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SDI and Corporate Contractors: Momentum, Ambivalence, and a Push For Early Deployment

The role of corporate contractors has been central to the SDI debate. Critics of the program have focused on the SDI budget, fearing that large sums of money for the program would create irresistable corporate momentum for deployment of an anti-missile system. Supporters of the program have hoped that the critics' fears would be realized.

Has the SDI become unstoppable? The SDI has created a formidable political and corporate constituency possessing both the motivation and the means to favorably influence a deployment decision. This gives the program tremendous political momentum. But there are internal sources of tension within these constituencies.

There are several constituencies who favored a continuation of the arms race: conservative politicians who desired a continuation of political confrontation with the Soviet Union; strategic analysts, particularly those enamored with nuclear war-fighting postures; and arms contractors that needed the work.

It is already possible to see essentially all of the weapons systems that will be deployed through the end of this century. Most of these will be deployed within the next six or eight years. And few of these systems are qualitatively novel. There are no more large expensive strategic offensive systems left to develop, and certainly there are no more systems that

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CORPORATE INTEREST IN THE SDI

With the large sums of money to be spent in the R&D phase of SDI, coupled with the prospect of even larger sums for production and deployment, it is not surprising that the defense contracting community has shown considerable interest in the program. At an early classified briefing on the program by SDIO Director Abrahamson, nearly 1200 representatives from defense contractors were in attendance.

There are two levels at which the contractors would be interested in the SDI. First, in absolute terms, the SDI is a large and rapidly growing part of the Defense budget. Second, in the long run the SDI may prevent the decline in the size of the strategic forces segment of the defense budget.

The SDI Budget

Defense market analyst Wolfgang Demisch of First Boston argues that "SDI is the future of the defense industry. No competitive high-tech company can afford not to be a part of SDI."

SDIO officials have indicated that a decision to deploy the SDI may be made by 1991 or 1992. Initial Operational Capability (IOC) for some components could come at the end of 1995. Prior to a deployment decision in 1991, the SDI will have spent about $40 billion in research and related construction. And by the time Initial Operational Capability for some SDI components arrives the SDIO may have spent over $100 billion.

These figures illustrate the large sums of money to be made in just the R&D stage and Full Scale Engineering Development. Long before the first SDI component could be put in the field, billions upon billions of dollars will have gone to the defense contractors. The development costs of SDI alone will make it the most expensive weapons program to date.

Declining Spending on Strategic Forces

For some defense contractors, if the SDI didn't exist, it would have to be invented. Under the Reagan Administration the strategic hardware budget experienced a major increase in the early 1980's. But barring some novel development this part of the Defense budget is likely to fall in the 1990's back to the level of the 1970's.

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SDI CONTRACTS – THE BASIC FACTS

BUDGET APPROVED	1983-87	$10,200,000,000
BUDGET PLANNED	1988-92	$35,000,000,000
TOTAL BUDGET	1983-92	$45,200,000,000
CONTRACTS SIGNED	1983-87	$10,900,000,000
OF WHICH OBLIGATED	1983-87	$ 5,300,000,000
ADDITIONAL IN COMPETITION	1987-92	$19,500,000,000
TOTAL CONTRACTS	1983-92	$30,400,000,000
CONTRACTS SIGNED IN COMPETITION	1983-87 1987-	3300 300

Bethe, Garwin, and Mark on Comprehensive Test Ban, pg. 11; New Staff Members, pg. 12

(Continued from page 1)

would produce a qualitative difference in the strategic balance.

While the SDI could represent a major new market for the aerospace industry in the 1990's, there are a variety of problems with the program that have tempered industry's enthusiasm. SDI contracts are thus far solely for research, and such contracts are normally conducted on a break-even basis by companies that hope to make a profit on eventual procurement of a deployed system. The contracts are expensive to bid on, and the competition for follow-on contracts is a protracted and uncertain process. The danger that the program might be greatly truncated as a result of an arms control agreement is an a constant source of concern. And programs such as the Conventional Defense Initiative and the University Research Initiative offer alternative sources of funding.

SDI: GAINING MOMENTUM

Despite these obstacles, the SDI has developed a major role in the future of many companies and government agencies. Unlike the B-1 bomber, which achieved immortality through contracts in every Congressional district, work on the SDI is geographically concentrated in just a few states.

But the SDI has a much broader corporate constituency than the B-1, given the large number of companies working on the program. Although the SDI is only a small share of the sales of the large defense contractors, for the subsidiaries of these companies that specialize in strategic and space systems, the program is of major and growing importance. The contractors have repsonded to the SDI by establishing program offices and divisions to focus their efforts, and by purchasing small firms that specialize in SDI-related technologies.

The agencies in the Defense Department that work on SDI have also been reorganized, providing further institutional momentum for the program. But the SDI organization itself has had limited sucess in managing rivalries between the services. The proposed SDI Institute is an attempt to improve the central management of the program.

The SDI has also sought support from Allied contractors and universities. But non-U.S. firms are unlikely to receive significant levels of funding, and the academic community continues to be a major focus of opposition to the program.

The mixed reception of the SDI among contractors is probably one factor in the recent push for early deployment of SDI, since the contracts for an operational system would be much more lucrative than continued research, and a decision to deploy sooner rather than later would also increase the certainty that large procurement contracts would actually materialize.

—JEP

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In order to fill this void, there will be tremendous political pressures to deploy SDI. These pressures are enhanced since SDI is the only program currently in the pipeline which could prevent a sharp decline in funding for strategic forces in the mid-1990's.

Wolfgang Demisch argues that "the traditional defense budget clearly isn't going to grow much in the near future. Every company is on notice that, if they want to be a long-term player, they can't let SDI get away."

The budget decline has already begun with strategic forces research and development, which was steady at about $2 billion dollars a year under the Carter administration. This part of the budget peaked at about $8 billion a year in 1985, and has been declining since then. Strategic forces research and development, with the exception of the Strategic Defense Initiative, should return to the Carter Administration level of about $2 billion a year by the early 1990's. But the SDI funding projected by the Reagan Administration will keep the funding in the range of the $8 to $10 billion level throughout this period.

DISINCENTIVES FOR CORPORATE INTEREST IN THE SDI

However, corporate support for the SDI was fairly weak in the first two years of the program. This is rather counter-intuitive behavior, in the sense that their long-term interests would suggest that the aerospace industry would be fairly enthusiastic about SDI.

