DEFENSE SYSTEMS MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE
INDIVIDUAL STUDY PROGRAM

DEVELOPMENT OF AN INTEGRATED
MASTER SCHEDULE FOR
WEAPON SYSTEM ACQUISITION

STUDY PROJECT REPORT
PMC 77-1

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Major USAF

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DEVELOPMENT OF AN INTEGRATED MASTER SCHEDULE

FOR

WEAPON SYSTEM ACQUISITION

Individual Study Program

Study Project Report

Prepared as a Formal Report

Defense Systems Management College

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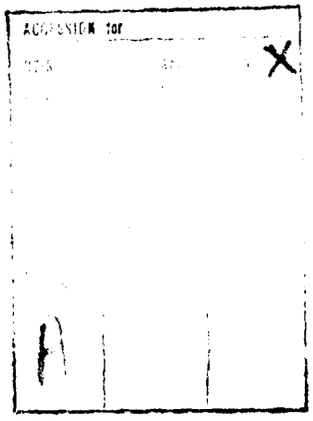
Class 77-1



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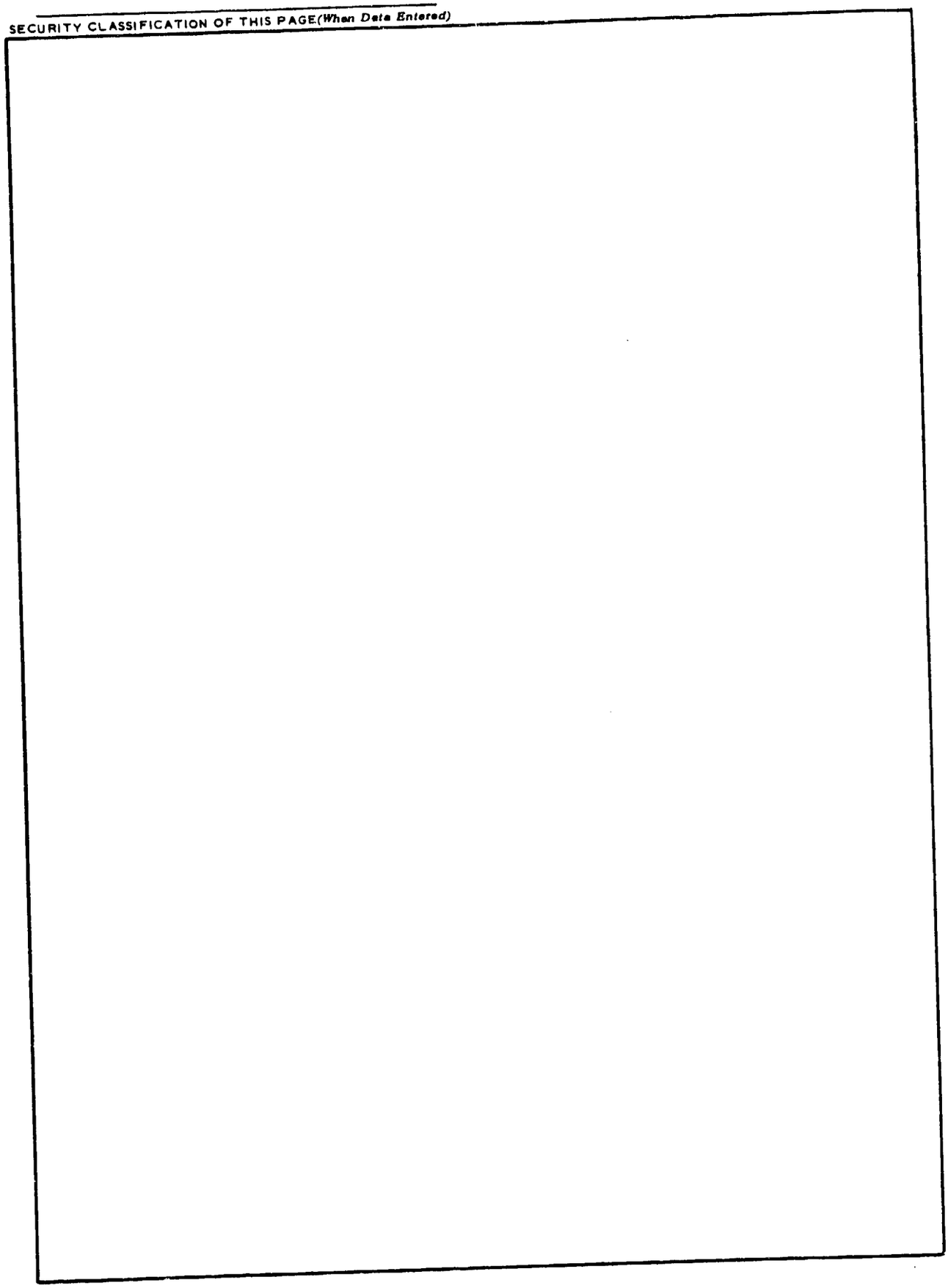

DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE: DEVELOPMENT OF AN INTEGRATED MASTER SCHEDULE FOR WEAPON SYSTEM ACQUISITION

STUDY PROJECT GOALS:

To illustrate the need for an integrated master schedule in the weapon system acquisition process, and then provide a practical guide for the development and use of such a schedule.

STUDY REPORT ABSTRACT:

This paper is a summary of the lessons learned in program scheduling during the past 18 months by the author while acting as a consultant to many Air Force Program Offices. The paper stresses the need for a master integrated schedule and documents problems that have occurred when one did not exist. Scheduling problems are discussed and a step by step approach to the development of a master schedule presented. The report contains a section on the pros and cons of schedule mechanization and stresses the need for mastering simple non-mechanized techniques prior to mechanization. Lastly, the report contains a section which discusses the use of the master schedule and stresses the need for schedule discipline and control within the program office.

