

Characteristics and Problems of Aerospace Company Management¹

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Introduction

It is a premise of management scholars that the same basic skills are required for good management in any industry. Given this basic premise, there still remain technical problems which readily differentiate management jobs in one industry from comparable jobs in another. It is the purpose of this article to discuss some of the basic and unique problems of management in aerospace/defense firms.

The aerospace/defense industry is easily the largest industry in the United States in terms of both sales and employment. In 1964, "these (aerospace/defense) programs accounted for 25 % of all capital goods produced and approximately \$25 billion worth of goods and services."³ In 1963, The Census of Manufacturers, published by the U. S. Department of Commerce, listed total employment in aerospace/defense firms at approximately 2,100,000; and due primarily to the war in Viet Nam, the size of the industry has grown substantially since then. A good measure of the size of this industry is that "defense/space-oriented industries employ more personnel than the primary metal industries and the motor vehicles and equipment industries combined."⁴ The industry is especially important to the U. S. balance of payments. While talking about the aerospace segment of the industry, *Time Magazine* said, "These (aerospace exports) have become one of the largest items (\$1.4 billion last year) in the U. S. Trade Surplus, which underpins the value of the dollar."⁵

The aerospace/defense industry is composed of an extremely heterogeneous group of companies. In addition to companies such as North American Aviation, McDonnell Aircraft, Lockheed, and Northrop Corporation, which are almost entirely aerospace/defense oriented, many other companies play an important role in the industry. General Electric Company and Westinghouse Electric Corporation both make over 20 % of their sales in aerospace. Raytheon Corporation does 80 % military work, while Sperry-Rand does almost 50 % government business and Burroughs Corporation has 25 % defense work. The large automobile companies, Chrysler, Ford Motor Company, and General Motors

Corporation are all heavily involved in defense industry work. Literally thousands of smaller companies (such as Boston's Microwave Associates and Itek Corporation) are heavily oriented towards the aerospace/defense industry.

Most of the aerospace/defense industry companies can be categorized into one of four groups. The first group might be called the old airframe contractors and includes companies such as Douglas, Lockheed, and Northrop; all of whom have been in the airplane manufacturing business since the beginning of World War II. In order to survive, most of these companies have branched out into other areas, such as space or electronics, in addition to retaining their airframe manufacturing capabilities. A second group of companies is the broad ground-based large companies who are primarily known for products other than aerospace/defense. Included in this group would be companies such as General Motors, Ford, and American Machine and Foundry. Many of the fantastic forward steps resulting in the sophisticated hardware we now see in space and defense have been made possible by the efforts of the third group, the electronics companies such as IBM, Sperry-Rand and American Telephone and Telegraph. These companies are largely responsible for the sophisticated command and control systems in modern day military and aerospace hardware. The companies in the fourth group are relative newcomers and are known in the industry as "think tanks." The primary output of these companies is paper. The sophisticated thinking required to plan, analyze and control modern-day systems is reflected in the paper. Well-known companies in this group include The Rand Corporation, Aerospace Corporation, The Institute for Defense Analysis and TRW Systems (which grew out of Ramo-Wooldridge and Space Technology Labs).

Many unique characteristics of the aerospace/defense industry, ranging from Marketing through Finance, are discussed in the following sections of this article. Most of what makes aerospace company management unique, however, stems from two basic considerations: the product and the customer.

The product is unique because on the shoulders of this industry falls the responsibility for developing the necessary equipment for the defense of the country. It is an unfortunate truism that war, which is certainly distasteful for the country as a whole, is good for this particular industry. Because of modern day achieve-

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³ Reference [7], page 21.

⁴ Reference [7], page 22.

⁵ Reference [1], page 73.

ments in science and engineering, the waging of war has become an extremely technologically oriented enterprise. Accordingly, the responsibility for extending the state-of-the-art in all matters which could relate to the defense of the country has fallen on the aerospace/defense industry. Almost every scientific field known to man has been used and extended by the aerospace/defense industry.

In addition to the type of product, a unique characteristic of aerospace/defense firms is their market place and type of customer. Their main customer is the United States government, because the Government is the agency in our society that is charged with defense responsibilities. The market is generally considered to be dominated by this one customer (monopsonistic) even though various branches of the government do operate semi-independently in their procurement practices.