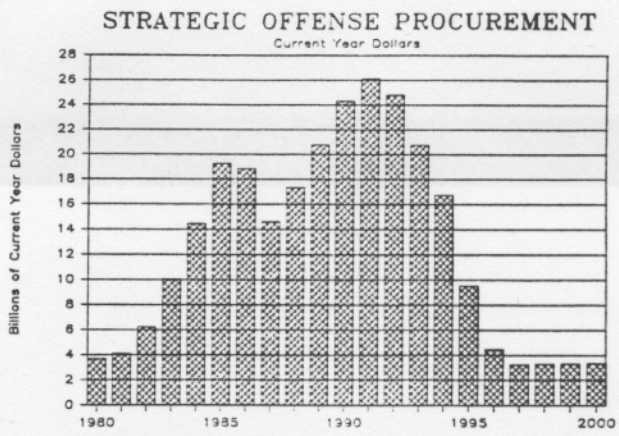
The political advocates of SDI have had a hard time selling the program to industry. In 1983 and 1984 there were frequent presentations at industry conferences to the effect that industry was not supporting SDI, and that if this didn't change that the program would be in trouble.

The reasons for industries skepticism about SDI are not difficult to identify. Initially the program was very poorly defined. And it was far from clear that there was any underlying reality to it, given the uncertainty about the outcome of the 1984 Presidential election. But there were also some very immediate and practical problems that industry had with the SDI as a business proposition. There are so problems with SDI contracts that by the time a company nears the pot of gold, the rainbow may have faded.

Expensive Competitions

The first problem was that the SDI contracts are very expensive to compete for. Normally defense contracts require relatively little cost to prepare a bid proposal, on the order of $100,000 for a multi-million dollar contract, and much less for smaller concept definition contracts.

But the SDI requires the contractors much more work in preparing the initial proposal. These contracts are very expensive to bid on, and companies would have to spend hundreds of thousands of their own dollars simply to prepare the proposal. Stanley Morgan, who heads GTE's SDI effort, notes that "the price of admission to this game is much higher that usual. If you want to be competitive, you have to be prepared to spend accordingly." He indicated that between 1983 and 1985 GTE spent $3,000,000 of its own money preparing proposals for SDI contracts.



Funding on strategic forces procurement, which was less than $4 billion a year during the 1970's, rose to almost $20 billion in 1985, and could reach $25 billion a year by the early 1990's. But by the mid-1990's, with the completion of the procurement of the Stealth Bomber, Midgetman and Trident, the strategic procurement budget would quickly fall to less than $5 billion a year by the late 1990's.

At least in the initial stages of a competition, the companies were probably losing money on the contracts that they initially won, because they wanted to be in line to get the big contract that might be three or four years out there in the future. And the high cost of competing for SDI contracts undoubtably created a competition within companies for scarce bid and proposal funding.

Long Odds Against Winning Big

The second problem is the poor odds of actually winning a profitable contract. Although stock analyst Wolfgang Demisch is generally bullish on the SDI, he does concede that "Star Wars isn't going to be a profit producer for the rest of the 1980's." Robert Walquist, a TRW Vice-President and the company's SDI program executive, laments that "If there is to be big money in SDI we won't know it for years." David Lang, Vice President of Lehman Management Company concurs. "Lower profitability is one of the less pleasant features" of SDI. "Star Wars contracts are of smaller dollar amounts. Capital and personnel requirements are more difficult to estimate and manage. Subcontractor relationships become as complex as the systems they interface. Technical risks are obviously higher."

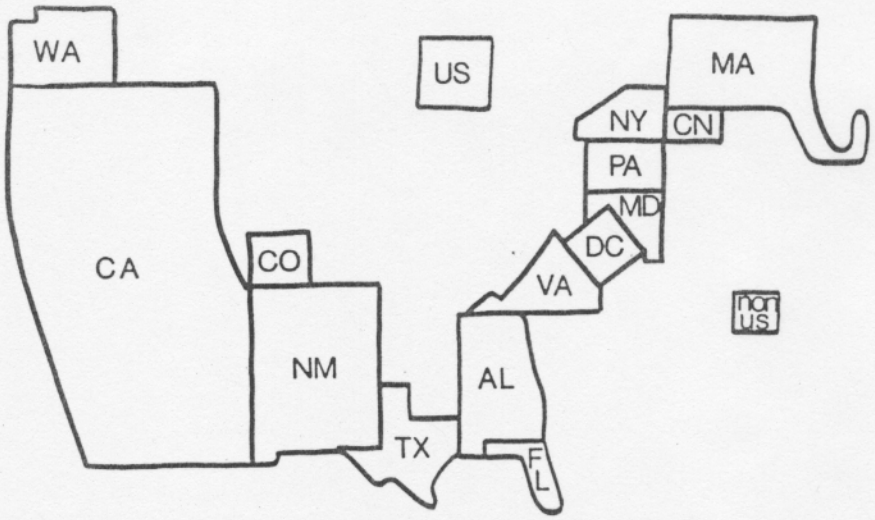
Most of the contracts are structured as multiple stage competitions with perhaps a dozen companies in the Phase Zero concept definition, six in Phase One Requirement Definition, three companies in Phase Two Ground Demonstration, with only one company winning the Phase Three Field Test contract, which would be the only contract that would be really profitable.

Stalled Competitions

The third problem is that the SDI is an extremely uncertain business environment because the SDI program is redesigned every year. Defense stock analyst Jerry Cantwell notes that "SDI has been a big disappointment . . . Competitions are extra long and constantly recompeted." Some projects that start out in Phase Zero face a long

THE LEADING SDI STATES

STATE	CONTRACT VALUE IN MILLIONS	% OF TOTAL
California	$4,900	45.1 %
New Mexico	$1,300	12.4 %
Massachusetts	$ 900	8.4 %
Alabama	$ 600	6.1 %
Washington	$ 500	4.7 %
Texas	$ 400	3.8 %
Virginia	$ 300	2.8 %
Pennsylvania	$ 230	2.1 %
D.C.	$ 230	2.1 %
New York	$ 220	2.0 %
Colorado	$ 190	1.8 %
Maryland	$ 180	1.7 %
Florida	$ 120	1.1 %
Connecticut	$ 110	1.0 %
Utah	$ 60	.6 %
New Jersey	$ 50	.5 %
Illinois	$ 40	.4 %
Minnesota	$ 35	.3 %
Ohio	$ 35	.3 %
Georgia	$ 28	.2 %



and winding path to Phase Three, where the real money is to be made. The contractors have to keep the design team together using their own money on the off chance that they eventually go to the next phase of the competition, with no guarantee that that's actually going to happen.

