Diversification Into Civilian Public Sector Markets: A Method of Transferring Aerospace Technology

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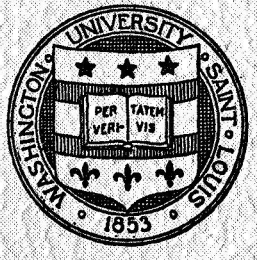

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PREFACE

This report presents the results of an initial survey and analysis of the attempts of defense/space contracts to transfer technology into civilian uses by diversification within civil public sector markets. More intensive evaluations are now underway.

DIVERSIFICATION INTO CIVILIAN PUBLIC SECTOR MARKETS: A METHOD OF TRANSFERRING AEROSPACE TECHNOLOGY

The newest and perhaps the fastest growing aspect of contracting out the performance of government activities to the private sector involves the use of the major defense and space contractors, that is, the government-oriented corporations, in the programs of domestic, welfare agencies. From the viewpoint of these companies, the civilian agencies provide potential market diversification. For the agencies, these high technology private companies provide capabilities not present in the government's own work force. From the viewpoint of society, the results and implications are far more subtle and mixed; the growing involvement of industry in the government's business brings complication and concern as well as new resources. An examination in some detail should be of some value and is attempted here.

Early Defense-Space Industry Diversification Efforts

A brief historical analysis of the diversification efforts of the major defense and space contractors can provide considerable insight into their current interest in and potentials for serving civilian public sector programs. [1/]

Post World War II Burst of Enthusiasm

Ever since they attained the production peaks of World War II, the major military contractors have been concerned with the problem of diversifying into new markets and new types of production in order to maintain and expand the scale of their operations. The older and more established industries, such as automobiles, rubber, and steel, which had originally converted from civilian markets, experienced little difficulty in returning to their traditional lines of business when the war was over. Backlogs of pent-up demand and accumulated wartime savings made this transition relatively easy.

In contrast, however, the specialized defense contractors -- notably those in the aircraft industry -- had typically grown during the wartime period from small job shop operations to large industrial enterprises. The virtual or at least temporary disappearance of their basic market when the war ended brought fundamental problems of adjustment. The multitude of efforts that these companies made to diversify into other lines of business was characterized b diversity, enthusiasm, and confusion. One among numerous examples of the naivete of some of these efforts was contained in the recommendation by a prestigious consulting firm to one large aircraft producer that it manufacture pesticides for farmers. The basic justification apparently was on theological grounds: "anything that stays the hand of pestilence is fundamentally sound."

Some of these efforts were frankly designed to take immediate advantage of a temporary demand for consumer items which had been missing from the economy during World War II. Other efforts were designed to utilize the substantial cash reserves accumulated during the war, and to help tide the companies over during the reconversion period. Some of the defense companies began producing buses, trolley coaches, marine engines, aluminum canoes, and sport boats, which required their skills in fabricating light metal products. Some of the related products were a bit far afield from their customary fields, including bottle labelers, coin changing machines, dry cleaning apparatus, artificial hands and midget racing cars. Among the most imaginative efforts was the production of coffins, both stainless steel and aluminum.

Several defense firms became subcontractors for established companies in commercial markets. In that role, they built heater cases, parts for musical instruments, automobile components, plumbing, cabinets for radios and water tanks for railway cars. One company bought into a consumer finance agency in order to prepare for the postwar boom in private aircraft that never materialized.

In general, the income from these new ventures was disappointing. They did not generate a significant fraction of the sales attained during World War II; the profits were often negative. This was illustrated by the experience of the major aircraft companies during the initial postwar adjustment period, 1946-48, when sales declined to a tenth of their former peak and losses totaled over $50 million.

Most of the diversification activities by the major, specialized defense contractors which were begun at the end of World War II were abandoned as unsuccessful or marginal, or sold to firms traditionally oriented to industrial or consumer markets. The expansion of the military budget brought on by the Korean War soon turned the primary attention of these firms back to the military market. When faced with the alternative, few aircraft companies preferred to manufacture powered wheelbarrows or buses rather than bomber or fighter airplanes.

Post-Korean Industrial Diversification

The end of the Korean War, of course, sparked another round of interest in commercial diversification on the part of defense contractors. These efforts attempted to take account of some of the worst mistakes of the past, bypassing particularly the consumer markets which had proven to be so alien to the high-technology defense-oriented firms.

The largest diversification efforts were represented by the closest adaptations of military work -- aircraft for the airline and executive markets. The other diversification projects also typically were limited to industrial markets. These included industrial electronics, small gas turbine engines, nuclear reactors, wall panels for commercial buildings, and heavyduty land vehicles. Despite the variety of these latter efforts, the non-government sales of the major aircraft companies during the middle 1950's were almost entirely transport aircraft delivered to the commercial airlines. 2/ Most of these industrial diversification

efforts outside of aerospace fields have since been abandoned. The surviving diversification programs continue generally at marginal levels -- either actually losing money, barely breaking even, or at best showing profit results below typical military business returns.

