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This study investigates and analyzes the factors influencing the recent capital budgeting policies of the U.S. Shipbuilding industry. A description of the decisional elements involved in past capital investment programs of the U.S. Shipyards and the effect these programs have had on shipbuilding capability and capacity have been derived from an analysis of a selected sample of U.S. shipyard data.

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This study not only explains the investment policies of the shipbuilding industry, but also relates these policies to the behavior of the defense industry and the defense industrial base as these terms are usefully defined in the study. Comparisons are made between 1) the defense industry and commercial sector industries and 2) the platform industry per se, i.e., ships, aircraft, missiles, and armored vehicles, and those firms that manufacture mission-related equipment. This study is at once conclusive and exploratory: conclusive in its explanation of the dynamics of the U.S. shipbuilding industry and exploratory in that it points to critical unanswered questions about the overall structure of the U.S. economy in general and the defense industries in particular.

THE CAPITAL BUDGETING POLICIES OF THE U.S. SHIPBUILDING INDUSTRY: AN ANALYSIS OF DEFENSE INDUSTRY BEHAVIOR

OCTOBER 1979

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CHAPTER I
THE SHIPBUILDING INDUSTRY

Summary and Overview

The purpose of this report is to provide an overview of the capital investment policies pursued by the U.S. shipbuilding industry during the 1970's and is driven by a recognized need to better understand the dynamics of a key component of our defense industry.

From an analytical point of view, we have elected to concentrate on the capital budgeting decision since this decision, perhaps more than any other, encapsulates management level assessments of the long-term profit potential of an industry. Monies invested in long-life assets are not easily converted to cash such that any major investment in new plant and equipment represents a significant commitment of funds both to the industry and to a mode of operations.

In theory, the decision to invest in new plant and equipment is based on senior management's ability to forecast future demand and determine the incremental profits that can be earned by either replacing people or old plant and equipment with new.

Practice is, of course, different. No management can predict economic conditions with certainty because of underlying and oftentimes unanticipated social, psychological and political pressures within our economy. Because of this, management has to be acutely aware of these "background noises" and how they may impact on the economy in general and their industry in particular. Very often management must be prepared to make decisions involving substantial sums of money based on no more than a personal evaluation of the meaning and implication of a set of economic, political and psychological data.

The decision is a difficult one even where a firm has a reasonable degree of control over the markets in which it competes. Where it has little or no market control, as in the defense industries, the decision becomes even more complex. The defense contractor must contend not only with Congressionally mandated Department of Defense planning, procurement and contracting procedures but also with such variables as changing definitions of weapons systems. These variables in and of themselves can quickly obsolesce prior investments in plant and equipment. As will be argued later, the defense industries are unique. Because of this, they must approach the capital investment process differently than their commercial counterparts.

This report, then, deals with an analysis of the shipbuilding industry's response to this unique environment. Based on our analysis of this one industry, we believe that it is possible to draw conclusions on the behavior of the U.S. defense industry as we later define it.

In a sense, the U.S. shipbuilding industry is unique not only because of the scope of its involvement in the defense procurement process but also because little attention has been paid to it by either the academic or the financial community. Given the preeminent position that seapower occupies in our strategic thinking, this lack of attention to the industrial base on which this power relies is, at best, perplexing.

From a financial or economic perspective, however, this shortcoming is not unexpected. After all is said and done, the U.S. shipbuilding industry is rather small, virtually profitless, highly cyclical and somwhat backwards technologically. In peacetime its economic value to the United States is minimal; ships can easily be purchased abroad at more favorable prices than can now be obtained in the United States. For this reason, it attracts understandably little attention from the analytical community. It is only in wartime that our strategic dependency on this and other industries becomes evident leading one to at least the tentative conclusion that

there is no logical place in a peacetime, price-oriented free economy for the prototypical defense industry.

However, the fact is that we do need a peacetime defense industry. First, technological growth relies on a continuing development process. Second, there is the very obvious need to maintain a pool of capital and labor capable of supporting a rapid increase in productive capacity should the occasion arrive. For this reason, maintaining a defense industrial base is essential irrespective of its lack of conformity either with generally accepted economic theory or financial practice. The issue then becomes one of finding and developing those industrial base maintenance techniques that do the least amount of violence to our perspectives of a market-oriented free economy.

Because of this, then, there is a need to understand more fully the responsive behavior of the defense industry. If components of our defense industrial base need to be restructured in order to meet specific national goals, we then need to know what incentives will bring about this restructuring.

In this regard, the history of the shipbuilding industry is particularly perplexing in that it invested massive sums of money in new plant and equipment during a period of time when its profitability was deteriorating rapidly.[1] Because of this it may be alleged that the industry responded to a set of false economic signals, or that it is poorly managed and incapable of meeting the managerial challenges that it now faces. At the same time, it can be argued with a great degree of conviction that the industry is the victim of an incoherent national maritime policy that has failed to recognize the vital need to maintain a continuity between peacetime economic desires and wartime strategic needs. Because of the failure to harmonize these two oftentimes conflicting requirements, it is possible that substantial sums of money were invested by the private sector in plant and equipment for which there is little or no foreseeable use in the future. This implies unnecessary and avoidable economic waste.

If this is so, there is a need to refine the policy formulation process at the national level to avoid the potential for misleading other components of our defense industrial base. Even now, it may be alleged that this lack of a national policy has contributed to the failure of many of our major companies to actively pursue defense business despite the fact that these companies are the ones that we may have to rely upon in any future military emergency.

In a sense, then, we are suggesting that the need for this study is dictated not only by the necessity for better intelligence but also for the insights into what can only now be classified as the "economics of the defense industry."

A Brief History of the Shipbuilding Industry

The specific chain of events that gave rise to this study is represented by the figures set forth in Exhibit I. From 1970 through 1976, the shipbuilding industry invested $1.4 billion in new plant and equipment. Equivalent size investments were made in 1977 and 1978, bringing to almost $200,000,000 per year the amount of funds committed to new facilities during the early to mid 1970's. These figures are striking for a number of reasons:

- After 1967, the overall profitability of the industry declined precipitously.

- From 1967 through 1976, the eleven major firms in the industry earned a sparse $37 million on sales of $21.8 billion for a rate of return on sales of two-tenths of one percent.[2] Even more disconcerting analytically is the fact that the greatest portion of the losses that contributed to this poor profit performance were realized in 1968 and 1969 when General Dynamics and Lockheed sustained after-tax losses of $94.6 million and $87.6 million respectively.[3] These losses, as might otherwise be expected, failed to discourage the later investment by the industry of substantial sums of money. As of 1979, there is no foreseeable market demand for the use of a substantial portion of the facilities purchased with these funds.

- Through at least 1967, the industry can be characterized as "financially conservative." Although some $370,000,000 was invested in new plant and equipment for the ten years ending in 1967, internally generated depreciation allowances provided the bulk of the funds. Indeed, the net depreciated value of the fixed assets increased by only $61,900,000 during this time span, or to $135.4 million from $73.5 million.[3] Despite post-tax profits of approximately $154.0

million, the net worth of the industry increased by only $56.0 million, which means that some $100,000,000 was returned to the stockholders as dividends and other cash distributions leaving little for reinvestment in the industry. During this period of time, the industry's use of external debt was extremely limited.[4]

EXHIBIT I
The United States Shipbuilding Industry
(SIC 3731) Capital Expenditures by
Year, 1957 through 1976

Year	Capital Expen. ($ in 000,000)	Capital Expen. (¢/$ of Sales)	Capital Expen. Per Employee
1957	$58.0	3.8¢	$475
1958	38.7	2.4	326
1959	33.7	2.2	291
1960	29.9	1.9	267
1961	31.6	1.9	277
1962	23.0	1.3	205
1963	24.4	1.4	212
1964	32.8	1.7	285
1965	44.6	2.1	343
1966	52.8	2.2	391
1967	70.3	2.7	505
1968	75.9	3.1	535
1969	88.1	3.4	616
1970	144.1	5.3	1088
1971	89.0	2.7	695
1972	142.0	5.1	979
1973	131.0	3.3	862
1974	216.0	4.5	1333
1975	297.9	5.3	1785
1976	354.6	6.0	2132

Source: The Federal Trade Commission

After 1967, the climate within the industry changed radically in that the eleven major firms that account for the bulk of the industry's sales invested an unprecedented $1.4 billion in new plant and equipment. Of this amount, only $530 million was provided by the sale or disposal of assets and depreciation leaving some $800,000,000 to be funded by profits and/or borrowings. Inasmuch as the industry earned less than $50,000,000 from 1967 through 1976, this leaves some $750,000,000 in cash that the industry had to have borrowed either from outside sources or from its conglomerate parents. The basic data from which these conclusions are drawn are set out in detail in the appendix to this chapter.

The figure is staggering in that it suggests that the industry had taken on long-term debt equivalent to some 250 percent of its net worth. Traditionally, this is a prescription for financial disaster. In light of the industry's poor profits one would normally have expected to see major elements of the industry in the bankruptcy courts. That the industry has not been forced to do so is due primarily to the realities of the conglomerate ownership of the industry.

As measured by cash flow, each of the big losers is fortunately owned today by a major conglomerate that can, if only for a limited period of time, sustain the negative cash flows incurred by its shipbuilding subsidiaries. Were shipbuilding a free-standing industry, i.e., independent companies not otherwise connected to or sustained by larger corporate parents, there are only one of two possible outcomes that could have been obtained. First, many of the companies would have simply foregone major investments in new facilities. Second, those who did invest, assuming the money was in fact available from outside sources, would have gone bankrupt. It is more likely that investments in new plant and equipment would have been made only when it was absolutely necessary to do so to fulfill the requirements of a specific shipbuilding contract. Even then, in keeping with earlier patterns of behavior, investments would have been made very selectively: the maintenance of a very basic ship-

building capacity as opposed to investments in technologicaly oriented equipment.

This more conservative policy was apparently pursued by Nassco, American, Alabama, Bath, and Todd, the five firms in the industry that are either independently owned or, as in the case of Bath, now owned by a larger conglomerate.

The more important issue, then, is the obvious fact that the industry most likely would not have survived in its present form without conglomerate ownership. The new yard at Pascagoula would most likely not have been built. It is also doubtful whether the G.D./Quincy yard would have been reopened.

Similarly, we do not believe that an independently owned Newport News could have undertaken the massive investments recently made in its new North Yard. In 1967, as the largest firm in the industry, its net worth was only $85.0 million, a relatively unprepossessing amount of money for a major U.S. corporation. Despite the fact that it was then the most profitable firm in the industry, its post-tax earnings never exceeded $7.0 to $8.0 million per year, or approximately 2.5 percent on sales[5]. As an independent firm, it is unlikely that it would have had either the capital base or the earnings capacity to justify the more than $300,000,000 that its conglomerate parent has since invested in new facilities.

Thus, the conglomerates have reshaped the U.S. shipbuilding industry. Without their participation, the industry's capacity would be substantially less than it is even today.

Further, without their intervention, the industry would most likely have been unable to respond to the Navy's demands for costly and complex combatants.

The issue here is not so much technical as financial: the extremely large capital base needed by an individual company to sus-

tain a sales level of some $750 million to $1.0 billion per year. Of the non-conglomerates, only Sun and Bethlehem have corporate parents rich enough to provide the capital needed to sustain this high a sales volume; Nassco, Todd and Bath do not.

The more critical point now, however, is the fact that the industry has suffered a capital investment induced cash drain these past ten years of at least $700,000,000. Its financial condition, apart from the protection provided by the conglomerate parent, of necessity, has to be tenuous.

And even this staggering figure does not provide recognition for the large losses suffered in 1978 by Litton and G.D./Electric Boat as the result of the claims settlement process. The losses here are estimated to be $200,000,000 and $350,000,000 respectively.[6] If these losses are added to the cash flow deficits noted above, the net cash outflow sustained by the industry through 1978 as a result of both operating losses and investments in new facilities increases to a staggering $1.2 billion.

Based on any reasonable extrapolation of earning capacity plus depreciation funded by on-going ship construction programs, it appears unlikely that the industry's cash position will be restored much before 1985. This judgment is based on an estimate of current depreciation expense within the industry of some $150,000,000 a year, and a predicted level of profits of no more than $50,000,000 a year. Although this level of profits appears to be very low, it is, in fact, a rate of earnings that has not been obtained by the industry since the early 1960's.

Because of this, the industry will not have any substantial funds available much before 1985 to invest in new plant and equipment. Labor savings improvements in the industry will come slowly if at all during the next few years since, in the absence of any specific Navy funding for this purpose, the industry will not have the monies available for funding these improvements.

Adding even further to the industry's cash flow difficulties is the buildup in working capital required to fund an increase in sales from $1.3 billion in 1968 to $4.2 billion in 1977. Because the industry earned virtually no money during this period of time, the estimated $0.5 billion in working capital needed to fund this growth could come only from short- or long-term borrowing and Navy progress payments. Although these monies normally are used to fund self-liquidating working capital items, they are, in fact, invested in non-liquidating assets except as the industry suffers a sharp decline in sales. Apart from the relief provided by progress payments from the Navy, the industry has no doubt exceeded any normal measure of its debt capacity.

Here again, the role of the conglomerate is critical. Were it not for its ability to offset shipbuilding losses and cash flow deficiencies with the profits from non-shipbuilding activities and to pass back to the corporate parent the tax shelter benefits of shipyard depreciation expenses, major segments of the industry would be in a tenuous financial condition. Indeed, one of the unanswered questions now is the eventual impact on Litton and General Dynamics of the cash drains generated by the shipbuilding division. If conventional measures of financial strength are used neither firm is financially strong. In other words, the impact of Litton and GD's shipbuilding losses could well be felt in other segments of the defense acquisition arena and specifically in the aerospace industry where both hold preeminent positions.[7]

Appendix A: The Data Base

Because all but two of the major shipbuilding firms in the United States are subsidiaries of much larger corporations and consolidate their operating results with those of their parents, there is no complete, publicly available source of financial data on the industry. In recognition of this, we asked each of the major shipyards for data which is, for the most part, "company confidential." Each of the yards responded positively to our request subject to our guarantee that its confidentiality would be maintained. This has required that the data set out in this appendix be presented in a truncated format. However, it should be noted that these summary data have been derived from complete data sets in our possession. Each of the exhibits in this section of this report is based on data from the following companies:

- Avondale
- Sun
- American
- Nassco
- Ingalls (Litton)
- Newport News
- G.D./Electric Boat
- G.D./Quincy
- Todd
- Alabama
- Bath

Exhibit II shows the annual pattern of capital expenditures from 1968 thru 1977 for these eleven companies and is sufficiently similar to data set out in Exhibit I to suggest, as is expected, that these eleven companies accounted for the bulk of the industry's investment in new plant and equipment. This is not unexpected, since these firms account for the greater bulk of the industry's sales.

EXHIBIT II

Capital Expenditures Per Year
1968 through 1977 for a Selected Sample
of Major U.S. Shipbuilding Firms

Year	Capital Expenditures (000,000s)
1969	$ 50.2
1970	114.6
1971	94.7
1972	82.0
1973	96.8
1974	239.5
1975	285.0
1976	178.3
1977	88.1
	$1229.2

Source: Company Confidential Data

Exhibit III then shows the impact of these expenditures on the industry. Gross investment in plant and equipment increased from $446.2 million (line #1) in 1968 to $1,675.4 million (line #3) in 1977. This was reduced to the $1,562.2 million (line #5) reported by the industry by the sale or other disposal of $113.2 million in assets (line #4).

During this period, depreciation allowances were $365.7 million (line #6) bringing to $478.9 million (line #8) the internally generated funds used for the purchase of this new capital equipment. This then leaves a balance of $750.3 million (line #9) to be funded by profits and external sources. Since profits were only $45.2 million (line #11 and Exhibit IV) during this time frame, some $705.1 million (line #12) had to have been funded either by a reduction in the cash position of the industry, or by borrowing either from the shipbuilding subsidiary's parent or external sources, or a combination of these three. Irrespective of the source of funds, however, the industry, as noted earlier in this report, will have sustained

$700,000,000 in cash outflows for the nine-year period ending in 1977. This is apart from the losses sustained by Litton and General Dynamics in 1978 as the result of the settlement of various ship-building claims against the Navy.

EXHIBIT III
Selected Financial Characteristics
For a Selected Sample of U.S. Shipyards
1969-1977 (Dollars in Millions)

1.	Plant and Equipment (Gross) 1968	$ 446.2
2.	Capital Expenditures 1969-1977	1229.2
3.	Gross Investment 1977	1675.4
4.	Sale and Disposal of Assets 1969-1977	-113.2
5.	Plant and Equipment (Gross) 1977	$1562.2
6.	Depreciation Expense 1969-1977	$ 365.7
7.	Sale or Disposal of Assets	113.2
8.	Total Internal Source	$ 478.9
9.	Total External Source	750.3
10.	Capital Expenditures 1969-1977	$1229.2
11.	Total External Sources	$ 750.3
12.	Industry Profits 1969-1979	45.2[1]
13.	Total Funds Provided by Reductions In Cash Position and/or Borrowings	$ 705.1

Source: Company Confidential Data
[1] See Exhibit IV, Footnote 1, p. 14

The $705.1 million cash drain shown in Exhibit III is not, of course, spread evenly throughout the industry. Some of the firms show, as might be expected, a cash surplus, others a deficit. Exhibit V presents data on these companies. In order to maintain confidentiality, the ordering of companies in Exhibit V is different

than that in Exhibit IV. Further it should be noted that there is an analytical discontinuity in Exhibit V in that the profits used in calculating the need for external funding are those earned in the ten-year period beginning in 1967 and ending in 1976, whereas the capital expenditure data is for the nine-year period from 1969 through 1977.

EXHIBIT IV

Shipbuilding Industry Profits
1967 through 1976

Company	Profit (Loss) in $000,000s
1	$50.1
2	35.4
3	31.4
4	23.1
5	(76.1)
6	(23.6)
7	19.0
8	94.7
9	13.7
10	(84.5)
	$45.2[1]

Source: The Profitability of the U.S. Shipbuilding Industry, Edward M. Kaitz, 1978.

[1] Due to variations in sampling data, this figure is smaller than the actual caclulated sum of this column. A complete set of data was available from those shipyards noted earlier in this report; however, a profit (loss) figure only was available from another major shipbuilder. This figure is included here in order to give as accurate a picture of the shipbuilding industry as possible.

Because the industry's capital expenditures in 1967 were approximately the same as they were in 1968, and because the industry's 1977 profits were not substantial, the analytical discontinuity noted above is not significant enough to alter the conclusions that can be drawn from an analysis of Exhibit V.

EXHIBIT V

Cash Flow, Selected Shipbuilding Firms, Based on Net Need for External Sources to Fund Capital Expenditures, 1969-1977, and Profits, 1967-1976 (Dollars in Millions)

Company	Cash Flow
1	$ 15.0
2	(29.7)
3	(2.0)
4	14.2
5	(34.3)
6	5.4
7	(250.4)
8	(181.3)
9	10.9
10	(214.7)
	$(666.9)

Source: Company Confidential Data and The Profitability of the U.S. Shipbuilding Industry, 1947-1976, Edward M. Kaitz, 1978.