SUBJECT DESCRIPTORS

Scheduling, planning, procurement lead time, management control.

EXECUTIVE SUMMARY

This report is essentially a guide to the preparation of an integrated master program schedule for the development of a weapon system. It can be applied, however, to any complex acquisition effort. The report discusses major problems associated with the development of a master schedule and deals with the need for such a schedule. The use of a master schedule is also discussed along with some pros and cons associated with computerized scheduling. The report stresses the need for programs to keep their scheduling techniques simple until SPO personnel have learned how to use the schedule and have documented the need for more complex procedures. Lastly, the report recommends methods of, and sources for, data collection as the schedule is being constructed.

ACKNOWLEDGEMENTS

This report is dedicated to my fellow members of the Program Management Assistance Group of Headquarters, Air Force Systems Command. The thousands of miles and hours we have traveled and toiled together have brought a new dimension of Esprit-de-Corps into my life.

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SECTION I

INTRODUCTION

The student of systems acquisition management within the Department of Defense (DOD) quickly learns that there are three basic parameters which are used to control the acquisition process; system cost, system performance, and the acquisition and deployment schedule. Traces of this conceptual viewpoint can be found throughout the official directives within the DOD that set forth policy and guidance for the conduct of the system acquisition process. (For example, see DOD Directive 5000.28)

In recent years, let's say 5 to 7, there has been an increasing drive within the DOD to give the cost parameter equal weight with schedule and performance as a driving factor in the acquisition process. Much has been written about this trend and I do not intend to give a detailed account of these developments in this paper. Rather, I would like to quote what former Deputy Secretary of Defense Clements said in 1973 when he made design to cost goals mandatory for all DSARC level programs.[1] "These implementation plans should provide the services and their program managers authority to make the performance and schedule adjustments necessary to achieve design to cost levels." (emphasis mine)

(1) Memorandum for Secretaries of the Military Departments, Defense Systems Acquisition Review Council Principals, June 18, 1973 Design to Cost Objectives on DSARC Programs.

In structuring this introduction as I have, I am hoping that the reader will forgive my unwillingness to pursue the rise of cost as an equal or even predominant factor in the acquisition process and concentrate instead on the implications of such a policy on the other two parameters.

During the past 18 months I have been assigned to the Systems and Resources Management Action Group in the Air Force Chief of Staff's Office and the Program Management Assistance Group at the Headquarters Air Force Systems Command (AFSC). This period of time has given me a chance to make numerous visits to the three Buying Divisions of AFSC, most of the Air Force Plant Representative Offices (AFPROs), and many of the labs and other centers within the Air Force where major weapon systems are procured. This first hand experience (as a consultant not an inspector) has lead me to the conclusion that many Air Force program offices lack the ability to develop and manage the detailed scheduling required to bring a major program through the DSARC process while making meaningful cost to schedule trade-offs.

The purpose of this paper is to describe to the reader the kinds of scheduling problems I have encountered (sanitized in regards to program specifics) while examining the Business Strategy of many Air Force programs and to document my view on how to develop an in-house scheduling capability within the program office.

SECTION II

WHY AN INTEGRATED MASTER SCHEDULE?

SOME HORROR STORIES

Every Program in DOD has a "schedule". The review process of the services assures that some form of schedule is developed. Many programs, however, have two loosely connected levels of scheduling. The most detailed level is usually a PERT or CPM type chart which is prepared by the contractors involved in the program. The less detailed level is usually prepared by the SPO and used for the program review process. This level often contains only the amount of detail that can be presented on a slide or viewgraph.

Many of the problems that will be cited in this chapter have as their genesis the fact that the programs did not have an integrated program schedule and instead utilized the two-level approach described above.

I have spent considerable time over the past several years attempting to explain to people who are at levels of the acquisition community other than the System Program Office (SPO), or even people within SPOs who are away from the scheduling process, what is happening today in the schedule area of the three parameters, Cost, Schedule and Performance. My experience has taught me that most people are skeptical when you describe problems in the acquisition process unless you can cite concrete examples to prove your point. This chapter contains a collection of such examples, "sanitized", of course, but "real-world" none the less.

The Integrated Master Schedule

In order to understand why certain programs get into schedule trouble or build unworkable schedules one needs a frame of reference regarding what a program schedule should consist of. I have developed the following definition to explain what I mean by an integrated master schedule:

"An integrated master schedule is a detailed program schedule which portrays all of the major elements of a program and all related development efforts in such a manner that the interrelationships are easily seen. The schedule is updated regularly and is recognized by all program personnel as the master schedule and the only schedule authorized for publication outside the program. The schedule is reviewed and validated at least monthly by the program manager."

Some Horror Stories

Over the past two years I have been a consultant on seven Air Force programs that meet the DOD 5000.1 criteria for DSARC review and not one had a program schedule which could be described as even close to the above definition. All of the programs had the overview schedules utilized for program reviews at higher levels of authority. Most had detailed schedules available which had been submitted by the contractors for various parts of the program in question. None of the programs had a control room and none updated schedules on a regular basis. None had a policy in effect for controlling the scheduling process or for release of schedule information. The following are real world examples of what resulted:

(a) One program had an acquisition strategy which was close to the classical contract definition method. Two contractors were being carried through the validation and demonstration phase with the idea of selecting one contractor for Full Scale Engineering Development (FSED). Both contractors were required to submit proposals for FSED based on proposal instructions which were to be furnished by the program office. These instructions were to be based on the results of the trade-offs conducted by the contractors during the validation phase. Unfortunately, the program office had no schedule for this process or for approaching the DSARC II gate. Because of this, the program office drifted into a situation where they had only two weeks to analyze the final reports of both contractors and integrate these results into a single system specification and statement of work and forward these to the contractors for the development of FSED proposals. Needless to say, the mad rush that resulted produced a less than optimum request for proposal package.