Reorientation in Defense and Space Industry Diversification

During the late 1950's and early 1960's, the interest and attention of the high technology companies that primarily serve the military and space markets were focused predominantly on the expanding military and close-related space budgets. The cutbacks in 1963-64 in military procurement programs, particularly for large missile systems, produced a reorientation of defense industry thinking on diversification, a shift with particular significance for the civilian parts of the public sector.

Several reexaminations of the previous diversification efforts of defense contractors, as well as new evaluations of their peculiar strengths and weaknesses, led to the awakening of their interest in doing work for government agencies other than the military establishment. 3/ The success of the leading defense firms in gaining the major NASA contracts was an important indication of their ability to use their engineering and scientific skills in other government markets. That significant and successful diversification within the government market also showed that it was not the ability of defense producers to fabricate light metals (shades of aluminum and stainless steel coffins) which was their primary competitive characteristic. Rather, it was their scientific and systems management capability which enabled them to develop and penetrate new markets. In their search for additional civil public sector business, often the new market had to be established and developed before it could be penetrated. That is, the potential contractors for civilian public sector systems not only had to convince the

government customer that they had the ability to perform as promised, but that the very undertaking itself was something that the government, rather than private enterprise, should sponsor and fund.

Evaluating the Obstacles to Diversification

In evaluating the diversification efforts of the major defense and space contractors, it is helpful to consider these undertakings from a broader view than merely entrance into commercial markets.

In terms of diversification within military and related high technology government markets, these firms have been eminently successful. The shift from aircraft to missiles and space systems ranks as a noteworthy accomplishment in the development and sale of new products, (see Table 1). Moreover, this latter type of diversification also met such basic and important business standards as high return on investment, increasing the growth rate of the enterprise, and effective utilization of surplus resources and capabilities. This is a striking contrast with their commercial experience.

A variety of explanations is given by students of the defense industry for the inability of the large specialized government contractors to use their capabilities successfully in commercial endeavors. The major reasons for the past failures fall into two major categories; lack of management motivation and lack of required capabilities. [4/]

The lack of management motivation, it appears, is due to such basic factors as their belief that strong incentives to change are absent. This is bolstered by their feeling that commercial opportunities are inadequate. Thus, defense company personnel who are concerned with reorienting their operations to more traditional lines of industry obtain limited interest or support from management. These factors are cumulative and interacting.

Table 1

MARKET DIVERSIFICATION OF AEROSPACE COMPANIES

Customer	Percent of Sales								
	1960	1961	1962	1963	1964	1965	1966	1967	1968
Dept. of Defense	76	77	75	71	64	55	54	58	55
NASA and other Government	2	4	7	13	18	22	20	15	14
Commercial Aerospace	13	10	9	7	10	14	15	17	22
Non-Aerospace	9	9	9	9	8	9	11	10	9
Total	100	100	100	100	100	100	100	100	100

Source: Aerospace Industries Association

The absence of incentive results in good measure from the belief of the top managements that there are adequate sales opportunities in government work and that the profit rates are, if anything, higher than on risky commercial ventures (some evidence to bear this out was presented earlier). Interviews with defense industry chief executives repeatedly show their firm belief in the long-term nature and rising trend of the military market. Also, their many prior unsuccessful diversification attempts have engendered the strong point of view that there are inadequate commercial opportunities for companies which have become oriented primarily to government work. The following quotations from interviews with defense-space industry chief executives are typical: 5/

> "There is nothing to convert to; it is all a matter of marketing, timing and being able to commercially exploit the technology and you can't legislate it...you can't make them buy it."

> "There are darn few applications requiring high level technology. It is easier to escalate technology than to depress it."

The defense-space industry failures at commercial diversification would fill a large chamber of horrors: 6/ One company acquired a plastics research firm and subsequently closed down the operation. Another large defense-space contractor began producing metal curtain wall panels, lost money, and discontinued the venture. A third defense-space company acquired firms manufacturing mobile homes, reported operating losses, and subsequently sold the entire line of business. One of the companies also began and subsequently abandoned an effort to penetrate the industrial computer business. The unsuccessful commercial diversification efforts literally ranged from canoes to computers to coffins. As a result, there has been in most cases very limited management support in defense-space companies for or even interest in diversification. This is

evidenced by the few investments made in comparison with more traditional military or airline projects. Another indication is their reluctance to commit full-time senior management or top technical personnel to these diversification ventures. Again, the statements of defense-space industry executives are revealing:

> "Diversification would dilute management's effort on the basic product line."

> "Management believes that it should devote its energy and money to what we are doing and what we know how to do."

The second set of reasons for lack of success at commercial diversification relates to the specialized capabilities of these government contractors. These firms -- compared with commercially-oriented companies -- have relatively low capitalization, little if any commercial marketing capabilities and limited experience in producing at high volume and low unit cost. Moreover, their entire administrative structure is geared to the sometimes unique reporting and control requirements of the governmental customer.

