THE APOLLO PROJECT MANAGER-CONTRACTOR
INTERFACE

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Preface

During the conduct of the research investigation of Apollo project management, the plants of five major prime contractors were visited and over fifty interviews were conducted (and recorded) with personnel of these contractors. The contractors and their major prime Apollo contracts are listed in the table below.

Contractor	Location	Contract
Grumman Aerospace Corp.	Bethpage, N. Y.	LM
No. American-Rockwell Corp.	Downey, California	CSM
No. American Rockwell Corp.	Seal Beach, California	SII Stage
Rocketdyne	Canoga Park, California	F-1, H-1, J-2 Engine
McDonnell-Douglas Corp.	Huntington Beach, Cali.	SIVB Stage

Although not all of the major Apollo prime contracts have been involved in the research thus far, those indicated above constitute a majority of the prime contracts and are certainly typical of the rest. The interviewees comprised a representative cross-section of upper echelon Division officers, program and functional managers, as well as NASA resident personnel from both MSC and MSFC.

Syracuse University participants in the plant interviewing trips were E. E. Drucker, H. G. Frederickson, A. Sallett and B. K. Kelmachter.

This paper is in essence an outline of the author's impressions concerning the NASA-contractor interface, as obtained from the field interviews with contractor personnel. The tendency of the author at this time is to look through the contractors' eyes. In a subsequent publication, the NASA-contractor relationship will be treated in a more impartial manner, by carefully weighing and balancing the collective viewpoints of the two principals.

The observations and ideas set forth in this paper will be largely cast in the form of two types of comparison. One of these concerns the similarities and differences between MSC and MSFC, while the other has to do with NASA and contractor styles of project management.

Introduction

In examining the relationship between Apollo project managers and Apollo contractors, perhaps the only generalization that can survive close scrutiny is the statement that the relationship is among the most important in the NASA Apollo Program. This follows from the fact that most hardware design, essentially all manufacturing, and most test work is done by contractors. Yet the essential, if not legal, responsibility of participating in the awarding of, monitoring and changing contracts resides with the NASA project managers. It is true, of course, that the NASA managers have important working relationships with in-house NASA engineers, scientists, legal and contracting personnel, etc. Nevertheless, of the many elements which comprise the total program the two most vital ones are the industrial contractors and the project managers who respectively, do the work and see that it is done.

The legal nature of the NASA manager - contractor relationship is well defined in contractural documents. The actual nature of the relationship, however, varies widely in the Apollo program, generally developing well beyond the specifications of the contract in terms of frequency of contact, informality, and mutual aid. The basic reasons for the existence of a variety of types of relationships are set forth below.

a) The relations undergo distinct changes with time, due mainly to the fact that the work usually progresses through conceptual, design, manufacturing and test phases. The fact that different contracts may be in effect for different phases is of minor consequence, since the same contractor usually is engaged for all of the phases. Yet the nature of problems and subject matter discussed and acted upon are vastly different in the concept phase than in the manufacturing phase, for example. In the former case there is significant communication in terms predominantly of technical matters. "Technical" decision

implies a decision based on engineering or scientific information which affects the working or performance of a piece of hardware, computer program, or flight plan. In manufacturing, on the other hand, concern will be focused on delivery schedules, minor engineering changes, and inspection and check-out procedures.

b) The missions of the contractors are each unique, the magnitude of the contracts vary tremendously and the reliability and safety requirements for the various components differ significantly. These differences each introduce variations in the manager - contractor interface.

c) The Centers with whom the contractors interface have different management organizations and philosophies, or at least they have different apparent management practices. Inevitably, then, the manager - contractor relationship will differ substantially for contracts issued by the two major centers under study, MSC and MSFC.

d) Personalities paly an extremely important part in determining interface relationships, as they do within NASA, and in shaping management practices. No one can deny that, to varying degrees, personality characteristics are important variables in any organization composed of people. Nevertheless, most theory assumes that an organization is built up by first constructing an organizational skeleton or framework, then filling the slots with appropriate individuals. Contrary to this theory, in the real NASA world it is more often the case that individuals establish methods of dealing with others, following which this real behavior is codified by fitting an organizational framework around them.