As will be brought out later in the article, many of the unique characteristics of aerospace company management are a result of the uniqueness of the customer and the customer's attempts to compensate for the deficiencies in the market characteristics.

The character of the product sold by the aerospace/defense industry has changed markedly over time. As the growth of the "think tank" attests, much of today's aerospace/defense dollar goes into sophisticated research and development and systems analysis. "... there has been a substantial increase in expenditures by the Department of Defense for research, development, test and evaluation. . . ."⁶ and a corresponding increase in the percentage of defense funds spent for sophisticated electronics systems. This trend is probably one that will continue while the defense industry continues to become more "think" oriented and less production based.

Marketing

The single, most important characteristic of the aerospace/defense market place is its monopsonistic character. Not only is the market dominated by a single customer, but often it is this customer rather than supplying firms who initiates business contacts. The customer develops his own requirements and presents them to the industry asking for proposals which are then evaluated. Because of the large expense involved in creating the product, competing products for a specific proposal are not usually developed and produced. The customer (the U. S. Government) has to evaluate contract proposals and decide relatively early in the game (as compared to the ordinary commercial environment) who the supplier is to be.

In the attempt to adjust for the lack of a competitive market place, the government has resorted to several types of techniques. The first of these is regulation of performance before, during, and after the contract. The United States Air Force Systems Command 375 Series

⁶ Reference [4], page 21.

of Directives and NASA's Directive 500.1 are illustrative of this type of regulation. In addition to these basic documents outlining customer performance requirements, many other government agencies have regulations (e.g. Fair Labor Practices) that have to be met by the aerospace/defense contractors.

Because neither the U. S. Government nor individual firms usually care to bear the expense of developing competitive products for the same proposal, the government has had to set up several steps of proposal evaluation that result in the choice of a contractor before a product is actually developed and built. For example, the request for quote (RFQ) and request for proposal (RFP) result in documents which are evaluated by the government. Because the proposal is of primary importance in determining who wins the contracts or business, companies go to great efforts to make good proposals. "The cost of preparing proposals has been estimated at from 3-5% of total annual (company) sales." It was one researcher's conclusion that "the major marketing communications activity in terms of time, effort and cost in the defense/space industry is the preparation of proposals."⁷

To the individual firm, perhaps the most important regulation is that the government contractually retains the right to decrease a company's profit in any case where it feels profits are excessive. This renegotiation in order to limit aerospace company profits has been the subject of much complaining from the industry.

Another one of the prime characteristics of marketing in the aerospace/defense industry is the political environment. Perhaps more in this industry than any other major industry, political considerations are explicitly recognized for their importance. The importance of political considerations in the market that aerospace/defense firms serve is easy to understand considering the fact that funds for this industry are appropriated by the United States Congress.

In addition to the various product characteristics, the geographical location of the contractor is of primary importance in the award of a contract. The government likes to spread the work around and, although California is easily the most predominant state in terms of aerospace/defense industry, many attempts (not all successful) have been made to spread military contracts to other parts of the country. Any contractor who bids on, and expects to get, a large contract must include plans to subcontract a good percentage of the total work effort to other companies in other states. The government will not allow any one company to become completely predominant in obtaining contracts, regardless of the quality of its work.

The government goes to great efforts to make sure that small business shares in the defense dollar. As one leading aerospace industry executive has said, "Efforts have been made in the past by the small business

⁷ Reference [7], page 191.

⁸ Reference [7], page 345.

administration to obtain the right to screen proposed subcontract placement and to determine on the basis of need which small business concern should be awarded this work... it is unlikely that the small business administration can possibly obtain and maintain sufficient data to enable it to make adequate judgements in these matters in all areas and under all circumstances that are present in the decision to award subcontracts in the small business area."⁹

In addition to being acutely sensitive to local and national politics, aerospace/defense firms are very directly tied to the state of international affairs. "All aerospace companies are sensitive to the hot and cold winds of international relations. 'A communist leader sneezes in Moscow or Peking,' says Lockheed's Executive Vice-President Kotchian, 'and we feel it here in Burbank.'"¹⁰