The Space Surveillance and Tracking System, a mid-course discrimination and tracking satellite system, has basically been stuck between Phase Two and Phase Three for over two years, and is being held up because SDIO and the Air Force can't firmly establish the project's requirements and priority.

The same thing happened with the Booster Surveillance and Tracking System competition which was delayed almost a year before moving to the next phase of the competition. The National Test Bed competition has been stretched by a year. And the Architecture Studies were originally to remain in Phase Two for only a year, and then to move into Phase Three that would narrow the field from five to one final system architect, has now been extended into Phase II-C for an extra year.

Cancelled Contracts

The fourth problem is the risk that contracts that are awarded might subsequently be cancelled, either because of technical problems or changes in program priorities. One of the very real problems for the coalition of interest supporting the SDI has been the maintenance of an architecture for the system as a whole that is broad enough to include most of the major contractors.

There were several fairly painful examples of this early in the program. Lockheed had been working on the TALON GOLD targeting system for several years, but their contract was terminated in mid-stride. TRW suffered a similar fate with the ALPHA space-based chemical laser. Aerojet won a contract to build an infrared sensor as part of the Army's Airborne Optical Adjunct program, but after a few months this $40-50 million sub-contract was cancelled.

The Threat of Arms Control

Corporate enthusiasm for the SDI has also been tempered by the realization that the program could be drastically truncated by this or the next Administration as part of an arms control agreement with the Soviets. This prospect has discouraged the contractor constituency, and limited their interest in the program. Shortly before the Geneva summit in 1985, Richard Perle noted that "the mere suggestion that the SDI program is on the table (for negotiation) would do irreparable harm to the people and industrial firms working on it." He further argued that it was necessary to assure those working on the program "that the rug is not going to be pulled out from under them in midstream— that those years of toil in the laboratory will not go down the drain because some abrupt political decision has been made to reverse field and abandon the project. The same applies to industry, which has to decide how deeply to involve itself in government programs. Because if the programs are ephemeral, then the commitment of corporate resources will inevitably produce failure."

CONTRACTS BY SECTOR

	TOTAL	CONTRACT VALUE		CONTRACTS
CORPORATIONS	460	$8,000,000,000	73 %	2250
FEDERAL LABS	14	$1,500,000,000	14 %	120
UNIVERSITIES	80	$ 700,000,000	6 %	350
GOVERNMENT	53	$ 450,000,000	4 %	375
NON-PROFITS	16	$ 100,000,000	1 %	100
FOREIGN	130	$ 100,000,000	1 %	130

MEASURING INSTITUTIONALIZATION

There are a number of measures that provide an indication of the degree to which the SDI has become institutionalized. The distribution of contractor money by state and by metropolitan area provide one type of measure of interest in the program. The distribution of the work among contractors is another measure.

The SDI involves a wide array of government agencies, corporations and research centers. A total of 695 different entities have received at least one of the 3325 SDI contracts awarded between March 1983 and March 1987. The SDI contractors fall into five institutional groups: the private sector, which includes U.S. business firms and non-profit corporations; Federally Funded Research and Development Centers (FFRDCs); University systems; Government agencies; and Foreign contractors.

Although the picture is mixed, it is clear that the SDI is well on its way to achieving considerable support from these contractors.

However, to date we have not witnessed the B-1 type of lobbying campaign for the SDI. There are at least three reasons why the defense industry has not yet waged a stronger campaign for the SDI.

The first is the effect of Ronald Reagan's advocacy. As a Boeing executive commented: "When the President of the United States is your lobbyist, you're best advised to sit down and shut up." President Reagan and Defense Secretary Weinberger have spent a substantial amount of their time promoting SDI. In addition, SDIO representatives spend much of their time arranging public displays of SDI technology and otherwise promoting the program.

With players such as these out stumping for them, defense firms are likely to utilize their own resources to promote other company projects which lack such powerful advocates. Campaigning from the defense industry will be more critical in the future when an new administration, which will likely be less committed to SDI, is in power.

Second, industry's reluctance to actively campaign for the SDI stems in part from a concern for their public image. Reports of $600 toilet seats and contractor fraud have brought a lot of heat on the defense industry in recent years. An active campaign in support of SDI at this time would probably be viewed as self-serving and would further erode the industry's public image.

Third, at this stage of the game, the SDI may be in the interest of the defense industry as a whole but individual firms are unsure as to how big of a piece they might get. While some front-running contractors have already emerged, the big money is still to come and the large production contracts are still up for grabs. Which of these major contractors will come out the big winners is still an open question.

Geographical Distribution

The B-1 bomber is the standard example of a weapons system that was institutionalized by the contractor community by virtue of the broad geographical distribution of contract money. There are several ways of comparing the SDI and the B-1. One measure is the geographical distribution of the spending for the program.

The B-1 program had contracts in every Congressional district. But the SDI is much more geographically concentrated than the B-1. To the first approximation, the SDI is a California program—almost 45 percent of the SDI contract money has gone to that state. But eight states are receiving less than $1 million from SDI, and six states have received no SDI money at all. To the second approximation, SDI is basically a Los Angeles, San Francisco, Seattle, Albuquerque, Huntsville, Washington, D.C., Philadelphia and Boston program.

One problem faced by the SDI is finding companies to give the money to, given the fairly narrow industrial base of companies and design teams with expertise in BMD technology. Prior to the President's speech, spending for these type of technologies was only about a half billion dollars a year, and only a few companies were heavily involved in the field. For high end research activities like the SDI, you have to go where the expertise is, whereas for a procurement program like B-1, you can always find some rubber band plant that will supply rubber bands to the B-1 program office.

However, another measure of the geographical distribution of SDI is not by workplace, but rather by the location of the corporate headquarters. By this measure, California still does very well, but other states, such as Missouri with McDonnell-Douglas, and Michigan with General Motors, also do fairly well.

