A SURVEY OF QUANTITATIVE MANAGEMENT METHODS

by

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INTRODUCTION

The following is a survey of some of the tools and resources available to Project Managers to assist in the management of complicated development projects. These tools, resources, and methodologies effectively guide managers throughout the length of their projects to provide efficient administrative, planning, and documentation support.

A short overview will show the basic desires and needs of a project management system. Many different requirements and desires have collectively led to the development of these management tools. Managers have always sought efficient methods to monitor the proper mix of time, money, and resources to achieve optimum production or results. This paper will discuss two separate systems that are made up of many of these tools.

CHAPTER ONE

REPORT OVERVIEW

A project is defined as "an undertaking with a given start point and a definite end objective." (ASAP81) A project will require resources such as materials, manpower, and money. In order to properly utilize these resources and ensure that the objective is attained, the project should follow certain steps or phases. There should be a phase to determine how to complete the project, and a phase where the actual progress of the project is compared with the project plan. In order to effectively control these activities, one central figure, a Project Manager (PM) is given the responsibility for the project. He has the responsibility to "guide" the project from the beginning to the end.

There are two basic aims in the planning phase for the project. They are:

- To set goals for the various aspects of the project.
- To determine the best methods to achieve these goals.

These aims help attain the overall objectives or project planning which are to improve work performance and product quality with effective cost control. A simple technique to do this is to separate the project into activities. The relationships among these activities now determine the sequence in which they will be carried out. A time analysis is then conducted to calculate the

appropriate dates of each activity and each milestone. In order to make a more complete schedule, a resource and cost analysis is done. A time-phased budget plan is then selected from several alternate schedules and used as a baseline against which to judge contract costs and time schedule performance.

The control phase of a project simply compares actual performance to the performance measurement baseline described above. Reports should be generated to show the status of the project as it relates to time, costs, and resources. Based on this, existing schedules can be maintained or revised to show new developments in the project. Figure 1-1 shows how the planning and control phases may be graphically depicted.

In the past, managers have been forced to rely on manual methods in order to plan, schedule, and allocate funds. There were time consuming processes utilized to operate suspense files, activities calendars, etc. Highly complicated formulas and high level mathmatical calculations were needed to obtain information concerning risk, resource management and effects of changes. Accountants were required to maintain books and ledgers of all money transactions. It was difficult to stay currently informed and the possibility of making a quick accurate decision was not always good. Each process was usually slow, time consuming, required a large staff, and was only as accurate as the human who conducted it.

Over the years a multitude of management systems have been developed that enable managers to have a wealth of information

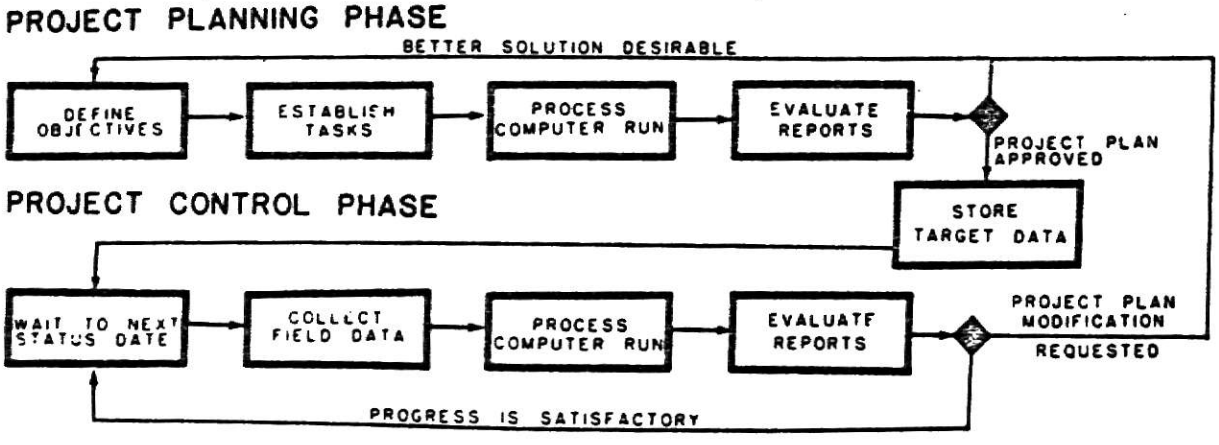


FIGURE 1-1

PLANNING AND CONTROL PHASE

available with the press of a terminal key. These systems come made-to-order and in varying degrees of complexity to suit a variety of management levels. An inexperienced user may select a system that is extremely easy to operate and understand. Very little training would be necessary for personnel within the organization to be able to utilize a system of this type. Since most of the work is made simpler and easier, the whole job of project management becomes simplier and easier.

