in restraint of trade or an illegal monopoly, or an attempt to lessen competition or fix prices arbitrarily.	District of Columbia Cooperative Association Act, 54 Stat. 490; 29DC Code 840 ff (1940 ed); P.L. 642; 76th Cong. (1940).
	Exempts from the operation of antitrust laws the enforcement of the right of action created by *state law* to obtain damages for advertising, offering for sale, or selling any commodity at less than the price or prices	McGuire Act, 66 Stat. 632; 15 U.S.C. 45(a); P.L. 542, 82nd Cong. Amendment included in Sec. 5(a) of the Federal Trade Comm. Act.

Name of Agency	Nature and Scope of Regulation	Statute
	prescribed in resale price maintenance agreements or contracts, whether or not the person so advertising, offering for sale, or selling is or is not a party to such an agreement or contract.	
D. *Unfair Methods of Competition*		
The President	Declares unlawful, unfair methods of competition and unfair acts in the importation or sale of articles into the United States with the effect or tendency of destroying or substantially injuring an industry, efficiently and economically operated, in the U.S., or to prevent the establishment of such an industry, or to restrain or monopolize trade and commerce in the U.S. The FTC is authorized to investigate possible violations, hold hearings, and report its findings to the President.	Unfair Practices in Imports Act, 46 Stat. 703; 19 U.S.C. 1337; P.L. 361, 71st Cong. (1930).
Federal Trade Commission	Specific practices declared to be unfair methods of competition are contained in the Federal Trade Commission Act (dissemination of or causing to be disseminated any false advertisement); Wool Products Labeling Act of 1939 (misbranding of wool products); Fur Products Labeling Act (misbranding of fur products); Flammable Farbics Act (manufacture, sale transportation, etc. of highly flammable wearing apparel); and Textile Fiber Products Identification Act (misbranding and false advertising of any textile fiber product), all of which are described in Part B of this compilation of laws.	
E. *Miscellaneous*		
Food and Drug Administration	Prohibits the adulteration or misbranding of any food, drug, device, or cosmetic and the introduction or delivery for introduction of any adulterated or misbranded food, drug, device or cosmetic in interstate commerce. Prohibits any act which causes a drug to be a counterfeit drug; or the sale or dispensing, or the holding for sale or dispensing, of a counterfeit drug.	Federal Food, Drug and Cosmetic Act, June 25, 1938, Ch. 675, Sec. 301; 52 Stat. 1042; 21 U.S.C. 331.

Appendix C

EXAMPLES OF POSSIBLE CONFLICTS BETWEEN POLICIES ON COMPETITION AND VARIOUS PRACTICES INVOLVING INNOVATION

The following hypothetical situations illustrate various business practices concerning technological matters which could possibly conflict with national policies concerning antitrust and competition. These examples also illustrate the kinds of questions with respect to which the group, proposed in Recommendation #13, would conduct research and provide advice based upon the results of its investigations.

Situation 1: The owner of a small manufacturing corporation, invents and patents an invention highly important in its field, and useful in other fields as well. He is willing to grant licenses under his patent but only if he can impose what he regards as appropriate conditions on his licensee in order to protect his own best interests. Such conditions might include restrictions with respect to some or all of the following: price, quality, quantity of production, geographic area in which the licensee manufactures and sells, field of use, and grant-back of nonexclusive rights under improvement patents.

Situation 2: In order to strengthen its position vis-a-vis competitors, a company which dominates its industry, engages in the following practices:

(a) imposes stringent contract conditions on its employees which preclude divulgence or use of inventions made or learned of while in its employ and for two years following termination of employment with the company;

(b) bars employees from working for competitors for two years after leaving its employ;

(c) hires away competitor's key research personnel and follows a practice of outbidding competitors for promising new personnel;

(d) deliberately delays by lawful means the issuance of an important patent covering a product that is unlikely to become commercially significant for 20 years.

Situation 3: A corporation owns a number of patents under which it licenses other corporations to manufacture articles covered by its patents. The licensing agreement includes a provision which requires the licensee to grant-back exclusively to the licensor any patentable invention or improvement relating to the field of the licensed patent.

Situation 4: A group of companies within a specified industry forms a restrictive or closed patent and know-how pool.

