

Controlling Resources in the Apollo Program

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Following is a slightly modified version of a paper written as part of our training effort for new staff members and interns in the Apollo Resources Control group in the Office of Manned Space Flight. Some of the points may seem elementary today, but I think many of the points are worth repeating. My tendency is to emphasize personal involvement and responsibility for estimates and conclusions. To some extent, this paper reflects my concern that the emphasis on automation tends to de-emphasize these concerns. Nevertheless, today I would put more emphasis on cost rate analysis, discussed below.

What We Are Trying To Do

One objective is to make sure that the budget plan really reflects the intent of management. This means the estimates must cover the program that management has approved and that there must be a reasonable basis to believe that the estimated amounts will buy what they are intended to.

Conventional budget reviews have been directed toward making sure the estimates are not padded. In R&D programs, the real problem is often one of underestimating what it takes to do a job, in both time and money. Any energetic agency has more good ideas than dollars. The budget process is aimed at getting as much program as possible within the dollars available, and at the same time making sure that we do not unknowingly take on commitments which we cannot support within the available funding. An important part of our analysis effort is to make sure that the estimated resources are a reasonably valid reflection of what it would really cost to do each option.

An essential function of our office is to get obligational authority from the review levels above it. This means preparing and supporting budget

requests and, more importantly, preparing our own top management to support the budget request.

Looking in the other direction, we must determine how much obligational authority the offices really need. What we want to do is to provide for a tolerably sufficient but somewhat uncomfortable allocation. There is no question in my mind that a certain amount of pressure caused by funding levels below apparent demands is essential to any sort of management discipline.

Other vital activities in monitoring progress are to determine if the use of funds is in accord with the agreed-to plan or known intent to deviate from the plan; any units are running too far over or under availability; or reallocation of funds is needed.

Another function is to keep management informed. The key here is to sort out the type of information and the level of detail that are really useful to management. This depends in large part on the personality and interests of the manager. I believe that the most common mistake in this regard is to try to give the manager too much unfocused detail.

Approach: How We Do It

The way you work depends somewhat on your level in the organization, the management relationships with other offices, and the people involved. I think, however, some general techniques are applicable to almost any sort of budget review function.

Personal contact is usually more important than paper work. In many organizations, you get your important points across to top management by telling them rather than writing to them. You learn more about what is really going on by talking to people than by reading reports. One important

technique is assigning **reliability factors** to people. Over a period of time you come to know that information received from some sources will almost always be right and well considered, whereas other sources are relatively unreliable. Other people will form an evaluation of your reliability factor with respect to both the information they get from you and the use you are likely to make of information you get from them. Establishing a good reliability factor for yourself and assessing that of others are two of the most important things you do.

The concept of correlation and probability testing applies to just about any sort of learning and evaluation process. **Common sense correlation** is, to my mind, the most important technique in assessing data. This means that, over time, you formulate an idea of what things ought to cost and, when any new estimates are presented, you have a basis for comparison. You are constantly testing the probability that what you hear or read is correct. Does it make sense when put beside what you already know?

Besides correlating various inputs of information on costs, you need to compare dollar estimates with non-fiscal data such as progress against scheduled accomplishments, complexity of work to be done, possible knowledge of other work assigned to the same organization, and other relevant factors you know. Multiple sources of data should be sought and the results constantly compared.

The type of correlation I have in mind is more intuitive than mechanical. It becomes a habit; it grows on you. To promote its growth, you need to develop a reservoir of knowledge on your own programs and related programs. You need an understanding of what needs to be done to make the program succeed. You need a general grasp of the technical problems, the management problems, the political environment, and the capabilities of the people we are relying on to do the job. It takes time and effort to acquire this background. You need to conscientiously study the hardware and operational aspects of the program. You also need to spend time working with the numbers. You need to "own" the figures. I believe that you are more likely to develop this by personally working with the numbers rather than relying on automated data. Once you have done enough of this work with the proper frame of mind, the correlations will come naturally. Your mind will accept or reject figures, often without knowing the specific reasons, but you will usually be right.

A great deal of work has been done to establish mechanical means of correlating funding estimates with factors such as weight, complexity, speed, size, production rates, etc. So far, these efforts have been only partly successful and do not provide a substitute for well-developed intuitive judgment.

It is almost always true that the whole is better than the sum of the parts. In developing estimates, I believe in building up pieces to the extent that time and knowledge permit a reasonable job to be done, but this should always be correlated against a broad scope look at the overall picture. If there is a conflict in the results, I would base my judgment on what a common-sense look at what the overall picture says rather than a meticulous addition of the pieces. I believe that excessive immersion in detail is not only tedious but also can be detrimental to doing a good job at the overall program level. A balance between specific knowledge of details and judgment at the total level is needed.

Cost rate analysis is an important way to look at overall program trends. Contractors build momentum which is not easily changed. It is like a river that keeps on flowing no matter how hard you blow on the surface. In most cases you can safely judge that cost and manpower utilization rates will not change rapidly unless some very strong pressure is applied or some unusual program factors are involved.

A commonly misunderstood technique is what I call the "spot probe." In reviewing an estimate, you probe in depth into a specific item. You ask difficult and detailed questions and generally give the person defending the estimates a hard time. This can be done in a civil manner. You are not really interested in the specific details, but you are trying to determine how carefully the estimates have been developed. Probe several points. You should not judge too much by a test of any one area; but by probing several areas, you do get a feeling for the degree of confidence you can place in the work that went into developing the estimates. Be careful in applying this technique. Do not embarrass people unnecessarily. You will be dealing with them later. If a proper rapport is maintained, you can work with them to correct any deficiencies you find.

