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PROGRAM CONTROL FOR MISSION SUCCESS

by G. W. Longanecker

My first premise is that in order to exercise program control, you must have a controllable program, which is one that has been properly scoped technically, realistically scheduled, and adequately budgeted.

The first step in scoping a program is obtaining a set of minimum performance requirements to meet the mission objectives. I know that this is a difficult task, because your customer is intent on achieving the maximum possible performance. However, my recommendation is to get an agreement with your customer on the minimum requirements, and then set the specifications to achieve a reasonably increased level of performance. This will allow for possible descoping actions later in the program, should the need arise. Since our programs nearly always involve state-of-the-art technology, and with today's emphasis on resource control, a good descoping plan developed early in the program is important to have in your back pocket.

The other two ingredients of a controllable program are schedule and cost. The two are very much interdependent and must be balanced with the degree of risk deemed appropriate for the program. There has been a lot of rhetoric on the subject of risk, especially in recent years. However, in my 30 years with the agency, I really didn't see much risk-taking, even with the unmanned scientific and applications satellite programs. Risk is extremely difficult to quantify, especially when you're dealing with single satellite programs. How do you explain a risk trade-off to a group of space physicists who are committing possibly half of their professional careers to a single satellite mission?

My consummate goal was always mission success. What this really boils down to is that you need to have adequate schedule slack and budget contingency to solve the inevitable problems that will confront you along the way. Headquarters must hold sufficient reserves to cover any changes in scope. This is important enough to reiterate. The project manager at the field Center budgets and controls reserves for problem solving; the program manager at Headquarters budgets and controls reserves for scope changes. The last line of defense is to descope the program.

As I said earlier, if you have set your specifications with some margin over the minimum goals, you should have some room to descope and still meet mission objectives. The real challenge for a manager is that you probably will have to make some descoping decisions during the development phase so that you have some remaining contingency for the test and evaluation phase, mission operations, data collection and data processing.

Properly scoping a program requires that sufficient studies be performed during the definition phase. As a rule of thumb, four to eight percent of the expected total run-out cost of a program should be spent through Phase B. In my experience, NASA is notorious for skimping on definition-phase funding. When you skimp during Phase A and Phase B, you have an open invitation to performance, schedule and budget problems during Phases C and D. As part of the procurement planning process, you will develop in-house a "should-cost" estimate for the program. Your budget requests will be based on this "should-cost" figure plus contingency. Because of competition, you will most likely negotiate a contract for less than the "should-cost" estimate. The difference should not be considered part of your contingency for problem solving, but rather it represents the additional funds required to realistically perform the prescribed effort without prob-

lems. Occasionally a contractor will propose a scheme that should save some money, but again my experience has been that you should pay attention to your "should-cost" estimate.

Beyond the programmatic obstacles to a controllable program, the single biggest hardware obstacle in my experience has been piece parts. I can't remember a single program (and I've launched 21 satellites) where we didn't have problems with piece parts. We'd design a circuit, breadboard it, test it and then find that we couldn't get flight-qualified versions of the parts. We also suffered from being a small-volume user of piece parts since most of our programs involved a single satellite. The only advice I can offer is to use standard parts as much as possible in your designs, order your parts as early as possible in the program, and look for second-source suppliers for your critical parts. Even after doing all of the above, the odds are that you will have piece part delivery problems.

As for program control, there are many good techniques and tools. Everything starts with a good work breakdown structure (WBS). You will have developed one during the definition phase and for the Phase C and D procurement package and, subsequent to contract award, will agree to the WBS with your prime contractor. The WBS is the basis for your schedule projection and budget estimate. It must have sufficient granularity to identify the critical elements or building blocks of the program.

Your schedule must have slack identified at critical points in the program. It is not sufficient to carry all the slack in the period just before the launch readiness date. This is especially true when you're dealing with intergovernmental or international partners in a cooperative program. In most cases you'll find that the cooperating agencies have even less flexibility to deal with schedule and budget changes than we do in NASA. Once established, the schedules can be tracked by any number of computer-generated systems. Critical paths are easily identified and tracked. However, I advise you not to rely solely on the automated schedule systems. I've always found it useful to prepare a few charts on critical elements that I could update manually to look for schedule trends. My favorite is one that tracked on a monthly basis, for a few selected milestones, the currently planned date versus the originally scheduled date (Figure 1).

I would frequently find that I could apply the slope of the trend for intermediate milestones to forecast the most probable completion date for a downstream event, even though the contractor continued to forecast the original event date. I found it easier to look at my few graphs than to study the computer-generated charts covering the walls of the "war room." You have to keep a perspective on the big picture.