The low capitalization of the large defense-space corporations -- the relatively small amount of stockholders' investment in relation to sales volume -- was shown earlier. A related problem is that the traditionally low price-earnings ratio of the stock of these companies limits their ability to diversify through merger; because their stock is so often selling at a discount compared to commercially-oriented companies, it is difficult for them to diversify through merger without diluting the equity of existing shareholders.

The lack of commercial marketing experience is a familiar refrain in defense-space industry circles. One company president has stated that "it's not a merchandising industry." A typical comment of another chief executive evoked the same theme:

"Lack of knowing the market prevents
us from coming up with a salable product,
even though we could compete with the
established companies on a technical basis."

Because of the more specialized nature of military and space equipment, there is less emphasis on volume production at low unit costs. Rather, these firms are used to producing at close tolerances and high quality, under great pressure from the governmental customer to develop even more advanced equipment. Meeting that last one percent of military or space system specifications may be very expensive, but essential. In contrast, in commercial work the company usually starts off with broader specifications and then trades off continually between improving the product and lowering the cost. Thus, firms used to the environment of weapon and space system design and development may not have developed the cost orientation needed to perform and compete successfully in commercial markets. As one defense-space industry executive put it, "Our company doesn't know how to cut corners well enough."

A new model of refrigerator at half the price of current types may have a large market even if it suffers from significant reductions in quality. The second best missile, in contrast, may hardly be a bargain. The comparison of course is oversimplified. Nevertheless, it illustrates the different nature of product innovation characteristics of commercial competition as compared to technological competition in the military or space field.

It is thus not hard to understand why defense-space company managements are so reluctant to move from fields they have mastered and feel at home in, into lines of business quite alien to them. Their lack of knowledge of non-governmental markets is pervasive. It includes ignorance of products, production methods, advertising and distribution, financial arrangements, funding of research and development, contracting forms, and the very nature of the private customer's demands.

Clearly, the type of company that can successfully design and build a new multibillion dollar ICBM network or space exploration system has a capability differing from that of the soap, steel, toy, or other typical cost-conscious but low technology company operating in the commercial economy.

Even if we examine companies that have divisions producing weapon and space systems as well as commercial product divisions, we find little transference of either personnel or product ideas from government to commercial work within the same firm. A company's commercial departments may be hiring engineers, while simultaneously a military-space department may be laying off experienced technical personnel.

Available surveys show that large proportions of the engineers and scientists who leave a company doing military-space work go to other firms similarly engaged on government contracts. There has been considerable movement of professional and technical personnel from universities and nondefense industries to government work, but relatively little movement in the opposite direction. Differences in pay scales and degree of challenge in the work are often cited as barriers to movement from government to commercial work.

Hence, the key resources of the government-oriented corporations -- their management and their scientific personnel -- become locked-in and further dependent on the governmental customers. Every failure at commercial diversification and equally every successful governmentally-contracted undertaking serves to accentuate the locked-in nature of the government-oriented corporations.

A More Positive Approach

Despite the negative findings of the previous section, a positive approach to utilizing the capabilities of defense-space contractors in other areas may still be possible. A balanced appraisal of a company's or industry's true assets and liabilities should be made in relation to the tasks to be undertaken.

The seller's lack of a vast distribution network is of little concern to the military customer which maintains a substantial system of supply depots of its own. The lack of mass production experience is of limited interest to a civilian space agency responsible for the design and development of relatively few numbers of new, scientifically advanced systems. Rather, the absence of these unneeded commercial-type capabilities may tend to keep overhead down and to orient the company to uniquely meeting the needs of its traditional government customers.

What then, are the positive resources of the large, specialized defense-space contractors? Clearly, their engineering design and development capability is especially strong. The work forces of these companies often approach being primarily large aggregations of scientists, engineers, and supporting technicians. Compared with the most technically-oriented industry serving commercial markets, such drugs or chemicals, the typical defense-space company may have four or five times the number of scientists and engineers to support a given volume of end-item sales. 7/ The top managements of many of the leading aerospace companies, for example, are dominated by engineers -- McDonnel-Douglas, Boeing, Lockheed, etc. Clearly, the specialized defense-space contractors possess strong capability to perform research extending the state-of-the-art, as well as preparing complex engineering designs. Related to that attribute is a management that is capable, some say uniquely capable, of managing the development, production, and integration of large and complex systems; this ability is often termed "systems management."

Similarly, these companies possess positive but specialized production capabilities. They are experienced at producing high value items incorporating advanced engineering and scientific design. A related manufacturing asset is the ability to work with exotic materials and to close tolerances.

Despite the numerous lamentations concerning their lack of marketing ability, these firms have been most successful in penetrating one large and rapidly growing market area -- government business. In fact, they have experienced unparalleled success in selling complex systems involving advanced technology to a select governmental clientele. Their knowledge of defense and space markets, customer requirements and public contracting procedures is detailed and often authoritative.