Technical Decision Making

It is comfortable to think that the NASA project manager's responsibility and therefore his decisions can be divided into technical, schedule and cost

categories. "Technical" decision implies a decision based on engineering or scientific information which affects the working or performance of a piece of hardware, computer program, or flight plan. There is no doubt that these three elements exist and are identifiable in most actions. But they are rarely, if ever, independent of one another. A "technical" decision can never be made without considering its influence on cost or schedule. It may have no influence, but certainly the project manager must think about and make a judgement in the matter. Similarly, a change in schedule cannot be made without any impact on cost and often performance.

Rather than trying to identify a decision as technical, schedule or cost according to the major subjective content of the problem, it is perhaps more rational to indicate the type of problem and decision by its origin. The need for a decision arises when a problem materializes and one of several alternative solutions must be chosen. The problem will commonly be of the nature of an indicated failure to meet performance specs, a schedule slippage or a potential cost overrun. These are clearly identifiable by source, but the solution to each (or decision making) will surely involve all three classical elements. Decision making is nothing more than the selection of one of alternative solutions. The function of the project manager is to examine and evaluate the alternatives and make the most rational choice. The manager has staff personnel who gather and prepare basic information concerning performance (systems engineer, sub-system manager, or R&D liaison person), schedule (program control) and cost (contracts and pricing). Managers will have various degrees of familiarity with technical details, depending upon the individual and the NASA center. He relies, therefore, to a greater or lesser extent on his engineering staff members for evaluation of the performance side of problems and their alternative solutions.

In matters of technical origin, it would appear that the MSFC project manager relies very heavily on the in-house R&D people for engineering evaluation. His activity has been characterized aptly as a "lateral management," as a Chairman of the Board, as a mediator of the technical laboratory representatives and perhaps more of a coordinator than an independent decision maker. Contractors generally consider this style to be a consequence of the strong laboratory orientation of Huntsville, in turn a historical institutional development, by no means devoid of personality factors. As far as the contractor is concerned, this managerial style, dependent as it is upon concurrence of many people, makes for a lengthier decision making process, but also a more carefully considered one than the strong project management format.

This latter style, in a rather general sense, is characteristic of MSC project management. Inherent in this generalization is the danger that the style attributed to the center is in fact a reflection only of one or two individuals at MSC. Regardless of the underlying causative factor, however, the empirical observation of Contractors and researchers alike is that the MSC manager sits astride a pyramidal organization, takes more of the decision-making responsibility upon himself. This may require, or it may follow from a greater participation of the manager in the technical details of the problem and its solution. It is inevitable that the less a manager avails himself of staff technical judgement, the more he must provide by himself. This accounts for the excrutiating detail with which some MSC managers become familiar with the engineering content of their projects, a phenomenon which never ceases to amaze contractor managers to which this concept is generally foreign.

A point of similarity between both Centers and the contractors is the technique of the CCB's (Configuration Control Boards). All organizations have parallel CCB's at different program levels. Engineering change proposals

(ECP's) are processed more rapidly at Houston than at Huntsville because of the greater degree of centralized project management at the former center.

Contract Negotiation

If the NASA and Contractor project managers have the responsibility for making program decisions, the Contracts or Contracts Pricing offices only have the legal authority to translate these decisions into contractual documents, or changes thereto. Since, in the technical world of NASA, decisions and negotiations are of a highly sophisticated nature, and since Contracting personnel are generally not engineers by background, there is a natural communication and understanding barrier that exists between project manager and contract administrator. This is not to say that the barrier is insurmountable, it is simply inherently there.