(b) One program was developing several different kinds of communication equipment. Some of this equipment was to be installed as GFP as part of the communication equipment of another much larger program. At the same time, significant amounts of this equipment was promised as GFP to a new development effort within the SPO then in source selection. Because no one in the SPO except the engineer in charge of the technical aspects of the equipment in question knew the status of the development schedule the SPO found itself grossly over committed. The Program Director on the major program was an influential, dynamic, and firm, General Officer. As a result, all available units went to his program. Because of this a

very sensitive source selection had to be modified and extended. The final result was that the source selection dragged on for over one year.

(c) One program, a major high-visibility program, had the mission of producing a piece of equipment and an enormous amount of facilities to furnish to another government agency as a part of a national program. Both the equipment in question and the facilities would be required to interface with many DOD and non-DOD systems hence the need for much intra-program integration effort. The Advanced Procurement Plan (APP) of the program indicated that a number of medium sized integration contracts were contemplated. These contracts were to be controlled and managed by the program office in a sort of "integrating the integrators" effort. Unfortunately, the positions for the personnel within the SPO needed to implement this strategy were not approved. Because of this the SPO rather leisurely decided to switch strategies and procure integration through one single, large, omnibus, integration contract. The average procurement lead time for such a contract at the buying division in question was (54) weeks for a competitive award. As of 3 weeks before the needed award date the SPO had not notified their procurement staff of the change in strategy or drafted the SOW or SPEC for the proposed contracts. This SPO had several officers devoted full time to scheduling, but these officers had not developed a master schedule and instead were trying to develop a computerized scheduling process.

(d) Another instance of loss of control occurred on a program that had as part of its mission the development of equipment which was to be utilized in several smaller programs as GFE. The program developing the

hardware had not developed a control room or a procedure for control of its scheduling process. Because of this, schedules were developed and issue outsiders by project engineers without approval by the program manage The result was that different program schedules were furnished to a numb r of different organizations outside the SPO. Some of these outside ganizations had made major program constructive decisions based on these chedules and had to restructure a second time when the SPO finally veloped an integrated schedule.

I mmary, I believe that within the Air Force systems acquisition community many programs have lost their ability to manage the schedule parameter of systems acquisition. Many of our schedules,

(a) are simplistic (limited by the size of a viewgraph)

(b) do not include all program events

(c) are not updated and reviewed on a regular basis

(d) are not controlled in a disciplined manner

(e) are not integrated between related programs

The next section will discuss some common problems encountered in the development of an integrated schedule.

SECTION III

SOME COMMON PROBLEMS

This section is presented with the objective of acquainting the reader who has the intent of developing an integrated master schedule with problems that are very likely to arise in that endeavor.

Paying the Price (It Takes Time & People)

There are no free rides in the world of program management (or the rest of the world for that matter). Developing and maintaining a master program schedule takes time and effort. That has to be understood from the very beginning. The key to making this investment of resources cost effective is that the schedule function must be removed from the various other offices in the SPO and placed in a central office such as program control. Once given this responsibility this central office must resist the tendency to rush out and attempt to automate schedules, hire consultants, develop fancy facilities, and otherwise inject complex procedures into the effort. The amount of resources devoted to the schedule function can be kept to a minimum while still producing outstanding work if emphasis is placed on keeping things simple and of high quality until the capability to master more complex methods is developed within the SPO.

Getting Data

The ease with which data will be available will be a function of where you are in the program and how much support you receive from the "front office". Most people, experienced in systems acquisition, tend to know, almost instinctively, that information is power. They are therefore,

reluctant to release it without good cause. What you need to know is where to get data from, how much to get, and how often to get it. The answers to these questions will be presented later in the section on how to develop a master schedule. At this point, however, I simply want to make the point that getting the data you need will not be an easy task unless you are prepared. Prior to launching out on this task I recommend that you develop a list of the information you need and obtain the front office's "blessing" prior to requesting the data. Not only will this make your task of getting data easier but will probably give you some good feedback on whether or not you've asked for the correct things. Lastly, you should realize that data from outside the SPO, from contractors or from other SPOs, may be difficult to obtain. Data from contractors almost always involves money and the Contract Data Requirements List (CDRL). Data from other SPOs usually involves a Memorandum of Agreement (MOA) or a personal contact. More will be said on this later.

Defense Systems Acquisition Review Council (DSARC)

The scheduling of DSARC decision points is an especially difficult problem. This is true because each one is different and there are no time limits for the decision process. The only time parameter that I know of is that the Decision Coordinating Paper (DCP) is due into the DSARC principals for coordination 30 work days prior to the scheduled DSARC meeting, and the DCP must be complete for Air Staff coordination 90 work days prior to DSARC. Many programs also make the mistake of oversimplifying the process of DCP writing and coordination. This process, together with the series of briefings dealing with the climb up the military chain of command on the way to the DSARC will be covered in detail later.

Procurement Leadtime

The underestimation of the time required to complete complex procurement actions is a common problem throughout the Air Force Systems Acquisition community. An examination of the reasons for the extremely long lead time requirements for complex, large dollar, procurement is worthy of a study project as a separate topic. I do not intend to attempt to sort the reasons out here. What is important to the planner and scheduler is to make a realistic assessment of the time and actions required to complete the procurement cycle.

There is a tendency in this area to view the problem as one belonging to and controlled by the procurement community. This view is simply not viable in the real world. There are a number of events in this cycle such as preparation of the Statement of Work, CDRL, Specifications, and other documents that simply are not controlled by the procurement community. It is a fact that these technical documents must be complete before the procurement specialist can really do his job. Some average lead times will be presented later, but the important point is, what is the lead time in the procurement organization that serves the progam office developing the schedule?