Trade Associations

One of the problems that the SDI program has presented for the aerospace industry is that while it may be in the collective interest of the industry as a whole, given the long term trends in procurement and R&D spending, until recently it has been a little difficult for an individual company to identify its specific interest in the program.

In the first two years of the program, the most active advocates for the program and for developing the constituencies for the program were the trade associations. This is

not surprising, since the trade associations exist to represent the interests of the industry as a whole.

Industry trade associations, particularly the American Defense Preparedness Association, have been very active. Several associations, notably ADPA, have formed a Strategic Defense Section with a staff to organize support for the SDI. These committees are often made up of contractor representatives and military officers attached to the strategic defense programs. The executive board of the ADPA strategic defense division is made up almost entirely of representatives from SDI contractors.

In addition, professional associations like the American Society of Mechanical Engineers, the American Institute for Aeronautics and Astronautics, have held a number of conferences on the SDI, which have the effect of building a constituency for the program.

The Contractors

The private sector makes up the largest single group of SDI contractors with 331 separate business firms and 15 non-profit corporations receiving SDI contracts. These comprise both public and closely-held corporations, as well as partnerships based in the United States.

Wherever possible we have traced a business firm to the firm's ultimate parent. Therefore, SDI work performed by divisions and subsidiaries has been consolidated within the parent company.

The SDI program consists of a small number of big companies for which the SDI is a small part of their business, and a large number of small companies for which SDI is a large part of their business. General Motors is probably the best example of this. GM is a $100 billion a year company, the second ranked SDI contractor with about $100 million a year of revenue from SDI. But this is so small that the GM board of directors probably can't even find time to deal with SDI.

But within those large companies, SDI can be a very large part of the business for the division that is working on it. At Boeing, a $10 billion a year company that is doing about $100 million worth of SDI business, the bulk of the company's cash flow is from their civil aircraft division. But for Boeing Aerospace, the division that is working on SDI, the SDI has grown from less that 1% of their business in 1983 to over 10 % of their business by 1986. The Spacecraft Division at TRW has seen its SDI business grow from 6% of the division's sales in 1983 to over 15% of sales in 1986, despite the company's setbacks with the chemical laser program. And the SDI already accounts for over a third of the sales of the Spacecraft Division of Grumman.

Compared to the B-1, the SDI is much more diversified in terms of its corporate constituency. In general only a few large companies had a major stake in the B-1. Its main supporter was Rockwell, the prime contractor. General Electric, which makes the engines, also had a large interest in the program, as did a few other companies responsible for the electronic systems. Although there were a large number of companies that had some interest in the program, it was not a primary or basic interest for them.

But with the SDI, there are several dozen companies that regard SDI as a major source of current or potential revenue. While the geographical base of the SDI is somewhat narrower than that of the B-1, the SDI's corporate base is much broader.

In addition, there are a number of smaller companies that are highly dependent on the SDI program. All of the heavily dependent companies have experienced rapid sales growth in the last few years. For most of these companies, sales have doubled since the SDI was officially started. Sparta in particular has experienced an incredible growth rate. Sparta's annual sales increased almost 1600% between 1981 and 1985. This rapid growth earned Sparta a place on *Inc. 500's* 1985 list of "America's Fastest-Growing Private Companies."

If one were to describe the typical heavily dependent company it would be a small, privately-held corporation under 10 years old. The company would most likely be located in Huntsville, Alabama. This typical heavily dependent company would average annual revenues between $2 and $6 million and have between 20 and 60 employees. The sales of this typical company have doubled since 1983 and this rapid growth in sales can be traced almost entirely to the SDI.

A prime indication of corporate interest in the SDI is the acquisition by large companies of some of these smaller companies that specialize in SDI technologies. Over the past year there have been a number of acquisitions of small companies specializing in SDI technologies.

Titan Corp. has conducted a very aggressive program of purchasing smaller SDI-related companies, under the leadership of then-Vice-President Gerold Yonas, formerly Chief Scientist of the SDI Organization. In 1986 these acquisitions included Spectron Development Labs, Aeronautical Research Associates and Pulse Sciences, which all had active SDI contracts at the time of the purchase. United Technology purchased Adaptive Optics, Kaman bought Electromagnetic Launch Research Inc. and Emhart Corp. acquired Planning Research.

A further expression of corporate interest in the SDI is the trend of setting up special SDI divisions and vice-presidencies. In late 1985 General Dynamics, a leading defense contractor which has thus far played a minor role in the SDI, formed the Valley Systems Division to concentrate on strategic defense programs. Rockwell has formed a Strategic Defense Center under the leadership of George Jeffs, who is also the President of the company's North American Space Operations. The Center will serve as the focal point for Rockwell's SDI effort. Rockwell has also established a Laser Systems Organization to handle concept analysis for directed energy weapons. A reorganization at the Aerospace Corporation led to the formation of the Defense and Surveillance Operations division to consolidate the center's SDI programs. And Gerold Yonas was recently named President of the newly-formed Titan Technologies division of Titan Corp.

TRW has named Space & Technology Group Vice-President Robert Walquist as program executive for its SDI Office. General Electric created a SDI Program Office as part of its Aerospace Group in 1984. Lockheed and Sver-

LEADING CORPORATE CONTRACTORS

COMPANY	CONTRACT VALUE	% OF TOTAL
Lockheed	$1,000,000,000	9.4 %
General Motors	$ 730,000,000	6.7 %
TRW	$ 570,000,000	5.2 %
McDonnell-Douglas	$ 490,000,000	4.5 %
EG&G	$ 475,000,000	4.4 %
General Electric	$ 420,000,000	3.9 %
Rockwell International	$ 370,000,000	3.4 %
Raytheon	$ 250,000,000	2.4 %
LTV	$ 230,000,000	2.1 %
Fluor	$ 200,000,000	1.8 %
Grumman	$ 190,000,000	1.8 %
Gencorp	$ 190,000,000	1.8 %
Teledyne	$ 190,000,000	1.8 %
Honeywell	$ 150,000,000	1.4 %
Martin Marietta	$ 130,000,000	1.2 %
Textron	$ 120,000,000	1.0 %
Flow General	$ 90,000,000	.8 %
Science Applications	$ 90,000,000	.8 %
Kaman	$ 80,000,000	.8 %
Bechtel	$ 80,000,000	.8 %

drup have also established SDI program offices.