The aerospace/defense industries have reacted to their political environment through their marketing departments. Omnipresent is the "retired officer" syndrome. Marketing departments of most large aerospace contractors are heavily populated with retired Army, Navy, and Air Force officers. These people are hired with the hope that their presence will give the firm an insight in how to deal with Washington in addition to the possibility that retired officers many retain high level contacts within various purchasing agencies. Aerospace/defense companies maintain field offices in most sensitive locations. "Lockheed not only keeps a 22-man Washington team circulating among the Pentagon, NASA, the FAA and Capital Hill; but deals with 300 separate offices and agencies of government through seventeen sales offices across the U. S."¹⁰

In addition to maintaining proper contacts, aerospace/defense marketing departments are responsible for obtaining intelligence information about competitors' products and plans and about the government's desires, and are often responsible for long-range planning. Long-range planning is a matter of life or death in the aerospace/defense industry, because of the complexity of the product and the necessarily long lead times for required research and development, engineering and production. Decisions often have to be made five to ten years ahead of time in order for a company to be an active competitor in any particular area. The desirability and necessity of obtaining information about government desires and competitors' plans is obvious.

What aerospace/defense marketing departments don't do is also interesting. "Aerospace marketing organizations do not generally perform the marketing functions of product adjustment, physical distribution, transaction or post transaction."¹¹ Since the customer usually takes delivery of the product at the producer's plant, there is no need for distribution systems and

indeed, one finds that aerospace/defense industry firms do not in general have distribution networks.

Government regulations have produced an interesting characteristic in many aerospace firms where public relations departments perform functions that would be normally marketing oriented. The Defense Department does not consider company advertising to be an "allowable" expense. This means that it may not be charged against a contract. Aerospace/defense firms do advertise, but as a result of this regulation it is often difficult to find all advertising costs listed as itemized expenses. Some advertising costs may be spread out and buried under other titles. As a result, "advertising is not recognized as a marketing activity; public relations departments usually have the responsibility in this area."¹¹

Some companies elude the requirement that advertising is not an allowable expense by advertising company products under the guise of seeking new employees. Any scientific journal usually has several ads in which a company has a product prominently displayed with a small paragraph mentioning that scientists and engineers are needed to work on the project. The ad, which serves both the purpose of advertising the company's product and of searching for new employees, may then be legitimately passed off as a cost of finding and hiring personnel.

Contracts and Sales

Aerospace/defense contractor sales are made in the form of contracts. The sale almost never consists of standard items that are coming off a production line, and that are ready for immediate delivery. Relatively standard items might be sold to the government, but usually the customer needs amounts in excess of that immediately available and provides a contract which the firm uses as a basic commitment in setting up engineering and production facilities.

The specific nature of contracts with the U. S. Government differs substantially from contractual obligations in the normal commercial world.

"To regard the defense contract as merely a special kind of sales contract, or special kind of employment contract, is to misunderstand its true character. The contract not only sets forth the description and performance requirements of the article or system being purchased, the compensation to be paid the producer, and the mode of payment; it also spells out the many restrictions on the activities of the defense contractors. For example, they are required to pay their employees a specified minimum wage; to refrain from discrimination in employment because of race, creed, color, or national origin; to use only materials of domestic origin; and to favor small business concerns in making purchases.

"The contract also spells out the management decisions which may require the approval of, or initiation by the government. Included among such decisions are those which change the specifications of the article being produced, determine whether to 'make or buy,' and those which concern contractual relationships with subcontractors. Many defense contracts also differ substantially from the ordinary commercial contracts in the power they give the government to adjust the

⁹ Reference [5], page 3-9-5.

¹⁰ Reference [1], page 79.

¹¹ Reference [7], page 466 & 467.

compensation both *during* the performance of the contract and *afterwards*, and to examine the books and operations of the defense contractor in conjunction with such power.