Symbology

The problem that many programs run into here is that they don't adopt a common symbology for use throughout the program. I remember one program that had no integrated schedule beyond the viewgraphs of the SPO director. This program had scheduling done by each division and by each contractor and further by a systems engineering contractor advising the program office. All of these groups were using different

symbology. Some were using bar charts, others milestone charts, still others pert type event charts. When all of the hoge-poge was sorted out the program had some major problems that were completely masked by the disconnected schedules of the various divisions within the SPO. How to avoid this through the development of a master integrated schedule is the topic of the next section.

SECTION IV

HOW TO DEVELOP A MASTER INTEGRATED SCHEDULE

Discussions of past problems, theoretical concepts, and policy positions do little to help the person in the program office who is charged with the task of developing an integrated program schedule. This section has the objective of providing that help. It is intended as a practical, step-by-step, guide and covers many of the problems mentioned in the previous section.

Getting Started

The first things that will be needed (besides time and people) are materials and a good place to work. The place to work should be somewhere where you can push together at least four standard size DOD conference tables. It should also be available on an uninterrupted basis for at least 7 to 10 days. If this is not possible, the only solution I know is to wrap up your work periodically and move as the occasion requires. I've found in the past that the best place is usually a conference room that can, with the proper support, be blocked for the time needed. A good supply of the largest size graph paper available is next. I have experimented with both 36" rolls and 36" x 36" sheets. Both ultimately have to be taped together but the rolls tend to reduce the taping requirements. Next, procure plenty of pencils, erasers, tape, and felt-tip pens of a variety of dark colors and you are ready to start the layout.

The Layout

The next step is the selection of a proper system of grid coordinates. These should be selected to provide you with the length of time you need (on the schedule) and the room vertically to list all the interrelated parts of the program. Most programs require a time span of 7 to 10 years to portray the complete program. This means that the chart should be at least 7 to 10 feet in length so that each month can be represented by at least one inch on the chart. This inch/month is strictly an approximation; the exact figure should be selected to match the grid length on the paper being used; however, on extremely detailed charts the grid should be expanded accordingly up to the space available to hang the chart (2"/month requires 14 feet to indicate 7 years). The vertical size of the schedule should be at least 4 to 6 feet and again, expanded or contracted, to meet the needs of the program.

After selecting the scale, the grid should be layed out on the tables, taped together, and the time coordinates plotted on the chart in months, calendar years, and fiscal years. This time scale should be plotted in a bright color to aid in the plotting of details as the schedule is constructed.

Symbology

There are a wide variety of charting techniques and types of symbology which are generally acceptable to the development community. I believe that the principal purpose of these techniques and symbols is to communicate

and therefore strongly lean towards the selection of a set of symbols and a charting technique which is most familiar, or easiest to understand, for the personnel within the program in question. If schedule data is already being received from a contractor or set of contractors it would be best to utilize the same symbology used on these schedules unless this symbology is extremely hard to read or otherwise difficult to adopt to the master schedule. It is important to realize that once a standard set of symbols is adopted, data which is not provided to the SPO in this format will have to be translated to the standard symbology for plotting on the master schedule. This process is usually quite simple and involves little more than converting arrows to triangles, or blocks to lines, etc. The point is that this process takes time and can be minimized by selection of the proper symbology for the master schedule.

Some good references which illustrate different types of symboloby and charting techniques are:

(1) AFSCP 800-3, Chapter 6

(2) ASPR 1-2100, Procurement Planning

(3) Army Pamphlet No. 5-4-6, Work Scheduling Handbook, Jan 74

(4) AFSCP 800-23, Secretary of Air Force SPR/PAR/CAR Guidance

(5) AFSC 27-6 The AFSC Programming Process

Keeping Track of Sources

As you begin to build your master schedule you will be gathering data from a wide variety of sources. I strongly recommend that you start off right with a folder for each data source. Each folder should contain a log which indicates where the data came from, who your contact point is, and the "as of" date of the material collected. These folders will not only

help you find things in a hurry, but will give you a convenient place to store your material when it's not being plotted on the master schedule. Lastly, these folders provide a chronological history of how your data was developed as time passed.

Program Business Strategy

Before you begin to plot, it is important to know the overall business strategy of the program. There is a definite relationship between this strategy and the best way to lay the schedule out. It is also important to know where the program is in regards to the implementation of the strategy. If for example, the program is in the conceptual phase of development and there are several contractors working in parallel then it would be wise to lay the schedule out so that the detail schedules of these contracts are close enough to each other to quickly indicate the relative progress being made by each contractor with respect to each other as well as with respect to time and the established goals of the conceptual phase. On the other hand, if the program is mature and in the FSED or production phase, there is likely to be only one contractor involved in the main development effort. In this case the detailed schedule associated with this contract should be plotted adjacent to schedules for other events which could impact the development effort such as GFE deliveries, test schedules, or related program schedules. Remember, however, that scheduling is an iterative process. If during your first attempt the layout you select turns out to be awkward or less than what you desire -- change it. Once the data has been gathered and plotted, rearranging it in better groupings is relatively easy to do.

Good sources of data for this kind of information are the Program Management Plan, the Program Management Directive, and the Advanced Procurement Plan. If the strategy is not contained in these plans (God forbid) or they are not yet written, the place to start is the Program Manager. On new programs that are just getting started the development of a master schedule requires the overall general plan of the program manager and a lot of crystal ball type planning. Difficult though it may be, the construction of a master schedule at this time is possible and, in fact, almost essential for the baseline cost estimates required for the program initiation decision in the new DODD 5000.1

Existing Contracts

Now that a place to work has been found, materials gathered, time coordinates established, and program strategy conceptualized, hard data can be plotted. Since all weapon systems are procured through contracts the most universal place to start plotting is the existing contract structure within the program office. The start date and completion date of all contracts managed by the program office should now be plotted. These plots should be grouped in a logical manner as discussed above. The data needed to plot these start and end dates should be readily available within your procurement organization. It is important to stress here that what you want to plot is the actual dates in the contract - not some proposed dates to be added later - these can be plotted when these proposals are negotiated or incorporated into the contracts by change order.