Other companies have set up new local program offices to handle new contracts. General Dynamics created a new office in Albuquerque in mid-1986 to handle its work with the Air Force on railguns. McDonnell-Douglas opened a new office in the same city a few months later to oversee the company's particle beam activities. And in December, 1986 the French firm Thomson-CSF opened a new office in Huntsville to coordinate work with the Army Strategic Defense Command and Missile Command.

These organizational changes will give strategic defense a stronger foothold within these corporate families. In addition, strategic defense contracts represent new career tracks for individuals within these organizations. As a company's SDI contracts grow larger, project managers will become division chiefs and division chiefs will become company vice-presidents.

A further indicator of corporate interest in a program is the coverage in the companies' annual report. The major SDI contractors have given increasing prominence to their involvement in the program. Gencorp notes in its 1985 annual report that "with the national defense build-up, a number of Aerojet projects have shown particular promise. These include . . . the Strategic Defense Initiative . . ." And in its 1986 annual report the company observes that "expertise in propulsion and sensor systems is keeping Aerojet at the forefront of research for the Strategic Defense Initiative."

Full page ads in the *Washington Post* are another indicator of industry interest in a program. In 1982, McDonnell-Douglas, Lockheed and Boeing were slugging it out for a big cargo airplane contract, and for a period of about six months, every day in the *Post* there would be an ad from one of those companies extolling the virtues of its airplane. And when Navy contracts are up, there will be full page ads out about the merits of the DDG-51 or the Ticonderoga.

Until recently, there were very few corporate awareness ads extolling the virtues of SDI. However, in the last year there have been a growing number of in full page ads in major newspapers and trade publications featuring the SDI.

Another indicator of corporate interest is employment advertisement. During 1986, we monitored want ads in *Aviation Week*, the *New York Times* and the *Washington Post*. Contractors representing something like two-thirds of the total face value of the contracts have placed want ads saying that they're interested in hiring people. In addition, a number of employment services have run ads indicating an interest in SDI.

Federally Funded R&D Centers

Federally Funded Research and Development Centers (FFRDCs) are research institutions sponsored by a government agency to perform, analyze, integrate, support and/or manage basic research, applied research, and/or development. Fifteen of the thirty-eight FFRDCs are involved in SDI contracting.

FFRDCs account for a majority of the contract value in the DOE projects. The weapons labs at Livermore, Los Alamos, and Sandia each share a major part of this work. MIT's Lincoln Laboratory accounts for almost all of the total sensor contract value awarded to FFRDCs. This value ($240 million) is anticipated SDI work under Lincoln Laboratory's general contract with the Air Force Electronic Systems Division.

These four FFRDCs (Livermore, Los Alamos, Sandia, and MIT) perform the bulk of the SDI work awarded to FFRDCs. In the last three years, SDI funds have become a significant part of the budget for these labs. Figures for Lincoln Laboratory show that roughly 22 percent of their budget for fiscal year 1985 was SDI related. SDI funds for Lawrence Livermore and Los Alamos grew from around 3% of their budgets in fiscal year 1983 to 12% in fiscal year 1985. A little less than 5% of Sandia's budget for fiscal year 1985 was SDI related.

LEADING FEDERAL LABORATORIES

LAB	CONTRACT VALUE	% OF TOTAL
Lawrence Livermore	$550,000,000	5.1 %
Los Alamos	$450,000,000	4.2 %
Sandia	$220,000,000	2.0 %
SDI Institute	$125,000,000	1.1 %
Argonne	$ 35,000,000	.3 %

Government Agencies

The military bureaucracy has played a major role in shaping the SDI program, and has been shaped by the program in turn. The tripartite nature of U.S. military forces often results in lively battles for bureaucratic "turf," particularly in regards to new missions and weapon systems. The divisiveness that these struggles created in the 1950's and early 1960's was at times used effectively against the services by "outsiders"—most notably the Office of the Secretary of Defense (OSD) under McNamara. By the late 1960's the three services reached something in the way of a detente in order to present a united front to OSD and Congress. Pet projects of one service would be supported by the other services on a quid pro quo basis. However, the incorporation of a potentially major role for strategic defense in U.S. nuclear strategy creates "new ground" over which inter-service rivalries may flare up.

The Strategic Defense Initiative Organization (SDIO), Washington, D.C., is the management organization for the SDI, giving direction and setting priorities for the participating services and agencies. While the SDIO manages a few of its own contracts, most SDI contracts are let and administered through the services.

The largest SDI contracting activity for the army and for the entire SDI is the Army Strategic Defense Command (SDC) in Huntsville, Alabama, formerly the Army Ballistic Missile Defense Systems Command (BMDSCOM). Within the Air Force, the Systems Command at Andrews AFB, outside of Washington, D.C., has the overall responsibility for SDI programs. The Systems Command has numerous subordinate Divisions which in turn manage various parts of the SDI program.

The growing institutional presence of the SDI is reflected in the numerous organizational changes to accommodate the program in recent years. As with the creation of special SDI program offices in the private sector, these new bureaucratic structures will serve as continuing centers of advocacy for the SDI long after the end of the Reagan Presidency.

In response to the SDI, on 1 July, 1985 the Army formed the Strategic Defense Command (SDC), headed by Lt. Gen. John Wall, through the consolidation of the Ballistic Missile Defense Organization in Washington, D.C., and the BMD Systems Command and BMD Advanced Technology Center, both in Huntsville, AL. The new SDC organization includes Directors for each of the five SDI program elements.

The importance of the SDI for the Army is highlighted by the exceptional treatment afforded SDC in various Army organizational changes. In contrast to other Army programs, SDC has maintained direct reporting access to the highest levels of the Army. SDC escaped control by the new Space and Special Weapons Directorate of the Office of the Deputy Chief of Staff for Operations and Plans is the focal point for all other Army space activities. The SDC is the only Army program where the Program Element Officers do not report directly to the Assistant Secretary of the Army for Acquisition. And SDC has remained independent of the Army Material Command (unlike the Air Force Space Division, which is subordinate to the Systems Command).