"The defense contractor, moreover, is subject to regulations which may not even be contained in his contract. In a recent case, for example, a construction contractor was held to be subject to the provisions of a termination clause *not appearing in his contract*, but which was *required* to be incorporated in his contract by the applicable procurement regulations."¹²

The government uses and has used several different types of standard contracts and fee arrangements in dealing with private industry. Cost plus fixed fee (CPFF), cost plus incentive fee (CPIF), and fixed price (FP) are the names of some contracts presently used by government procuring sources. The various types of contracts are used in situations where the reimbursement procedure is deemed appropriate; and the popularity of different types ebbs and flows with time. Probably the most infamous type of contract was the cost plus percentage of cost (CPPC), where the contractor's profit was a direct percentage of the total amount of money he spent on development of the item. It would be hard to imagine a reimbursement procedure with a more direct incentive for mismanagement and overspending. Because of this, the contract was outlawed and is not now used. In recent years, the Defense Department has made an attempt to place heavier emphasis on contractual incentives for good performance.

Probably the most popular contract over the last few years has been the cost plus fixed fee (CPFF) contract, whereby the supplying firm makes a fixed profit regardless of what it spends on the contract in addition to being reimbursed for its costs. Because of the fact that much work done by aerospace/defense firms is on development of the state-of-the-art, costs can be very difficult to forecast; the idea of a cost plus contract has developed as a most feasible solution to the uncertainty. The fact that there exists no free market with supply and demand to determine sales price also has dictated the necessity to fall back on cost as a basis for determining sales price. Although this contract does not directly penalize a supplier for poor performance, it does provide some incentive in that late delivery times and higher development or production costs will result in a lower return on time investment for the firm than would otherwise be possible.

Recently, however, the government has felt it advisable to provide even greater incentives for good contract performance than the CPFF contract provides. Much more popular recently has been the cost plus incentive fee contract. For example, in August of 1966, NASA reported converting two major contracts from CPFF to CPIF. These contracts were with the Chrysler Corporation for the manufacture, assembly and test of twelve Saturn I first-stage rockets and with North American Aviation, Inc. for 52 J-2 engines for the

Apollo Lunar Landing Program. The incentive fee contract determines a contractor's profit inversely to the way the cost plus percentage contract determined profits. If the contracting firm underruns forecasted costs, their profit is adjusted upwards so that the firm shares in part of the savings. If the firm overruns costs, then the firm's profits are correspondingly negotiated downwards so that not only the return on time and investment is lowered, but the actual total dollar profit is also lowered. Under the current Johnson administration, CPIF and fixed price contracts will probably become more popular as the Defense Department and other government agencies attempt to instill free market incentives into defense contracting.

The concern with cost lowering is a natural outgrowth of the "cost effectiveness" policies that Robert McNamara has instituted in the Department of Defense. Defense Department procurement has a long history of being much less interested in the cost of the product than its performance capabilities. Considering the use of aerospace/defense products, perhaps this approach is easy to understand. As was recently concluded by one researcher, "Cost factors are still not considered to be the dominant factor in the selection of contractors."¹³ The recent award of the TFX (F-111) plane contract to General Dynamics over a lower cost bid by Boeing illustrates this point.

In addition to most of the restrictions already mentioned, the government also requires contractors to invest substantial efforts in reporting on the progress on the work they are doing. The government does this to maintain control of the work and work effort provided by contractors. The objectives are certainly the best; however, the bureaucratic implementation of these objectives often results in less than desirable situations. Typical of aerospace/defense industry executive comments is the following:

"In the matter of finance controls there is found an increasing tendency to require the management to furnish detail data and reports on contracts that of themselves cannot benefit either the government or the contractor, but merely serve to create costs that must be borne in the end by the government. For instance, for reasons which of themselves are excellent, the government requires each contractor to submit itemized data on each major contract (Form DD1097) specifying contract values and the amounts to be expended by months and quarters to the end of the contract, as a means of determining the probable cash flow requirements of the government for all Department of Defense products under contract. It is obvious that such a report is meaningful and useful to predict government cash payments to be made in the future. The problem lies, however, in that if a contractor reports a deviation from the projected expenditure of more than 3%, he is required to explain in detail the reason for such change, whether it be more or less than the prediction and justify his action to the satisfaction of the government.

"It is almost self-evident that this leeway is so small that a contractor will tend not to report deviations which he believes are susceptible to remedial action, in order not to be faced

¹² Reference [4], page 32.