At MSFC, the Contracts Office is not a subdivision of the Apollo Program Office, but is an independent staff or functional group. The manager - contract administrator relationship therefore tends to be somewhat formal and somewhat far apart, and the process of translating program needs into legal documents tends to be lengthy and needful of better coordination.

At MSC, the contracting and technical people have a less formal and more closely allied relationship, and as one Contractor respondent aptly put it "are closely in bed with each other." The NASA contract people participate in technical negotiations between NASA and Contractor managers, a practice not followed at MSFC. As a result of the close liaison there generally is quicker contract action. Organizationally, this takes place through the Contract Engineering Offices, which are jointly responsible to the Program Office (via Program Control) and to the Director of Program Control and Contracts on the staff side of the house.

In terms of Contractor preference, there is little doubt that the MSC type of contract negotiation is the more desirable of the two. This feeling is illustrated by the statement of a Contractor Executive who had had experience with both Centers: "I have never yet had a verbal commitment out of Houston sitting in this office with the contracting people and the technical people that wasn't lived up to by the contracting people." By implication, there were experiences with Huntsville, in which, at the very least, there were difficulties with NASA contract follow up of prior technical agreements.

NASA Influence on Contractors' Organizations

Virtually every Contractor has indicated that NASA has influenced its organizational form, pushing it toward a strong program, semi-autonomous organization within the parent firm. This has been characterized as "a company within a company." To some contractors the programmatic organizational form was not new. Some contractors resisted but all seemed to have evolved a strong program office. Ironically, these contractor program offices appear to be considerably stronger than those in NASA itself, the very stimulant to the emergence of the aggressive, action-oriented management format. There undoubtedly also has been some influence on the NASA organization by contractors, but this is much more difficult to assess.

The notion that the NASA and the Contractors' program offices have corresponding or counterpart positions is widespread in NASA. However, it was found that the Contractor's Program Manager in general does not have a single counterpart in the Space Agency, in spite of the efforts of the latter to bring this about. The desirability of counterpart personnel throughout the affected organizations is clear, in that it makes obvious points of contact and promotes ease of communication and pinpointing of responsibility. It was found,

though, that there is an overlap, rather than a clear cut matching of responsibilities. Correspondingly, it was indicated that particular contractor managers had several alternative points of contact in NASA, at different authority levels. This is particularly conspicuous at MSC, where despite the official designation of only one program manager for Apollo, there are assistant and subordinate persons whose responsibilities although not titles, correspond closely to those of a project manager.

It is understandable that each NASA project and sub-system manager desires to see his Contractor's manager occupy a position of great authority within his Company. This insures the assignment of a generous share of the Company's resources to the project involved and a high standing on the Company's priority list of in-house work. However, the strength of the Program Manager within his Company depends on the relative value of the Contract to the Company, measured not exclusively in dollars but in terms as well of the future potential of the product concerned or the technical capabilities acquired. Some of the Contracts were so large and important that the Program organization quickly assumed the actual, but generally not titular, status of a separate division of the Company, physically not contiguous to the Company and having most of the staff support usually associated with a parent company. A good example of this arrangement is the SII Stage Program, conducted by the Space Division of North American-Rockwell Corp. at its separate facility in Huntington Beach.

On the other end of the spectrum, where there are several projects of relatively small and equal size, the company resources are economically distributed to the project in the recently designated "matrix form." That is, the several projects draw on functional services of Company Departments, and personnel have joint responsibility and loyalty to both programmatic and functional organizations. In contractor parlance, this process is known as "projectization."

Resident NASA Organizations

As a consequence of the differences in project manager authority at the two NASA field centers, the resident NASA personnel at the Contractor sites appear also to have corresponding differences in authority. After all, the resident manager is an extension or a representative of the Center manager, and the observation above is therefore to be expected. The Houston RASPO (Resident Apollo Spacecraft Office) people apparently make more on-site decisions than the Huntsville RMO (Resident Management Office) personnel, who more typically refer problems back to Huntsville for review and decision.