Hence, a balanced appraisal does yield some positive strengths on the part of the government-oriented corporations -- their striking engineering and scientific talent for developing new products and services, their systems management capability, and their knowledge of how to serve government agencies. It is not surprising thus that the most recent diversification efforts of these government-oriented companies have been into newly-emerging, high technology markets within the public sector itself. Here there is little fear of competition from firms entrenched in the market, nor is there need for that elaborate merchandising and distribution capability required for many commercial markets. Rather, here is where the government-oriented corporation may find itself at a strong advantage. Nevertheless, the development of new markets, as we shall see, is full of both pitfalls as well as potentials.

Defense-Space Companies and Public Sector Markets

From a national viewpoint, the utilization of defense/space capabilities in other parts of the public sector possesses considerable attraction. It would represent a useful civilian return on this primarily security-related investment and also would be helping to meet other national objectives. From the viewpoint of the individual company, such public sector diversification would reduce its dependence on two fairly closely related government markets -- defense and space. Finally, by using the by-products of the basic defense/space product lines, the

nation as well as the companies would be getting an added return on an investment which already has been made and has been written off.

The California Experiment

One of the most ambitious efforts to utilize defense-space contractors and technology, certainly the most widely publicized program, consisted of four exploratory contracts awarded by the State of California in late 1964 and early 1965. The impetus for these contracts came from the reductions, in 1963-64, of military orders for large missile and related aerospace weapon systems, the mainstay of the state's large defense industry. The plans were ambitious, particularly in view of the relatively small size of each contract -- $100,000. The Lockheed Aircraft Corporation was chosen to design a statewide information handling system and to develop a plan for its implementation. North American Aviation was charged with developing a work program indicating the content and specifications for a systems approach to solving basic transportation problems. Aerojet-General Corporation received two of the contracts. One was to explore the feasibility of applying systems engineering and operations analysis techniques to social problems, and to recommend a program for prevention and control of crime and delinquency. The other was to assess the suitability of the systems approach and related analytical tools for solving Claifornia's waste management problems.

Each of the companies spent more than $100,000 on the assigned study, thus investing some of their own funds into the effort. Thus, they also postponed to a later date the possibility of breaking even in this new area of business, much less earning a profit. Inevitably, a flow of reports resulted from the four contracts. How successful were they? The evaluations that have been made yield mixed results.

There were several frequently voiced criticisms of the four studies. Some contended that they were weak in their knowledge of the subject matter, as

evidenced by incomplete or incorrect data, as well as inadequate knowledge of the pertinent literature or the state-of-the-art. Others maintained that the recommendations were politically naive and impractical to implement. Another complaint concerned the overemphasis on engineering and insufficient attention to social, political, and administrative aspects. 8/

The most basic criticisms related to the naivete of defense-space industry personnel which led them to think that they could blithely apply the so-called systems approach as readily to social, political, and economic questions as they had to military problems. As the president of one aerospace company was quoted as saying, "Creating a system to warn a field army the enemy has launched an attack of germ warfare is basically no different from creating a system to control juvenile delinquency." 9/ The reader is apt to parody Gertrude Stein and conclude that this line of thinking readily degenerates to the view that a system is a system is a system. There also comes to mind that probably mythical manual that listed three types of security: internal security, port security, and social security!

Apparently the four systems studies attempted to accomplish too much in too little time. Each of them thus wound up in recommending that the state subsequently undertake follow-on programs, costing at least $1 million a year. To date, none of these follow-on programs have been implemented. This may be explained in part by the fact that, although the four contracts were paid for by the State of California, the program was financed to a substantial degree by funds that were Federal in origin.

On the positive side, most of the publicity was favorable, if not uncritical. In his analysis of this particular aspect of the contracts, John Gilmore concludes that "...the studies were successful." 10/ Harold Walt, who at the time was a senior California state official dealing with the four

exploratory contracts, reported as noteworthy the fact that the state attracted the attention of industry to its problems and that industry thus also made the state aware of its capabilities. 11/ It may be indicative of this new government-industry relationship that two of the companies that received contracts established offices in the state capital, which they did not have previously.

As a result of the $440,000 expenditure by the state for the four initial studies and related consulting work, California has received about $1 million in Federal funds to support five additional systems studies. These cover a criminal justice information system, planning information for waste disposal, land use planning data, and an examination of public assistance systems. Some of these research funds were utilized by state agencies; the great bulk was contracted out to defense-space companies.