To coordinate its SDI effort the Air Force created in August, 1984 a SDI Special Assistant, who heads the SDI Office and reports both to the Air Force Chief of Staff and to the commander of the Air Force Systems Command. Brig. Gen. Robert Rankine initially filled this post, until he was succeeded by Brig. Gen. Thomas Honeywell in mid-1986. There have also been a number of changes in subordinate Air Force offices. In early 1986, the Space Technology Center at Kirtland Air Force Base underwent a major reorganization, forming new Directorates for SDI Programs and for Neutral Beam Technology. In August, 1986 the Electronic Systems Division established the SDI Program Office, which had been set up under the Deputy for Development Plans, as a separate entity. And the Armament Lab at Eglin Air Force Base has established at Strategic Defense Branch to conduct railgun programs.

The bureaucratic struggles between the Army (Green) and the Air Force (Blue) are reflected in the SDI program. In general, the Air Force has laid claim on space-based BMD systems while the Army claims ground-based and "pop-up" systems. This division of the "turf" means that bureaucratic fortunes hinge on the incorporation of these various systems into an overall defensive design and their respective significance to the mission of strategic defense.

LEADING AGENCIES SPONSORING SDI CONTRACTS

AGENCY	CONTRACT VALUE	% OF TOTAL
ARMY – TOTAL	$4,000,000,000	37.0 %
Strategic Defense Command	$3,475,000,000	32.2 %
Corps of Engineers	$ 290,000,000	2.6 %
Missile Command	$ 125,000,000	1.1 %
Other Army	$ 110,000,000	1.0 %
AIR FORCE – TOTAL	$3,400,000,000	31.5 %
Space Division	$2,240,000,000	20.7 %
Electronic Systems Division	$ 710,000,000	6.6 %
Aeronautical Systems Division	$ 225,000,000	2.1 %
Armament Division	$ 75,000,000	.7 %
Other Systems Command	$ 150,000,000	1.5 %
NAVY – TOTAL	$ 535,000,000	4.9 %
Office of Naval Research	$ 250,000,000	2.3 %
Sea Systems Command	$ 230,000,000	2.1 %
Space & Naval Warfare Command	$ 22,000,000	.2 %
Other Navy	$ 33,000,000	.3 %
OTHER DEFENSE DEPARTMENT	$1,080,000,000	10.0 %
SDI Organization	$ 630,000,000	5.8 %
Defense Nuclear Agency	$ 280,000,000	2.6 %
DARPA	$ 170,000,000	1.6 %
OTHER GOVERNMENT	$1,750,000,000	16.2 %
Energy Department	$1,650,000,000	15.3 %
NASA	$ 85,000,000	.9 %

The SDIO has failed to manage this bureaucratic infighting. Whenever the SDIO has locked horns with the Army or the Air Force, it has been the SDIO that ended up backing-down. SDIO's failure is a result of three factors.

First, the SDIO is a joint organization. Not only is the SDIO essentially balanced between Green and Blue but it is inherently weaker as a bureaucratic unit. Promotions are not decided by joint organizations—there are no SDI generals, only Army generals and Air Force generals. Thus, second, the SDIO is at a disadvantage in attracting more capable personnel.

And third the SDIO is a small organization relative to the Army and Air Force bureaucracies working on the SDI. The SDI has about 200 personnel, in contrast to 900 Army and 800 Air Force personnel.

The SDI Institute is in part an effort to solve these problems by creating a large "purple" organization that will be able to attract capable people to establish a "purple" system architecture. The Institute has been criticized because of concerns that its efforts might be biased by its close relationship with the SDI Organization. In reality, this close relationship is the key to the Institute's role in achieving some degree of central control over the SDI program.

Universities

Of the total $10 billion in SDI contracts to date, over $700 million has gone to eighty universities. Contracting activity among U.S. The academic community has received almost 350 contracts with an average value of approximately one million dollars.

Most of the university work is conducted at the Johns Hopkins Applied Physics Lab and the MIT Lincoln Lab (which is actually a Federally Funded Research & Development Center). The University of Texas at Austin is getting a fair amount of money for work on railguns, and the University of Utah for space research, but most of the rest of the university research is very small scale. Although the impact for most universities as a whole is small, in individual mechanical engineering or aerospace department or computer science departments the impact can be significant.

One way the SDI program has ameliorated the narrow geographical distribution of contracts is by giving money to universities. The SDIO has a very aggressive program in the Innovative Science and Technology Office and the Small Business Innovative Research Program for this purpose.

Not surprisingly, the geographical distribution of SDI money to the universities is much broader than for the aerospace contractors. There are a number of states where most, if not all of the SDI activity in that state is taking place in the university community.

The concern that's been expressed within the university community that university funding is being used to generate political support for the SDI is well founded. The broader geographical distribution of SDI funding to the academic community may translate into political influence. There will certainly be Congressional delegations and local newspapers that will have people from their locality supporting the SDI because of the funding going into the university community.

Universities have been a focal point for much of the opposition to the SDI. For example, a pledge not to accept SDI funds was circulated and signed by over 6500 faculty members and graduate students in the science and engineering fields at major U.S. universities. In addition, administrators at leading universities (ie. MIT, Caltech, Harvard, & Stanford) have publicly deplored the attempts by SDIO officials to link SDI research performed at these institutions with an official endorsement.

LEADING UNIVERSITY CONTRACTORS

COMPANY	CONTRACT VALUE	% OF TOTAL
MIT*	$350,000,000	3.2 %
Johns Hopkins*	$ 97,000,000	.9 %
University of Utah	$ 55,000,000	.5 %
University of Texas	$ 35,000,000	.3 %
Georgia Tech	$ 28,000,000	.3 %
Stanford	$ 25,000,000	.2 %
Auburn	$ 14,000,000	.1 %
University of California	$ 9,500,000	.1 %
State University of New York	$ 5,900,000	.1 %
University of Dayton	$ 5,800,000	.1 %

*Most of the MIT total is accounted for by work conducted at the MIT Lincoln Laboratory. Most of the Johns Hopkins work is conducted at the Applied Physics Laboratory.

Foreign Contractors

So far only seventeen foreign entities have been involved with SDI projects. These include foreign government agencies, foreign universities, as well as foreign corporations. One of the major sources of non U.S. participation in the SDI program is through U.S. subsidiaries of foreign companies. The Computer Corporation of America is an SDI contractor, a subsidiary of Crowntech, a Canadian company. And the first Italian contract for SDI turned out to go to an Italian subsidiary of a Swiss company.