Situation 5: A number of companies form patent and know-how pools by which:

(a) Parties cross-license conflicting and competing patents on a nonexclusive basis and grant one licensee the right to sub-license under all the patents. Licenses are granted to all applicants on condition of a grant-back of inventions in the licensed field. Licenses are granted only by ac-

ceptance of the entire package. Only one licensee can grant licenses under the whole package. Licenses are on standard terms and royalties.

(b) The licensing party grants a license under the package to a foreign licensee, which is exclusive outside the U.S. The foreign licensee grants a return license under its patents, exclusive for the U.S., with rights to sub-license.

Situation 6: Company A licenses Company B under Company A's foreign patents in exchange for a license from Company B under Company B's U. S. patents.

Situation 7: A foreign company wants to get the benefit of the American market for a product involving technology not known in the U. S. It is unwilling to license a U. S. company for fear the latter will compete with it in its own markets, using its know-how. It introduces the new product into the U. S. market through a *joint venture* agreement with a U. S. company under which it retains a share of the profits and management authority. The new company created by the venture receives exclusive rights for the U. S. but no rights elsewhere. This is the only way that the technology is likely to get into the U. S. within a reasonable time, for the U. S. partner cannot itself develop the technology in a timely manner. Another U. S. company is the sole U. S. producer of the product, under a different, patented process. This U. S. company now dominates the field which the joint venture seeks to enter. Barring the joint venture, the parties to it might each have gone into the market separately, but this would have delayed the introduction of the product approximately eight years.

Situation 8: Two companies engage in a joint research activity, but exclude others from participating or obtaining licenses.

Situation 9: Several companies ask an independent R&D laboratory to do R&D for them, for the purpose of developing new processes in a certain industrial field. It is agreed that each must pay a certain amount per annum for this R&D, and each will have nonexclusive rights in the results. However, the final agreement to undertake the project is deferred pending the parties agreement on the legal implications of issues such as: (a) Must the project be open to all applicants on the same terms? (b) Since applicants in later years will not have paid as much as those in earlier years and will thus get the benefits of the R&D done with money contributed by the others in earlier years, can the later applicants be required to pay the assessments for prior years?

Situation 10: Corporation A acquires Corporation B, a research-oriented concern and a potential competitor of Corporation A, with the objective of expanding and enlarging Corporation B's research activities to cover as well the areas in which Corporation A has been operating.

Situation 11: An independent inventor sells his invention to the highest bidder, which is the dominant company in the field to which the invention relates.

Situation 12: Similarly, a technically-oriented entrepreneur (individual or corporate) seeks to sell out to the highest bidder, who is dominant in the field. The adverse effect upon competition if the sale is permitted, and adverse effect on innovation stimulus if prohibited, present conflicting considerations.

Situation 13: A machinery company, the dominant firm in its industry, invents an attachment that will make its machine so much more effective than those of its competitors as to reduce seriously the effectiveness of their competition. However, fear of antitrust vulnerability causes it to:

(a) refrain from incorporating the device in its machine;

(b) sell machines containing the device at a higher price than it otherwise would; or

(c) refrain from the vigorous sales efforts that the improved machine would justify.

Situation 14: In the interests of more effective and economical merchandising, a company considers undertaking the following:

(a) forming, with other concerns, a buying cooperative to take advantage of quantity discounts;

(b) forming, with other concerns, a cooperative merchandising program, including such features as joint advertising and common use of a collective symbol; or

(c) forming, with others in the industry, a quality control program to improve the industry's performance and reputation.

However, it decides against these because of possible antitrust and Robinson-Patman complications.

Situation 15: A company, in order to introduce a new product:

(a) Gives a distributor a long-term exclusive distributorship within a limited territory.

(b) Offers the product at a price below the cost of producing it.

Situation 16: A corporation, attempting to break into a new market, reduces its selling price in that market below its price in other areas.

Situation 17: A corporation, introducing a complex and experimental product into the market, requires that purchasers buy their supplies and replacements, and obtain their servicing, from the corporation.

Situation 18: Building contractors and their labor union enter into an agreement (in the face of a strike threat) not to use certain new materials and methods of construction. The new methods and materials will improve the quality of building and reduce its cost, but will also sharply reduce the amount of manual labor required.