In a more general way, all of the original contractors, as well as other defense-space firms, have expanded their civil sector systems activity since the completion of the initial California effort. Most are performing work for a variety of state, local, and Federal government agencies. Aerojet received two additional contracts from the State of California, but neither was a direct follow-on to its earlier work. 12/

The Demonstration Effect

The at least temporary cutbacks in military procurement in 1963-64, and the demonstration effect of the California experiment, encouraged many other defense-space contractors to seek business in the parts of the public sector they had previously ignored. Although the dollar volumes of these undertakings are still small judged by the scale of military and space programs, they do involve government agencies now doing business with high-technology private enterprises that were originally attracted to government work by the military establishment. Some non-defense firms have also begun to seek contracts in these newly emerging public sector markets.

The present appears to be a period of substantial exploration on the part of both government agencies and business enterprises in assessing the kinds of relationships through which they can successfully do business with each other. Table 2 indicates some of the variety of recent contracts awarded by civilian government agencies to the government-oriented corporations. In most cases, these business-government relation ships did not exist as recently as five years ago. It is, hence, too early to judge the successes or failures, or even to judge with great confidence the long-term trends that may be developing. However, on the basis of experience to date, four areas stand out as civilian public sector activities where the type of systems analysis and advanced technology possessed by the leading military-space contractors can usefully be involved: transportation, water systems, communications systems, and regional development. 13/

Transportation

Innovations in the area of transportation which have been suggested as potential endeavors for defense-space contractors include mass urban transportation networks, integration of existing surface systems, highway safety and traffic control, modernizing the merchant marine, and developing an alternative to the passenger automobile for personal transportation. In some of these cases, the most difficult barriers may not be technological at all, but rather political, social, and institutional obstacles to change.

A current example of innovative transportation work by a government-oriented corporation is the development by Lockheed Aircraft Company of a transportation plan for the Sudan. This work is being undertaken through contracts with the Agency for International Development and the Sudan's Ministry of Finance and Economics. In its systems analysis of Sudan transportation, Lockheed is charged with developing a broad plan for development of all forms of transportation, indicating specific projects and establishing priorities among them.

Table 2

TYPICAL CIVILIAN PUBLIC SECTOR CONTRACTS AWARDED IN RECENT YEARS

Subject	Governmental Customer	Corporate Contractor
Auto Safety	New York State	Fairchild-Hiller
Campus Design	St. Louis Jr. Colleges	McDonnell-Douglas
Classroom Scheduling	St. Louis Jr. Colleges	McDonnell-Douglas
Desalinization Plant Design	U.S. Dept. of Interior	Lockheed
Education Information System	City of Philadelphia	Philco-Ford
Education Information System	State of California	Aerojet-General
Educational Reference Center	U.S. Office of Education	North American Rockwell
Educational Technology	U.S. Dept. of Education	Lockheed
High Speed Ground Transportation	U.S. Dept. of Transportation	Hughes Aircraft
High Speed Ground Transportation	U.S. Dept. of Transportation	TRW Inc.
Information System	State of Alaska	Lockheed
Information System	State of California	Lockheed
Information System	State of Massachusetts	Lockheed
Instrumentation Research	U.S. Dept. of Transportation	Melpar
International Development	AID	Lockheed
Medical Information System	State of Vermont	TRW, Inc.
Parcel Sorter	U.S. Post Office	Aerojet-General
Power Management System	U.S. Dept. of Interior	North American Rockwell
Regional Development	Dept. of Commerce	Litton Industries
Satellite Communications	Comsat Corporation	Northrop Corporation
Supersonic Transport Aircraft	U.S. Dept. of Transportation	Boeing
Supersonic Transport Engines	U.S. Dept. of Transportation	General Electric
Systems Analysis of Poverty	State of Colorado	Philco-Ford
Traffic Control System	New York City	Sperry-Rand
Transportation System Design	State of California	North American Rockwell
Turbines for Ground Transportation	U.S. Dept. of Transportation	United Aircraft
Waste Management	State of California	Aerojet-General
Waste Management	U.S. Public Health Service	Aerojet-General
Zip Code Reader	U.S. Post Office	Philco-Ford

Sources: Denver Research Institute and Washington University NASA Economic Research Program

Within the United States, TRW, Inc., is conducting detailed engineering studies of transportation requirements for the Northeast Corridor. The company is evaluating, for the U.S. Department of Transportation, alternative modes and travel concepts which can be used in a safe and convenient high speed ground transportation network.

At the more specific product level, United Aircraft Corporation has built an experimental "Turbo Train" under sponsorship of the Department of Transportation, for the Penn-Central Railroad. Made mostly of aluminum and other light weight materials, and powered by aircraft-type gas turbine engines, the Turbo Train is designed to provide high-speed comfortable surface transportation to help alleviate the airport and highway congestion problems of the Northeast Corridor of the United States. 14/ Similarly, the Bell Aerosystems subsidiary of Textron, with the assistance of funds from the U. S. Department of Housing and Urban Development, has developed an "air cushion" vehicle, the "Jet-Skimmer," which is being used to take passengers from the Oakland and San Francisco airports to downtown San Francisco across the Bay via a quick water route in contrast to a lengthy drive on the California freeways. 15/

Clearly, the systems type of public transportation market in the United States is in an early developmental state. The governmental funding generally is in terms of hundreds of thousands of dollars, characteristic of exploratory study phases, rather than the contracts in units of tens of millions which are associated with actual production of operational systems.