In reality, there are a number of barriers to significant Allied participation in the SDI. These include the ABM Treaty, restrictive American contracting regulations, and the unwillingness of the U.S. Congress to fund Allied work in areas with potential commercial applications.

The participation of non-U.S. firms in the SDI program has gone through a complex evolution, with three distinct periods. In the first phase, the Reagan Administration tried to sell the Allies on the vision of a perfect defense. When this failed, the second phase attempted to buy support from Allied contractors. But the lack of a significant industrial base in Europe effectively precluded significant alliance participation in the SDI. Thus the third phase of

TOTAL FOREIGN PARTICIPATION IN THE SDI

COMPANY	TOTAL CONTRACTS	WORK PERFORMED LOCALLY
Germany	$ 47,000,000	$47,000,000
United Kingdom	$ 34,000,000	$34,000,000
Israel	$ 6,200,000	$ 6,200,000
France	$ 5,200,000	$ 5,200,000
Italy	$ 1,500,000	$ 3,200,000
Canada	$ 1,800,000	$ 1,200,000
Netherlands	$ 10,000,000	$ 200,000
Belgium	$ 200,000	$ 0
Ireland	$ 85,000	$ 85,000
Switzerland	$ 2,700,000	$ 0
TOTAL	$109,000,000	$97,000,000

Following two years of negotiations, allied contracts account for less than one percent of the SDI program. The first column includes contracts with companies with headquarters in the indicated country that may have operations in more than one country. The second column reflects work actually conducted in the indicated country.

alliance management has focused on anti-tactical ballistic missile defense, and work on these technologies is perhaps within the reach of Allied companies.

CONTRACTORS AND THE PUSH FOR EARLY DEPLOYMENT

The emergence of the debate over early deployment of the SDI is in part a response to the coalition management problems of generating contractor support for the program. Aerospace contractors do not expect to earn significant profits from research. Rather, they make their money in procurement of operational systems. The larger companies, in contrast to the smaller specialty companies in Huntsville or Arlington, have mainly been interested in the SDI program because of the prospect for eventual deployment.

The significance of the cost estimates for deploying the SDI is paradoxical. The observation that SDI might cost a trillion dollars looks very different depending on whether the trillion dollars is coming from you the taxpayer, or going to you the contractor. But contractors will only make the trillion dollars when SDI actually goes into deployment.

Starting in August of 1986, Lockheed began urging early deployment of some SDI components. And it's no accident that Lockheed was the first contractor to come out in favor of early deployment, since the company is the top SDI contractor and of the major contractors it receives the largest percentage of their revenue stream from SDI.

It is increasingly clear which contractors would benefit from early deployment. Lockheed builds the Exo-atmospheric Reentry Vehicle Interception System (ERIS), and is one of two companies in the Booster Surveillance and Tracking System (BSTS) competition. McDonnell-Douglas is the prime contractor for the High Endo-atmospheric Defense Interceptor (HEDI). Boeing is responsible for the Airborne Optical System, which is one of the primary early deployment sensors. General Motors' Hughes is the subcontractor working on the infrared sensors for all three of these systems. LTV is developing the Extended Range Homing Intercept Technology (ER-HIT) missile that would provide the last ditch line of defense for military facilities. Grumman is also a prime contractor for the BSTS. Raytheon is the prime contractor for the Terminal Imaging Radar, a sensor for ground-based interceptors. Each of these contracts are currently worth several hundred million dollars, but would be worth billions of dollars if the program moves into procurement.

One major contract still remains to be awarded, the Space-based Kinetic Kill Vehicle. This contract will be awarded in mid-1987.

Thus there is already a very broad coalition of aerospace companies which would have an interest in pressing for early deployment of SDI.

A STRATEGY FOR REDUCING THE SDI PROGRAM

The pattern of contracts suggests a straight-forward means of winding down the SDI, should the next administration choose to do so. Because many of the major SDI contracts are slated to expire after the next election. Over $1 billion worth of contracts, including the Booster Surveillance and Tracking System and the Airborne Optical Adjunct, will expire in 1990, and almost $2 billion will expire in 1991, including the HEDI and ERIS ground-based rocket interceptors. Under the current program plan, these contracts would be followed by larger development and procurement work.

Rather than requiring an affirmative action on the part of the next Administration, scaling back the SDI simply requires inaction on the part of the next administration. This would take the form of a decision not to proceed with the next phase of the competition.

There is a basic dichotomy in the SDI budget between research and development. There is perhaps $1 billion to $2 billion in the budget that goes for research. This activity is compliant with the ABM Treaty and would probably be conducted under any administration.

The part of the program that has been the source of the policy controversy over SDI is the field testing and development, which accounts for the rest of the budget.

This bifurcation in the program is readily apparent within the budget, and the dichotomy is also apparent at the contracting level. The basic division among the contractors is that the big aerospace companies are working on development and the smaller companies and the universities are working on research.

To the extent that the small companies and universities have created that broad geographical constituency for the SDI program, eliminating the pernicious part of the program will not offend that constituency.—John E. Pike ■

ENDING NUCLEAR TESTS: A TECHNICAL BASIS

The attached letter of February 3 was solicited by FAS for release in connection with a demonstration in Nevada, led by Carl Sagan, on the occasion of the U.S. renewing of its testing that ended the Soviet moratorium. The authors are, very senior experts. Hans Bethe, Nobel Prize laureate in physics, was the head of the Theoretical Division at Los Alamos during World War II. Carson Mark was his successor, and Richard Garwin has been consulting for Los Alamos on related subjects since 1950, and is renowned for his analyses of strategic issues.

In view of claims and counterclaims about the need for the United States to continue nuclear explosion testing, we want to summarize our views:

1. Nuclear explosion testing is not needed to ensure the reliability of weapons in stockpile which have been tested in their production version. It is not needed to detect degradation nor to remedy degradation. Non-nuclear testing is used for detection, and remanufacture to original specifications is an adequate remedy. In testimony April 8, 1986 to the Senate Armed Services Committee, the Director of the Livermore Laboratory agreed that, "Given enough time and money, replication could be achieved.'