The major milestones between the start and complete date of each contract may or may not be available in the procurement organization. Most

contracts require the contractors to work according to some schedule or to submit to the government their proposed work schedules. Larger development contracts usually require contractors to prepare a master schedule for the contract, usually a PERT or CPM format. These schedules are usually obtainable from the technical office within the program office that monitors the work in question. The master schedule that you are developing should not normally duplicate these detailed schedules. Therefore, the major events on these schedules should be identified so that they can be plotted on the SPO master schedule. Examples of these events are design reviews, equipment deliveries, report due dates, program reviews, configuration audits, etc.

If you are on a new program and do not know what kind of data to ask for from the contractors on your program or you want to find out what data the contractors are required to submit, you should visit the data management officer for your program. The data management officer can tell you what data is being submitted on existing contracts and should be able to tell you who it is being submitted to from his copies of the Contract Data Requirements List (CDRL). The data management officer should also be able to show you descriptions of the approved schedule data items which can be requested from contractors. Lastly, he or she should be able to help you tailor these data items so they will generate the schedule data that you and your program need.

Proposed Contracts

There are two sets of data that you need here. The milestones leading to contract awards and the proposed milestones on the future contracts.

The first place to look for this information is the current Advanced Procurement Plan (APP) for the program. Do not plot this data, however. APPs are notoriously out of date almost before they are published. The APP can serve as a guide to what efforts are planned in the next year or so. The latest plan for getting these contracts awarded should then be obtained from both the procurement and technical offices. I say both because it is typical that these two sets of plans will not agree. What you then must do is get the latest information from the technical offices as to when they will get their procurement packages over to the procurement office, then obtain from the procurement office what the procurement milestones are from the receipt of the procurement packages to contract award.

If your program is in the early stages of development you may have to utilize standard times for procurement lead time in order to plot procurements that you know will be occurring in the out years beyond the scope of your APP. Appendix 1 indicates average procurement lead times for a major Product Division of AFSC. A similar document should be available from the procurement staff which is supporting your program. If no such document exists I strongly recommend one be developed since procurement lead time will be a recurring element of scheduling and planning throughout the life of any program.

The other set of data that you need on future contracts is the proposed contract milestones. If the proposed contracts are to be awarded in the near future this data may be readily available from the technical office generating the requirement. If, however, the contract is one that lies

several years in the future, perhaps in the next stage of development you may not have data readily available. In this case you may have to ask the technical office in question to produce the data you need. It's very likely, however, that your need for detailed planning in these out years may be challenged. If this occurs, I recommend that you take a hard look at the data you are requesting to insure you are asking only for the data you need to construct the schedule. To do this you may have to ask yourself what are we doing on this contract and what does it contribute to the overall program, then isolate the contributions that are needed to go on to the next phase or to conduct other actions within the same phase. The dates when these contributions are needed then become your major milestones and the basis for further construction of the schedule. If after all this the technical offices still cannot produce the dates you need, I recommend that you develop the dates yourself, based on the overall time constraints of the program. It has been my experience that people who do not like to plan suddenly get in the planning business when others start to plan out year program events. A good source of data for "crystal ball" planning in this area is the staff level people at your buying organization. Usually these people have seen many programs come and go and can provide sage advice on how to "ballpark schedule" major events such as PDR, CDR, Test dates, etc, on out year contract efforts.

Test Schedules

Test schedules are of critical importance to any SPO because they usually involve the combined efforts of many organizations. Again,

depending on where your program is in the development cycle these schedules may or may not be available. A good source of data in this area is the Test and Evaluation Master Plan (TEMP). If no TEMP is available or it is out of date, revised T&E schedules can usually be obtained from the T&E section in your SPO. There are several things that need to be considered in developing T&E schedules, some of the most important are discussed below.

Hardware Deliveries

It seems incredible to me that people need to be told to keep the hardware schedule and the test schedule in sync, but experience has taught me that these things do often get out of sequence. The test schedule should be set up so that all hardware required has been built, inspected, checked out, and modified for the test if required. All this must be closely monitored to insure that the proper tests can begin on time, and remember, the test range gets your test money whether you come and test or not, so if you are late, you will have a bill mounting up for every day you're not there testing.

Special Test Equipment

Many tests require special test equipment or special equipment for the range on which the test will be conducted. This equipment has to be funded with SPO money but is often procured by outside agencies such as the test ranges. Be sure to find out whether or not your SPO has this kind of requirement and how to get data on the proposed acquisition effort. The T&E directorate of your SPO should have this information. If not, find out where the testing is to be accomplished and try the range Directorate of Operations. Someone there should be a point of contact for your program and should have the information you need.

Test Results

When developing your schedule be sure to leave time for the reduction and analysis of test data. This sometimes takes weeks and even months and can come at a time when big decisions are being made. A SPO that does not leave sufficient time in its schedule for this effort is really saying that the test was not an experience in validation but a waste of time.

Test & Evaluation Funding

The National Ranges have been "direct" or "reimbursement" funded since 1971. This means that the cost of operation of the ranges is paid for partly by the programs that use the ranges. Once you have agreed with the range on the test schedule, and the scope of your testing, the estimated cost of the testing is negotiated. After this happens your funds are "fenced" at HQ AFSC. That means your funds go to the range whether you do your test or not. The reason for this is the fact that the range must commit itself to your test prior to its start and once committed cannot terminate its efforts in an efficient manner. The final result is that testing schedules must be firmed up years in advance in order to get the money in the budget and once planned, cannot slip without a great amount of lead time and much additional cost.