What this exhibit shows is that there are only four firms in the industry, apart from the requirement for increased investments in accounts receivables and inventory, that could have improved their cash positions from 1966 through 1976/7. The remaining firms in the industry suffered major cash outflows, i.e., an excess of cash out over cash in. As noted earlier, these cash outflows are understated because this analysis does not include the additional investments in inventory and receivables required by increased sales volumes. Sales data for the industry is presented in Exhibit VI. Based on this and other data available to us, we have estimated working capital generated cash requirements at a minimum of $500,000,000 for the 10 major companies comprising our data. However, we have made no attempt to verify this figure or attribute portions of it to specific companies. Our central concern in this analysis has been with the massive cash outflows suffered by the industry since 1970 . . . an estimated $1.2

billion to $1.5 billion . . . and the minimal likelihood that the industry has of restoring its cash position much before 1985. That is, in our opinion, the key economic reality that the industry and its customers will have to "live with" for at least the next ten years.

EXHIBIT VI

Sales For Selected Time Periods
of a Selected Sample of Major
U.S. Shipbuilding Firms
(Dollars in Millions)

Shipyard	1977	1976	Ten Year Average 1968-1977
Avondale	$ 427	$ 361	$288
Nassco	247	223	145
Sun	65	103	93
American	152	133	89
Ingalls	963	610	415
Todd	213	245	194
Alabama	40 est.	32	37
Newport News	786	688	467
Bath	167	114	87
General Dynamics	1149	1044	497
Average	$ 4210	$ 3553	$2312

Source: The Profitability of the U.S. Shipbuilding Industry, 1947-1976, Edward M. Kaitz, 1978.

CHAPTER II

CORPORATE STRATEGY

Introduction

From the corporate point of view, there is unfortunately no one simple description of the character of the shipbuilding industry.

Ownershipwise, the industry has one joint venture,[1] a number of conglomerate-owned shipbuilding subsidiaries,[2] two shipbuildng divisions of non-conglomerate major corporations[3] and three independently-owned yards.[4] Even within the conglomerate group, there are subtle differences.

Based on dollar volume, some of the yards are "small" businesses, others are medium-sized businesses, and at least three may now be categorized as large-scale businesses.[5]

Marketwise, some are basically, if not solely, in the commercial market. Others are primarily in the defense market. And some manage to remain in both markets although the relative emphasis between the two sectors varies over time.

Last, with two possible exceptions, all of the yards do some new construction, overhaul and conversion work.

Because of this, it is virtually impossible to treat the industry as if it were homogenous. Each of the individual firms within the industry has pursued a business policy which is unique to them although there are striking similarities between some pairs of companies, for example, Todd and Bath.

However, a number of useful generalizations can be made about the industry:

1. Through at least 1970, this industry was two-tiered, consisting of one group of companies that was routinely profitable, and another group whose earnings were extremely volatile. The aerospace conglomerates, Lockheed, General Dynamics and Litton, fall into this latter category.

2. Through at least 1970, sales volatility and poor profit performance appear to have been related. Since 1970, however, the industry has become more stable and, in fact, somewhat more profitable than it was, say, from 1967 to 1970. Unfortunately, as an industry it has not yet recovered from the losses sustained in the late 1960's. Nor do we know how key elements of the industry will respond to the losses they suffered in 1978.

Perhaps more important to our current analysis, however, is the fact, as noted earlier, that prior to 1970 the industry made no significant investments in new plant and equipment. Based on our analysis we believe that it can be assumed that the industry was gradually minimizing its investments in shipbuilding by reinvesting only those sums of money needed to maintain its basic ability to build ships. Further, relatively substantial cash distributions were made to stockholders. This would suggest that management was neither looking to expand their base of operations nor otherwise diversify into other industries. This is not to suggest that they should have sought out these investment possibilities but rather to underscore the historically conservative bent of the industry through the latter half of the 1960's. In light of the relative lack of demand for ships, this conservatism made profound sense. Clearly the industry could not then hope to become internationally competitive. Domestically, there was then, as there is now, little that could be done by them to stimulate the demand for U.S.-built ships. Indeed, government tax policy appears to have been designed in the early 1960's to discourage any sharp increase in this demand.[6]

After 1966, however, the prospective environment for the industry changed. The Navy entered into a public debate on the need for the fast deployment logistics ship (FDL) and almost simultaneously signaled the potential for a number of major shipbuilding programs, e.g., the thirty-ship DD 963 program, and the five-ship LHA program. Shortly after this, the Department of Commerce's MarAd 70 program calling for the construction of 300 commercial vessels in ten years was enacted by Congress. The industry was looking at a potential boom in shipbuilding.

Collaterally, two significant changes were being imposed on the industry. The first of these was the demand for extremely large ships. The second of these was the DOD's adoption of the Total Package Procurement concept (TPP).

In and of itself, the demand for very large ships (VLCC) hastened the obsolescense of otherwise outmoded facilities. The yards simply had to have facilities capable of assembling the large ships being demanded by the market or lose the business entirely. Avondale and Bethlehem's relatively heavy investments in new facilities from 1967 through 1971 can be seen as an immediate response to this problem. Other shipyards such as Sun and Nassco responded somewhat later to this need by developing the relatively basic, albeit expensive facilities needed for the assembly and construction of extremely large ships. With the possible exception of Sun, however, each of the yards built the facilities only in response to orders actually on hand.

The impact of the Total Package Procurement (TPP) concept is somewhat more difficult to measure. Although the procedure was used only once in the shipbuilding industry, the specific contractual procedure having since been discredited, the fact remains that the use of the concept was derived from a pervasively changed view of the scope and content of the weaponry then being developed by the three military departments. In response to various technological pushes, it became progressively more evident that the military departments

were rarely buying weapons per se, but rather a "weapon system" comprised of a basic platform plus various forms of ordnance, electronic systems, command and control devices for placing in or on the platform.

In recognition of the industrial complexities created by this trend, the DOD sought to shift the major management responsibility required by this process onto the defense contractor by requiring the contractor to take all of the intricate steps necessary to design and produce a complete system. Hence the Total Package Procurement concept.

The experiment failed for various and sundry reasons but mostly, based on the written history, because the concept required of the contractor a design, development and production capability possessed then by few firms in the United States.

Historically, the failure of the contracting system itself may be nowhere near as important as the fact that it brought to the fore the subtle shift in defense thinking that had begun in the United States in the 1960's; i.e., the deemphasis of concern with a weapon as such and the more generalized concept of a "weapons system"--a highly integrated unit of equipment that is based on doctrinal considerations and, in turn, is an integral subsystem of an even larger system.[7]

For the shipbuilding industry this meant that they potentially had to be something more than shipbuilders were they to compete in this new environment. The DD 963 contract, for example, illustrated the need for the less technically sophisticated shipbuilder to team with a more technologically-oriented company which, because of its more highly visible technologic capability, would most likely become the driving force in the teaming arrangement. The platform builder, in this instance the shipyard, would become, in fact if not in contract, the junior member of the team. The shipyards' technical assembly requirements would ultimately be driven more by the require-

ments of the high-technology producer of mission-related equipment than by his own needs. From a business point of view, this would eventually result in a further weakening of the market position of the shipbuilder vis-a-vis the Navy, or, in other words, a lessening of his ability to control his own business as he was gradually forced to assume the position not of a prime contractor but as first-tier subcontractor to a potentially more viable firm technologically and marketwise. In an environment such as this, heavy investments in fixed capital do not make profound sense. The more logical approach is to invest money in capital equipment only in response to the needs established by a contract firmly in hand or to seek to diversify more heavily into commercially-oriented markets. This is how we now interpret the data on the industry presented in Chapter I.

As is obvious, there is no simple explanation for the industry's behavior these past ten years. Each of the firms no doubt responded in a manner unique to their circumstances. However, for other than Newport News and possibly Sun, it is reasonably evident that none of the firms committed substantial monies to the industry in the absence of firm contracts. It is also evident that the bulk of the funds was spent in anticipation of a large commercial demand for U.S.-built ships.

In this regard, it can, of course, be alleged that the industry was at least the partial victim of a confused national maritime policy. If this is so, then there may be important lessons to be learned from the industry about the impact of government policy on industry behavior. But this provides only a partial explanation of the dilemmas facing the industry. Perhaps even more important than maritime policy is the technological thrust embodied in new weapons systems. Based on our analysis, we believe that there are subtle economic and technological changes underway that will continue to undermine the economic viability of not only the U.S. shipbuilding industry but also, in the longer run, of heavy segments of the U.S. airframe industry. Based on the evidence, both industries have been responding intuitively to these changes but have not, as yet, brought

these concerns to the surface for public debate. Some of these issues, along with the related data, are discussed in subsequent chapters of this report.

Industry Capacity

In order to assess the impact on the industry of the heavier-than-normal investments made in capital equipment, we attempted to make an estimate of the peacetime capacity of the U.S. shipbuilding industry. It is surprisingly limited. At best, on a normal, one-shift basis the industry, as defined in Table 1, can turn out 35 or 36 ships per year. This output could be increased, but not appreciably so in the short term, by moving to longer work weeks or second and third shifts.

TABLE 1
ANNUAL PEACETIME SHIPBUILDING CAPACITY

Avondale	3 Surface Ships
Bath	5 Surface Ships
Todd (Seattle & L.A.)	6 Surface Ships
Electric Boat	6 Submarines
Newport News	2 Submarines
	4 Surface Ships
Nassco	2 Surface Ships
American	2 Surface Ships
Bethlehem	2 Surface Ships
Sun	1 Surface Ship
Lockheed	2 Surface Ships
Quincy	2 Surface Ships
TOTAL	37 Ships

In light of the lack for demand for vessels, the U.S. shipbuilding industry has excess capacity. But this is for a peacetime scenario only. Were it necessary to rebuild the Navy or the Merchant Marine, limits on the industry's capacity would soon be met. In some instances, the limit would be related to facilities. In other

instances, the limiting factor would be the availability of a highly-skilled work force. As of the moment, four of the six shipyards upon which the Navy relies most heavily are located in areas with populations too small, in our opinion, to support any massive wartime buildup in shipbuilding output; i.e., Bath, Maine; Pascagoula, Mississippi; Newport News, Virginia; and Groton, Connecticut. The Navy now has no large, active shipbuilders in major urban areas with substantial pools of labor that would be quickly available in the event of a military emergency.

Further, based on a recent study, it would appear that most American shipyards do not have either the technologically-oriented facilities or the physical space needed to maintain a sharp increase in output. Of these two factors, there is a sense that working space may be even more important to shipyard efficiency than capital equipment. This particular issue is beyond the scope of this study. However, one of the more important but as yet unanswered questions about the production function within the shipbuilding industry is the relative importance of capital equipment other than space and the ultimate trade-off between capital and labor.[8] Although conventional wisdom would opt for capital intensity, there is now no clear-cut relationship in the industry as it is now organized between capital intensity and efficiency. The relative positions of Todd Shipyards and Bath Ironworks point out a potentially major discontinuity here.

Neither of these firms has invested substantial sums of money in new plant and equipment these past ten years in contemplation of the serial production of the FFG-7 class ship in which they are now involved. The main asset "controlled" by these two critically important firms appears to be a properly motivated labor force aided and abetted by moderate and strikingly conventional investments in plant and equipment and operating procedures. Despite this lack of investment, both yards are apparently able to produce the reasonably complex FFG-7 class frigate and at a cost which the Navy believes reflects an efficient use of resources.

However, since both yards are outstanding for their lack of investment in capital equipment, it is possible that the Navy has paid inadequate attention to the "special case" represented by these two yards. Could the cost of this very vital ship have been further reduced by astute but selective investments in labor-saving equipment? We have no answers here!

Indeed, one of the most important unanswered questions in the industry is whether or not the lack of investment in the 1960's is indeed one of the root causes of the rapid runup in the cost of shipbuilding in the United States or whether it is due to other less evident causes such as labor-force distribution and "choke-point" prices for vital materials.[9] That the smaller, more conservative shipyards in the United States have in relative terms both survived and prospered is an extremely important fact which needs further investigation.

That the big losers are aerospace companies is equally significant. On one hand, it suggests that the managerial skills in use in the aerospace industry are not transferable to shipbuilding. Conversely, it may also suggest that organizational changes are potentially overdue in that segment of the shipbuilding industry that concentrates on the assembly and construction of combatants.

Prior research has hinted at the possibility that "small is beautiful" in shipyards; that 7,000 to 10,000 production-line workers may be the maximum that can be brought together in one area and properly coordinated and managed.

Prior research has also hinted at the possibility that aerospace production and systems integration practices are less than efficient where concurrency in ultimate design and production is apparently essential.

Last, insufficient attention appears to have been paid to the differences between the construction and assembly procedures in use

in the typical shipyard and the production-line techniques employed in the aircraft industry. A ship ultimately is infinitely more complex than an aircraft if only by virtue of the time that it must stay on station for weeks at a time. The life support facilities, for example, that have to be provided and maintained for the crews, introduce an element into the shipbuilding process that is entirely lacking in aircraft design and production. Conversely, the weapon systems in a modern ship are as complex as that of any aircraft which suggests the need for marrying in the shipyard the rather basic construction techniques needed to provide plumbing, electrical and other life-support facilities for the crew and the high technology associated with mission-related equipment such as computers and sonar domes.

Some Notes on the Future

It seems evident now that those yards without the resources to respond aggressively to the business potential suggested by the FDS, DD 963, LHA and MarAd 70 programs have been, in the final analysis, the most fortunate business-wise. Because they did not have the financial resources to respond to these programs, they remained with the more secure but less glamorous side the shipbuilding industry. Thus, the yards that survive the 1980's may be those which, however economically efficient, are the least modern and technologically-oriented as these terms are now used.

In response to the substantial losses that they have been forced to absorb, the more technologically-oriented yards such as Litton and General Dynamics will, no doubt, limit sharply their future reinvestments in the industry and, absent any significant pressure to the contrary, allow their plant and equipment to age and once again become obsolescent. Newport News may similarly be tempted to do the same. Indeed, Newport News is the only shipyard heavily involved in Navy work that is owned by a corporate parent rich enough to allow for the precipitate closing down and mothballing of its facilities if it projects little likelihood of recovering its prior facilities investments within a three- to five-year period of time. Unlike either Litton, General Dynamics or Lockheed, Tenneco is not heavily dependent on DOD acquisition policies. For this reason, it cannot be pressured by the Department of Defense and is able to pursue a reasonably independent course of action. The same is not true for the three other yards.

Although most large firms do not like to forego sales or otherwise close down facilities, some of the conglomerate-owned shipyards may be encouraged to do so because of their ability to pass depreciation tax shelters back to their corporate parent and, in so doing, recover a major portion of their prior investments at substantially less risk to them than that posed by continuing operations. For

firms such as Newport News, Sun and Bethlehem, the more relevant criterion for the future of their shipbuilding subsidiaries is an analysis of the out-of-pocket costs required by a shipbuilding subsidiary. If those out-of-pocket costs entail any substantial degree of business risk, the more appropriate decision would be to close the shipyard and use the tax shelters provided by shipyard depreciation allowances to diversify into other, more profitable ventures.

In addition, during periods of tight money, any financial analysis must include an extremely hard look at the debt capacity used to maintain the shipbuilding subsidiary and the opportunity cost to the parent of liquidating monies invested in shipbuilding inventories and receivables. These monies may be used more profitably elsewhere in the corporation. In this regard, it should be remembered that the net cash deficit sustained by the industry since 1970 has been some $1.2 billion. If key elements of the industry became convinced that they can never recover these funds, they will have no choice but to divest themselves as quickly as possible of their shipbuilding interests.[10]

That is, at best, a set of circumstances which is unique for an industry whose capabilities are so relevant to any statement of national interests.

Obviously, the industry will not close down overnight. The aerospace firms clearly cannot take on the short-term political risk of such an action because of their ultimate dependency on the Department of Defense. Because of this they may be forced into a long-term divestiture program, i.e., the type of planned obsolescence that made the old, family-owned shipbuilding industry a target of the conglomerates in the 1960's.

Thus, it may be the smaller firms only that remain in the shipbuilding industry. Since they cannot pass depreciation-based tax shelters back to their conglomerate owners, and since they apparently have no external investment possibilities, they have no choice but to

remain in the shipbuilding industry. By the mid 1980's, the industry could once again be organized as it was in the late 1950's and early 1960's: a collection of relatively small, labor-intensive firms. We believe that this last point needs to be considered when formulating maritime policy for the United States.

CHAPTER III
THE DEFENSE INDUSTRIAL BASE

Introduction

It became evident during the initial stages of this study that a free-standing analysis of the capital investment policies of the shipbuilding industry would be of minimal value unless this industry's behavior was not only related to specific driving forces within our economy, but also examined within the larger context of the so-called "defense industrial base," i.e., that group of companies upon which the Department of Defense relies for the design, development and ultimate acquisition of military equipment. However, the use of the term "defense industrial base" poses a problem since no precise definition of that term exists despite its generalized use in the military community.

About the best that can be said in defining the term is that any industry or company which provides or is able to provide military-oriented goods and services to the Department of Defensed can be regarded as a constituent member of the base. At the extreme, this broad definition includes virtually the entire industrial sector of the United States, as well as a significant portion of the service sector. The governing factor here is the scale and intensity of a wartime mobilization effort; in peacetime, however, the size and constitution of the base is more clearly constrained.

In our opinion, a rigorous analysis of the components of the defense industrial base leads quickly to the conclusion that it is two-tiered: that it consists of one group of firms correctly categorized as being in the "defense industry" and another group of firms which, although primarily oriented toward the commercial market, nonetheless participate to some extent in the defense acquisition process. Based on our analysis, we believe that these two groups can be specifically identified as such inasmuch as they display different

economic characteristics. Furthermore, we believe that the "defense industry" segment of the "defense industrial base" behaves in ways which cannot be fully or appropriately explained by conventional economic theory. Acquisition policy, however, is formulated by the government on the assumption that it does. As will be discussed later, we believe that this assumption has led to acquisition strategies, policies, and practices which are potentially inconsistent with critically important national goals and interests.[1]

It should be noted here that corporate size alone is not a distinguishable factor since both groups of firms are made up of a vast number of business entities which vary in size and strength. Even a small company can have a significant lock on a specific military or industrial market, and, in military terms, control a vital "choke point." In this regard, the small, commercially oriented firm which participates, from time to time, in defense procurement, can be more crucial to the economics of the acquisition process than is otherwise realized. For example, if the firm is reluctant to meet the many contractual requirements involved in providing goods or services to the Department of Defense, it may insist upon a price or delivery time premium as compensation for the costs of compliance. This is especially so where a firm has a monopoly on an extremely critical component because the market is otherwise too small to induce the entry of an additional number of firms.

In order to distinguish between the defense industry per se and the more loosely defined "defense industrial base," we have elected to define the defense industry as consisting of those firms whose:

1. Ultimate sales volume and profitability are critically dependent on defense acquisition programs, i.e., defense programs generate at least 30% to 40% of their annual sales volume.

2. Major product lines are basically military in design and application.

3. Major marketing effort is DOD-related both in peace and in wartime.

The U.S. shipbuilding, aircraft and missile industries as well as a large portion of their supplier and subcontractor bases fall into the defense-industry category. One would also normally expect to find the ordnance and armored vehicle industries in this category; however, in practice, the distinction is blurred in the United States because most armored vehicles are produced by firms whose main business orientation is toward the civilian market.[2] With the exception of the GOCO plant, the same is true of the ordnance and munitions industry. This distinction will become important later when the financial structure and strength of the individual firm and industry is factored into an analysis of their business policies and practices. The electronics industry has been excluded from the defense industry category because we as yet have been unable to identify any firms which meet the three definitional constraints noted above.