The contractors for the most part recognize some benefits, to them, of the presence of NASA resident personnel (mostly where the personalities are conducive to cooperative mutual aid), but also feel that residents to some extent hinder the progress of the contractor's work. This is natural. When viewed from the NASA point of view, however, it is clear that the residents have played an essential role in keeping the contractor's progress as well as his potential problem sources highly "visible" to Center project and vehicle managers.

Some Contractor Complaints

It is inevitable that the forced intimacy of a public and a private agency will produce certain tensions, points of friction and irritation. In defense of the overall system, however, it must be emphasized that all parties concerned agree that the general nature of the NASA - Contractor relationship is not only satisfactory, but has helped more than hindered the achievement of program objectives while fully protecting the public interests. The complaints made by the contractors should be viewed against this background, and perhaps considered as suggested areas of potential improvement in the NASA - Contractor mode of operation.

1. There is excessive monitoring on the part of NASA, and undue penetration into the internal affairs of the Company. This is no doubt due to a well meaning, paternalistic attitude on the part of NASA toward its contractors. Nevertheless, it creates in the contractor organization a "goldfish bowl complex." Monitoring activities have been decreasing in recent months, as projects near completion.

2. There is a general feeling that NASA is overmanned, especially at the resident level. This is more so now than in the earlier stages of the program, and is partly attributable to the small degree of flexibility that NASA has regarding the decrease of civil service personnel. At any rate, a sort of Parkinson Law affect sets in which leads to

3. Excessive requests by NASA for information, briefings, proposals, etc. The tendency to have meetings increases in inverse proportion to the amount of work that people have to do. At the same time that pressures on NASA personnel are relaxed, the work load on contractor personnel tends to increase in view of the phasing down of manpower toward the end of the contract period. This accentuates the time demands placed on contractor personnel by NASA in the final project phases.

4. There is some ambiguity in NASA management, compared to the Company's clear lines of authority. Who to go to to get particular decisions? Who is authorized to require the contractor to make changes? There is no single chief engineer on the NASA management team for a particular project. There is a whole spectrum of changes, from those lightly suggested by intermediate level NASA people to those demanded, authorized and contracted for by top level NASA managers and contract officers. This is a difficult allegation to prove, because in a legal sense there is a formal, well defined procedure for bringing about not only hardware changes, but schedule, cost, contractor personnel and other changes

as well. However, one cannot ignore the intangible effects on contractors of suggestions and requests specifically voiced or implied by NASA representatives from various organizations. For example, although many contracts are funded and monitored by Centers, much of the authority for approving the contracts, changing them renewing them, etc. lies in Washington. Therefore, the contractors find it difficult to resist their natural tendency to satisfy various members of the Headquarters establishment. Directions thus indicated sometimes cause conflict with Center or project managers.

5. Contractors sometimes get caught in the middle of an inter or intra-center dispute. In particular certain NASA internal personality conflicts, which have been difficult to keep concealed, have had adverse effects on some contractors.

6. Ordinarily, hardware in production at a contractor plant is subjected to quality control checks by both plant personnel and NASA resident QC personnel. In some cases, however, other federal agency QC personnel are utilized in a plant at which other than NASA projects are also in progress. These might be Army, Navy or Air Force civilian QC personnel, who are responsible directly to their own agency supervisors, although they are representing NASA in their relations with the Contractor. In effect, then, there are three parties involved in QC affairs in the plant, and since many of the QC judgments which must be made on the floor are subjective in nature, a good deal of friction can easily be generated.

7. As discussed earlier in this paper, there exists on the part of the NASA managers the tendency to become involved in a great deal of technical detail. This causes some of the contractor managers to be uneasy because they feel oblicated to participate in a like manner in project detail, at the same time that they have demands on their time which are different than those of the contractor managers. In the section which follows, the description of

this difference is amplified.