¹³ Reference [7], page 49.

with the problem of explaining a potential action that would normally lie within his prerogative as a manager.”¹⁴

Again, of course, the purpose of requirements such as this one is to attempt to correct for the lack of control provided by a free market place.

The attempt to control government contractors by various contractual restrictions often results in different governmental agencies issuing conflicting requirements. One of the most infamous examples of this was the following problem which has since been remedied.

“To cite one of the most glaring examples of over-control in this connection, an employer is required to advise one branch of the Government how many employees it has of races other than Caucasian. Another branch of the Government denies an employer the right to have any code or identification on its personnel records to indicate distinction of race, color, or creed!”¹⁵

Although most contractors have gotten around this dilemma by informal procedures, it serves to illustrate a fallacy of overcontrol.

In a probably useful attempt to regulate contractor performances, various data banks are kept by the Federal Government on contractor performance. The purpose of these data banks is to permit government agencies to evaluate a contractor's forecasted performance in light of his past performance. Any company tendency to forecast low costs and perform at high costs may be counteracted by using the data bank to evaluate the company's past performance.

In trying to provide an equitable return to companies in the aerospace/defense industry, the government often inadvertently provides contracts with disincentives for good management. The objectives may be good, but the policies which provide implementation for these objectives are often deficient. A good example is the fact that under many government contracts, producers are reimbursed a good percentage of their costs, as these costs are incurred. The purpose of a provision of this type is to prevent undue financial strain on the contractor and to permit him to undertake more production than would be possible if he were financially constrained to his own resources. Under this type of policy, a contractor can be reimbursed for purchases made from outside vendors that apply to the relevant government contract. In order to be effective, the reimbursement is made rapidly. Ironically, the very rapidity of this reimbursement can in itself provide a disincentive to good management. It is possible for a company to order heavily as soon as possible in order to receive the reimbursement and then to delay up to the maximum possible in paying for the goods purchased from the vendor. In this way, companies can obtain temporary usage of the government funds that are intended for vendor reimbursement. This “float” can be an extremely attractive method of financing. Another example of this type of disincentive is the type of contract

¹⁴ Reference [5], page 3-9-2.

¹⁵ Reference [5], page 3-9-6.

that reimburses a company for the expenses of engineers and scientists who are charging directly to a contract. The engineer's take home pay may be from \$5 to \$8 per hour; however, the company is reimbursed at \$20 to \$25 an hour for the engineer's time to cover overhead allocations. The company determines its budgets and overhead factors with the anticipation that it will enjoy this source of funds to cover overhead expenses. Accordingly, if it is later found out that not all of the people are needed to work on the project, the company has no incentive to dismiss the surplus since they would only save the direct labor cost of paying the individual while losing all of the funds from the government to cover overhead expenses (usually a much larger amount than the direct cost).

Finally, one prominently mentioned disincentive to good management is the government contract provision calling for renegotiation of profits, both during and after performance. The purpose for this factor is to insure “fair” treatment of both the government and the contractor while the contractor is working with technologies which are unknown and advanced. The unfortunate result is that much incentive to good management is eliminated because of the feeling that profits accruing from sharp management will simply be renegotiated downwards.

The person primarily responsible for carrying out the government's side of the bargain in any contract is the contracting officer. His role and responsibilities are somewhat unique and the following quote illustrates this.

“... the institutional pressures on contracting officers and, for that matter, on the defense contractors themselves, may prove in actual practice to be more influential than the judiciously phrased general principles so often found in regulations.

“... the contracting officer is rarely in a position to apply a regulation in full, even when he wants to. For example it is usually difficult to tell in advance what facilities of the contractor will be used on a particular contract, let alone on *all* the contracts which he has with the government. But even when the contracting officer may be able to exercise judgement concerning the various elements supposed to make up the profit factor in the negotiated price, the contracting officer's superiors are not in a position to determine whether the contracting officer has exercised his judgement wisely.

“Many contracting officers chose the expedient solution to their quandary: through experience they arrive at a profit or fee rate that is well below the maximum permitted but high enough that the contractor will accept it, and they use these few rates over a long period for all contracts they negotiate regardless of contractor or situation. As time goes on, they tend to lower the rates slightly to establish themselves as good bargainers.