Program Decision Points

Since the implementation of the DSARC process through the 5000 series of DOD instructions, the practice of structuring DOD programs into phases (Conceptual, Validation, FSED, Production) has been extended down to even the smaller programs within DOD. Small programs who do not meet the DOD

criteria for DSARC contained in DODD 5000.1 now find that they face similar reviews at levels of the DOD below OSD. The previous section mentioned some of the problems associated with these reviews. This section contains guidelines for overcoming some of these problems.

The DSARC Review Process

The scheduling of the DSARC process begins with the development of the information required to develop the Decision Coordinating Paper (DCP) and the DSARC briefing, and ends with the decision of the Secretary of Defense. Some of the events in this process are controllable by the SPO and some are not. All, however, can be planned, and some kind of plan is essential to the control of the overall program schedule.

The writing or update of the DCP is, for example, an event controlled by the SPO. The coordination of the DCP is a formal process within the DOD. In the Air Force, the schedule for the coordination of the DCP at the Air Staff is covered by HQ USAF OI 800-1.

In addition to the times mentioned in 800-1, time must be allowed for review at HQ AFSC and product division levels. This means that the information needed to write the DCP must be available well in advance of the actual DSARC decision point. This is an important fact in the layout of the overall program strategy.

If the DCP cannot be completed until certain test data is analyzed or until a certain report is received from a contractor, then the start of the DSARC process should be keyed to these points. A common complaint against the DSARC process is that it forces programs to slow down or pause and creates "gaps" in the contractual coverage of a program. How to minimize these problems will be discussed later.

The briefing cycle leading to a DSARC meeting is an example of events only marginally controlled by the SPO. The best advice I can give on this block of time is to schedule at least 6 weeks for these briefings and be prepared to travel a lot. Above all, be organized and don't volunteer briefings to people or agencies that cannot help your program. Several days of briefings at Product Division, HQ AFSC, and Air Staff levels, hopefully separated by 10 days to 2 weeks is a good going in schedule to propose.

The DSARC decision process itself is almost totally outside the influence of the SPO. Many program managers seem to believe that if they are clever enough, or if they tell the council they need an immediate decision, they can get a decision in one or two days. My advice is to schedule two to four weeks for a formal decision and be sure to have a contingency plan for waiting longer.

Long Lead Approvals

As military hardware becomes more complex, lead times tend to increase drastically. In most weapon systems there will be certain items with sufficiently long lead time to require firm contractual obligation far in advance of the rest of the weapon system. Complex computers are an example of this type of hardware. Often the decision to order these items must be made long before the decision to move the weapon system into full production or even into Full Scale Engineering Development. If this situation arises, special approvals and funding allocations will be required.

These long lead decision points should be clearly indicated on the program master schedule and their relationship to other program milestones closely monitored. One program I reviewed, for example, was not plotting these dates; when they were plotted it turned out that the long lead order point came before the preliminary Design Review (PDR) on the item in question, an extremely risky way to do business.

Schedule of Related Programs

If your program is tied to another development effort, (most are these days), be sure to have the main elements of that effort plotted on your master schedule. This will require a reliable and accurate information flow from the organization developing the related system. Usually this can be specified in a Memorandum of Agreement (MOA) between the two organizations. When the information does arrive be sure that it is validated by a responsible individual and properly dated. Once you receive this information, plot it exactly as received. You will probably get informal corrections and updates in between your formal reports, these should be plotted in pencil or in some other tentative manner but do not rearrange your schedule on the basis of a phone call unless you are 100% sure of your sources.

Decision Point "Gap" Problems

I mentioned earlier that the DSARC process tends to cause problems to programs because it creates pauses and gaps as programs transition from one phase to another. This problem becomes acute when two or more contractors are on board in one phase and only one is to be selected for the next phase. When to announce the winner! Before or after DSARC? Which technical approach goes into the DCP if a source selection is in process? How long should contract proposal offers be valid - source

selection time alone or source selection plus DSARC time? These are the questions that face the program planner at these decision points.

I strongly recommend that a plan be developed in detail to cover these transition periods. Most programs I've reviewed seem to schedule DSARC decisions after the contract effort for the previous stage is complete. I don't recommend this. I believe that to force contractors to "stand down" during DSARC decisions is extremely wasteful and there is no doubt in my mind that DOD pays for these pauses in the end. I recommend that some form of level of effort work, long lead fabrication, testing, and whatever else seems consistant with program strategy be planned during these periods. These efforts should be planned so that the contracts expire 60 to 90 days <u>after</u> the scheduled DSARC decision point. If the DSARC decision is negative the old contracts can then be allowed to expire and the program terminated. If the DSARC decision is for delay prior to entry into the next stage of development, the contract can be modified accordingly. Lastly, if the decision is positive the award of the new contract for the next phase can be made and the old ones allowed to expire.

Bear in mind that this strategy must be approved and should be reflected in the Program Management Plan (PMP) and Advanced Procurement Plan (APP). Also bear in mind that the information required to write the DCP, prepare the DSARC briefings and otherwise convince the acquisition leadership that the program should proceed must be complete <u>well in advance</u> of the DSARC decision point even though the contracts do not expire at that time.

Planning Programming Budgeting System (PPBS)

Earlier I mentioned that the grid should be laid out in both fiscal and calendar years. In addition to this I recommend that somewhere on the margin of the schedule the major events of the PPBS cycle be plotted. This data should show where the five year Defense Plan (FYDP), the Program Objective Memorandum (POM), and the budget submittals are for each fiscal year. This information will be a great aid when later using the schedule to work real world problems. Information regarding these cycles can be obtained from the comptroiler at your buying division. Other sources of data are:

(a) Fiscal and Life Cycles of the Defense Systems (March 75) second ed. General Dynamics, Pomona Div.

(b) DODI 7045.7 "The Planning Programming and Budgeting System" Oct 29, 1969.