Water Systems

The suggestions that have been made for the application of defense-space industry science and technology to public sector activities in the water area vary from mining of the ocean floor to sea farming to salt and brackish water conversion on a commercial scale to effective water pollution control systems for

entire watershed areas. In many instances there are important questions of benefit-cost analysis to be answered, particularly with regard to the allocation of the benefits and costs to specific groups and industries. Substantial obstacles to government action may be present, for example, in those cases where the cost of pollution controls is expected to be borne entirely upstream on a river, but where the benefits entirely accrue to residents in downstream localities. These are not simple questions, nor are the solutions readily available. They may require public policy decisions of a very subtle nature before markets for industry develop to a significant degree.

At a less ambitious level, several government-oriented corporations (Aerojet General, General Dynamics, McDonnell-Douglas and United Aircraft) have been testing to determine whether waste water can be reclaimed through "reverse osmosis" (filtering out impurities with thin membranes). The General Dynamics Corporation has been working with sanitation authorities in Los Angeles County and the City of San Diego. Westinghouse Electric Corporation is under contract with the State of Pennsylvania to determine whether techniques used for desalting water can be employed to purify acid mine drainage, a major source of stream pollution.

As in the case of the public sector opportunities for innovation in transportation, the markets that have developed to date for water systems have been quite limited in terms of effective demand on the part of government agencies both willing and able to award large-scale contracts. Rather, the efforts to date mainly indicate some of the future potentials for diversification of defense-space contractors.

Communications

Numerous specialized communications applications come to mind as possible public sector diversification on the part of companies now primarily working on defense and space contracts. Custom-designed communications could enable the

individual schools in a given school district to utilize a single set of specialty teachers. Such networks also could link the outlying field offices and divisions of a large government agency or department. A world-wide satellite relay system is another possibility and would be an outgrowth of the existing communications satellite (Comsat) spin-off from government space programs. Still another possibility is the establishment of a truly effective communications system for a single large institution, such as a hospital or a prison -- cases where improved information may lead directly to improved decision-making capability. A variety of potential public customers is apparent here, including state, local and Federal governments, as well as foreign governments.

Many defense-space contractors have obtained civilian government contracts in which modern computer technology is drawn upon to improve communication systems, notably in the areas of education, health, and justice. For example, Aerojet-General Corporation has been working with the California Department of Education on a computer system for evaluating teacher credentials. This should reduce the time required to review all teacher applications. General Precision Systems, Inc. is developing closed circuit, on-site telecasts for schools via a mobile video control room. The mobile facilities can film, process the film, and broadcast the results to remote monitors. The McDonnell-Douglas Corporation has used its Automation Center to do the Physical planning for the St. Louis Junior College District. By achieving more efficient space utilization patterns, the computer analysis yielded a 100,000 square feet reduction in the proposed building plan and a cost saving of over 20 percent out of a $13\frac{1}{2}$ million construction budget. The McDonnell Automation Center has done work for a variety of other public and private clients, including county, state, and federal agencies, hospitals, religious institutions, and companies in numerous manufacturing and service industries.

At a more ambitious level, several major defense-space contractors have set up new units to penetrate the public education field through teaching machines and related software. LTV, Inc. has acquired three business colleges to form a division of its new subsidiary LTV Education Systems, Inc., and to provide a proving ground for its computer-assisted instruction, automated teaching aids and other new educational technology. 16/

Several defense-space contractors are actively attempting to develop improved communication systems for hospitals. TRW, Inc. did the systems analysis for a $100 million medical complex in Alberta, Canada, including designing and developing fully integrated communications, logistics, and information handling systems. The Mayo Clinic of Rochester, Minnesota, has retained the Lockheed Aircraft Corporation to study the speed of flow of medical information, seeking to free doctors from time-consuming routine. That company is also providing a computerized disaster casualty management system for the Texas Hospital Association. The University of California at Los Angeles has been using in its medical research a computer program originally created by North American Rockwell for use in solving a variety of rocket engine vibration and combustion problems. In the area of crime control, Northrop Corporation is under contract with the State of Pennsylvania to develop a criminal justice information system; this project began with a study of the requirements for a description of a recommended information system and will go on to develop a plan for implementation. 17/

On a broader scale, defense-space contractors are designing state-wide communications systems designed to streamline the flow of information and reduce the continuous demand for personnel. Such systems are being developed for such state governments as Alaska, California and West Virginia. It appears that the aerospace and electronics companies have been most successful to date in the new public sector markets involving computer technology and information-handling

systems. In many cases the work contracted for goes beyond preliminary exploration to the actual installation of operational systems and equipment.