“The virtues of the magic number system are obvious: the contracting officer has little risk of spurring an investigation by the General Accounting Officer (GAO) if the rate is stable and trending downward, the contracting officer's superiors (who are in a poor position to evaluate the reasonable nature of the costs) are pleased at what appears to be hard bargaining, and, finally, the contractor feels some sense of continuity—the known fee of today may be better than earnest negotiation on each contract may yield tomorrow.

The drawback to this system is that it tends to become universal and ignores the individual characteristics of each situation."¹⁶

Given the immense size of the defense industry establishment and the necessary requirements for individual serious negotiation on each contract it is doubtful that the government possesses, desires to obtain, or could possess the requisite personnel to alleviate the above mentioned problem.

Personnel

A statistical sample of the type of personnel employed in the aerospace/defense industry would certainly rate this industry as being unique. Engineers and scientists form an extremely high percentage of total aerospace/defense employment. For example, "today engineers and scientists constitute a third of Lockheed's work force against only 5% during World War II."¹⁷ No other industry in the United States comes even close to matching the total number of engineers and scientists who are employed in this industry. The engineer, scientist or technical Ph.D. is an extremely common commodity in this industry. Aerospace/defense firms have had to live with the scientist Ph.D. and have found that he does not need to be treated like a queen bee.

One outstanding characteristic of scientists and engineers is that they are in short supply. To fully appreciate how short the supply is one needs to pick up a copy of the Los Angeles Sunday *Times* and look through perhaps 30 pages of classified ads for engineers, scientists, programmers, et al. This shortage has enabled the engineer or scientists to sell his skills in a seller's market. This shortage has also, unfortunately (from the Company's point of view), led to a great amount of job hopping by technical people. It is a well-known fact in the aerospace industry that one can raise his salary much faster by changing companies than by staying in one job. Even though some companies have signed "anti-raiding" agreements any aerospace/defense industry's staff of engineers and scientists is in the majority composed of people who have also worked for other companies in the same industry.

Almost any company that bids on a major project does so without having all of the technical personnel that they need already hired; and does so in the expectation that if they receive the contract, they will be able to hire the necessary personnel away from competitors. Because of the shortage of technical people, companies are often unable to hire adequate personnel for their projects.

Production and Products

The most unique characteristic of aerospace/defense industry products is that they are constantly bordering on the very edge of the state-of-the-art knowledge. Technical innovation is the trademark of this industry.

¹⁶ Reference [4], page 22.

¹⁷ Reference [1], page 76.

In this one industry you will find all of the latest techniques and knowledge concerning almost any scientific field. In addition to always pushing forward the frontiers of knowledge in the various scientific disciplines, aerospace/defense industry products are extremely complex in that they often require integration of many seemingly unrelated disciplines. Space medicine, human engineering, aerospace dynamics, navigation, propulsion and information processing are all vitally inter-related in the project to land a man on the Moon. These, and many other disciplines, will all be involved in almost any space probe program that the United States carries out.

Items such as Mercury or Gemini capsules are complex and are also produced in such small quantities that they must be essentially hand-made. This complexity, however, can apply to products such as fighter planes, which are produced in much greater numbers. An extremely complex plane, such as McDonnell Corporation's Phantom II, or even a relatively simple plane, such as Northrop Corporation's F-5, is fantastically more complex than the fanciest airplanes of 30 years ago. Because they are so complex and utilize such modern techniques, advances and improvements are almost always being made on planes and other products which are coming off a production line. It often is a company's desire and an Air Force requirement that many of these advancements be fitted to the planes (or other products) as they are made. Sometimes these changes must be retrofitted to existing similar products. This constant change provides one of the major problems of production in the aerospace/defense industry.

Another unique characteristic of the aerospace/defense industry is that companies in this field sell research and development as an end product. In the normal commercial world, R & D is performed by companies in order to develop new and superior products so that the company can remain competitive in the market place. The payoff from the R & D is translated into profits by way of sales of improved products in the market place. In contrast, the aerospace industry performs R & D on a contractual basis as an end product in itself. As a matter of fact, this particular product is becoming more and more important as the character of the industry is veering away from being production oriented towards being more Research and Development and Engineering oriented.