(c) HQ USAF Operating Instruction 27-1, "DOD Programming System", 26 Sep 73

Validation and Adjustment

The master schedule should now be complete in its initial form. If you do not have several situations that indicate problems and conflicts by this point your program is well structured. Usually there are a number of areas that just don't mesh and need to be corrected after the first schedule iteration.

As mentioned earlier, each source of information should now be brought in to view the schedule (one at a time). These sources should validate your effort or correct it. Often during these sessions previous schedule problems will be resolved as the validator sees how his or her part

of the program is out of phase. Differences of opinion, organizational differences, and other problems which lead to schedule miss-matches can now be brought to the program manager who has the ultimate responsibility to validate the schedule in its integrated form. How the schedule can be used after validation is the topic of the next section.

SECTION V

USE OF THE MASTER SCHEDULE

Master Baseline

The master schedule for a program should serve as a time reference baseline for the program. In order to do this it must be kept up to date with the approved program for cost, schedule, and performance. By approved program I mean the official approved schedule which will achieve approved performance levels within approved cost allocations. There is a maintenance task here akin to that inherent in configuration control. There will be many changes in any devlopment program and these changes grow through an individual life cycle of their own. Program changes, whatever their source, start as proposals, grow into a firm plan, and eventually are incorporated into the program as approved changes. When to plot these is a question of judgement and should reflect the policy of the program manager. Each change should be plotted as a proposed or tentative change until the change is approved. A permanent record of each change should be maintained and illustrated where required. If the program has slipped, the slip should be shown until it no longer serves a purpose to do so.

Schedule Discipline

The degree of schedule discipline imposed within the program office can be a major factor in the use of the master schedule. Whenever copies of the master schedule are made they should be dated and should be authenticated by the signature of the program director or his appointed

schedule manager. Undated and unauthenticated schedules should not be released outside the program office. These are simple rules but many programs do not follow them and consequently suffer from the unauthorized release of schedule information that is not integrated into the master schedule and not approved by the program manager.

Program Reviews

The master schedule can serve as the framework for periodic program reviews within the program office. If constructed properly, the schedule will illustrate the top few levels of the Program Work Breakdown Structure (WBS) and therefore will likely be compatible with the programs Cost/ Schedule Control System reporting. Program reviews can serve as an excellent forum for the resolution of schedule conflicts and the genesis for controlled change to the schedule from within the program office. Most of the important leaders on the program office team are present at these reviews and therefore proposed schedule changes or slips can receive wide dissemination within the organization in this forum.

"What If" Exercises

The master schedule can serve as the framework for the "what if" exercises that are imposed on programs from outside the program office. Schedule changes can be plotted manually using overlays to the master. The use of the same grid coordinates in an overlay fashion allows the program office to see clearly and graphically the effect of compressions or extensions of the various sub-milestones on the program. Without the master to utilize as a baseline these exercises tend to require much longer to accomplish and often overlook important variances from the established program baseline schedule or plan.

Program Briefings

The master schedule can also serve as the baseline for program reviews at higher headquarters and other places external to the program office. Most programs have certain key milestones which are taken from the master schedule and presented in summary form on view graphs or slides. If these do not show the detail required to make a point the time span of the slide can be reduced down to the point where the details are visable. In last resort the master schedule can be transported with the team accomplishing the briefing but I do not recommend this. The handling is usually very hard on the paper and almost always results in a redrawing requirement when you return to the program office. (Remember, this schedule is usually on the order of 7' to 10' X 10' to 15' in size).

With these uses in mind let me now turn to the subject of mechanization of the scheduling effort.

SECTION IV

PROs and CONs of Mechanization

It has been my observation that many programs have a tendency to look to mechanization or automation of their scheduling effort as a "cure all" for scheduling problems and responsibilities. The purpose of this section is to sort out, for the program considering mechanization, some of the pros and cons I have seen in the field as programs attempted to automate or mechanize their scheduling process.

Some PROs

One advantage of an automated system is that it is easy to update. Changes are usually input to the system via punched cards, remote terminals or the like. Once the new data is in, the computer redraws the schedule based on the new inputs.

Another advantage may be the speed with which the computer can accomplish the update required. I say, may, because this is only an advantage if the program needs to update the schedule rapidly for some reason. If the need is there, most computer systems can reaccomplish the schedule in a matter of minutes.

A third advantage is that most computer systems on the market today which have been adapted to the process of scheduling offer the capability of gameing or accomplishing "what if" exercises. Many SPOs find this capability extremely attractive because of the many requests they receive for estimates of what will happen if "this" or "that" action takes place. These exercises typically occur during budget exercises and have to be accomplished with very short deadlines.

Still another advantage may be the mystique of the computer. I say maybe because this "mystique" is losing its effect as more and more people become familiar with computers. But still there is a certain aura about being able to say, "this schedule was derived by the computer".

Some CONs

The first is likely to be the cost of the system to be utilized. My caution here is that a complete cost analysis be performed. I have seen programs with automated schedules that could not be cost effective due to the size of the system in relation to the program office in question. How these systems were justified I do not know. I do know that many organizations simply give up on the idea of a manual system because it seems old fashioned and unglamorous. It's not a real cost analysis if you go in with the idea that the job can't be done manually. Lastly, be sure to get competition on the system design and let the ADP equipment and programs be adapted to your program - don't adapt your program to a given ADP system. There are a number of computer systems available today which can accomplish real-time scheduling and the market is highly competititve. Use this to your advantage. I have considered the inclusion of a list of corporations who market systems of the type required but decided against it because I do not want to appear to favor any commercial firm. Information regarding these companies and the program offices that are using their systems can be obtained from the Program Management Assistance Group (PMAG) at HQ AFSC, Andrews AFB, MD.