In apposition to this group of highly specialized firms are those firms which participate in specific defense acquisition programs despite the fact that their ultimate sales volume and profitability is only minimally dependent on the defense acquisition process. Here, there are two subgroups: 1) those firms which provide the DOD with a product that is basically military in design and application, and 2) those firms which provide the DOD with a product that is either the same as, or a direct analog of, the product that they produce for the civilian market. It is this larger group of firms, irrespective of their product line, that we have classified as being members of the defense industrial base. For many of these firms, the DOD is a marketing target of opportunity, i.e., they use the DOD acquisition process either to profitably broaden their sales base or to advance, very often in experimental and proprietary ways, their technological capabilities. Their economic motivation is different than that of the defense industry in that they can elect to be extremely selective in the products that they market to the Department of Defense. Because of this, they are less willing to

live within relevant defense acquisition rules and guidelines. Firms such as IBM, General Motors, General Electric, and Sperry Rand, to name but a few, fall into this category, whereas firms such as Lockheed, Grumman, Todd Shipuilding, General Dynamics and Fairchild clearly fall into the defense industry category.

The defense industry as we have defined it, then, is highly visible and, because of the more prevalent opinions of its organization and efficiency, severely constrained by law and acquisition regulation. The written evidence would suggest that the defense industry is regarded as the cutting edge of our military industrial programs. However, based upon an observation of their slow growth rates, their poor profitability, and the inability to develop and market high-technology products in the more profitable civilian market, we believe that they are not as significant a driving force, technologically or economically, as they are otherwise alleged to be. Rather we believe that the true cutting edge resides in those companies which are primarily, if not overwhelmingly, civilian in orientation, and for whom the Department of Defense is a marketing target of opportunity. We believe that these are the firms that drive the technology which in turn drives the doctrinal and force-structure concepts which heavily shape our military strategy and, in turn, shape the systems acquisition process.

The sections that follow deal, first, with an analysis of those portions of the data on which we relied in formulating this opinion, and, second, with an interpretation of this data. Before that, however, a footnote on profit theory.

A Footnote on Profit Theory

We stated rather categorically earlier in this chapter, that the defense industry does not behave in ways which can be explained by conventional economic theory. Quite simply we were saying that the economics of the defense industry differs from the economics of those industries which cater primarily to the civilian sector. The basis for this statement is two-fold:

1. To date, no major component of the defense industry has been allowed to go out of business despite major reductions in specific sections of the acquisition budget. In other words, the industry has been protected from the Darwinian effects of competition in a price-oriented, free economy by Congressional edict and DOD reimbursement practices. The basis for this protection rests upon two perceptions: The Congressional perception of the need to maintain employment in general and the defense acquisition community's perceived need to maintain "capability." Taken together, these two forces have served to guarantee the perpetuity in the United States of the more visible elements of our defense industries.

2. The defense industries have been willing to pay a quid pro quo for this protection in the form of their profits which, in a free economy, can be regarded as extremely low insofar as they do not provide them with the funds needed to either stimulate technologically-oriented risk-taking or maintain highly automated production facilities. Because of the need to maximize the purchasing power of the taxpayer's dollar, the DOD has gradually evolved a series of acquisition regulations which have placed extreme emphasis on price competition.

In an environment generally characterized by excess capacity, however, there is no guarantee that intense price competition does in fact maximize the purchasing power of the tax dollar. Indeed, we would hazard the guess that constraining the profitability of the defense industry has maximized systems acquisition costs by shifting the focus of technological growth from the more easily controlled defense industry and into segments of the defense industrial base which are less than fully susceptible to government regulations. Our data strongly suggest that by electing to guarantee the perpetuity of the defense industry, the DOD has created an economic climate in which it can no longer rely fully on the defense industry per se for technological innovation. Rather, it would appear that the focus of this responsibility has gradually shifted to the marketing-oriented sector of our economy. This has happened because there is a "chicken and egg" routine with respect to profits, growth and risk taking. In a marketing-oriented free economy, high profits normally go to those large firms which can afford the risk of seeking technological change and innovation, e.g., a Xerox. They search for change and innovation in order to maximize profits while protecting or otherwise guaranteeing their markets. In many instances, they may pioneer a product while simultaneously creating a market for it by defining a new need or by taking advantage of the psychology of the marketplace by catering to a felt need, e.g., the growing emphasis in defense thinking on technologically derived force multipliers.

However, risk-taking is for the profitable only. Indeed, major risk-taking such as that implied by a belief in a technolocially-oriented force multiplier, is generally possible only for the very large and very profitable firm already in this type of market. The marginally profitable firm cannot take the risk; it simply does not have the money. If it takes the risk and loses, it may force bankruptcy or, as in the case of the defense industry, a continued but somewhat conflict-ridden relationship with the defense acquisition community. Thus, because of the profit policies flowing from the DARs and the concomitant belief in price competition as a way of reducing costs, the defense industry rarely has been allowed the

profits or discretionary cash flow that would allow it to create the technological base needed to improve its overall comparative position in the U.S. economy.[3]

Instead, the innovative thrust has come instead from those less visible companies which belong to the amorphously defined defense industrial base. They have had the funds and the freedom to drive the technology base and, in so doing, to garner the profits from this action. At the same time, by pioneering in the design and development of mission-related equipment, e.g., radar; electronic countermeasures; imbedded software; and command, control and communications devices, they have served to create products which drive doctrine and force structure. They do this by being responsive to specific elements of a threat analysis in ways which the basic platforms--the plant, the ship, the armored vehicle--cannot hope to do. These firms then end up by being the leaders in the market for technologically-oriented equipment which, according to military theory, provides the requisite force multiplier which, in turn, allows quality to be substituted for quantity.

This de-emphasis on quantity, however, impacts most heavily the economics of the platform producer. Due to the basic lack of demand for his product and the length of time needed to produce this product, he is least able to attain cost saving economies of scale that might allow for an increase in the demand for platforms. In other words, the platform producer is trapped by the politics of the budgetary process, and the combined interaction among doctrine, force structure and the economics of the production process.

Further, the high-technology firm, unlike the platform producer, does not lose a concomitant share of the market when the demand for the new platform is reduced because (1) it is possible to retrofit mission-oriented equipment into existing platforms and thus increase the size of the market, and (2) the market for this equipment, unlike that for platforms, is subject to short-term obsolescence as the perceived threat changes. In other words, the market for mission-

related equipment is self-perpetuating since one form of technological change and innovation is required to offset another. Because the product itself is more esoteric than the platform, it is not easily subject either to cost comparisons or to direct price-oriented competition. Indeed, for technologically-oriented products, system performance may be more important than price competition. This, in turn, allows for a relaxation of cost control procedures. The higher profits earned on these contracts in turn stimulate the search for new product advancements, i.e., market control. If pursued to the extreme, the dollars devoted to mission-related equipment eventually will limit severely the dollars available for platforms. In economic terms, mission-related equipment has become the basic economic force with which to contend. The number of platforms to be built represents no more, and no less, than the demand derived from the higher order need for mission-related equipment.

From a military point of view, this outcome is not surprising inasmuch as the emphasis on mission-related equipment is consistent with current military practice vis-a-vis a threat analysis. Each "side" seeks to gain a technological edge over its opponents by maximizing the efficiency of a current system or designing a new system to counter a perceived threat. Physical laws, however, dictate a limit to the improvements that can be made in the effectiveness of a platform. Ultimately it is a rather basic piece of equipment. The focal point of systems effectiveness thus shifts away from the platform itself and toward the components built on or into the platform since there are fewer physical constraints on the ultimate performance of this type of equipment. Even so, high technology, high performance equipment has a life of its own in that for full effectiveness, it needs to be linked to other equally sophisticated command, control, and communication and target acquisition systems. Without these coordinating systems, the platform is ineffective. Thus the key focus of a threat analysis is, of necessity, the components and not the platform. As such, the demand for platforms is an economic and military residual.

Although it may be stretching the point somewhat, the major commitment of Navy funds to ship conversion, with its heavy emphasis on the retrofit of mission-oriented equipment, can be regarded as evidence of the impact of this inter-industry form of competition. If this form of competition persists, the defense industry will continue to weaken financially and become no more and no less than the privately financed surrogate for wholly-owned government facilities. This will further alienate this segment of U.S. industry from the private sector.

Whether this is good or bad economics is not the issue in this paper. Our concerns are: (1) the fact that it is indeed happening, and (2) the eventual impact of this on our ability to mobilize in the event of a conventional war of extended duration. As may be inferred from the data to be presented in the section that follows, this reality is now serving to limit our industrial capacity in ways which we do not believe have been thoroughly examined. The military consequences of this reality are, of course, beyond the scope of this paper.

The Data Base: I

As an initial departure point for collecting data to be used in an analysis of the defense industry, we used Exhibit VII, which is a list of the 100 largest defense contractors for FY 1975, based on the value of the contracts that they received for that year. Although we would have preferred to use actual sales data, this was not routinely available, and we therefore elected to use contract value as a surrogate for sales. In order to assure the validity of using this surrogate measure, we reviewed contract data for a number of years to determine the consistency of awards to the larger firms and the general dollar range of these awards.

Having verified the validity of the sample, we then stratified the 100 companies into two groups. The first group is comprised of those firms tentatively defined as the defense industry, because a minimum of 30 percent of their sales was defense-related. The second group is comprised of those companies tentatively defined as part of the defense industrial base because of their lesser dependence on defense-related sales. As shown in Exhibit VIII, the 22 companies classified as defense industry companies garnered $13.0 billion in contracts in 1975, or 47 percent of the total $26.9 billion accounted for by the full list.

We accepted the 30 percent cut-off as valid because virtually all of the companies which meet this criterion are, in fact, platform producers, primarily aircraft and missiles. In addition, three of them, Lockheed, General Dynamics, and Litton are also in the shipbuilding industry. As might be expected, the 10 or 11 platform producers accounted for the greater bulk of the acquisition dollar. Interestingly enough, none of the armored vehicle producers . . . FMC, Chrysler or General Motors . . . are sufficiently dependent on Department of Defense dollars to allow them to be classified as defense industry companies.

EXHIBIT VII
100 LARGEST DEFENSE CONTRACTORS
FY 1975

COMPANY	RANKING[1]	MIL. PRIME CONTRACT AWARDS[2] ($millions)	NET SALES ($millions)	CONTRACTS/ SALES 2 ÷ 3 (%)
LOCKHEED AIRCRAFT	1	2080	3387	61
BOEING	2	1561	3719	42
UNITED TECHNOLOGIES	3	1408	3878	36
MCDONNELL DOUGLAS	4	1398	3256	43
GRUMMAN	5	1343	1329	101
GENERAL DYNAMICS	6	1289	2160	60
GENERAL ELECTRIC	7	1264	13399	9
LITTON INDUSTRIES	8	1038	3433	30
HUGHES AIRCRAFT	9	1026	n.a.	--
ROCKWELL INT'L	10	732	4943	15
RAYTHEON	11	681	2245	30
NORTHROP	12	620	988	63
TEXTRON	13	546	2459	22
AT & T	14	510	28957	2
SPERRY RAND	15	437	3040	14
GEN'L MOTORS	16	390	35725	1
LTV	17	366	4312	9
IBM	18	360	14437	3
EXXON	19	330	47796	1
MARTIN MARIETTA	20	320	1053	30
WESTINGHOUSE	21	315	5863	5
STAN. OIL (CA)	22	301	17524	2
HONEYWELL	23	292	2760	11
TRW	24	286	2586	11
RCA	25	286	4790	6
CHRYSLER	26	283	11598	2
FORD MOTOR CO.	27	260	24009	1
TENNECO	28	242	5630	4
TELEDYNE	29	236	1715	14
IT&T	30	233	11338	2
TEXACO	31	227	24507	1
SINGER	32	214	2061	10
MOBIL OIL	33	204	22135	1
FAIRCHILD	34	192	219	88
AMERADA HESS	35	191	3180	6
BENDIX	36	181	2590	7
GEN'L TIRE & RUBBER	37	170	1752	10
GT&E	38	165	5948	3
R.J. REYNOLDS	39	154	4838	3
FMC	40	145	2292	6
HERCULES	41	144	1413	10
TEXAS INSTRUMENTS	42	144	1367	11
SANTA FE ENG.	43	144	n.a.	--
HARRIS	44	142	479	30
SANDERS ASSOC.	45	141	180	78
	(1)	(2)	(3)	(4)

EXHIBIT VII (cont.)
100 LARGEST DEFENSE CONTRACTORS
FY 1975

COMPANY	RANKING[1]	MIL. PRIME CONTRACT AWARDS[2] ($millions)	NET SALES ($millions)	CONTRACTS/ SALES 2 ÷ 3 (%)
GOODYEAR	46	135	5452	3
TITAN GROUP	47	126	112	113
CONTROL DATA CORP.	48	115	1218	9
AMERICAN MOTORS	49	115	2282	5
STAN. OIL (IND.)	50	112	11034	1
GUAM OIL	51	110	n.a.	--
NORRIS	52	107	387	28
GOULD	53	101	773	13
THIOKOL	54	101	345	29
E-SYSTEMS	55	100	254	39
MIT	56	98	n.a.	--
DUPONT	57	97	7222	1
PANAM	58	96	1606	6
OGDEN	59	94	1250	8
AVCO	60	93	608	15
HARSCO	61	92	522	18
JOHNS HOPKINS U.	62	91	n.a.	--
SIGNAL	63	90	2142	4
PACIFIC RESOURCES	64	90	247	36
PHILLIPS	65	86	1410	6
MOTOROLA	66	86	1312	7
DRAPER LABS	67	85	n.a.	--
AUTOMATION IND.	68	81	246	33
WALTER KIDDE & CO.	69	81	1156	7
VINNELL	70	80	n.a.	--
GULF OIL	71	79	15838	1
THE AEROSPACE CORP.	72	78	96	81
ATLANTIC RICHFIELD	73	73	7747	1
EMERSON ELECTRIC	74	72	1250	6
TOWNE REALTY WOERFUL	75	71	n.a.	--
CHAMBERLAIN MFG.	76	70	118	59
ALGERNON BLAIR	77	70	n.a.	--
SVERDRUP & PARCEL	78	69	n.a.	--
DAY & ZIMMERMAN	79	67	n.a.	--
EASTMAN KODAK	80	63	4959	1
LORAL	81	61	55	111
LEAR SIEGLER	82	56	643	9
SHELL OIL	83	53	8144	1
SYSTEM DEV. CORP.	84	52	109	48
BURROUGHS	85	50	1023	5
MITRE	86	50	n.a.	--
COASTAL STATES GAS	87	49	1874	3
CUTLER-HAMMER	88	49	401	12
NATIONAL PRESTO	89	49	110	45
A-T-O	90	49	480	10
	(1)	(2)	(3)	(4)

EXHIBIT VII (cont.)
100 LARGEST DEFENSE CONTRACTORS
FY 1975

COMPANY	RANKING[1]	MIL. PRIME CONTRACT AWARDS[2] ($millions)	NET SALES ($millions)	CONTRACTS/ SALES 2 ÷ 3 (%)
CATERPILLAR	91	48	4964	1
CONTINENTAL OIL	92	48	7500	1
COMPUTER SCI.CORP.	93	47	177	27
UNIROYAL	94	47	2188	2
GENERAL FOODS	95	46	3675	1
CLABIR	96	46	25	184
XEROX	97	45	4054	1
PROCTOR & GAMBLE	98	45	6082	1
TESORO PETROLEUM	99	45	816	6
ASHLAND OIL	100	44	3882	1
TOTAL		27144		
	(1)	(2)	(3)	(4)

SOURCE: PRICE, WATERHOUSE & CO., 1976 SURVEY OF FINANCIAL AND ACCOUNTING PRACTICES OF GOVERNMENT (COLUMNS 1,2,3).

[1]RANKING BASED ON LARGEST DOLLAR VOLUME OF MILITARY PRIME CONTRACT AWARDS IN FY 1975.

[2]DOLLAR VALUE OF MILITARY PRIME CONTRACT AWARDS IN FY 1975

EXHIBIT VIII
COMPANIES CLASSIFIED AS DEFENSE INDUSTRY COMPANIES

COMPANY	MIL. PRIME CONTRACT AWARDS ($millions)	NET SALES ($millions)	CONTRACTS/ SALES (1 ÷ 2) (%)
LOCKHEED AIRCRAFT	2080	3387	61
BOEING	1561	3719	42
UNITED TECHNOLOGIES	1408	3878	36
MCDONNELL DOUGLAS	1398	3256	43
GRUMMAN	1343	1329	101
GENERAL DYNAMICS	1289	2160	60
LITTON INDUSTRIES	1038	3433	30
RAYTHEON	681	2245	30
NORTHROP	620	988	63
MARTIN MARIETTA	320	1053	30
FAIRCHILD	192	219	88
SANDERS ASSOC.	141	180	78
TITAN GRP.	126	112	113
E-SYSTEMS	100	254	39
PACIFIC RESOURCES	90	247	36
AUTOMATION IND.	81	246	33
AEROSPACE CORP.	78	96	81
CHAMBERLAIN	70	118	59
LORAL	61	55	111
SYS. DEV. CORP.	52	109	48
NATIONAL PRESTO	49	110	45
CLABIR CORP.	46	25	184
HARRIS	142	479	30
TODD SHIPYARD	--	217	--
TOTAL	12824		
	(1)	(2)	(3)

SOURCE: EXHIBIT VII

However, Exhibit VIII contains a number of key anomalies that we recognized and, where possible, corrected for in our subsequent data collection activities.

1. Because virtually every other shipyard in the United States is owned by a conglomerate, we added Todd Shipyards to the list. Todd is the only major shipyard in the United States which can be identified as such and is the only company for which complete financial data are routinely available. Although Todd is not in the 1975 list, we were aware of Todd's heavy involvement after 1975 in the very substantial FFG-7 class procurement that would have otherwise qualified it for inclusion in a list of major defense contractors.

2. We recognized that Exhibit VIII potentially understates the defense-related sales of some of the larger companies. There are a number of large firms which function both as prime contractors and as first-tier subcontractors to other primes such that an analysis of these firms based solely on the sales volume generated by prime contracts may be misleading. Litton falls into this category, as does Hughes Aircraft. We suspect that Rockwell International and two or three other large companies also fall into this special category, but do not believe that a full clarification of this specific issue would add to the analysis that follows.

3. Because the data contained in Exhibit VIII are based on the absolute size of the contracts awarded, it automatically eliminates the massive number of small to medium sized firms which also participate in defense acquisition programs. Based on our definition, a number of these firms should be classified into the defense industry. Although we do not believe that broadening our list to include a sampling of these companies would alter the conclusions drawn in this report, their exclusion from a complete analysis of industrial capacity would be shortsighted. Many of these firms

produce highly specialized "choke point" products or otherwise have technological skills not broadly available, even in an economy as large as our own.