Comparision of NASA and Contractor Project Management

Several similarities and differences between NASA and contractor project management have been alluded to in the paragraphs above. A thorough exposition of the subject would require a lengthy paper in itself, and indeed this is an objective which is being pursued. At this time, however, an outline would be useful of several of the more salient features of project management as practiced by the principals involved in this study.

1. The contractor's fundamental motive is profit, whether it be direct or the acquisition of an expertise and experience base from which other enterprises may be launched. This is not to deprecate industry; on the contrary, the indirect motive is the very vehicle by which NASA funded technological developments are most effectively transferred to the industrial community.

Obviously, NASA's function is not to earn money but to insure the meeting of performance and schedule goals set in the early stages of each project. While project managers operate under money constraints, they are generally less concerned with effecting economies than they are with obtaining the greatest performance and reliability of their hardware in a given time.

While there is no conflict between NASA and contractor by virtue of basic motives, these do influence the general philosophies of the two groups.

2. The contractor's major problem areas are detailed design in the early phases; manufacturing, labor, union and associated difficulties in the latter project phases. In the early stages of most project developments, the NASA manager often participates in technical evaluation and critique, but as the project matures, his concerns shift to scheduling, supplementary funding and controlling changes. Thus, the roles of the NASA and contractor managers are not the same and they diverge to some extent with time. The managers are

therefore not "counterpart" in the sense of performing similar or parallel tasks, but are complementary to each other and act more as members of the same rather than competing teams.

3. The contractors' program organizations are strong and highly pyramidal in shape, at least in the case of major prime contractors. NASA's influence in this direction has been large, but by the nature of private enterprise, supervisors have more authority over subordinates than in public service (with the exception of military and police types of functions). The NASA program organization appears to be weaker in terms of line authority, having the nature more of a coordinating, monitoring and advising group. However, there are or have been particular project managers who are highly authoritarian, even bordering on dictatorial.

4. Contractor project organizations of any size have designated chief engineers (generally called Project Engineer). The project manager relies heavily on his chief engineer for technical work and decisions, concerning himself with schedule, cost, contract and change negotiations, production, quality, and customer relations.

The NASA project manager in effect has many engineers, but no chief engineer. Some individual may, by virtue of his personality or stature, take on the responsibilities of a chief engineer, but there is no formal structure of this kind.

5. Contractor program managers tend to delegate more authority to their staffs than do the NASA managers. Many possible reasons for this behavior may be suggested, but evidence to confirm the predominance of any particular one is presently lacking.

6. It could be predicted from observations 4 and 5 that NASA managers tend to engage in greater amounts of technical detail than do the contractor

managers. Indeed, this has been found to be the case, as was pointed out in earlier references, particularly with regard to the MSC management style. Contractor managers, it was shown, depend heavily upon their chief engineers for technical detail, because there is a formal staff structure and because the managers themselves have decision making responsibility in many different areas.

7. The prime contractor is a middle man with respect to sub-contractors; that is, he is both contractor and contractee. This position can create certain problems which the NASA managers do not encounter with their single outside interface. Of course, it is also true that NASA managers do assume active relationships with many sub-contractors. But these relationships, certainly in a legal sense, are different from those of the prime contractors.

Summary

The interface between Apollo program manager and contractor has been discussed from two points of view. In one, the similarities and differences between the two types of managers are examined. Differences exist because there are government agency and private industry operations involved, with quite different motivation. This in turn leads to dissimilar organizational structure and manager authoritativeness.

Interfaces are also discussed with a view toward existing variations at the NASA field centers of management style in contractor dealings. These variations result from the differences in institutional history and in key-figure characteristics.

In a separate listing, various pieces of contractor criticism of NASA are tabulated, in a manner which is somewhat biased in favor of the contractors' bones of contention. More detailed study and analysis of both NASA and contractor interviews will yield, it is certain, supporting evidence for most of

the impressions and hypotheses stated herein. In the final analysis, hopefully an unprejudiced analysis of the complaints of both principals may be made.