The extremely complex nature of the skills required and the products made in this industry have caused the aerospace/defense industry to pioneer in the solution of both internal and external communication problems. Internally, the companies have the problem of integrating the efforts of highly-trained experts from widely diverse fields and producing a single product from these efforts. Externally, the environment and contractual obligations expose the companies to an extremely difficult communications problem. For example, most major contracts have one or more prime contractors in

addition to several associate contractors each of which may have subcontractors and several tiers of subcontractors below the first. When one subcontractor of another subcontractor of an associate contractor of a prime contractor (*ad infinitum*) suggests a change, all of the other companies must be notified of and approve the change. When you consider that in addition to this, the relevant governmental agencies must also approve changes, the level of the communication problems becomes more clear. Interested governmental agencies, in addition to those legally or contractually obligated, will often have an influence in plans. For example, the Air Force and Air Force Systems Command are vitally interested in all NASA projects because they follow the possibility of militarily adapting them. When the Air Force makes a suggestion on a NASA contract, any aerospace firm is desirous of conforming to the suggestion because of the possibility of generating future sales to the Air Force. At the very minimum, no aerospace contractor cares to offend the United States Air Force, a major customer.

Finance and Control

In addition to the many restrictions applied to, and reports required from government contractors, the basic control function in an aerospace/defense company may be affected by governmentally-imposed criteria. Most aerospace/defense companies are project instead of functionally oriented. To a large extent, this is the result of the type of sales that the companies make. The acquisition of a contract represents a sale. The contract is usually for the completion of a specified task and companies organize in project form to perform this task. The prevalence of project orientation in the industry is probably much greater than in the ordinary commercial world. "Industry experience supports the concept of planning, budgeting and reporting costs by organization units. This approach is the result of the distillation of many years of experience by practitioners of management planning and control. On the other side, through PERT and PERT/CO, the military's needs have been identified as requiring planning, budgeting and control of cost by event or activity. . . . These conflicts . . . require the Wisdom of Solomon to balance."¹⁸

Many contractors feel that the government prefers a project orientation because it is easier to control and evaluate the events and progress under this organization. It also requires the company to assign specific people to a project and therefore, the government can know exactly who is working on it. Cost accumulation is relatively simpler in a company that is project oriented because the problem of prorating joint costs is not as great as it is under a conventional functional organization. As a matter of fact, probably the only major disadvantage of organizing along project lines is that some overhead functions have to be performed individually by a staff at each project and as a result the

total overhead cost is greater than it would be under a functional organization.

When talking about the subject of finance, sooner or later everyone ends up at that favorite subject, profits. Two major conclusions can be made concerning profits in the aerospace/defense industry. The first is that compared with the rest of American industry, profits as a percentage of sales are very low for aerospace/defense industry contractors. The second is that because of government supplied equipment and financing, the return on investment earned by aerospace firms seems to be adequate and competitive with industry in general.

"... examines at some length the trends in defense profits and the question of whether these profits are, in fact, adequate. Profits in the aerospace industry at least as a percentage of sales, are found to be declining steadily over the past few years. There has been a long, continuing debate between governmental officials (particular officials of the Renegotiating Board) and the defense industry concerning the profitability of the industry. This debate has centered about the selection of the base employed to measure profitability.

"Those contending that the profits of the industry have been or are inadequate are impressed particularly by the low profit to sales ratios in the industry. On the other hand, those who have regarded defense profits in past years as high—or even too high—point to the consistently higher than average return on net worth of the companies involved.

"*Fortune* reported that the return on sales in 1961 of the aircraft industry (2.2%) was the lowest of any of the 21 manufacturing industries. But it also reported that the return on invested capital (11.6%) was the third highest."¹⁹

Recently, the profits to sales ratio of the industry has been increasing slightly. According to *Time* Magazine, "... aerospace profits remain low: 3.1% of sales against 5.5% for all U. S. manufacturers. One reason: in a little noted change of vast consequence, cost conscious Robert McNamara has switched Pentagon buying away from lax, cost plus contracts towards fixed-price, incentive awards."²⁰ Industry executives feel that in the past couple of years profit ratios have slightly increased, but the reason given by *Time* for the still low profit ratios is probably incorrect. As a matter of fact, profit ratios have increased during exactly the same period that cost consciousness has become part of Pentagon thinking. Most industry executives prefer the newer Pentagon incentive approach since they feel it is the only way to increase profit ratios while at the same time improving performance.