More important than the above is the fact that the vast majority of the firms shown in Exhibit VII cannot be categorized as belonging to the defense industry despite the fact that they are major contributors to our military industrial effort. First and foremost, the final sales volume and profitability of this larger group of companies is only marginally dependent on the defense acquisition process. Despite the massive absolute size of their defense related sales, companies such as IBM, General Motors, Ford and American Telephone and Telegraph could refuse to bid for DOD contracts. For GM, for example, defense contracts in FY 1975 accounted for only slightly more than 1 percent of total sales volume. Although defense sales of $390,000,000 would, by itself, have qualified a company for inclusion in the Fortune 500 list, the loss of this business by GM or an IBM would, in no way, threaten the financial or marketing viability of these firms. For these companies, defense sales are a "sideline," i.e., the direct concern of but a relatively small segment of the corporate structure.[4] This point cannot be overemphasized. Although most businesses are reluctant to reduce sales or lose business, the overwhelming fact is that a majority of the large-scale firms on which the DOD relies is relatively, if not absolutely, invulnerable in peacetime to the trend in defense expenditures. This does mean that they will not compete strenuously for their share of DOD dollars. <u>However, it does mean that they will compete only when they perceive it to be in their best interests.</u> In this regard, it should not be forgotten that many of these large-scale companies could, if they so desired, become major factors in the defense industry. Entry would be relatively simple. Since the book and/or market value of companies such as Todd Shipbuilding, Fairchild Industries, Grumman, Lockheed and others is negligible, takeover could be accomplished by either merger or the open market purchase, at low prices, of the common stock of the targeted defense companies. That the

large commercially-oriented firms do not do this suggests that their underlying rationale for competing for defense contracts is motivated by concerns other than their share of this particular market. The evidence would suggest that one rationale for their competing in this market is to keep abreast of the activities of their major competitors in the civilian sector. A second rationale is the potential involvement in the development of goods or services which may provide an entry point to highly profitable commercial markets. Finally, as noted earlier, a reasonably significant proportion of these companies provide the DOD with virtually the same product that they provide the civilian sector such that their participation in the defense acquisition process is merely an extension of their normal business activities. For them, having a relationship with the DOD simply makes good business sense.

An analysis of Exhibit VII thus shows that most of the prime contractors upon whom the DOD relies are neither economically nor financially dependent upon the defense acquisition process. Although it seems obvious that they would prefer a stable and predictable acquisition cycle, their corporate future is not dependent on it. They could adapt economically and financially to more cyclicality in the acquisition process, i.e., a rapid increase or a rapid decrease in sales designed either to accelerate deliveries to the armed forces of badly needed weapons systems or to reduce unit costs provided that: (1) they were given sufficient information on the extent and duration of the upturn, (2) the timing of the downturn, and (3) a profit base large enough to cushion the otherwise negative effects of the downturn. In other words, many of the firms which are critical to the defense effort need only to be provided with the data that will allow them to assess the true risks involved in defense production. Based on our analysis, we do not believe that this risk is substantially greater than that posed by normal commerical competition.

For the Department of Defense, the more critical risk to be considered in a highly cyclical acquisition policy is its effect on the pool of professional and skilled labor that is essential to defense-

oriented production. If an expandable cadre of highly skilled workers cannot be held together after a downturn, then the issue of business risk noted above is an irrelevant one. The more critical risk is to the buyer. Will the capacity to expand the base in the future exist should the need arise? There is sufficient history here to suggest that the labor base can be expanded and contracted within acceptable bounds if and when the need arises. Furthermore, this history would suggest that "rationalizing" specific elements of the defense industry would not impact as heavily on employment as is otherwise maintained.

Because of an apparent failure to distinguish between the defense industry per se and the more amorphous defense industrial base, we have apparently failed to develop a national strategy for the management of these two segments of our industrial base and their inherent relationship, first, to our military structure and, second, to our foreign policy. This failure to understand industrial behavior may become even more critical as we move toward more intensive industrial collaborations with our highly industrialized European allies.[5]

On inspection, then, it is reasonably evident that the firms shown in Exhibit VII can be classified into three main groups:

1. Defense industry companies.
2. Defense industrial base companies (products which are basically military in design and application).

3. Defense industrial base companies (products which are the same as or a direct analog of products produced for the civilian market).

The reason for this typology is our previously stated belief that each of these groups responds differently to the requirements of the defense acquisition process and, because of this, should be subject to a different set of "ground rules." Before entering into this

discussion, however, we believe that the analytical basis for the classification system should be clarified.

Data Base: II

In order to test the potential usability of the defense/defense industrial base dichotomy outlined above, public source data on the more narrowly defined "defense industry" were gathered and analyzed. The data sources include three major components:

I. Data on approximately 40 industries as categorized by the Standard Industrial Classification (SIC) number. Where available, data on the industry were gathered from 1961-1976. Exhibit IX contains the representative data for the shipbuilding industry, SIC 3731.

II. Financial data on approximately 110 medium- to large-scale corporations for the period 1967-1976 inclusive.

The selection here was not random, but rather began with the selection from Exhibit VII of twelve companies that met our defense industry definition. These companies are:

- Boeing
- Fairchild
- Grumman
- United Technologies
- Raytheon
- Northrop
- Todd Shipbuilding
- Lockheed
- McDonnell-Douglas
- Martin-Marietta
- Litton
- General Dynamics

The rationale for selecting these companies was their known involvement as major suppliers of military equipment and the fact that a signficiant, if not major, proportion of their res-

pective sales revenues is defense related. No attempt was made in this first cut to specify as a criterion a minimum percentage of defense-related sales. These twelve companies were then individually compared to seven other companies. Exhibits X-A through X-K are representative of the data collected for each of the companies included in this sample. Exhibit X-A, for example, relates the sales of Lockheed, the defense industry company, to seven other selected companies. The selection here was purposeful in that companies were selected for comparison on the following bases:

- One company whose sales were comparable in 1967 to Lockheed's (Kodak).

- Two companies whose sales volume was comparable to Lockheed's in 1976 (Armco and Sperry Rand).

- One company whose net worth was comparable to Lockheed's in 1967 (Johns-Manville) and one whose net worth was comparable in 1976 (Cluett Peabody).

- One company whose asset base was comparable to Lockheed's in 1967 (American Cyanamid) and one whose asset base was comparable in 1976 (Singer).

For other than the criteria noted above, the selection process was random.

Subsequently, the following data (1967-1976) were either gathered or calculated from the data available to us:

- Exhibit X-B: The net worth of the eight companies.

- Exhibit X-C: The asset base of the eight companies.

- Exhibit X-D: The after tax profit of the eight companies.

- Exhibit X-E: Capital expenditures of the eight companies.

- Exhibit X-F: The return on net worth of the eight companies, (profit/net worth).

- Exhibit X-G: The return on assets for the eight companies (profit/assets).

- Exhibit X-H: The return on sales for the eight companies (profit/sales).

- Exhibit X-I: Sales to assets ratios for the eight companies.

- Exhibit X-J: Sales to net worth ratios for the eight companies.

- Exhibit X-K: Sales to capital expenditures ratios for the eight companies.

The data collection formats initially were determined by (a) an inspection of the data routinely available from public sources, and (b) the judgments of the project staff on those formats which would prove to be most useful analytically. This last decision was made based on the relevant experience of the project staff and does not necessarily conform to any other financial analysis scheme.

Cash flow data, as set out in Exhibit XI, were prepared for the more than 100 companies included in our data base.

EXHIBIT IX

SELECTED DATA

U.S. SHIPBUILDING AND REPAIRING INDUSTRY

SIC 3731

R	PROD. WKRS. NUMBER (000)	PROD. WKRS. PAYROLL (000,000)	NON-PROD. WKRS. NUMBER (000)	NON-PROD. WKRS. PAYROLL (000,000)	TOTAL WKRS. NUMBER (000)	TOTAL WKRS. PAYROLL (000,000)	CAP. EX. (000,000)	GROSS FIXED ASSETS (000,000)	COST OF MATERIALS (000,000)	VALUE OF SHIPMENTS (000,000)
1	96	$569	18	$160	114	$729	$32	n.a.	$701	$1621
	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
2	118	1053	27	369	145	1422	142	$1227	1400	3291
3	121	1134	31	426	152	1560	131	1297	1743	3959
4	129	1291	33	478	162	1769	216	1531	2264	4825
5	133	1461	34	535	167	1996	298	1809	2692	5615
6	132	1619	34	600	166	2219	355	2157	2610	5896

RCE: U.S. BUREAU OF THE CENSUS, CENSUS OF MANUFACTURES.

EXHIBIT X-A
FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF SALES: 1967-1976
($000,000)

YEAR	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	CLETT PEABODY	AMER.CYANAMID	SINGER
1967	2336	2392	1138	1563	510	284	937	1138
1968	2217	2644	1375	1607	556	446	1023	1799
1969	2075	2747	1566	1755	584	478	1087	2069
1970	2536	2784	1584	1739	578	488	1158	2059
1971	2852	2976	1696	1824	685	499	1283	2100
1972	2473	3478	1911	2229	796	547	1359	2218
1973	2757	4036	2391	2614	905	536	1472	2528
1974	3279	4584	3190	3041	1106	538	1780	2587
1975	3389	4959	3047	3203	1107	519	1928	2061
1976	3203	5438	3151	3270	1309	580	2094	2126
TOTAL	27117	36038	21049	22845	8136	4915	14121	20685
AVERAGE[2]	2712	3604	2105	2285	814	492	1412	2069

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS".

[1]FOR A DESCRIPTION OF THE METHOD BY WHICH COMPANIES WERE SELECTED, SEE PAGE 49ff.
[2]THIS FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

EXHIBIT X-B
FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF NETWORTH: 1967-1976
($000,000)

YEAR	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	CLUETT PEABODY	AMER.CYANAMID	SINGER
1967	350	1644	888	596	352	89	655	466
1968	371	1836	954	692	371	138	684	633
1969	322	2036	1079	718	385	151	691	699
1970	234	2226	1042	774	406	153	731	745
1971	250	2430	1060	815	453	155	846	769
1972	266	2755	1098	886	477	160	898	763
1973	283	3118	1145	980	506	160	895	818
1974	27	3427	1275	1059	561	146	981	769
1975	75	3709	1331	1169	581	153	1044	306
1976	167	4026	1406	1180	672	166	1109	373
TOTAL	2345	27207	11278	8869	4764	1471	8534	6341
AVERAGE[2]	235	2721	1128	887	476	147	853	634

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD BY WHICH COMPANIES WERE SELECTED, SEE PAGE 49ff.
[2]THIS FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

EXHIBIT X-C
FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF ASSETS: 1967-1976

($000,000)

YEAR	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	CELETT PEABODY	AMER.CYANAMID	SINGER
1967	881	2233	1444	1045	428	164	910	1049
1968	937	2565	1633	1284	478	290	975	1410
1969	1271	2830	1846	1414	502	314	1001	1438
1970	1323	3043	1979	1482	529	316	1066	1635
1971	1471	3298	2044	1653	654	308	1281	1670
1972	1632	3757	2083	1841	736	317	1389	1609
1973	1502	4302	2259	2155	851	319	1442	1897
1974	1634	4703	2542	2533	987	321	1603	2016
1975	1573	5056	2606	2581	1077	278	1722	1797
1976	1586	5524	2834	2642	1188	305	2002	1589
TOTAL	13810	37311	21270	18630	7430	2932	13391	16110
AVERAGE[2]	1381	3731	2127	1863	743	293	1339	1611

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD BY WHICH COMPANIES WERE SELECTED, SEE PAGE 49ff.
[2]THIS FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

EXHIBIT X-O
FINANCIAL COMPARISONS: SELECTEO COMPANIES[1]
COMPARISON OF PROFITS: 1967-1976:
($000,000)

	DEFENSE INOUSTRY COMPANY	OTHER SELECTEO COMPANIES[1]						
YEAR	LOCKHEED	KODAK	ARMCO	SPERRY-RAND	JOHNS-MANVILLE	CLUETT-PEABODY	AMER.CYANAMID	SINGER
1967	54	352	71	64	33	11	70	50
1968	44	375	88	77	40	18	86	71
1969	(33)	401	96	81	42	17	90	80
1970	(86)	404	56	72	33	10	92	75
1971	12	419	51	54	43	12	94	72
1972	13	546	76	90	49	14	109	88
1973	14	653	107	113	56	8	114	95
1974	23	630	204	136	72	(9)	155	(10)
1975	45	614	116	145	38	12	148	(451)
1976	39	651	124	157	53	17	136	60
TOTAL	125	5045	989	989	459	110	1094	130
AVERAGE[2]	13	505	99	99	46	11	109	13

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INOUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOO BY WHICH COMPANIES WERE SELECTEO, SEE PAGE 49ff.
[2]THIS FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

EXHIBIT X-E

FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF CAPITAL EXPENDITURES: 1967-1976
($000,000)

	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
YEAR	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	CLUETT PEABODY	AMER.CYANAMID	SINCER[3]
1967	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1968	93	279	123	159	25	107	57	n.a.
1969	120	282	123	149	38	107	96	85
1970	44	311	183	127	45	87	94	93
1971	18	295	145	235	52	113	111	82
1972	22	252	75	116	75	118	72	111
1973	62	358	72	136	106	75	84	122
1974	23	553	104	188	106	71	139	96
1975	39	571	247	138	110	50	204	43
1976	33	497	272	129	70	66	232	47
TOTAL	474	3398	1344	1377	627	794	1089	679
AVERAGE[2]	53	378	149	153	70	88	121	85

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD BY WHICH COMPANIES WERE SELECTED, SEE PAGE 49ff.
[2]THIS FIGURE IS THE 9-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1968-1976. EXCEPT WHERE NOTED, THE UNAVAILABILITY OF 1967 DATA IS THE EXCEPTION RATHER THAN THE RULE WITH RESPECT TO OUR DATA BASE.
[3]THE AVERAGE FIGURE FOR THIS COMPANY IS THE 8-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1969-1976.

EXHIBIT X-F
FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF RETURN ON NET WORTH: 1967-1976
(%)

	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
YEAR	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	ELLETT PEABODY	AMER.CYANAMID	SINGER
1967	15.4	21.4	8.0	10.7	9.4	12.4	7.5	10.7
1968	11.9	20.4	9.2	11.8	10.8	13.0	8.4	11.2
1969	(10.0)	19.7	8.9	11.3	11.7	11.3	8.3	11.4
1970	(36.7)	18.1	5.4	9.3	10.9	6.5	7.9	10.1
1971	5.0	17.2	4.8	6.6	9.5	7.7	7.3	9.4
1972	4.8	19.8	7.2	10.2	10.3	8.8	8.0	11.5
1973	4.9	20.9	4.5	11.5	11.1	5.0	7.7	11.6
1974	85.2	18.4	16.0	12.8	12.8	(6.2)	8.7	(1.3)
1975	60.0	16.6	8.7	12.4	6.5	7.8	7.7	(147.4)
1976	23.4	16.2	8.8	13.3	7.9	10.2	6.5	16.0
TOTAL	161.9	188.7	81.5	109.9	100.9	76.5	78.0	(56.8)
AVERAGE[2]	16.1	18.9	9.2	11.0	10.1	7.7	7.8	(5.7)
AVERAGE[3]	5.5	18.6	8.8	11.2	9.7	7.5	12.8	(2.1)

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD BY WHICH COMPANIES WERE SELECTED, SEE PAGE 49ff.
[2]THIS FIGURE IS A SIMPLE AVERAGE, i.e., AVERAGE RETURN ON NETWORTH = TOTAL RETURNS ON NETWORTH (1967-1976) ÷ 10 YEARS.
[3]THIS FIGURE IS CALCULATED BY DIVIDING AVERAGE PROFITS (EXHIBIT X-D) BY AVERAGE NETWORTH (EXHIBIT X-B).

EXHIBIT X-C
FINANCIAL COMPARISONS: SELECTED COMPANIES [1]
COMPARISON OF RETURN ON ASSETS
(%)

YEAR	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	CONSOL. COAL PEABODY	AMER. CYANAMID	SINGER
1967	6.1	15.8	8.0	6.1	7.7	6.7	7.7	4.8
1968	4.6	14.6	9.2	6.0	8.4	6.2	8.8	5.0
1969	(2.6)	14.2	8.9	5.5	8.4	5.4	9.0	5.6
1970	(6.3)	13.3	5.4	4.9	6.2	3.2	8.6	4.6
1971	0.8	12.7	4.8	3.3	6.6	3.9	7.3	4.3
1972	0.8	14.5	7.2	4.9	6.7	4.4	7.8	5.5
1973	0.9	15.2	4.5	5.2	6.6	2.5	7.9	5.0
1974	1.4	13.4	16.0	5.4	7.3	(2.8)	9.7	(0.5)
1975	2.9	12.1	8.7	5.6	3.5	4.3	8.6	(25.0)
1976	2.5	11.8	8.8	5.9	4.5	5.6	6.8	3.8
TOTAL	10.9	137.6	81.5	52.8	65.9	39.4	82.2	13.0
AVERAGE[2]	1.1	13.8	8.2	5.3	6.6	3.9	8.2	1.3
AVERAGE[3]	0.9	13.5	4.6	5.3	6.2	3.8	9.1	0.8

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD BY WHICH COMPANIES WERE SELECTED, SEE PAGE 49ff.
[2]THIS FIGURE IS A SIMPLE AVERAGE, i.e., AVERAGE RETURN ON ASSETS= TOTAL RETURNS ON ASSETS(1967-1976) ÷ 10 YEARS.
[3]THIS FIGURE IS CALCULATED BY DIVIDING AVERAGE PROFITS (EXHIBIT X-D) BY AVERAGE ASSETS(EXHIBIT X-C).

EXHIBIT X-H
FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF RETURNS ON SALES: 1967-1976
(%)

YEAR	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	GILLETT PEABODY	AMER.CYANAMID	SINGER
1967	2.3	14.7	6.2	4.1	6.5	3.9	7.5	4.4
1968	1.9	14.2	6.4	4.9	7.2	4.0	8.4	3.9
1969	(1.6)	14.6	6.1	4.6	7.2	3.6	8.3	3.9
1970	(3.4)	14.5	3.5	4.1	5.7	2.0	7.9	3.6
1971	0.4	14.1	3.0	3.0	6.3	2.4	7.3	3.4
1972	0.5	15.7	4.0	4.0	6.2	2.6	8.0	4.0
1973	0.5	16.2	4.5	4.3	6.2	1.5	7.7	3.8
1974	0.7	13.7	6.4	4.5	6.5	(1.7)	8.7	(0.4)
1975	1.3	12.4	3.8	4.5	3.4	2.3	7.7	(21.8)
1976	1.2	12.0	3.9	4.8	4.0	2.9	6.5	2.8
TOTAL	38.8	142.1	47.8	42.7	59.2	23.5	78.0	7.6
AVERAGE[2]	0.4	14.2	4.8	4.3	5.9	2.4	7.8	0.8
AVERAGE:[3]	0.5	14.0	4.8	4.3	5.9	2.4	7.8	0.6

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD WHEREBY COMPANIES WERE SELECTED, SEE PAGE 49ff.
[2]THIS FIGURE IS A SIMPLE AVERAGE, i.e., AVERAGE RETURN ON SALES=TOTAL RETURNS ON SALES (1967-1976) ÷ 10 YEARS.
[3]THIS FIGURE IS CALCULATED BY DIVIDING AVERAGE PROFITS (EXHIBIT X-D) BY AVERAGE SALES (EXHIBIT X-A).