Regional Development

The possibilities for applying defense and space technology and systems concepts to area or regional development are numerous and far-reaching. They range from technical assistance to developing nations overseas to urban renewal and redevelopment in our major metropolitan areas to conceptually as well as geographically new housing and community development projects ("New Towns" or "Satellite Cities"). Related alternatives include industry-operated educational and training centers.

The most far-reaching attempt thus far to apply systems analysis to the economic development of a region is the contract with the Government of Greece under which Litton Industries has committed itself not only to analyze and plan the growth of agriculture, industry, and commerce in an underdeveloped area (Crete and Western Peloponnesus), but actually to attract new investment to it. In part because of the adverse international image that the current Greek regime projects in some quarters, the investment goals ($60 Million of outside investment in two years) are not likely to be realized. Only $3\frac{1}{2}$ million of firm commitments were reported during the first 16 months of the project; however, the attraction of long-term capital would be expected to be a relatively slow, drawn-out affair. 18/

Litton's undertaking in Greece is one of the few diversification projects for which some profit data are available. The company receives costs plus an 11 percent profit on its economic studies and 1.9-2.25 percent of the equity capital or long-term foreign loans that it attracts to Crete or the Peloponnesus. However, numerous misgivings over the project have been expressed from a broader

viewpoint: from the viewpoint of public policy how desirable is it for a large American corporation to be under contract with a foreign military dictatorship with the objective of strengthening the economic base of such a regime? This is clearly a question with important political ramifications which are difficult for an individual profit-seeking business enterprise to take account of in any meaningful way. The Litton experience also indicates the wide-ranging potential role of systems contractors in doing government business. Litton itself has entered into somewhat similar arrangements with Portugal and Turkey. Northrop Corporation has contracted with Iran to revamp irrigation and transportation systems.

Within the United States, several defense-space firms have begun to do work in the urban field, an area of growing public concern. On a much less ambitious level, General Electric Company's center for advanced studies, TEMPO, is working with the City of Detroit to introduce budgeting techniques learned through its cost-effectiveness work on projects of the Department of Defense. That company is also involved with the University of Minnesota on an experimental city to be built near Minne polis.

Ten major government contractors (Aerojet-General Corporation, Control Data Corporation, Emerson Electric Company, Litton Industries, Ralph M. Parsons, American Cement Company, Northrop Corporation, TRW, Incorporated, Raytheon Company, and Lockheed Aircraft Corporation) formed a consortium early in 1968 to apply aerospace technology to urban problems. The organization, Urban Systems Associates, Inc., was headed up by two retired Air Force generals and was launched with considerable fanfare. Not too surprisingly, it got off to a slow and shaky start. By the end of the first year, four of the companies had dropped out. Aerojet, Litton, and TRW all decided to go it alone. Raytheon determined that it was not yet ready for the "urban" market. No specific undertakings by

the consortium have yet been announced. 19/

In a more specific but no less ambitious way, the U. S. Office of Economic Opportunity has awarded Westinghouse Electric Corporation a special contract to develop a comprehensive program to attack all the problems of a designated slum area in Baltimore. 20/

Several large companies have been operating Job Corps camps for the Federal Government's anti-poverty program. The General Learning Corporation, a joint venture of General Electric Company and Time, Incorporated, is operating a Job Corps Center in Clinton, Iowa. IT&T is operating the Center in Camp Kilmer, New Jersey and Thiokol Chemical Corporation the one in Clearfield, Utah. Philco-Ford is cooperating with the University of Oregon to manage the Job Corps installation in Astoria, Oregon. In a somewhat related effort, General Dynamics Corporation, Litton Industries, and Westinghouse Electric Corporation are running Peace Corps training stations in the United States. For example, General Dynamics leased a Girl Scout Camp near San Diego to use as a center where Peace Corps trainees are learning Hindi and farming techniques before going to rural villages in India to help increase agricultural yields. 21/

In view of rising national concern with the complex of racial and poverty problems that are centered in the major urban areas, it is likely that the relatively small undertakings just described will in coming years grow into large-scale government utilization of private industry. Already, many public and private figures have urged the formation of new forms of government industry partnerships in order to rebuild in a fundamental way major portions of the central cities of our largest metropolitan areas.

A Preliminary Evaluation

It is not hard, thus, to work up considerable enthusiasm for the nation obtaining some civilian return on its massive investment in military and space

programs through the type of undertakings in transportation or communication or hydrology or urban systems described above. Nevertheless, upon some reflection, a number of significant caveats come to mind.

From the viewpoint of the individual companies, are these types of projects likely to lead to profitable lines of business in the long run? So far, it does not appear that they have. If substantial profitability is not achieved in the years ahead, is there likely to be a day of reckoning resulting in a complete industrial disenchantment with or revulsion from the government as a customer?

From the vantage point of the government agency, does the continued and increasing contracting out of government programs tend to reduce the effectiveness of public control over the use of public funds and the conduct of government programs?