Appendix D

RELEVANT TAX PROVISIONS

Sec. 172 IRC

Net operating loss deduction. This Section permits a deduction, in the taxable year, for net operating loss carryovers and carry-backs to the taxable year. Net operating loss means the excess of allowable deductions over the gross income. A net operating loss can be carried over to each of the FIVE taxable years following the taxable year of such loss, and deducted from income.

Sec. 174 IRC

Research and experimental expenditures. This section permits a taxpayer to treat research and experimental expenditures, which are paid or incurred by him in connection with his trade or business, as current deductible expenses. It also contains the option to treat these expenditures as deferred expense which the taxpayer may amortize over a period not less than five years, beginning with the month in which he first realizes benefits from the expenditures.

Research and development experimental expenditures do not include expenditures made for depreciable research equipment nor for the cost of constructing depreciable property designed for production as distinguished from pilot model purposes.

Sec. 421 and 422 IRC

Stock options. Section 421 provides that no taxable income shall result from the transfer of a share of stock to an individual who has exercised an option that meets the requirements of Section 422. (Note: this section also applies to other stock option plans which are covered under Sections 423 and 424, but which are not applicable to the subject being considered here).

Section 422 defines a qualified stock option and lists two conditions which must be met before the exercise of such option will be accorded the treatment provided under Section 421, as described above. A qualified option

is an option granted by a corporation to an individual, for any reason connected with his employment, to purchase stock in the corporation. The two conditions are: (1) the individual must hold the stock for three years, after the transfer pursuant to the exercise of the option, before he makes a disposition, and (2) if the individual ceases to be employed by the corporation granting the option, he must exercise the option within three months following the termination of the employment.

The option must also meet a number of criteria, the two most pertinent for present purposes being: (1) "the option by its terms, must be exercised within five years after the date the option is granted" and (2) the optionee cannot own stock possessing more than 5% of the total combined voting power or value of all classes of stock of the employer corporation, except where the equity capital of the corporation is less than $2,000,000 (where this exception applies, a formula is used to determine the permissible percentage of voting powers, which may range from 10%, the maximum, down to 5%).

Sec. 1235 IRC

Sale or exchange of patents. This section permits long term capital gains treatment for payments received by a holder from the "transfer of property consisting of all substantial rights to a patent". The payments qualify for this treatment even though they are "payable periodically over the time of the tarnsferee's use of the patent," or they are "contingent on the productivity, use or disposition of the property transferred." The "holder" is defined as "any *individual* whose efforts created the property, or who has acquired his interest in the property . . . from the creator prior to actual reduction to practice of the invention covered by the patent, if such individual is neither the employer of or related to the creator."

Sec. 1244 IRC

Losses on small business stock. This section provides that "a loss on Section 1244 stock issued to an individual or to a partnership . . . shall be treated as a loss from the sale or exchange of an asset which is not a capital asset," and therefore, deductible from ordinary income. The loss on the sale or exchange of 1244 stock may not exceed $25,000, or $50,000 in the case of a joint return by a husband and wife for any taxable year.

1244 stock is defined as stock in a domestic corporation if (1) the corporation adopted a plan to offer the stock for a period specified in the plan, not exceeding two years after the date such plan is adopted; (2) the corporation was a small business when the plan was adopted (a corporation is a small business if "the sum of the aggregate amount which may be offered under the plan, plus the aggregate amount of money and other property received by the corporation, for stock, as a contribution to capital, and as paid-in surplus does not exceed $500,000; and the sum of the aggregate amount which may be offered under the plan, plus the equity capital of the corporation does not exceed $1,000,000"); (3) at the time the plan was adopted, no portion of a prior offering was outstanding; (4) the stock was issued, pursuant to such a plan, for money or other property, excluding stock and securities; and (5) the corporation, "during the period of its five most recent taxable years ending before the date of the loss on the stock is sustained . . ., derived more than 50% of its aggregate gross receipts from sources other than royalties, rents, dividends, interest, annuities, and sales of stock or securities."