EXHIBIT X-I
FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF SALES/ASSETS RATIOS: 1967-1976
(X)

	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
YEAR	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	GULF & WESTERN	AMER.CYANAMID	SINGER
1967	2.7	1.1	0.8	1.5	1.2	1.7	1.0	1.1
1968	2.4	1.0	0.8	1.3	1.2	1.5	1.0	1.3
1969	1.6	1.0	0.8	1.2	1.2	1.5	1.1	1.4
1970	1.9	0.9	0.8	1.2	1.1	1.5	1.1	1.3
1971	1.9	0.9	0.8	1.1	1.0	1.6	1.0	1.3
1972	1.5	0.9	0.9	1.2	1.1	1.7	1.0	1.4
1973	1.8	0.9	1.1	1.2	1.1	1.7	1.0	1.3
1974	2.0	1.0	1.3	1.2	1.1	1.7	1.1	1.3
1975	2.2	1.0	1.2	1.2	1.0	1.9	1.1	1.2
1976	2.0	1.0	1.1	1.2	1.0	1.9	1.0	1.3
TOTAL	20.0	9.7	9.6	12.3	11.0	16.7	10.4	12.9
AVERAGE[2]	2.0	1.0	1.0	1.2	1.1	1.7	1.0	1.3
AVERAGE[3]	2.0	1.0	1.0	1.2	1.1	1.7	1.1	1.3

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD WHEREBY COMPANIES WERE SELECTED, SEE PAGE 49ff.

[2]THIS FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

[3]THIS FIGURE WAS CALCULATED BY DIVIDING AVERAGE SALES (EXHIBIT X-A) BY AVERAGE ASSETS (EXHIBIT X-C).

EXHIBIT X-J
FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISON OF SALES/NETWORTH RATIOS: 1967-1976
(X)

YEAR	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	CLUETT PEABODY	AMER.CYANAMID	SINGER
1967	6.7	1.5	1.3	2.6	1.4	3.2	1.4	2.4
1968	6.0	1.4	2.5	1.5	3.2	3.2	1.5	2.8
1969	6.4	1.3	1.5	2.4	1.5	3.2	1.6	3.0
1970	10.8	1.3	1.5	2.2	1.4	3.2	1.6	2.8
1971	11.4	1.2	1.6	2.2	1.5	3.2	1.5	2.7
1972	9.3	1.3	1.7	2.5	1.7	3.4	1.5	2.9
1973	9.7	1.3	2.1	2.7	1.8	3.4	1.6	3.1
1974	121.4	1.3	2.5	2.9	2.0	3.7	1.8	3.4
1975	45.2	1.3	2.3	2.7	1.9	3.4	1.8	6.7
1976	19.2	1.4	2.2	2.8	1.9	3.5	1.9	5.7
TOTAL	246.1	13.3	18.1	25.5	16.6	33.4	16.2	35.5
AVERAGE[2]	24.6	1.3	1.8	2.6	1.7	3.3	1.6	3.6
AVERAGE[3]	11.5	1.3	1.9	2.6	1.7	3.3	1.7	3.3

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSIRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD WHEREBY COMPANIES WERE SELECTED, SEE PAGE 49ff.

[2]THIS FIGURE IS A SIMPLE AVERAGE, i.e., AVERAGE SALES/NETWORTH RATIOS = TOTAL SALES/NETWORTH RATIOS (1967-1976) ÷ 10 YEARS.

[3]THIS FIGURE IS CALCULATED BY DIVIDING AVERAGE SALES (EXHIBIT X-A) BY AVERAGE NETWORTH (EXHIBIT X-B).

EXHIBIT X-K

FINANCIAL COMPARISONS: SELECTED COMPANIES[1]
COMPARISONS OF SALES/CAPITAL EXPENDITURE RATIOS: 1967-1976
(%)

YEAR	DEFENSE INDUSTRY COMPANY	OTHER SELECTED COMPANIES[1]						
	LOCKHEED	KODAK	ARMCO	SPERRY RAND	JOHNS-MANVILLE	CLUETT PEABODY	AMER.CYANAMID	SINGER[3]
1967	N.A	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1968	24	9	11	10	22	4	18	N.A.
1969	17	10	13	12	15	4	11	24
1970	40	9	9	14	13	6	12	22
1971	158	10	12	8	13	4	12	26
1972	112	14	25	19	11	5	19	20
1973	44	11	33	19	9	6	18	21
1974	143	8	31	16	10	8	13	27
1975	87	9	12	23	10	10	9	48
1976	97	11	12	25	19	9	9	45
TOTAL	722	91	158	146	122	56	121	230
AVERAGE[2]	80.2	10.1	17.6	16.2	13.6	6.2	13.4	28.8

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]FOR A DESCRIPTION OF THE METHOD WHEREBY COMPANIES WERE SELECTED, SEE PAGE 49ff.

[2]THIS FIGURE IS THE 9-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1968-1976. EXCEPT WHERE NOTED, THE UNAVAILABILITY OF 1967 DATA IS THE EXCEPTION RATHER THAN THE RULE WITH RESPECT TO OUR DATA BASE.

[3]THE AVERAGE FIGURE FOR THIS COMPANY IS THE 8-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1969-1976.

EXHIBIT XI

CASH FLOW DATA: 1970-1977

GENERAL DYNAMICS CORPORATION

(DOLLARS IN MILLIONS)

YEAR	CAPITAL EXPENDITURES	NET INCOME	DEPRECIATION and AMORTIZATION	CASH FLOW(2+3)	NET CASH FLOW (4-1)
1970	49.6	(6.5)	48.4	41.9	(7.7)
1971	60.6	20.6	47.0	67.6	7.0
1972	62.8	26.0	48.4	74.4	11.6
1973	53.5	40.3	46.8	87.1	33.6
1974	108.3	51.6	50.2	101.8	(6.5)
1975	167.9	81.1	59.7	140.8	(27.1)
1976	146.4	99.6	81.2	180.8	34.4
1977	103.1	103.4	94.4	197.8	94.7
	(1)	(2)	(3)	(4)	(5)

SOURCE: STANDARD & POOR's CORP., STANDARD NYSE STOCK REPORTS.

Testing The Data: Capital Expenditures

Because of our concern with understanding the capital investment policies of the shipbuilding industry, the first test to which the data were exposed was an analysis of a potential relationship between sales and capital expenditures. In order to do this, a sample measure was selected. For each of the approximately 100 companies included in our sample group, the average annual sales for the ten-year period (1967 through 1976) were divided by the average annual capital expenditures for the same period. Because corporate size is a key determinant of corporate strategy, that sample group was then stratified into groups of companies whose annual 1967-1976 sales averaged:

- $2 billion or more (Exhibit XII);
- $1 billion but less than $2 billion (Exhibit XIII);
- $500 million but less than $1 billion (Exhibit XIV); and
- less than $500 million (Exhibit XV).

Accordingly, an inspection of the data in these Exhibits shows that over the ten years under review, companies investing the least amount of money in capital equipment are either defense-related firms or food-processing firms. This relationship is most evident in those firms with average sales of $1 billion per year or more. It is less evident for those companies whose sales are greater than $500 million but less than $1 billion. For the smaller firms shown (Exhibit XV) no specific relationship can be inferred. This last outcome was not expected. Analysts generally concede that there is a critical relationship between corporate size, profitability and capital investment policy. A more stable, higher rate of investment would normally be expected of a larger company. Smaller firms, if only by definition, do not have the financial flexibility of the larger firm and thus cannot always pursue stable capital investment policies.

EXHIBIT XII

SALES, CAPITAL EXPENDITURES OF COMPANIES WITH 1967-1976 AVERAGE ANNUAL SALES OF $2,000,000,000 AND ABOVE[1]

COMPANY	SALES: (1967-1976)[1] ($000,000)	CAPITAL EXPENDITURES (1967-1976)[1] ($000,000)	SALES/ CAP. EXPEN.[1] (1) ÷ (2) (X)
UNITED TECH.	2895	84	34.5
GENERAL DYNAMICS	2132	86	24.8
ROCKWELL	3248	141	23.0
CATERPILLAR	2936	207	14.2
REYNOLDS TOBACCO	2354	199	11.8
PROCTOR & GAMBLE	3878	234	16.6
ESMARK	3668	104	35.3
KRAFT	3414	80	42.7
GENERAL FOODS	2531	105	24.1
LITTON	2552	106	24.1
AMER. CAN	2148	109	19.7
BORDEN	2365	99	23.9
CONT. GROUP	2319	159	14.6
XEROX	2424	607	4.0
LOCKHEED	2712	53	51.2
KODAK	3604	382	9.4
ARMCO	2105	149	14.1
SPERRY RAND	2285	153	14.9
McD-DOUGLAS	2933	44	66.7
RCA	3911	395	9.9
W.R. GRACE	2481	179	13.9
INT'L PAPER	2264	260	8.7
BOEING	3278	60	54.6
WESTINGHOUSE	4725	202	23.4
FIRESTONE	2829	209	13.5
UNION OIL	2791	517	5.4
	(1)	(2)	(3)

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]EACH FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

EXHIBIT XIII
SALES, CAPITAL EXPENDITURES OF
COMPANIES WITH 1967-1976 AVERAGE ANNUAL SALES
OF $1,000,000,000-$1,999,000,000[1]

COMPANY	SALES (1967-1976)[1] ($000,000)	CAPITAL EXPENDITURES (1967-1976)[1] ($000,000)	SALES/ CAP. EXPEN.[1] (1) ÷ (2) (X)
GRUMMAN	1081	24	45.0
AMER. HOME	1641	45	36.5
MOTOROLA	1077	82	13.1
STANDARD OF OHIO	1574	618	2.6
NAT'L STEEL	1772	167	10.6
GEORGIA PACIFIC	1747	289	6.0
OWENS ILLINOIS	1687	136	12.4
REP. STEEL	1820	133	13.7
J.P. STEVENS	1035	40	25.9
CARNATION	1380	41	33.7
CROWN ZELLERBACH	1265	110	11.5
CPC INC.	1767	80	22.1
RAYTHEON	1581	61	25.9
CELANESE	1483	179	8.3
SIGNAL CO.	1617	66	24.5
PEPSI COLA	1504	93	16.2
AMER. BRANDS	1756	57	30.8
KENNECOTT COPPER	1038	198	5.2
DEERE	1757	97	18.1
KIMBERLY CLARK	1075	111	9.7
OLIN MATHIESON	1170	124	9.4
INLAND STEEL	1598	155	10.3
WARNER LAMBERT	1438	65	22.1
CAMPBELL SOUP	1150	61	18.9
ALLIS CHALMERS	1047	41	25.5
BOISE CASCADE	1495	136	11.0
PFIZER	1156	86	13.4
FMC	1651	122	13.5
	(1)	(2)	(3)

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1] EACH FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

EXHIBIT XIV
SALES, CAPITAL EXPENDITURES OF
COMPANIES WITH 1967-1976 AVERAGE ANNUAL SALES
OF $500,000,000-$999,000,000[1]

COMPANY	SALES: (1967-1976)[1] ($000,000)	CAPITAL EXPENDITURES (1967-1976)[1] ($000,000)	SALES/ CAP. EXPEN.[1] (1) ÷ (2) (X)
NORTHROP	713	21	34.0
ETHYL	716	76	9.4
COLT	801	34	23.6
JIM WALTER	823	57	14.4
CUMMINS	588	43	13.7
MARTIN MARIETTA	990	81	12.2
SQUIBB	851	57	14.9
KOPPERS	708	60	11.8
UNION CAMP	624	79	7.9
INT'L MINING	682	76	9.0
JOHNS MANVILLE	814	72	11.3
EMERSON ELEC.	846	41	20.6
CROWN CORK	543	37	14.7
CLARK	913	39	23.4
TIMKEN	530	45	11.8
MERCK	995	111	9.0
NAT'L DISTILLERS	803	42	19.1

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S INDUSTRIAL CORPORATIONS."

[1] EACH FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

EXHIBIT XV
SALES, CAPITAL EXPENDITURES OF
COMPANIES WITH 1967-1976 AVERAGE ANNUAL SALES
OF $499,000,000 OR LESS[1]

COMPANY	SALES (1967-1976)[1] ($000,000)	CAPITAL EXPENDITURES[1] (1967-1976) ($000,000)	SALES/ CAP. EXPEN.[1] (1) ÷ (2) (X)
BEMIS	432	24	18.0
NAT'L GYPSUM	464	24	19.3
FAIRCHILD	255	7	36.4
HOOVER	428	11	38.9
AMPEX	267	17	15.7
ALLEN GROUP	157	5	31.4
OLYMPIA BREWING	132	9	14.7
FEDERAL MOGUL	307	15	20.5
RIEGEL TEXTILE	202	9	22.4
RELIANCE ELEC.	409	17	24.1
TODD	189	6	31.5
BANGOR PUNTA	284	9	31.6
SNAP ON TOOLS	111	6	18.5
ROBERT SHAW	168	6	28.0
CECO	217	6	36.2
REDMAN	156	3	52.0
AVNET	375	8	46.9

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS."

[1]EACH FIGURE IS THE 10-YEAR AVERAGE OF THE ANNUAL FIGURES FOR 1967-1976.

To clarify the quantitative relationship between sales and capital expenditures, we established a 20:1 cut-off point and then rank-ordered the firms as shown in Table Two.[2] Because of the techniques employed, the higher the ratio, the lower is the relative sum of money invested in new plant and equipment. However, as discussed in Chapter V, there is nothing normative about the ratio. Nonetheless, the use of this ratio revealed that the firms with the highest ratios, McDonnell-Douglas (66.7) and Boeing (54.6) are major defense contractors. Similar ratios obtained for all other defense-industry companies. This, and the data on other defense-industry companies, confirmed the contention that the investment in plant and equipment of this group of companies is low when compared to firms with similar sales volumes. One can draw 2 tentative conclusions from this: (1) the need for facilities in the defense industry is minimal, and/or (2) firms in the defense industry are reluctant to commit funds to plant and equipment. Based on our knowledge of the shipbuilding industry, it appears reasonably safe to conclude from this data that the more critical factor is the reluctance on the part of defense contractors to "facilitize."

It should be noted here, however, that there is nothing normative about this analysis. Neither a high ratio (minimal reinvestment) nor a low ratio (maximum reinvestment) can be construed as being anything other than representative of what is happening in an industry. As such, it is neither "good" nor "bad." It is simply fact.

In point of fact, some industries have little need for substantial investments in capital facilities since they are unable to substitute capital for labor. These industries will then be characterized by high ratios.

TABLE TWO

COMPANIES WITH SALES TO CAPITAL EXPENDITURES RATIOS LARGER THAN 20:1 (RANKED FROM HIGH TO LOW)[1]

COMPANY	SALES/CAP. EXPENDITURES
MCDONNELL DOUGLAS[2]	66.7:1
BOEING[2]	54.6
REDMAN	52.0
LOCKHEED[2]	51.2
AVNET	46.9
GRUMMAN[2]	45.0
KRAFT[3]	42.7
AMERICAN HOME	36.5
ESMARK[3]	35.3
UNITED TECH[2]	34.5
NORTHROP[2]	34.0
AMERICAN BRANDS[3]	30.8
RAYTHEON[2]	25.9
J.P. STEVENS	25.9
ALLIS CHALMERS	25.5
GENERAL DYNAMICS[2]	24.8
SIGNAL[4]	24.5
GENERAL FOODS[3]	24.1
LITTON[2]	24.1
BORDEN[3]	23.9
COLT	23.6
CLARK	23.4
WESTINGHOUSE[4]	23.4
ROCKWELL[4]	23.0
CPC	22.1
WARNER-LAMBERT	22.1

SOURCE: [1]ALL FIGURES ARE ANNUAL FIGURES AVERAGED FOR THE PERIOD 1967-1976.

[2]DEFENSE INDUSTRY COMPANIES

[3]FOOD PROCESSING INDUSTRIES

[4]COMPANIES WHICH ARE AMONG THE FY 75 LISTING OF THE 100 LARGEST DEFENSE CONTRACTORS, BUT WHICH DID NOT MEET OUR DEFENSE-INDUSTRY CRITERION.

Other industries clearly have the ability to substitute capital for labor, or, collaterally, have a heavier reliance in their manufacturing process upon heavy machinery. They will then be characterized by a low ratio between sales and capital investments. Some industries, and it is our belief that the defense industry falls into this category, could "profit" from the substitution of capital for labor but overtly elect not to do so either as part of a risk minimization policy or in the belief that the market for their product will not allow for the utilization rates required to justify a highly-automated manufacturing facility. These firms will be characterized by the high ratios shown in the various Exhibits.

However, we believe that one critical factor discouraging heavy investment in capital equipment, in at least two basic defense industries (aerospace and shipbuilding), is the fact that the technology and economics of mission-related equipment are well beyond the scope of the platform producer. By this we mean that they have neither the funds nor the capabilities to produce this type of equipment and integrate it into the platform. Because of this, they neither know how to predict nor otherwise anticipate the changes in design and construction that developments in mission-related equipment will engender. Although they both recognize that a heavy investment in automated or semi-automated manufacturing equipment will improve their efficiency, they are concerned that this equipment may lock them into construction/production processes that may later prove to be incompatible with a change in the scope and content of the stuffing process, i.e., that they may not be able to accommodate to the assembly requirements imposed on them by mission-oriented equipment. If our contention is correct, a wiser manufacturing policy for the platform producers would be to retain the inherent flexibility provided by a labor-intensive manufacturing process. This is apart from any consideration of business risk or similar factors.

However, the "stuffing" process, as we have termed it, introduces another element into the economics of the defense industry. it is the inclusion on or in the platform of mission-oriented equipment

whose dollar cost is far greater than that of the platform itself. This equipment is normally provided to the prime contractor as government furnished equipment. Therefore, the prime has neither responsibility for nor control over total systems cost or configuration.

However, the DOD and the military departments are generally authorized by Congress to buy systems. Congress is influenced by the total cost of these systems and does not necessarily know or understand the split in costs between the platform per se and the mission-oriented equipment placed on it. As the cost of the total system increases, Congress, if it wishes to constrain the size of the defense budget, can do no more than limit the number of systems purchased. It cannot, or at least it has failed so far to, distinguish between the costs of mission-oriented equipment and those of the basic platform. When the need to reduce funding arises, then, it is the number of platforms that is reduced. The underlying assumption here is that the platform is the cost driver. This results in a reduction in the number of platforms purchased. This reduction in quantity impacts most heavily on the defense industry in that it suffers the more obvious and economically damaging reduction in unit output despite the fact that the platform most likely is not the major driving force behind total system cost.

In a convoluted kind of way, then, it can be alleged that companies within the low profit, poorly capitalized, high-risk aircraft and shipbuilding industries are not so much in competition with each other as they are with the firms who design, develop and produce the mission-oriented equipment that is today the hallmark of the modern platform. As the cost of the high-technology gear that they produce increases, the sums of money then available for the platform shrinks. The risk comes in the fact that many of the producers of technologically-oriented equipment are companies whose dependence on defense acquisition programs is, at best, marginal. These are the firms who can resist the more odious regulatory pressures of the DOD and, quite often, tell procurement officials to"take it or leave it."

Since it is the equipment of these base companies that is directly responsive to a threat analysis, it is more difficult to resist the purchase of this equipment than forego it in order to maximize the number of less sophisticated platforms acquired. In more traditional economic terms, those firms that produce the "stuffing" for the modern platform have induced the market to accept quality for quantity. In so doing, they have competed the aircraft and shipbuilding industries into a minimally profitable business situation in which it is wiser to forego capital investments. Since none of the intra-industry competitors is heavily invested in labor savings equipment, this is not a major factor to contend with when platform producers compete.

Although we are now unable to provide proof of our contention, we would maintain that the demand for mission-oriented equipment is relatively inelastic. By this we mean that it is unlikely that the price increases in this area will convince the military departments of the need to forego high technology. The available evidence suggests that they are willing to cut back on the number of platforms when faced with even a moderate increase in their cost. Because of this, the major impact of a reduction in the DOD budget will fall first on the platform producer. The richer defense industrial base companies will escape the heavier impact of these cuts because of their greater ability to raise prices when demand decreases. This ability is due to their lack of financial dependence on the DOD.