Probably the single most unpopular provision in government contracts is that provision providing for renegotiation of profits that are "too high."

"In the general field of finance, it is suggested that with all of the controls and reports and procedures requested for good reason by the Government, to insure economical practice and good management, one overriding and diametrically opposed control exists—renegotiation. If it is intended that management is worthy of its hire and that its most productive results

¹⁹ Reference [4], page 28.

²⁰ Reference [1], page 73.

¹⁸ Reference [3], page 4-5-3.

can be attained by incentive contracts and the continuation of the free enterprise system, surely the fact that ingenious and imaginative management efforts may well result in a renegotiation refund will stultify the management incentive to so improve its performance."²¹

Although loathe to publicly admit it, many industry executives feel that the government does not provide proper incentives for good management or disincentives for bad management. Not only do industry officials feel that they are not properly rewarded for inventive and ingenious solutions but some correspondingly feel that there is very little risk associated with average or subpar performance. "The government can't let us sink, we're a vital industry." " 'Frankly, it's awfully hard to lose money in this business,' says Westinghouse Space Chief Huggins, 'the risk isn't as great as it should be. The Government doesn't have the means of judging good performance and poor performance and penalizing it accordingly' ."²² Unfortunately, this accurately states the situation. The problems of correctly assessing performance are immense, and the fact that these problems have not been solved is a major cause for the inadequacy of the incentives as now applied. At the same time, however, there is general unanimity in the belief that the Pentagon has taken large steps forward in improving the situation both for incentives for good management and with disincentives for poor management.

Even though aerospace/defense industry contracts are getting more complex as time goes by, there is no question but that governmental administration of contract performance has also improved. While it may be easy to criticize, it is not always so easy to suggest valid improvements. There is no question but that the type of contracts used by the government are improving. No more do we find such absurdities as cost plus percentage types. Some governmental agencies are now putting page limits on proposals which force contractors to do more thinking and less sheer data generating. Governmental evaluation of important costs is becoming more sophisticated all the time. The earlier quote from *Time* Magazine concerning the trend from cost plus contracts towards fixed-price incentive awards are illustrative of this. Also illustrative of this is the fact that items such as computer expenses which used to be automatically reimbursed are now being evaluated on each contract. Both the government and the industry are very optimistic that these types of improvements will continue over time.

Conclusions

The primary purpose of this article has been to try to shed some light on those unique problems of management that executives encounter in the aerospace/defense industry. These unique characteristics are an outgrowth of the type of customer that the industry

²¹ Reference [5], page 3-9-3.

²² Reference [9], page 93.

has and the resulting market place and requirements dictated by this customer. The products of the industry are certainly technologically unique and correspondingly, the type of personnel skills required to produce these products are unique because of their level of sophistication.

While the aerospace/defense procurement system has major shortcomings and problems, it has successfully passed the most important test of all: success. An evaluation of United States technology and power can only result in the true claim that the United States is the most technologically advanced country in the world. This state of affairs is due in major part to the contributions made by the aerospace/defense industry. Many knowledgeable people feel that the status of the industry and its relationship with the government can only improve with time.

Most experts do not consider the market for aerospace/defense products to be a growth market. "The general market is no longer considered to be a growth market."²³ These experts have been wrong in the past but even if the market for these products does not increase and remains relatively stable, the aerospace/defense industry will continue as the largest (by many criteria) industry in the United States.

Befitting its status, this industry will doubtlessly remain the object of considerable study. The *Weapons Acquisitions Process* by Professors Merton J. Peck and Frederic M. Scherer of the Harvard Business School is but one example of large studies of the aerospace/defense industry that are currently ongoing. We can only hope that as a result of these studies, procurement and other procedures in the industry are bound to improve.

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²³ Reference [7], page 48.