Communications Upward

The work of building a budget or resources plan and monitoring performance against the plan is wasted unless:

- It enables you to do a job that you need to do
- It gives your management the information it needs to do its job, or
- It answers questions that need to be answered.

Give management the answers it really needs and wants--not the answers you think it would be nice for them to have. They already receive more information than they can handle. If a part of management has been delegated formally or informally to the resources office, I believe that authority should be exercised with only as much feedback to top management as they really want. Try not to take questions to management take solutions and take them only when there is a real reason to do so.

Examples of key questions that the resources office needs to be ready to answer are:

- Are we staying within our fund availability?
- Do we have enough funding to get the job done?
- Are there some areas where we have allocated more than we really need?
- How much room do we have within our fund availability to expand our plan or to take on new work?
- What are our problem areas and what are we doing about them?

We need to be ready to go into detail, but I think the basic guideline is to tell management what it needs to know--not what you think would be interesting.

The other types of reporting upward involve Review Authorities and Public Information. My basic ground rule is: ANSWER THE QUESTION ASKED. Don't volunteer information not requested. Answer honestly and simply in a manner that is meaningful to the recipient. If, for policy or other reasons, you can't give an honest answer, don't answer at all. Better to take some guff for not answering than to destroy your reliability rating. One qualification is that so long as you are on the payroll, you must support the agency policy and decisions even if you don't agree. The top management knows things you don't know which may make their decisions the best possible under the circumstances.

Characteristics of an Analyst

What are the characteristics we look for and seek to develop in a budget or resources analyst? I think the main factors are:

1. Reliability
2. A "why" mentality
3. A numbers sense
4. Interest in the program and enough background to understand it
5. Ability to work with others under stress
6. Willingness to get involved in a lot of "spread-sheet" work
7. A feeling for the big picture, even when working the detail
8. Ability to express ideas, oral and written
9. A sense of timing
10. Common sense and sound judgment

Reliability. This is probably the main qualification for any job. The person you are working for needs to know that you can be counted on for your best efforts and good judgment in carrying out any assignment.

"Why" Mentality. Whenever you are given information, there should be an automatic questioning of why this can or cannot be accepted at face value and how it relates to what you already know. The approach is not one of questioning integrity of the persons providing the information; but, in many cases, they will not have gone through this thinking process themselves. Before we can really use the information, we need to understand it.

Numbers Sense. It is my observation that numbers talk to some people the way words do to others. A good analyst needs a real feel for the numbers. I don't know why some people seem to have this and others don't, but I believe it is largely a matter of habit, interest, and basic aptitude.

Interest in the Program. To enjoy budgeting, you need a real feeling of identification with the program for which you are budgeting. As a minimum, you

need enough interest to acquire the basic knowledge to understand what you are budgeting for. Usually your effectiveness will increase in direct proportion to your real concern for accomplishing the objectives of the program.

Ability to Work with Others. You are always reliant on the work of other people. Sometimes our requests on others are somewhat unreasonable and have the potential of working against their interests. There is necessarily a good deal of stress involved in a budget operation, but success is dependent on ability to maintain a satisfactory rapport with the people with whom you need to work. I believe the main elements in this capability are:

- Openness in letting them know what we are doing,
- Giving them a sense of confidence on how we will use data, and
- An ability to distinguish between friction that arises in business and your personal relationship with an individual.

Detail Work. I believe that an analyst should actually enjoy a certain amount of spread-sheet work, even if it is partially automated. In my opinion, you need to work with the figures before they really become part of your thought processes.

Big Picture. All of our detail work is done for a purpose. To be effective, you need to be able to keep the objective in mind even while you are working on the detail. You also need an ability to depart from the detail approach when the objective requires that you do so. You need to be prepared to accept the fact that those above you may reach conclusions which differ from the results of your detailed analysis. You need to realize that the detail work is only one input into a large arena of decision-making.

Communication. For the results of our work to be effective, we need to express our ideas and conclusions both orally and in writing. We need to

learn to express them in a way that will reach the person for whom they are intended. Often, the ability to put the message into a concise written form is a good test of your real understanding. The approach will differ with different people and at different levels of management. For the top level, we need to say what needs to be said briefly and clearly when the opportunity presents itself.

Sense of Timing. This involves judgment as to which deadline needs to be met. It also means acceptance of the fact that a 70% job available a half-hour before a meeting is usually better than a 100% job a half-hour after the meeting. One of the most important aspects of providing support to management is providing it when needed. As an analyst, you need to be willing to take the risks involved in providing something less than a completely satisfactory product in time to do some good. This is a matter of accepting the goals involved in the overall purpose of the work rather than taking particular pride in any individual piece of the total effort.

Common Sense and Good Judgment. A requirement for these characteristics is inherent in any responsible job. It is implied in all of the above points. The need for common sense and judgment becomes especially important when guidance is inadequate, when there is not enough time to meet all requirements, or when dealing with matters which have become emotional issues. In much of our work, all three of these factors are present.

General Comment on Qualifications

No mention has been made on academic training. Over the years, I have worked with many excellent analysts, and I am not aware of any particular correlation of specific types of education and success in budgeting. Some accounting and management courses are probably desirable, if not taken too seriously. In programs such as space or defense, some background in science and engineering can be helpful. Training in written and oral communication has value. In general, I believe successful performance in the academic and work environment is more important than any specific training.