We believe one last inference to be essential to the interpretation of the data set forth in various sections of this report. It has to do with the market for GFE. In absorbing the responsibility for providing the prime contractor with government furnished equipment, the defense acquisition process has brought into the military-industrial relationship an economic and marketing force that it does not as yet fully comprehend. It appears likely that the Navy is a knowledgeable buyer of ships. Similarly, it appears likely that the Air Force is a knowledgeable buyer of airframes and possibly, engines. However, the evidence now available would suggest that few

of the military departments are knowledgeable buyers of the high-technology, mission-oriented equipment which we believe is the key economic force driving the systems acquisition procedure in the United States. In this regard, it should be remembered that inter-industry competition--the substitution factor--is apt to be more deadly than intra-industry competition.

In all likelihood, the defense industry knows this, if only intuitively, and responds policy-wise by avoiding heavy non-liquid investments in fixed capital.

Further evidence in this regard will be presented in Chapter V.

CHAPTER IV: FINANCIAL ANALYSIS

Introduction

Before presenting the additional data on which we have relied in preparing this report, a rejoinder is necessary. The central purpose of this report is to provide an explanation of the capital investment policies of the shipbuilding industry. The work on this project, however, was not the starting point either for this report or for many of the conclusions drawn from it. Rather, it is the culmination of a broader concern with the defense acquisition process. Based on this prior knowledge, we hypothesized that the defense industry would exhibit five distinct financial characteristics:

- minimal investments in plant and equipment as measured by the relationship between sales and capital expenditures. Data on this issue have already been presented;
- low profits as measured by the return on sales;
- high financial risk as measured by the relationship between sales and net worth;
- high profits as measured by the return on net worth; and
- poor cash flow.

There may be other industries that exhibit all five of these characteristics. However, with the possible exception of the food-processing industry, no conclusions about other industries can be drawn from our data. The defense industry is the one industry that appears to meet all five criteria. This is, of course, subject to our earlier caveat on the effect of corporate size of capital structure. It is virtually axiomatic that medium-sized to small-sized companies and most assuredly "small business" will be less well-structured financially than their larger counterparts and thus exhibit most if not

all of the characteristics noted above. Conversely, we believe that only the large-scale defense companies will, when compared to companies of equal size, exhibit all of these characteristics.

Our selection of the five measures was based on the following concerns:

1. The general concern of the DOD with the profitability of the defense industry. Various reports had suggested that the defense industry is the least profitable segment of the American economy.[1]

2. The many statements by the DOD urging the defense industry to invest more funds in capital equipment, and the DOD's unsuccessful attempt to stimulate this investment by providing an incentive for it in the Weighted Guidelines.[2]

Our earlier work confirmed the fact that the shipbuilding industry was virtually profitless and formed the basis for our use of the conventional measure of the rate of return on sales. However, the product life cycle in many defense industries oftentimes spans as much as ten years. Because of this we gathered and analyzed data for a ten-year period. We did this to avoid the distortion that might occur if we selected a shorter period of time. Our sense was that prior work on the defense industry was potentially misleading because of its failure to contemplate a sufficiently long time period.

Measures Used

1. Capital Expenditures and Sales

Our use of the relationship between sales and capital expenditures is somewhat unorthodox since we have not seen this ratio used in standard textbooks on finance. To the extent that we sought to be descriptive only, the use of this measure is reasonable. However, as we suggested earlier, the data do not allow for any definitive conclusions on whether American industry should have invested more or less money in fixed capital. We simply know how much they invested. In this regard, the defense industry lagged behind industry in general.

2. Sales to Net Worth

The measure of financial risk that we chose is once again not an evaluative measure used in traditional textbooks. It is not used in textbooks because this statistic more aptly describes the financial risk taken on by a large buyer in doing a substantial amount of business with a poorly financed industrial firm. In general, it is believed that defense contractors face an inordinate pricing risk when compared to the private sector. The issue that concerned us here was whether these defense firms were capable of absorbing this risk, i.e., what would happen if the buyer insisted that the contractor absorb the losses implied by a major cost overrun. Who was apt to pay the bill? Would it be the buyer? Would it be the seller? Why? It seems reasonably obvious that the DOD cannot accept a half-built ship. If the shipbuilder does not have a financial base that will allow him to absorb cost increases for which he is otherwise responsible, then the pricing risk remains with the buyer since, irrespective of contract provisions, the buyer must either pay the bill or forego the product. Thus, in simple terms, the buyer is the profit provider on the upside and the cost indemnifier on the downside. This is a rather unique relationship that does not obtain in the

civilian sector. For this reason, we searched for a statistic that might provide some measure of the financial risk to the buyer of a seller default. Thus, the use of the sales to net worth ratio as a measure of this risk.

3. Profit to Net Worth

A more conventional measure for determining corporate financial strength is the relationship between profit and net worth. However, there is a discontinuity that needs to be noted here. Extremely profitable firms, e.g, the drug industry, will show high rates of return on invested capital. At the same time, companies with only moderate to poor earnings may also show a high rate of return if their capital base is limited, e.g., the defense industry. Analytically, the way to cut through this potential contradiction is to relate profit on net worth to the ratio of sales to net worth. Well capitalized and highly profitable companies will show a low sales to net worth ratio and a high profit to net worth ratio (low-high). Poorly capitalized firms will yield high ratios for both or, occasionally, because profits are so low, an equally poor showing when profits are related to net worth (high-high or high-low). The defense industry shows both a high-high and a high-low relationship. Thus, these two evaluative measures should be related when establishing measures of corporate performance.

With respect to the defense industry, however, we believe that the more important relationship to be explored is that of sales to net worth for the reasons described above.

4. Cash Flow

We developed no quantitatively oriented measures of the "goodness" or "badness" of cash flow but instead simply gathered the statistics for 89 companies. For the larger firm, they confirmed the experience of the shipbuilding industry in particular and the defense industry in general, i.e., poor cash flow characteristics. Because

of its importance, this issue will be discussed in a separate section of this report.

Data Analysis: Companies With Average Annual Sales (1967-1976) Over $2,000,000,000

Exhibits XVI, XVII, XVIII, and XIX once again present data for the more than 100 companies sampled. As with the earlier exhibits, the sample population was stratified by sales volume.

Exhibit XVI presents data on the larger firms included in this sample and shows that profits on sales ranged from a low of 0.5 percent (Lockheed) to a high of 14 percent (Kodak).

When the firms are rank-ordered, however, 4 of the 5 firms with the lowest rate of return on sales are defense-industry companies (Table Three). Further, when the list is expanded to 13 firms in order to account for all of the companies classified as defense industry companies, the highest rate of profit shown is only 3.2 percent. The only industry group with comparatively low profits on sales are the food processors. With one exception, however, these companies tend to cluster near the upper end of the range.

Based on this data it seems reasonably safe to assume that companies classified as defense industry companies are the least profitable companies in our economy. Intriguingly enough, food processing firms appear to share a number of financial characteristics with defense industry companies, e.g., low profits on sales and minimal sums of money invested in capital equipment. However, based on the nature of competition within the agricultural sector of the economy, this outcome should be anticipated.

When sales are related to net worth, the defense industry once again ranks lowest. As shown in Table Three, the ratio for companies classified as defense industry companies ranges from a high of 11.6:1 (Lockheed) to a low of 3.5:1 (Litton). When the list is expanded to include all defense-related firms, only two food processing companies show up on this list (Kraft and Esmark).

As shown in Table Three, the ratios relating profits to net worth ranged from a high of 18.6 percent (Xerox and Kodak) to a low of 5.5 percent (Lockheed and Litton) and were not quite as anticipated, i.e., we had expected the companies classified as defense industry companies to show higher rates of return on net worth because of their smaller capital bases. However, for the 10 years reviewed, 3 of the companies had disastrously low profits such that extremely low rates of return on net worth are explainable if not expected.

However, of note is the fact that the anticipated high-low relationship obtained for the non-defense companies, i.e., high rates of return on net worth, low ratios of sales to net worth (Table Three). Once again firms within the food industry showed financial characteristics similar to those of the defense firm, albeit at the upper range of performance if the two industries are compared to one another.

EXHIBIT XVI

SALES, PROFITS, AND NET WORTH OF

COMPANIES WITH 1961-1976 AVERAGE ANNUAL

SALES OF $2,000,000,000 AND ABOVE[1]

COMPANY	SALES (1967-1976) ($000,000)	PROFITS (1967-1976) ($000,000)	NET WORTH (1967-1976) ($000,000)	PROFITS/ SALES 2÷1 (%)	PROFITS/ NET WORTH 2÷3 (%)	SALES/ NET WORTH 1÷3 (X)
UNITED TECH[2]	2895	70	673	2.4	10.4	4.3
GEN. DYNAMICS[2]	2132	41	406	1.9	10.1	5.3
ROCKWELL[4]	3248	92	870	2.8	10.6	3.7
CATERPILLAR[4]	2936	211	1225	7.2	17.2	2.4
REYNOLDS[4]	2354	242	1395	10.3	17.3	1.7
PROCTOR & GAMBLE[4]	3878	264	1569	6.8	16.8	2.5
ESMARK[3]	3668	44	475	1.2	9.3	7.7
KRAFT[3]	3414	96	771	2.8	12.5	4.4
GENERAL FOODS[3,4]	2531	110	785	4.3	14.0	3.2
LITTON[2]	2552	40	733	1.6	5.5	3.5
AMER. CAN	2148	61	747	2.8	8.2	2.9
BORDEN[3]	2365	69	730	2.9	9.5	2.4
CONT. GROUP	2319	94	755	4.0	12.4	3.1
XEROX[4]	2424	226	1222	9.3	18.5	2.0
LOCKHEED[2]	2712	13	235	0.5	5.5	11.6
KODAK[4]	3604	505	2721	14.0	18.6	1.3
ARMCO	2105	99	1128	4.7	8.8	1.9
SPERRY RAND	2285	99	883	4.3	11.2	2.6
MCD-DOUGLAS[2]	2933	93	710	3.2	13.1	4.1
RCA[4]	3911	113	1049	2.9	10.8	3.7
WR GRACE	2481	81	778	3.3	10.4	3.2
INT'L PAPER	2264	144	1243	6.4	11.6	1.8
BOEING[2]	3278	57	877	1.7	6.5	3.7
WESTINGHOUSE[4]	4725	149	1711	3.2	8.7	2.8
FIRESTONE	2829	125	1241	4.4	10.1	2.3
UNION OIL	2791	176	1645	6.3	10.7	1.7
	(1)	(2)	(3)	(4)	(5)	(6)

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS".

[1]ALL FIGURES ARE 10-YEAR AVERAGES OF THE ANNUAL FIGURES FOR 1967-1976.

[2]COMPANIES CLASSIFIED AS DEFENSE INDUSTRY COMPANIES; SEE EXHIBIT VIII.

[3]FOOD PROCESSING COMPANIES.

[4]DEFENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT COMPANIES WHICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY" CRITERION.

TABLE THREE

FINANCIAL RATIOS
COMPANIES WITH 1967-1976 AVG. ANNUAL SALES OF $2,000,000,000 AND ABOVE

PROFIT ON SALES[1]

NK-ORDERED: LOW TO HIGH

PANY	PROFIT ON SALES (%)
KHEED[2]	0.5
ARK[3]	1.2
TON[2]	1.6
ING[2]	1.7
. DYNAMICS[2]	1.9
TED TECH[2]	2.4
FT[3]	2.8
KWELL[4]	2.8
RICAN CAN	2.8
DEN[3]	2.9
[4]	2.9
TINGHOUSE[4]	3.2
-DOUGLAS[2]	3.2
GRACE	3.3
T. GRP.	4.0
RRY RAND	4.3
'L FOODS[3,4]	4.3
ESTONE	4.4
CO	4.7
ON OIL	6.3
'L PAPER	6.4
CTOR & GAMBLE[4]	6.8
ERPILLAR[4]	7.2
OX[4]	9.3
NOLDS[4]	10.3
AK[4]	14.0

SALES TO NET WORTH (RANK ORDERED HIGH TO LOW), PROFITS ON NET WORTH[1]
(HIGH-LOW RELATIONSHIPS)

COMPANY	SALES/NET WORTH (X)	PROFIT ON NET WORTH (%)
LOCKHEED[2]	11.6	5.5
ESMARK[3]	7.7	9.3
GENERAL DYNAMICS[2]	5.3	10.1
KRAFT[3]	4.4	12.5
UNITED TECH[2]	4.3	10.4
McDONNELL-DOUGLAS[2]	4.1	13.1
ROCKWELL[4]	3.7	10.6
RCA[4]	3.7	10.8
BOEING[2]	3.7	6.5
LITTON[2]	3.5	5.5
GEN'L FOODS[3,4]	3.2	14.0
WR GRACE	3.2	10.4
CONT. GRP.	3.1	12.4
AMERICAN CAN	2.9	8.2
WESTINGHOUSE[4]	2.8	8.7
SPERRY RAND[4]	2.6	11.2
PROCTOR & GAMBLE[4]	2.5	16.8
CATERPILLAR[4]	2.4	17.2
BORDEN[3]	2.4	9.5
FIRESTONE	2.3	10.1
XEROX[4]	2.0	18.5
ARMCO	1.9	8.8
INT'L PAPER	1.8	11.6
UNION OIL	1.7	10.7
REYNOLDS	1.7	17.3
KODAK[4]	1.3	18.6

URCE: EXHIBIT XVI

L FIGURES ARE 10-YEAR AVERAGES OF THE ANNUAL FIGURES FOR 1967-1976.

MPANIES CLASSIFIED AS DEFENSE-INDUSTRY COMPANIES; SEE EXHIBIT VIII.

OD PROCESSING COMPANIES.

FENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT
MPANIES WHICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY" CRITERION.

Data Analysis: Companies With Average Annual Sales of $1,000,000,000 to $1,999,000,000

Exhibit XVII contains but two defense industry companies out of a total sample of 30 companies. In confirmation of our hypotheses, these firms show the predicted financial characteristics. As Table Four shows, Grumman, with an average annual profit on sales of 0.9 percent for the 10 years, is the low earner for this group followed by Allis-Chalmers at 1.2 percent. Although regarded as among the more profitable and better financed defense firms, Raytheon ranks only 4th from the bottom profit-wise for this group of 30 companies. Third rank, at 2.2 percent, goes to J.P. Stevens, a textile manufacturing firm.

Similarly, when sales are related to net worth, Grumman is once again at the bottom of the list with an 8.1:1 ratio. Raytheon is second from the bottom with a 4.8:1 ratio.

The pattern of poor financial performance is further evident when profits are related to net worth (Table Four). Allis Chalmers ranks at the bottom with a bare 3.0 percent return on invested capital. Grumman, with its capital base down to a mere $134,000,000 ranks 6th. Raytheon, however, ranks nearer the upper end of the spectrum with a 14 percent return on net worth for the ten years ending in 1976.

Table Four is equally consistent with our hypothesis on the high-low ratio for commercially-oriented companies, i.e., high rates of return on net worth, lower sales to net worth ratios, and the more prevalent pattern in the defense industries of high sales to net worth ratios coupled with a less discernible profit to net worth relationship.

EXHIBIT XVII

SALES, PROFITS, AND NET WORTH OF

COMPANIES WITH 1961-1976 AVERAGE ANNUAL

SALES OF $1,000,000,000 TO $1,999,000,000[1]

COMPANY	SALES (1967-1976) ($000,000)	PROFITS (1967-1976) ($000,000)	NET WORTH (1967-1976) ($000,000)	PROFITS/ SALES 2÷1 (%)	PROFITS/ NET WORTH 2÷3 (%)	SALES/ NET WORTH 1÷3 (X)
GRUMMAN[2]	1081	10	134	0.9	7.5	8.1
AMER. HOME	1641	176	651	10.7	27.0	2.5
MOTOROLA	1077	47	438	4.4	10.7	2.5
STANDARD OF OHIO	1572	83	1051	5.3	7.9	1.5
NAT'L STEEL	1772	82	1005	4.6	8.2	1.8
GEORGIA PACIFIC	1747	119	776	6.8	15.3	2.3
OWENS-ILLINOIS	1682	83	704	4.9	11.8	2.4
REP. STEEL	1820	71	1104	3.9	6.4	1.7
J.P. STEVENS	1035	23	384	2.2	6.0	2.7
CARNATION[3]	1380	60	398	4.4	15.1	3.5
CROWN ZELLERBACH	1265	67	636	5.3	10.5	2.0
CPC INC	1767	74	517	4.2	14.3	3.4
RAYTHEON[2]	1581	46	330	2.9	13.9	4.8
CELANESE	1483	43	672	2.9	6.4	2.2
SIGNAL CO.[4]	1617	55	680	3.4	8.1	2.4
PEPSI COLA	1504	73	437	4.9	16.7	3.4
AMER. BRANDS[3]	1756	116	922	6.6	12.6	1.9
KENNECOTT COPPER	1038	107	1224	10.3	8.7	0.9
JOHN DEERE	1757	113	878	6.4	12.9	2.0
KIMBERLY CLARK	1075	62	592	5.8	10.5	1.8
OLIN MATHIESON	1170	43	566	3.7	7.6	2.1
INLAND STEEL	1598	77	847	4.8	9.1	1.9
WARNER LAMBERT	1439	113	748	7.9	15.1	1.9
CAMPBELL SOUP[3]	1150	60	549	5.2	10.9	2.1
ALLIS CHALMERS[4]	1047	12	396	1.2	3.0	2.6
BOISE CASCADE	1495	54	761	3.6	7.1	2.0
PFIZER	1156	104	675	9.0	15.4	1.7
FMC[4]	1651	73	668	4.4	10.9	2.5
AMERADA HESS[4]	1882	126	689	6.7	18.3	2.7
ANACONDA	1203	44	1108	3.6	4.0	1.1
	(1)	(2)	(3)	(4)	(5)	(6)

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS".

[1]ALL FIGURES ARE 10-YEAR AVERAGES OF THE ANNUAL FIGURES FOR 1967-1976.

[2]COMPANIES CLASSIFIED AS DEFENSE INDUSTRY COMPANIES; SEE EXHIBIT VIII.

[3]FOOD PROCESSING COMPANIES.

[4]DEFENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT COMPANIES WHICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY" CRITERION.