The final element of program control that I wish to discuss is a performance measurement system (PMS), or earned value system, which allows you to track progress versus expended resources compared to your plan. Essentially all major contractors have a PMS that they use for their programs. The key word here is "use." Having a PMS in your contract is a useless exercise if the contractor is not actually using the system to help manage the program. Accordingly, you should adopt the system your contractor is familiar with, rather than insist on a similar but different system. Due to the nature of our business, changes to the program baseline are to be expected. Obviously, such changes should be kept to the absolute minimum, but when it's unavoidable, any significant change must be quickly incorporated into the PMS.

Reporting earned value against an outdated plan is useless at best. It can be worse than useless if someone believes data that is blindly cranked out, based on an outdated plan. If

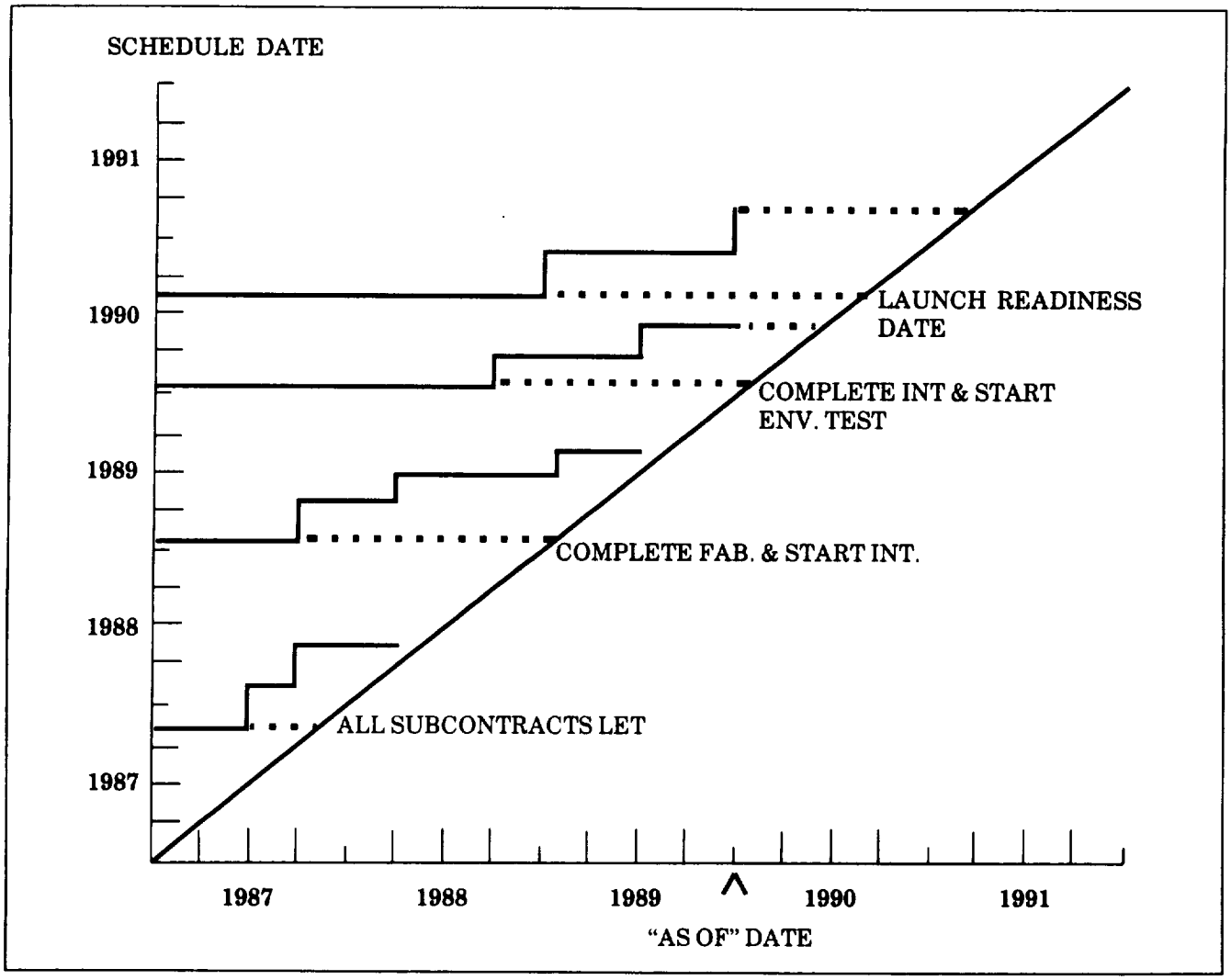

Figure 1. Sample Trend Chart

the data is current, a PMS can help you detect the trouble spots sooner and, therefore, direct your problem-solving energies more efficiently.

As with automated scheduling systems, PMS is not a panacea for the managers. You have to keep track of the big picture, and above all, use good old common sense.