2. The U.S. could not have confidence in the performance of nuclear weapons put into stockpile without testing, and we recognize that a comprehensive ban on nuclear tests, or one which bans all detectable tests, would prevent the acquisition of warheads of new nuclear design. Nevertheless, the Midgetman missile could perfectly well use the warhead which has been designed and tested for the MX missile—the W87. It might need shock-alleviation mounting for a mobile Midgetman subject to nuclear attack, but the demand for a new warhead is analogous to requiring that one redesign an astronaut before launching him or her into space. Careful attention to packaging will do.

3. Although modern security devices for nuclear weapons could be so closely integrated with the nuclear components that these particular systems could not be added to existing weapons, comparable function can be achieved by a system designed to be suitable for retrofit to existing weapons without testing. Insensitive high explosive (IHE) cannot be incorporated into existing weapons which lack them without nuclear testing, but existing weapons are already proof against accidental nuclear explosion, and we believe the incorporation of IHE is not of highest importance. Concern on this point is primarily a matter of peacetime comfort than of wartime need. Since in the absence of any limit on numbers of tests only some 40% of U.S. weapons now have IHE, we must not be alone in this view.

4. As for verifiability of a CTBT, some 25 unmanned seismic detection systems on the territory of the Soviet Union are probably adequate to provide high confidence of detection, location, and identification of nuclear explosions of yield of one kiloton or more. But a treaty should provide for the installation of as many as are required in areas of poor seismic propagation, even 100 stations if necessary. No seismic system can detect the stations if necessary. No seismic system can detect the smallest "nuclear explosion." We could readily design a reliable nuclear explosive of yield one-thousandth of a kiloton, simply to demonstrate that it could not be detected by a particular seismic system. So a *comprehensive* test ban is inherently not verifiable by seismic means. Yet some of the important benefits of a test ban would be lost if low-yield underground nuclear testing were permitted to the nuclear nations. The solution might be to have an initial ban on all nuclear explosions above 1 kiloton yield, a small initial quota of underground nuclear explosions below that yield, and a requirement to pre-announce all nuclear explosions of *any* yield above one ton, and to provide measurement of their yield by an approved method. The detection of violations would be aided by non-seismic and non-cooperative means, and potential violations of marginal detectability would not represent militarily important advances.

5. The benefits to the U.S. of a test ban arise from denying the *Soviet Union* the progress in nuclear weaponry which can be made only by nuclear explosive testing. For instance, the Secretary of Energy expresses concern about possible Soviet progress on the nuclear-weapon-powered X-ray laser. That would cease under an appropriate test ban. Even if the U.S. were first to achieve a new military capability by nuclear testing, our security might be impaired, on balance, if the Soviets then acquired the same capability; MIRV is generally regarded as a case in point. We believe that an important benefit of a test ban would derive from the much firmer base it would provide for our leadership of a world-wide effort to eliminate the spread of nuclear weapons to additional hands—an effort in which technical measures reinforced by strict sanctions would serve U.S. security interests.

6. It would be imprudent to believe that all parties would permanently abide by a test ban. So it would be necessary for the U.S. to maintain facilities, skills, and a program of research and design to ensure that we recognize the potential advances which might be achieved and are in a position to pursue them if the Soviet Union should renounce the test ban. Readiness to test need not be on a scale of days or weeks, since a year or more is required for a new weapon concept to affect military capability. Our skills should be honed by analysis, simulation, competitive design teams, and by the confrontation of simulation results with explosive-driven assemblies without nuclear yield.

7. We believe that it is in the U.S. interest to see an early end to the testing of nuclear weapons.

Richard L. Garwin (IBM Thomas J. Watson Research Center, and Cornell, Columbia, and Harvard Universities)
Hans A. Bethe (Cornell University)
Carson Mark (retired, Former Head of Theoretical Division, Los Alamos Scientific Laboratory, 1947-1973)

BACKGROUND ON THE CONTRACTOR STUDY

This issue of the Public Interest Report is the first published result of a study on SDI contracting that has been underway at FAS since the fall of 1985. Staff who worked on this study during this period included John Pike, Daniel Lindley, now at Brookings Institute, Erik Pratt and Mark O'Gorman, current staff assistant for space policy. In coming months more detailed analyses that formed the basis for this newsletter will also be released.

There are several reasons FAS conducted this study. The first relates to the question of whether the SDI budget would create an irreversible institutionalization of the SDI program. The contract data base has also been instrumental in our ability to follow developments in the SDI program, since it permits us to track what is actually being implemented. This is particularly important with SDI, because the amount of detailed information that has been released about the SDI program is fairly sparse compared to other programs.

We have compiled a data base that includes information on the 3300 contracts related to the SDI program. We have also tracked the 300 Request for Proposals that are currently active for contracts that will be awarded in the future. The major sources of information include the trade press, requests under the Freedom of Information Act, the daily press releases that the Defense Department announcing the major contracts that have been awarded announced the previous day, as well as the list of contracts published quarterly by the SDI Organization.

LONGSTRETH AND RAM JOIN FAS STAFF

Bonnie J. Ram is the new Bernard Schwartz Fellow in Energy and Environment. Ms. Ram is a geographer and specializes in project design and management. At FAS, she will analyze waste management policies at DOE nuclear materials production sites. Also she is exploring the link between environment and development and militarization in southern Africa.

Prior to joining the FAS staff, Bonnie was a Research Fellow and Project Administrator for the Beijer Institute of the Royal Swedish Academy of Sciences. Based in Zimbabwe for over two years, she coordinated a national energy planning project. Also she has been a consultant to the World Resources Institute and Research Associate at Clark University's Center for Technology, Environment and Development.

Thomas K. Longstreth, formerly Military Legislative Assistant to Senator Edward M. Kennedy, has joined the staff of FAS as a Senior Defense Analyst. At FAS, Mr. Longstreth will monitor American and Soviet strategic modernization programs, ongoing arms control negotiations, and Congressional activities in the defense and arms control areas.

Prior to working for Senator Kennedy, Thomas Longstreth was the Associate Director for Research and Analysis with the Arms Control Association. He has also worked as a research analyst with the Center for Defense Information.

CORRECTION

Carl Sagan was not in Moscow during the period reported on in the last newsletter. Accordingly, the FAS reference to a call by him to the Sakharov residence was an error arising from a different scientist calling with a similar sounding name.

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