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TABLE FOUR

FINANCIAL RATIOS

COMPANIES WITH 1967-1976 AVG. ANNUAL SALES OF $1,000,000,000 TO $1,999,000,000

PROFIT ON SALES
RANK-ORDERED: LOW TO HIGH
(%)

COMPANY	PROFIT ON SALES
GRUMMAN[2]	0.9
ALLIS CHALMERS[4]	1.2
J.P. STEVENS	2.2
RAYTHEON[2]	2.9
CELANESE	2.9
SIGNAL CO.[4]	3.4
BOISE CASCADE	3.6
ANACONDA	3.6
OLIN MATHIESON	3.7
REPUBLIC STEEL	3.9
CPC, INC.	4.2
MOTOROLA	4.4
CARNATION[3]	4.4
FMC[4]	4.4
NAT'L STEEL	4.6
INLAND STEEL	4.8
PEPSI COLA	4.9
OWENS-ILLINOIS	4.9
CAMPBELL SOUP[3]	5.2
CROWN ZELLERBACH	5.3
STANDARD OIL (OHIO)	5.3
KIMBERLY CLARK	5.8
JOHN DEERE	6.4
AMER. BRANDS[3]	6.6
AMERADA HESS[4]	6.7
GEORGIA PACIFIC	6.8
WARNER LAMBERT	7.9
PFIZER	9.0
KENNECOTT	10.3
AMER. HOME	10.7

SALES TO NET WORTH (RANK ORDERED HIGH TO LOW), PROFITS ON NET WORTH[1]
(HIGH-LOW RELATIONSHIPS)

COMPANY	SALES/NET WORTH (X)	PROFIT ON NET WORTH (%)
GRUMMAN[2]	8.1:1	7.5
RAYTHEON[2]	4.8	13.9
CARNATION[3]	3.5	15.1
CPC, INC.	3.4	14.3
PEPSI COLA, INC.	3.4	16.7
AMERADA HESS[4]	2.7	18.3
J.P. STEVENS	2.7	6.0
ALLIS CHALMERS[4]	2.6	3.0
AMER. HOME	2.5	27.0
MOTOROLA	2.5	10.7
FMC[4]	2.5	10.9
SIGNAL CO.[4]	2.4	8.1
OWENS-ILLINOIS	2.4	11.8
GEORGIA PACIFIC	2.3	15.3
CELANESE	2.2	6.4
OLIN MATHIESON	2.1	7.6
CAMPBELL SOUP[3]	2.1	10.9
CROWN ZELLERBACH	2.0	10.5
JOHN DEERE	2.0	12.9
BOISE CASCADE	2.0	7.1
WARNER LAMBERT	1.9	15.1
INLAND STEEL	1.9	9.1
AMER. BRANDS[3]	1.9	12.6
NAT'L STEEL	1.8	9.2
KIMBERLY CLARK	1.8	10.5
PFIZER	1.7	15.4
REPUBLIC STEEL	1.7	6.4
STANDARD OIL (OHIO)	1.5	7.9
ANACONDA	1.1	4.0
KENNECOTT	0.9	8.7

SOURCE: EXHIBIT XVII

[1]ALL FIGURES ARE ANNUAL FIGURES AVERAGED OVER THE PERIOD 1967-1976.

[2]COMPANIES CLASSIFIED AS DEFENSE-INDUSTRY COMPANIES; SEE EXHIBIT VIII.

[3]FOOD PROCESSING COMPANIES.

[4]DEFENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT COMPANIES WHICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY" CRITERION .

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Data Analysis: Companies With Average Annual Sales of $500,000,000 to $999,000,000

Northrop and Martin-Marietta are the only companies classified as defense industry companies included in the 18 company samples that make up Exhibit XVIII. Consistent with our hypothesis of the financial characteristics of the defense industry, Northrop earned the lowest rate of profit on sales (2.5 percent) and its return on net worth (11.8 percent) was as high as would be expected of a thinly capitalized firm (Table Five).

To the extent that Exhibit XVIII is representative of U.S. industry, it would appear that companies in this size group are, on a relative basis, the most profitable and financially secure of all large-scale companies. However, despite the fact that these companies were selected randomly, we cannot be sure that this sample is not otherwise unbiased.

EXHIBIT XVIII

SALES, PROFITS, AND NET WORTH OF COMPANIES WITH 1961-1976 AVERAGE ANNUAL SALES OF $500,000,000 TO $999,000,000[1]

IPANY	SALES (1967-1976) ($000,000)	PROFITS (1967-1976) ($000,000)	NET WORTH (1967-1976) ($000,000)	PROFITS/ SALES 2÷1 (%)	PROFITS/ NET WORTH 2÷3 (%)	SALES/ NET WORTH 1÷3 (X)
RTHROP[2]	713	18	152	2.5	11.8	4.7
NYL	716	47	327	6.6	14.4	2.2
LT	801	31	274	3.9	11.3	2.9
I WALTERS	823	45	309	5.5	14.6	2.7
MINS	588	19	182	3.2	10.4	3.2
RTIN MARIETTA[2]	909	54	486	5.9	11.1	2.0
IBB	851	68	461	8.0	14.8	1.8
PERS	708	31	268	4.4	11.6	2.6
ON CAMP	624	54	351	8.7	15.4	1.8
'L MINING	682	44	288	6.5	15.3	2.4
NS MANVILLE	814	46	476	5.7	9.7	1.7
ERSON ELEC.[4]	846	72	394	8.5	18.3	2.1
WN CORK	543	31	221	5.7	14.0	2.5
RK	913	41	306	4.5	13.4	3.0
KEN	530	44	385	8.3	11.4	1.4
CK	995	155	635	15.6	24.4	1.6
'L DISTILLER	803	52	460	6.5	11.3	1.7
RLING DRUG	718	55	369	9.1	17.6	1.9
	(1)	(2)	(3)	(4)	(5)	(6)

URCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS"

LL FIGURES ARE 10-YEAR AVERAGES OF THE ANNUAL FIGURES FOR 1967-1976.

MPANIES CLASSIFIED AS DEFENSE INDUSTRY COMPANIES; SEE EXHIBIT VIII.

OOD PROCESSING COMPANIES.

EFENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT COMPANIES HICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY" CRITERION.

TABLE FIVE

FINANCIAL RATIOS
COMPANIES WITH 1967-1976 AVERAGE ANNUAL SALES
OF $500,000,000 TO $999,000,000

PROFIT ON SALES[1] RANK-ORDERED: LOW TO HIGH		SALES TO NET WORTH (RANK ORDERED HIGH TO LOW), PROFITS ON NET WORTH[1] (HIGH-LOW RELATIONSHIPS)		
COMPANY	PROFIT ON SALES (%)	COMPANY	SALES/NET WORTH (X)	PROFIT ON NET WORTH (%)
NORTHROP[2]	2.5	NORTHROP[2]	4.7	11.8
CUMMINS	3.2	CUMMINS	3.2	10.4
COLT	3.9	CLARK	3.0	13.4
KOPPERS	4.4	COLT	2.9	11.3
CLARK	4.5	JIM WALTERS	2.7	14.6
JIM WALTERS	5.5	KOPPERS	2.6	11.6
JOHNS MANVILLE	5.7	CROWN CORK	2.5	14.0
CROWN CORK	5.7	INT'L MINING	2.4	15.3
MARTIN MARIETTA[2]	5.9	ETHYL	2.2	14.4
INT'L MINING	6.5	EMERSON ELECTRIC[4]	2.1	18.3
NAT'L DISTILLERS	6.5	MARTIN MARIETTA[2]	2.0	11.1
ETHYL	6.6	STERLING DRUG	1.9	17.6
SQUIBB	8.0	UNION CAMP	1.8	15.4
TIMKEN	8.3	SQUIBB	1.8	14.8
EMERSON ELECTRIC[4]	8.5	JOHNS MANVILLE	1.7	9.7
UNION CAMP	8.7	NAT'L DISTILLERS	1.7	11.3
STERLING DRUG	9.1	MERCK	1.6	24.4
MERCK	15.6	TIMKEN	1.4	11.4

SOURCE: EXHIBIT XVIII

[1]ALL FIGURES ARE 10-YEAR AVERAGES OF THE ANNUAL FIGURES FOR 1967-1976.

[2]COMPANIES CLASSIFIED AS DEFENSE-INDUSTRY COMPANIES; SEE EXHIBIT VIII.

[3]FOOD PROCESSING COMPANIES.

[4]DEFENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT COMPANIES WHICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY" CRITERION.

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Data Analysis: Companies with Average Annual Sales of Less than $500,000,000

Exhibit XIX presents the data for the smaller companies in our sample and must be regarded as inconclusive in its delineation of the financial characteristics of defense-related companies. Todd Shipbuilding lost money throughout ten years, but so did three more non-defense firms, i.e., Bangor-Punta, Redman Industries, and Ampex. We similarly regard as inconclusive the fact that Fairchild was the least profitable of the profitable companies. The only conclusive relationship shown in the exhibit is the sales to net worth ratios of 4.8:1 for Fairchild and 4.1:1 for Todd.

EXHIBIT XIX

SALES, PROFITS, AND NET WORTH OF COMPANIES WITH 1961-1976 AVERAGE ANNUAL SALES OF $499,000,000 OR LESS[1]

COMPANY	SALES (1967-1976) ($000,000)	PROFITS (1967-1976) ($000,000)	NET WORTH (1967-1976) ($000,000)	PROFITS/ SALES 2÷1 (%)	PROFITS/ NET WORTH 2÷3 (%)	SALES/ NET WORTH 1÷3 (X)
BEMIS	432	11	128	2.6	8.6	3.4
NAT'L GYPSUM	464	23	311	5.0	7.4	1.5
FAIRCHILD[2]	255	3	53	1.2	5.7	4.8
HOOVER	428	17	167	4.0	10.2	2.6
AMPEX	267	(3.3)	86	(1.2)	(3.8)	3.1
ALLEN GROUP	157	3	44	1.9	6.8	3.6
OLYMPIA BREWING	132	4	47	3.0	8.5	2.8
FEDERAL MOGUL	307	13	140	4.2	9.3	2.2
RIEGEL TEXTILE	202	6	70	3.0	8.6	2.9
RELIANCE ELEC.	409	21	139	5.1	15.1	2.9
TOOD[2]	189	(2.5)	47	(1.3)	(5.3)	4.0
BANGOR PUNTA	284	(0.5)	114	(0.2)	(0.4)	2.5
SNAP-ON-TOOLS	111	10	56	9.0	17.9	2.0
ROBERT SHAW	168	7	78	4.2	9.0	2.2
CECO	217	8	73	3.7	11.0	3.0
REOMAN	156	(1.1)	25	(0.7)	(4.4)	6.2
AVNET	375	19	116	5.1	16.4	3.2
CLUETT-PEABODY	492	11	147	2.2	7.5	3.3
INDIAN HEAD	468	14	124	3.0	11.3	3.8
BUCKER	106	4	27	3.8	14.8	3.9
	(1)	(2)	(3)	(4)	(5)	(6)

SOURCE: FORTUNE, "THE FORTUNE DIRECTORY OF THE 500 LARGEST U.S. INDUSTRIAL CORPORATIONS".

[1]ALL FIGURES ARE 10-YEAR AVERAGES OF THE ANNUAL FIGURES FOR 1967-1976.

[2]COMPANIES CLASSIFIED AS DEFENSE-INDUSTRY COMPANIES; SEE EXHIBIT VIII.

[3]FOOD PROCESSING COMPANIES

[4]DEFENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT COMPANIES WHICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY" CRITERION.

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TABLE SIX
FINANCIAL RATIOS
COMPANIES WITH 1967-1976 AVERAGE ANNUAL SALES
OF $499,000,000 OR LESS

PROFIT ON SALES[1] RANK-ORDERED: LOW TO HIGH	
COMPANY	PROFIT ON SALES (%)
TODD[2]	(1.3)
AMPEX	(1.2)
REDMAN	(0.7)
BANGOR PUNTA	(0.2)
FAIRCHILD[2]	1.2
ALLEN GROUP	1.9
CLUETT-PEABODY	2.2
BEMIS	2.6
INDIAN HEAD	3.0
RIEGEL TEXTILE	3.0
OLYMPIA BREWING	3.0
CECO	3.7
RUCKER	3.8
HOOVER	4.0
FEDERAL MOGUL	4.2
ROBERT SHAW	4.2
NAT'L GYPSUM	5.0
RELIANCE ELEC.	5.1
AVNET	5.1
SNAP-ON-TOOLS	9.0

SALES TO NET WORTH (RANK ORDERED HIGH TO LOW), PROFITS ON NET WORTH[1] (HIGH-LOW RELATIONSHIPS)		
COMPANY	SALES TO NET WORTH (X)	PROFIT TO NET WORTH (%)
REDMAN	6.2	(4.4)
FAIRCHILD[2]	4.8	5.7
TODD[2]	4.0	(5.3)
RUCKER	3.9	14.8
INDIAN HEAD	3.8	11.3
ALLEN GROUP	3.6	6.8
BEMIS	3.4	8.6
CLUETT-PEABODY	3.3	7.5
AVNET	3.2	16.4
AMPEX	3.1	(3.8)
CECO	3.0	11.0
RELIANCE ELEC.	2.9	15.1
RIEGEL TEXTILE	2.9	8.6
OLYMPIA BREWING	2.8	8.5
HOOVER	2.6	10.2
BANGOR PUNTA	2.5	(0.4)
FEDERAL MOGUL	2.2	9.3
ROBERT SHAW	2.2	9.0
SNAP-ON-TOOLS	2.0	17.9
NAT'L GYPSUM	1.5	7.4

SOURCE: EXHIBIT XIX

[1]ALL FIGURES ARE 10-YEAR AVERAGES OF THE ANNUAL FIGURES FOR 1967-1976.

[2]COMPANIES CLASSIFIED AS DEFENSE-INDUSTRY COMPANIES; SEE EXHIBIT VIII.

[3]FOOD PROCESSING COMPANIES.

[4]DEFENSE-RELATED COMPANIES, i.e., COMPANIES LISTED AMONG THE 100 LARGEST DEFENSE CONTRACTORS FOR FY 1975 BUT COMPANIES WHICH DID NOT MEET OUR "DEFENSE-INDUSTRY COMPANY"CRITERION.

CHAPTER V

CAPITAL EXPENDITURE PATTERNS: SHIPBUILDING AND AIRCRAFT

We hazarded the guess in Chapter I that the U.S. shipbuilding industry was gradually divesting itself in the 1960s of its commitment to shipbuilding. More pointedly, we suggested that the industry had invested only those sums of money needed to keep its facilities from deteriorating to the point where it would no longer be able to build ships. To support our position, we cited what we believe to be relevant statistics on the absolute number of dollars invested by the "large" shipbuilding firms. There is, of course, no way of proving this contention other than by allowing the figures to talk for themselves. However, we sought some additional support for our position and, as discussed in Chapter III, posited a reasonable significance between sales and capital expenditures.

In order to prove or disprove our contention that the defense industry is characterized by a pattern of low investments in capital equipment, we collected and analyzed Census of Manufactures Data, by 2, 3, and 4 digit SIC codes, for a number of industries. As shown in Exhibit XX, the data on shipbuilding is consistent with our hypothesis. From 1961 to 1969, the industry invested only minimal sums of money in new plant and equipment. Only in 1970 did the ratio drop below the 20:1 cut-off point discussed later in this chapter. This was due to the $131,000,000 invested by the State of Mississippi in the Ingalls/Litton Shipyard in Pascagoula. Absent this investment, the industry's overall investment ratio for 1970 would have been somewhere in the 70:1 to 80:1 range. Indeed, ratios as high as this are found in the early 1960s data. Equally revealing is the calculation showing the capital investment made per employee in the 1970s by the firms comprising the industry group.

Even after the industry began a rebuilding process in the early 1970s, the sales/capital expenditure ratios remained high. Only in

EXHIBIT XX
SELECTED DATA: U.S. SHIPBUILDING INDUSTRY
SIC 3731
1961-1976

	CAPITAL EXPENDITURE ($000,000)	SALES[1] ($000,000)	SALES/CAP. INV. (2÷1) (X)	TOTAL EMPLOYEES[2] (000)	CAP. INV./EMPLOYEE[2] ($)
1961	32	1621	50.7	114	281
1962	23	1670	72.6	112	205
1963	25	1680	67.2	115	217
1964	33	1826	55.3	115	287
1965	45	2078	46.2	130	346
1966	53	2339	44.1	135	393
1967	70	2518	36.0	139	504
1968	76	2488	32.7	142	535
1969	88	2560	29.1	143	615
1970	145	2682	18.5	130	1115
1971	89	2761	31.0	128	695
1972	142	3281	23.1	145	979
1973	131	3959	30.2	152	862
1974	216	4825	22.3	162	1333
1975	298	5615	18.8	167	1784
1976	355	5896	16.6	166	2139
	(1)	(2)	(3)	(4)	(5)

SOURCE: U.S. BUREAU OF THE CENSUS, CENSUS OF MANUFACTURES (COL. 1, 2, 4); EXHIBIT IX.

[1]THESE FIGURES ARE THE "VALUE OF SHIPMENTS" FIGURES SHOWN IN EXHIBIT IX.

[2]THESE FIGURES INCLUDE PRODUCTION AND NON-PRODUCTION EMPLOYEES; cf. EXHIBIT IX.

1975 and 1976 do they drop below the 20:1 ratio. This is due to the relatively massive sums of money invested in these two years by the Newport News Shipbuilding Company. Consistent with our thesis, these funds were spent to rebuild the North Yard, a facility designed basically to meet the projected demand for very large commercial ships. The investment for these years bears no relationship to the on-going major naval construction program for which this shipyard is also responsible.

In order to avoid the rejoinder that the shipbuilding industry is unique in this regard, we compared the shipbuilding industry to the aircraft industry, SIC 3721. The results here are even more convincing (Exhibit XXI). For the 16 years ended in 1976, the industry shows a low sales/capital expenditure ratio of 23.8:1 (1966) and a high ratio of 157.8:1 (1971). As might be expected, the high investment period (1966 and 1967) corresponds to the military build-up for Vietnam. Even then, the ratios are above the cut-off point of 20:1 (23.8:1 and 27.2:1) respectively. The low years are 1971 and 1972, and reflect the post-Vietnam cutbacks. However, ratios for the aircraft industry are even more disconcerting in light of the approximate $3,000,000,000 invested by the industry in the 1960s in the wide body jet.

In other words, the industry as represented by Exhibit XXI invested comparatively small sums of money in facilties and manufacturing equipment during the 1960s to accommodate not only to our needs for an increase in the output of military aircraft but also for the development of a major civilian market. We are aware, of course, of the fact that the Air Force provides many of its vendors with machine tools and other manufacturing equipment. But if the 20:1 ratio is meaningful, the Air Force would have had to have provided the industry with some $5,000,000,000 in machinery and equipment during the 1960s, i.e., have purchased and made available to the industry some $5,000,000,000/year in capital equipment. We are also aware of the fact that much of the development and initial production costs for the wide body jets do not necessarily involve the invest-

EXHIBIT XXI

SELECTED DATA: U.S. SHIPBUILDING (SIC3731) AND AIRCRAFT (SIC3732) INDUSTRIES

1961-1976

	AIRCRAFT			SHIPBUILDING
	SALES ($000,000)	CAP. EXP. ($000,000)	SALES/CAP. EX. (X) (1)÷(2)	SALES/CAP. EX. (X)
1961	6000	72	83.3	50.7
1962	6206	120	51.7	72.6
1963	6317	115	54.9	67.2
1964	6584	103	63.9	55.3
1965	7151	141	50.7	46.2
1966	9000	378	23.8	44.1
1967	11079	408	27.2	36.0
1968	13014	282	46.1	32.7
1969	12444	340	36.6	29.1
1970	10996	181	60.8	18.5
1971	9313	59	157.8	31.0
1972	8779	57	154.0	23.1
1973	10666	119	89.6	30.2
1974	11665	111	105.1	22.3
1975	12544	123	102.0	18.8
1976	13420	150	89.5	16.6
	(1)	(2)	(3)	(4)

SOURCE: BUREAU OF THE CENSUS, CENSUS OF MANUFACTURES (COL. 1, 2); EXHIBIT XX (COL. 4).

ment of massive sums of money in plant and equipment such that the $5,000,000,000 may well overstate the actual needs of a highly automated aircraft industry. But this is true only if there is no significant relationship in the airframe industry between capital equipment and productive efficiency.