Appendix E

THE RECOMMENDATIONS RECAPITULATED

RECOMMENDATION 1 — Page

We recommend that losses of small, technologically based companies, meeting criteria along the lines we have suggested, be allowed as a carry-forward against profits of the succeeding ten years instead of only five years. — 34

RECOMMENDATION 2

We recommend a liberalization of the stock option rules for small technologically based companies by (1) extending the permissible option period from a maximum of five years to ten years, and (2) reducing the holding period required to receive capital gains treatment to less than three years, preferably to six months. — 36

RECOMMENDATION 3

The Internal Revenue Code should be amended so that a "casual" inventor or innovator can deduct out-of-pocket expenses legitimately incurred for the purpose of ultimately producing income. — 37

RECOMMENDATION 4

The successful inventor who has a going business but did not declare his earlier development costs should receive a "generous backward look" by the Internal Revenue Service and be permitted to reconstruct his development costs and write them off over a period of five years. — 37

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RECOMMENDATION 5	
Research and development expenditures incurred to develop new products or processes should not be disallowed as a business deduction merely because they are unrelated to a taxpayer company's current products or processes.	38
RECOMMENDATION 6	
Professional inventors should be placed on the same tax footing as amateur inventors by permitting qualification under Section 1235 of the Internal Revenue Code so that a patent license qualifies as a transfer of "substantially all rights," even though the grant is limited to a particular field-of-use or a particular geographical area.	39
RECOMMENDATION 7	
Companies making taxable purchases of technological assets should be permitted some depreciation and tax write-off of these assets in excess of the value of tangible assets.	40
RECOMMENDATION 8	
In view of present information on the potential availability of venture capital, the Federal Government should take no action with respect to the establishment of new federally supported programs for the furnishing of venture capital. However, appropriate mechanisms should be developed to provide information on capital availability and the problems of new enterprise development at the regional level.	43

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RECOMMENDATION 9

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The Department of Commerce should broaden and complement its studies of the innovative and entrepreneurial processes by initiating an integrated program, in cooperation with the universities, including the preparation of empirical data and case materials on these processes, studies of the venture capital system, and experimentation with teaching methods to develop innovative and entrepreneurial talents.

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RECOMMENDATION 10

An interdepartmental ad hoc review of current contracting policies and procedures of such agencies as the Department of Defense, the National Aeronautics and Space Administration, the Atomic Energy Commission, and the National Institutes of Health, to ensure that these policies are conducive to the long-range growth of small enterprises.

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RECOMMENDATION 11

The Department of Commerce should serve as the Federal spokesman representing the interests of new technologically-based enterprises and should develop the necessary competence and organization to deal with problems associated with venture capital availability and the generation of such enterprises.

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RECOMMENDATION 12 Page

We recommend, at this time, no legislative changes in the antitrust and regulatory laws. However, we do recommend that in the interpretation and administration of these laws, the effect on innovation, as well as on competition, be taken into account. 52

RECOMMENDATION 13

A group should be established within the Federal Government to aid and advise the regulatory and antitrust agencies by performing such activities as:

(1) Developing criteria for helping these agencies judge the impact of antitrust and regulatory policies on invention and innovation.

(2) Systematically analyzing the consequences of past antitrust and regulatory activities in light of these criteria. 54

(3) Advising the responsible agencies on the probable consequences of proposed policy changes affecting invention and innovation.

(4) Providing technological forecasts as an additional factor for antitrust and regulatory planners to weigh in their policy formulations.

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RECOMMENDATION 14

To enable the antitrust and regulatory agencies to give greater attention to questions concerning technological innovation, their staffs should be strengthened by increasing the number of personnel who have a deep understanding of economic and technological development.

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RECOMMENDATION 15

In the legislative and judicial processes involving antitrust and regulation, more consideration should be given to the interaction of technological change and competition.

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RECOMMENDATION 16

(a) The antitrust and regulatory agencies should provide guidelines clarifying the legality or illegality of business conduct affecting competition and technological innovation.

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(b) These agencies should also devote more attention to the effect of remedies, orders, and decrees on innovation in relation to competition.

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RECOMMENDATION 17

(a) A White House conference on "understanding and improving the environment for technological innovation."

(b) Soon thereafter, a series of regional innovation conferences, composed of governors, mayors, bankers, academicians, scientists, engineers, entrepreneurs, and others —aimed at removing barriers to the development of new technological enterprises, jobs, and community prosperity in the respective regions.

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