From the point of view of the average individual, will government become even more remote with the interposition of a private contractor between the government itself and the ultimate beneficiary? Visions of people caught between two large bureaucracies -- one public and one private -- with almost infinite buck-passing capabilities conjures up demands for new types of ombudsmen that could create a novel growth labor market.

Finally, for society as a whole, would the close working relationships between the ostensibly private companies and government agencies result in accelerating the trend towards arsenalization of industry which already seems visible in the defense area? Given the anticipated rapid growth in civilian public expenditures in coming decades, would at least some of the locus of entrepreneurship, initiative, and risk-bearing shift from the private to the public sector of the American economy?

Certainly, these serious but unintended impacts of government-industry relationships need to be taken account of in a major way prior to any wholesale utilization of the government-oriented corporations for designing, developing, and producing new and large-scale systems for the civilian public sector.

Perhaps, technology will produce its own limits. For example, some of the enthusiasts in the defense-space industry for the application of the systems concept seem to have gone so far as to almost invite an inevitable reaction. Perhaps the ultimate in their naivete is a formal technical paper presented by an engineer with one large aerospace company in which he contended that the defense industry systems concept could usefully be applied to football. 22/

FOOTNOTES

1/ This section draws upon material in "Aircraft Makers Diversifying," Business Week, September 28, 1946; M. L. Weidenbaum, "Product Diversification in Aircraft Manufacturing Industry," Analysis Journal, May 1959: M. L. Weidenbaum, "Problems of adjustment for Defense Industries," in Emile Benoit and Kenneth Boulding, editors, Disarmament and the Economy, New York, Harper & Row, 1963.

2/ U.S. House of Representatives, Committee on Armed Services, Aircraft Production Costs and Profits, Washington, D. C., U. S. Government Printing Office, 1956, p. 2725.

3/ See Electronics Industries Association, Changing Times in the Defense Industry, 1964.

4/ M. L. Weidenbaum and A. B. Rozet, Potential Industrial Adjustments to Shifts in Defense Spending, Menlo Park, California, Stanford Research Institute, 1963.

5/ The quotations in this section are taken from Ibid.

6/ Weidenbaum and Rozet, op. cit., p. 31

7/ National Science Foundation, Research and Development in Industry, 1966, Washington, D. C., U.S. Government Printing Office, 1968, p. 73.

8/ John S. Gilmore et al, Defense Systems Resources in the Civil Sector, Washington, D. C., U. S. Government Printing Office, 1967, p. 43; Elliot F. Beideman, State Sponsorship of the Application of Aerospace Industry Systems Analyses for the Solution of Major Problems of California, (Unpublished doctoral dissertation,) University of Southern California, 1966.

9/ Wall Street Journal, June 9, 1965, p. 1

10/Gilmore, op. cit., p. 40

11/Harold Walt, "The Four Aerospace Contracts: A Review of the California Experience," in Applying Technology to Unmet Needs, Appendix Volume V, Report of the National Commission on Technology, Automation, and Economic Progress, Washington, D. C., U.S. Government Printing Office, 1966, p. 51.

12/Gilmore, op. cit., p. 46

13/M. L. Weidenbaum, "Strategies for Diversification of Defense/Space Companies," in American Marketing Association, 1967 June Conference Proceedings; and Aerospace Industries Association, Aerospace Technology: Creating Social Progress, Washington, 1968.

14/Paul W. Burton, "Testing the Turbo Train," United Aircraft Bee-Hive, Spring 1968, pp. 10-15.

15/Vertical World, August 1966, p. 5.

16/ Saturday Review, July 23, 1966, p. 35; McDonnell Automation Center, Automation: A Catalyst for Growth (undated); Eli Goldston, "New Prospects for American Business," Daedalus, Winter 1969, p. 100; Business Week, February 1, 1969, p. 68.

17/ Diversification News, August 29, 1966, p. 1; Business Week, October 29, 1966, p. 110; Boston Globe, November 27, 1966.

18/ Wall Street Journal, February 20, 1968, p. 32, and September 10, 1968; George P. Baker, New Markets for Business in the Public Sector (undated) p. 9; Industrial Research, November 1968, pp. 27-28.

19/ William H. Gregory, "Several Firms Planning Urban Programs, but Sales Prospects are Vague," Aviation Week, July 1, 1968, p. 38 et. ff.

20/ Monroe W. Karmm, "Great Society, Inc. U.S. Seeks to Expand the Role of Industry in Tackling Urban Ills," Wall Street Journal, December 15, 1967, p. 1.

21/ Business Teaches the Peace Corps," Business Week, October 22, 1966, pp. 133-138; St. Louis Post-Dispatch, October 20, 1966, p. 8A; John McHale, "Big Business Enlists for the War on Poverty," Trans-Action, May-June 1966, pp. 3-9.

22/ Roy B. Carpenter, Jr., Football-A Systems Challenge, American Institute of Aeronautics and Aeronautics Paper No. 66-896, December 1966.