Of equal importance, in our opinion, is that the industry appears to have spent only minimal sums of money in preparation for the production in the 1970s of the current generation of Air Force and Navy aircraft: the A-10, the F-14, F-15, F-16 and F-18. One can only conclude from this lack of investment that (1) the industry is either not susceptible to any major improvement in productive efficiency, or (2) it has no incentive to seek after major improvements. This is, of course, inconsistent with accepted economic and production theory and practice.

The claim can be made that the industry is living off its prior investment in facilities. This is no doubt true, but only partially so. As shown in Exhibit XXI, the aircraft industry invested comparatively large sums of money in facilities and equipment only in 1966, 1967, 1968 and 1969 such that the bulk of the monies is invested in equipment that is now ten years older or more. To verify this, we reviewed data on the capital investments of five companies in the aircraft industry that do not have major investments in other industries: Boeing, Fairchild, Grumman, McDonnell-Douglas and Northrup (Exhibit XXII).

In the early 1970s, Boeing invested virtually no money at all in capital equipment. The much smaller Fairchild similarly invested virtually nothing. The remaining three invested only what must, at best, be termed moderate sums of money.

Business-wise, however, the policy of minimal investment in capital facilities appears to make sense. Although aircraft industry sales increased from $6.0 billion in 1961 to $13.4 billion in 1976, a heavy portion of this was due to inflation. Evidence of this is

EXHIBIT XXII

CAPITAL EXPENDITURES OF 5 U.S. AIRCRAFT COMPANIES

($000,000) 1970-1977

	BOEING	FAIRCHILD	GRUMMAN	MCD-DOUGLAS	NORTHROP
1970	$21.3	$ 3.8	$24.4	$73.2	$19.3
1971	6.4	3.3	16.7	21.2	18.1
1972	9.4	6.5	10.8	23.6	16.2
1973	33.1	2.0	16.1	33.1	12.7
1974	84.1	5.3	17.7	35.0	32.0
1975	70.8	10.9	27.8	33.1	25.1
1976	67.2	11.1	22.9	40.9	25.9
1977	99.1	14.3	24.1	54.8	23.5
AVERAGE: (1970-1977)	48.9	7.2	20.1	39.4	21.6

SOURCE: STANDARD & POOR, NYSE STOCK REPORTS.

available from a review of the employment and other related statistics for the industry. In 1961, the industry employed 305,000 persons (Exhibit XXIII). Employment peaked at 418,000 in 1969 and has since fallen to 209,000 persons. Based on a quick extrapolation, industry sales in constant dollars in 1976 were some $4.1 billion, or only 75% of those attained in 1961. In other words, the industry appears to be suffering a secular decline in output much as the shipbuilding industry did in the 1960s. And, like the shipbuilding industry, it appears to be minimizing its investment in plant and equipment in order to retain financial flexibility. Unlike the shipbuilding industry, however, the aircraft industry currently is technologically superior to its foreign competitors. As a result, it may not be as vulnerable to a loss of a significant portion of either its domestic or international market as was the shipbuilding industry. However, it should be recognized that the commercial market is heavily dominated by Boeing, the one aerospace firm in the United States capable of investing relatively vast sums of money in efficiency-enhancing plant equipment. No other aerospace firm in the United States, with the possible exception of McDonnell Douglas, currently has the cash position needed to exploit technological innovations and production line efficiencies.

Because of this, we believe that the various exhibits provide data which strongly suggest that key elements of the U.S. aircraft industry may, in the 1980s, suffer a variant of the competitive pressures that the U.S. shipbuilding industry encountered in the 1960s. In light of the growing demand for co-production and other dollar sharing arrangements, it is possible that the U.S. airframe industry may be more vulnerable to foreign competition by the late 1980s than is now anticipated.

EXHIBIT XXIII

SELECTED DATA: U.S. AIRCRAFT INDUSTRY

SIC 3721

1961-1976

	CAPITAL EXPENDITURES ($000,000)	SALES ($000,000)	SALES/CAP. EXPEN. (2÷1) (X)	# of EMPLOYEES[1] (000)	CAP. INV./EMPLOYEE[1] ($)
1961	72	6000	83.3	305	236
1962	120	6206	51.7	326	368
1963	115	6317	54.7	302	381
1964	103	6584	63.9	284	363
1965	141	7151	50.7	295	478
1966	378	9000	23.8	357	1058
1967	408	11079	27.2	387	1054
1968	282	13014	46.2	418	675
1969	340	12444	36.6	396	859
1970	181	10996	60.8	320	566
1971	59	9313	157.9	238	248
1972	57	8779	154.0	232	246
1973	119	10666	89.6	239	498
1974	111	11665	105.1	239	464
1975	123	12544	102.0	220	559
1976	150	13420	89.5	209	717
	(1)	(2)	(3)	(4)	(5)

SOURCE: U.S. BUREAU OF THE CENSUS, CENSUS OF MANUFACTURES.

[1] THESE FIGURES INCLUDE PRODUCTION AND NON-PRODUCTION EMPLOYEES.

The 20:1 Cutoff Point

As we suggested earlier we used a 20:1 cutoff point as the dividing point between high and low reinvestments in capital equipment. The number was derived initially from an inspection of the historical data for those 89 companies which we examined. Its usefulness subsequently was reinforced by a review of the data on the shipbuilding and aircraft industry presented in this chapter. Because both industries are highly concentrated, and because we had backup data on the major companies within the industry, we were able to assess the statistical bias imparted to these figures by the inclusion of a substantial number of small firms. Because of this, we believe that the 20:1 cutoff point is a useful benchmark.

However, we have no way of knowing whether 30:1 or 50:1 is a more appropriate ratio than 20:1, i.e., if there is, in fact, a rate of investment in new plant and equipment that does guarantee the productive efficiency of an industry. It seems intuitively obvious that higher investments in capital equipment are essential to guarantee high levels of productivity. Since the more profitable civilian sector firms must invest relatively more money, and show ratios in the 5:1 to 10:1 range, we believe our judgment on the 20:1 cutoff point is valid. Notwithstanding the above, however, there is nothing normative about a 20:1 cutoff point.

In this regard, it should be noted that neither the shipbuilding industry nor the aircraft industry need worry today about cutthroat competition from highly facilitized producers. No firm in either industry has sought to attain that position. Indeed, in shipbuilding, the two big winners, Bath Ironworks and Todd Shipbuilding, appear to have invested virtually no funds in new equipment in order to compete successfully for the very substantial FFG-7 program. Since it is their comparative efficiency and not their absolute efficiency which is at issue, this failure to invest makes sense from

their point of view. Similarly, Fairchild has obviously invested virtually none of its money in the A-10 program.

On the outside chance that the aircraft industry might have actually diverted substantial sums of money into aircraft equipment (SIC 3728) or missile building subsidiaries (SIC 3761) and, in so doing, caused an understatement in the investment data for the aircraft industry, we checked the data for these two industries. The data are sufficiently similar to that of the aircraft and shipbuilding industries to eliminate this possibility. (Exhibits XXIV and XXV).

As a final check on our use of the data we compared the investment per employee figures for four industries (Exhibit XXVI). In our opinion, the most important potential comparison is between the cyclicality in investment patterns shown by the shipbuilding and aircraft industries.

EXHIBIT XXIV

SELECTED DATA

U.S. AIRCRAFT EQUIPMENT INDUSTRY
SIC 3728
1961-1976

	CAPITAL EXPENDITURE ($000,000)	SALES ($000,000)	SALES/ CAP. EXP. (2÷1) (X)	TOTAL EMPLOYEES[1] (000)	CAP. EXP./ EMPLOYEE ($)
1961	$ 95	4001	42.1	221	$ 430
1962	93	3857	41.5	211	441
1963	68	3359	49.4	186	366
1964	64	3223	50.4	180	356
1965	66	3234	49.0	169	391
1966	111	3992	36.0	200	555
1967	166	4694	28.3	220	755
1968	144	4317	30.0	200	720
1969	138	4504	28.5	197	802
1970	101	3888	38.5	163	620
1971	59	3820	64.7	136	434
1972	39	3012	77.7	102	382
1973	51	3467	68.0	106	481
1974	67	3893	58.1	107	626
1975	96	4445	46.3	110	873
1976	96	4409	45.9	100	960
	(1)	(2)	(3)	(4)	(5)

SOURCE: U.S. BUREAU OF THE CENSUS, CENSUS OF MANUFACTURES.

[1]THESE FIGURES INCLUDE PRODUCTION AND NON-PRODUCTION EMPLOYEES.

EXHIBIT XXV

U.S. GUIDED MISSILES/SPACE VEHICLES INDUSTRY
SIC 3761
1963-1976[1]

	CAPITAL EXPENDITURE ($000,000)	SALES ($000,000)	SALES/CAPITAL EXPENDITURES (%)	TOTAL EMPLOYEES[2] (000)	CAP. EXP./EMPLOYEE ($)
1963	49	3129	63.9	152	322
1964	69	3184	--	--	--
1965	45	3315	73.7	145	310
1966	100	4014	--	--	--
1967	111	4640	41.8	201	552
1968	117	4858	41.5	206	568
1969	89	4632	52.0	178	500
1970	62	3970	64.8	143	434
1971	56	3990	71.3	132	424
1972	63	4124	65.5	118	534
1973	78	4698	60.2	117	667
1974	87	5279	60.7	117	744
1975	85	5503	64.7	111	766
1976	88	5521	62.7	106	830
	(1)	(2)	(3)	(4)	(5)

SOURCE: U.S. BUREAU OF THE CENSUS, CENSUS OF MANUFACTURES.

[1]DATA NOT AVAILABLE FOR 1961 and 1962.

[2]THESE FIGURES INCLUDE PRODUCTION AND NON-PRODUCTION EMPLOYEES.

EXHIBIT XXVI

INVESTMENT PER EMPLOYEE, 1961-1976

SELECTED INDUSTRIES ($)

	SHIPBUILDING SIC 3731	AIRCRAFT SIC 3721	MISSILES SIC 3761	AIRCRAFT EQUIPMENT SIC 3728
1961	281	236	---	430
1962	205	368	---	441
1963	217	381	322	366
1964	237	363	---	356
1965	346	478	310	341
1966	393	1058	---	555
1967	504	1054	552	755
1968	535	675	568	720
1969	615	859	500	802
1970	1115	566	434	620
1971	695	248	424	434
1972	979	246	534	382
1973	862	498	667	481
1974	1333	464	744	626
1975	1784	559	766	873
1976	2139	717	830	960
	(1)	(2)	(3)	(4)

SOURCE: EXHIBITS XX, XXIII, XXIV, XXV.

SUMMARY

Based on the data presented in this report, it seems reasonably safe to conclude that the defense industry is the least profitable and the most poorly financed segment of the United States economy. Further, for whatever value the comparison has, it tends to invest fewer dollars in capital equipment than other major industries in the United States. Simply put, the defense industry favors a labor-intensive approach to the production process.

That it is the poorest segment of our economy is not really surprising. Based on peacetime demand, the industry is rife with overcapacity. Furthermore, the episodic nature of weapons systems development and acquisition in the United States does not lend itself to long-term planning at the corporate level. All too often, the individual firm is left with the impression that it must "bet the firm" each year simply to stay in business. This is, of course, somewhat of an oversimplification since the sales of most large defense industry firms show an amazing stability.[2] When compared to the private sector, however, the rate of growth in sales is smaller. But this obviously is not unexpected in a peacetime economy. Nonetheless, the bidding process for defense contracts often resembles an auction as opposed to the more orderly process that is typified by the private sector.

Analytically, the auction-like atmosphere of much of the defense industry should be anticipated. First and foremost, there does not appear to be a logical place in a peacetime, market-oriented, free economy for a defense industry. If the industry is not economically rationalized, i.e., if a smaller number of more profitable and better financed large companies are not allowed to take over the market, there simply is not enough peacetime business to keep all of the defense industry firms operating at close to capacity. As a result, rationalizing the industry economically would appear to make sense. However, the argument is oftentimes advanced that a rationalized in-

dustry may not have the surge capacity needed to meet mobilization requirements or that it may become more specialized product-wise than is acceptable to the military. Of the two points, we suspect that the concern with surge capacity is the more important one. Nevertheless, there is little evidence in support of the contention that an economically rationalized industry is militarily risky if surge capacity is the criterion. Similarly, product specialization does not appear to be a problem with the possible exception of nuclear powered naval vessels. Thus, it might be possible to rationalize the industry were this a strong national requirement by allowing for the American version of a "national champion." The one caveat here would be the ability of a rationalized defense industry to maintain a sufficiently large pool of skilled labor to allow for a reasonably ordered growth in labor force size should it be required. Given the general level of labor skills in the U.S., the transition to mobilization from a rationalized base should be no more difficult, costly or time consuming, in our opinion, than the transition from a redundant base.

This is reasonably evident, in our opinion, from an analysis of the Navy's FFG program and the Air Force's A-10 program. For both programs, the three prime contractors represented "start up" situations laborwise. Nonetheless, all moved into production apparently on time and efficiently.

Although the issue of whether a redundant base can expand more rapidly and efficiently than a rationalized base is beyond the scope of this study, some of the data would allow one to infer that a redundant industrial base provides no guarantee of an orderly expansion of industrial capacity during surge periods. However, we must quickly admit that we cannot document this contention.

The most often cited argument against economic rationalization is a political one: that the need to maintain employment is greater than the need to realize economies of scale in the production of weapons systems. No counterargument is possible here. If the production of military goods and services is conceived to be a component of

a broader concern with socioeconomic policy, then rationalizing the industry does not in fact make sense. The more critical issue then becomes a judgment at the national level on the financial and productive strength of this segment of our economy.[3] Our analysis to date would suggest that this issue has not yet been clarified. Because it is the least profitable segment of our economy, it seems safe to conclude that the defense industry may have neither the managerial nor the productive capacity otherwise ascribed to it. We believe that this is one of the inferences that can be drawn safely from an analysis of its capital investment policies.

CHAPTER I: FOOTNOTES

1. For a full discussion, see Edward M. Kaitz, The Profitability of the U.S. Shipbuilding Industry: 1947-1976, 1978

2. Idem.

3. These are shipbuilding losses only as indicated in their respective annual reports plus publicly available data provided to the Renegotiation Board.

4. We are unable to fully document this contention, but it would appear from our company confidential data that the industry's long term debt in 1967/1968 did not exceed $50.0 to $60.0 million. Our records show that those firms with external debt were exposed to approximately $3.0 to $5.0 million per firm.

5. Edward M. Kaitz, The Profitability of the U.S. Shipbuilding Industry: 1947-1976, 1978.

6. This statement is based on various newspaper articles and discussions with Navy personnel.

7. This is clearly an "opinion" statement that cannot be confirmed empirically. However, it would seem evident that neither of these firms is large enough or rich enough to absorb losses of these magnitudes without suffering severe cash stringencies in other segments of its business operations. In informal conversation with Air Force personnel, they have noted General Dynamics' lack of willingness to commit capital funds to the F-16 program despite its massive size. We regard this, perhaps improperly, as at least a partial response to the financial pressures created by its shipbuilding losses.

CHAPTER II: FOOTNOTES

1. Nassco.

2. G. D./Electric Boat, G.D./Quincy, Litton/Pascagoula, Lockheed, Beth, and Newport News.

3. Sun and Bethlehem.

4. Todd, Alabama, and American.

5. G.D./Electric Boat, Newport News, and Litton/Pascagoula.

6. Edward M. Kaitz, The Profitability of the U.S. Shipbuilding Industry: 1947-1976, 1978.

7. The thinking here is our own and is not, to the best of our knowledge, reflected either in official government documents or in the writings of other authors. Nonetheless, we believe that the mid-to-late-1960s must be regarded as watershed years in terms of the interplay between technology, doctrine, force structure, and those forms of industrial strength required to maintain our military posture. In a sense, the perceived need for technological growth appears to have become the dominant factor driving doctrine and for structure. The growing emphasis in official OSD literature on technologically-oriented "force multipliers" appears to confirm this. A full discussion of this, however, is beyond the scope of this report.

8. Although it may be stretching the point some, we regard "space", i.e., raw land, as a critical capital good in the shipbuilding industry. For a more complete discussion of the relevancy of space to modern shipbuilding techniques see Lowry and Hoffman Associates, Inc., Technology Survey of Major U.S. Shipyards-1978, 1979.

9. Based on an on-going analysis of the industry, it would appear that material is presently the main cost driver in the U.S. shipbuilding industry. See Edward M. Kaitz and Associates, Inc., Ship Cost Study, Working Paper I, 1979.

10. This point appears to get lost in current discussions of the industry which focus more on the perception of excess peacetime capacity in the U.S. shipbuilding industry than on the fact that segments of the industry may in fact welcome the opportunity to shut down shipbuilding facilities, and release monies otherwise tied up in low profit or loss operations. From the point of view of Maritime power broadly defined, this may well mean that the United States may never again have the capability of maintaining itself as a large scale, fully self sufficient maritime power. The issues here are more geopolitical than industrial and are treated at greater length in Edward M. Kaitz, Maritime Power and Industrial Stability, c. 1979.

CHAPTER III: FOOTNOTES

1. For a more complete discussion of these issues, see Edward M. Kaitz, Federal Procurement Policy and Profit Theory, c. 1979.

2. The Army appears to have paid little attention to this reality and relies on a number of otherwise civilian-oriented firms for armored vehicles of all types. Some of these firms, in turn, devote very little of their industrial capacity to these efforts and, in turn, subcontract out major portions of these contracts to smaller, more specialized firms. Two of the Navy's boatbuilders, for example, have participated reasonably extensively in the production and/or assembly of armored vehicles.

3. See Edward M. Kaitz, Federal Procurement Policy and Profit Theory, c. 1979.

4. Little is known about the behavior of the defense-oriented divisions of major non-defense companies such as General Motors. Conventional management theory would suggest that corporate management "suffers" their existence just so long as they meet required rates of return on invested capital and that, failing this, the defense-oriented divisions would be closed down. Were this to happen, the impact on our military-industrial strength could be devastating. Most mobilization base reviews appear to assume that those divisions are actively sustained by their corporate parents, an assumption that we now regard as highly speculative economically and militarily dangerous.

5. The current NATO RSI policy calls for a greater sharing of military research, development and production activities with our European allies on the assumption that there are costly redundancies in the U.S. and European defense industrial base. However, no full analysis is currently available indicating how this would be accomplished without impacting heavily on the financial and industrial strength of the U.S. defense industrial base. Further, there appears to be no established set of goals or standards delineating the desired scope and content of the U.S. defense industrial base, and how it would fare vis-a-vis the growth of a European defense industrial base given the differing geopolitical and economic context in which these two industrial groups operate. For a fuller discussion see Edward M. Kaitz and Heinz A. Georges, NATO RSI Policy: An Overview, 1978.

CHAPTER IV: FOOTNOTES

1. For a full discussion, see Department of Defense, Profit '76, 1976.

2. Idem.

CHAPTER V: FOOTNOTES

1. In our opinion, this is no longer so. Given the growth in Europe of both the transnational corporation and the "national champion" it would appear evident that Europe is moving to organize itself to better compete with the United States in the high technology market place. Because of Europe's lack of raw material and its greater dependency on export markets, it should be expected to challenge the U.S. in those markets such as high technology which are only minimally dependent on raw material. Further, the Europeans more so than the U.S., need the economies of scale in the output of military equipment because of the smaller size of their individual and collective markets.

2. See Exhibits X-A to X-K, Chapter III.

3. See Edward M. Kaitz, Maritime Power and Industrial Stability, c. 1979.