Another con is the communication barrier presented by the computer. It is difficult enough to get the wide variety of people in a SPO to accept a common schedule symbology. Getting them to utilize and depend on Computer Symbols which are new and strange is sometimes almost impossible. I know of one program where the schedule is computerized yet no one outside the program control office uses the computer versions, they all maintain schedules in formats they like. This same problem extends to people outside the program office. I have, myself, at times, tried to work with a computer schedule, and simply given up because I couldn't follow the symbology. Lastly, the kinds of schedules required for program reviews and other management meetings at higher levels of authority are quite different from the computertized schedules I've seen. Here again, I find the need for dual symbology.

In summary, look very closely at your requirement before you decide to mechanize. I can't stress enough to the program just getting started -- start manual -- start simple -- and grow from there, <u>if</u> you need to.

SECTION VII

SUMMARY

I was tempted to call this section "Summary and Conclusions" but I have dropped the "conclusions" from the title. I have done this because this paper is not intended to bring the reader to some decision or "conclusion". It is meant to be a practical guide for the development of a master integrated schedule for a systems acquisition effort. Having written other, much more rigorous academic papers, I am tempted to look back on this one as simplistic. That is, unfortunately, in my opinion, a sign of the times. We have, again in my opinion, somehow gotten ourselves into the position where we are losing our (the Air Force Systems Acquisition Community) ability to perform the basics, in this case, scheduling.

This paper started with the statement that I believe the scheduling area of the three primary DOD development parameters, (cost, schedule, performance) has been de-emphasized. This was followed by the presentation of several "horror stories" which I have personally observed occur due to the lack of a master integrated schedule and a definition of what I believe such a schedule consists of. Next came a presentation of problems that I have observed occur in the field that prohibited programs from developing an effective scheduling capability. The next section was a "cookbook" section on how to actually develop and lay out a master integrated schedule. This, in turn, was followed by sections on how to use the schedule once developed and some pros and cons of mechanizing the schedule.

Looking back, I would like to leave the Program Manager with the following messages:

1. If you dont' have an integrated schedule that you control and developed within the program office, you're headed for trouble.

2. Don't over estimate the job -- a couple of smart people can do amazing things given a week to 10 days.

3. Don't try to get too fancy too fast. Keep it simple until you know your people have mastered the program and the basics of the process.

4. Use the schedule as a core management tool and make it compatible with your WBS and contract structure.

5. Install discipline in your people. Do not allow program schedule changes to get out of the program office until you've approved them. Make sure everyone has the same schedule.

6. Plan for the unknown. Do not approach complex events like source selections or DSARC gates with a viewgraph level plan. How would you feel if your contractor did it that way?

7. Do not accept no for an answer when you ask to have such a schedule completed. The week I wrote this I had the opportunity to chat with the Chief of Program Control on a major Joint Service Program. He told me that he had a person working for six months to get a schedule for his program and never could get it done. Don't you believe it. It can be done, and if it's not, sooner or later, the price will be paid.

CRITICAL PATHS		1	2	3	4
TEP UMBER	STEP DESCRIPTION	MS $0 - $250K	SS $0 - $250K	MS $250K $1,000,000.	SS $250K $1,000,0
1	PR/MIPR Rec'd in Con Office				
2	PR/MIPR Coordination Comp				
3	PR/MIPR Package Completed	0	0	0	0
4	PR/MIPR Package Rec'd BUYAC	2	2	2	2
5	PR/MIPR Acceptance Comp	1	1	1	1
6	Procurement Plan Appr/D&F Appr	5	5	8	5
7	IFB, RFP, RFQ, RFTP Issued	20	15	20	18
8	PE, Bid, Prop/Quote Rec'd	7	3	10	3
9	Tech Eval Rec'd	13	8	29	24
0	Audit/ACO Comments Rec'd	4	2	5	3
1	Negotiations Completed	1	1	1	1
1a	ACD Transmitted	1	1	1	1
2	Approved ACD Received	1	1	1	1
2a	To Contract Writing	4	4	4	4
3	Contract File Completed	1	1	1	1
3a	To JAG for Review	1	1	1	1
3b	To Committee for Review	3	2	4	3
4	Initial Review Completed	6	6	6	6
5	Instrument Signed	1	1	1	1
6	Final Review Completed	1	1	1	1
7	Date Instrument Distributed	72 WD*	55 WD	96 WD	76
		29 H&W**	22 H&W	38 H&W	30
		101 Days	77 Days	134 Days	106

*Working Days
**Holidays and Weekends

CRITICAL PATHS

STEP NUMBER	STEP DESCRIPTION	5 MS $1,000,000. and Over	6 SS $1,000,000. and Over	7 Defin of Chg Orders Involving Inc. or Dec. In Scope of Work	8 Contract Overrun Funding
1	PR/MIPR Rec'd In Con Office				
2	PR/MIPR Coordination Comp				
3	PR/MIPR Package Completed				
4	PR/MIPR Package Rec'd BUYAC	0	0	0	0
5	PR/MIPR Acceptance Comp	2	2	2	2
6	Procurement Plan Appr/D&F Appr	1	1	1	1
7	IFB, RFP, RFQ, RFTP Issued	4	4	1	1
8	PE, Bid, Prop/Quote Rec'd	22	20	15	10
9	Tech Eval Rec'd	10	5	3	7
0	Audit/ACO Comments Rec'd	36	28	18	18
1	Negotiations Completed	10	5	4	3
1a	ACD Transmitted	1	1	1	1
2	Approved ACD Rec'd	1	1	1	1
2a	To Contract Writing	1	1	1	1
3	Contract File Completed	4	4	4	3
3a	To JAG for Review	1	1	1	1
3b	To Committee for Review	1	1	1	1
4	Initial Review Completed	5	5	2	2
5	Instrument Signed	10	10	6	6
6	Final Review Completed	15	15	1	1
7	Date Instrument Distributed	4	4	1	1
		128 WD*	108 WD	63 WD	60 WD
		51 H&W**	43 H&W	25 H&W	24 H&W
		179	151	88	84

Working Days
Holidays and Weekends

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