CHAPTER TWO

PROJECT MANAGEMENT REQUIREMENTS

In this chapter, I will discuss the typical areas of management concern that are usually handled by the components of a project management system. These areas are the three general topics of planning, scheduling and cost. In each of these areas, the topics will be divided into the necessary fundamentals and discussed in detail. Several other areas of concern not related to planning, scheduling and cost will also be discussed.

2.1 The Planning Phase

Proper planning is one of the most important functions a project manager must do in order to be successful. It is usually the project plan (prepared before starting the work) that determines to a major extent the outcome of a project in terms of time, costs, and technical performance. Both in the military and industry, once a project plan has been written and accepted, it is very difficult to alter or change. Future action may help guide the course of the project and may rescue it from disaster, but usually a faulty plan is destined to fail. For this reason the importance of a quality plan must always be stressed. To be sound, a project plan must be produced through a systematic, detailed analysis that includes a breakdown of the project into

components, tasks, work packages, events (milestones), and several possible solutions. Proper planning involves the examination and reexaminatiion of the problems which are anticipated and alternative ways in which to solve them. If done correctly, a realistic project plan can be produced that will result in a good project at the lowest development cost and in the shortest time.

2.1.1 Planning Fundamentals

There are certain basic objectives which are expected to guide the planning process. Probably the most important of these is to balance dollar commitments with program risks. One may see this as ensuring that a limit is maintained on the amount of resources committed just in case development efforts demand a major change or the program fails. There are five interrelated planning activities that assist the PM in maintaining this balance. They are:

- Assess the risk
- Reduce concurrency in risky situations
- Reduce risk prior to going into successive phases
- Control changes (requires complete analysis)
- Plan for unknowns

2.1.2 Assessing Risk

Risk assessment is nothing more than the evaluation and re-evaluation of the possibility of the successful occurrence of a particular event. Even though risk assesment may not formally be addressed in a system design, it is impossible to ignore it. There must be an analysis of the probability that a certain approach will result in a better chance of success than others. This risk assessment is made even more complicated by the fact that the smaller risk may not be the best choice.

"Inherently the risk of failure to meet objectives shadows all design and development programs. Yet because it is a negative aspect, the incidence of risk is quite often overlooked in the glare of optimism. Even where it is ignored completely, it may be appraised but not deeply enough, or perhaps not often enough to serve as a significant input for decision-making." (POLS66)

System development usually takes place over an extended period of time and several more years are added between the production decision and deployment. Care must be taken to ensure that it will not be obsolete when fielded. Often as not, there must be a constant push against the bounds of the technology of today to ensure that it will not be obsolete in the environment of tomorrow. All of this implies taking more and not less risk.

In this sense, risk assessment is a decision making tool. It is now an estimate of the probabilities of failure or success when comparing several different plans. It may also be a measure of the probability of meeting specified performance, schedule, or cost goals associated with a specific plan (i.e. if a heavy duty

transmission must be developed prior to the rest of the helicopter).

The manager must be prepared to deal with a defined set of technical performance and schedule requirements and the range of probabilities associated with them. There will also be cost and schedule implications of relaxed performance requirements and the possible deletion of one or more high risk system elements. Risk assessment may be defined as "...a set of curves displaying the probability of certain consequences given one and another set of technical performance, schedule, and cost objectives." (ANDE69) So risk assessment is a fundamental factor in the decision process of selecting a particular design alternative instead of another. It also becomes critical if a decision must be made about the necessity of a back-up development program to possibly improve low probabilities of success in some critical subsystem element. Risk assessment sometimes performs a major role in the determination of system characteristics or initial program design, especially if risky designs are the result of overstated requirements (i.e. To develop an attack helicopter equipped with passenger accomodations, when there is no requirement for such accomodations).

Risk assessment may also be used as a planning device. It provides a plan for a development and test program that will resolve uncertainty in known areas of great risk. There is also a control system to track and measure progress toward resolving uncertainty. Risk assessment is not a one-time occurrence. The

initial concepts of the first program decision should be reexamined throughout the development program. As more facts are documented as a result of developments, alternate solutions may begin to appear more attractive. If resources become scarce as a result of unexpected events, back-up programs may no longer be a good investment. Underestimated risk concerning the whole program may dictate reconsideration of program characteristics.

2.1.3 Concurrency Reduction

Risk reduction and concurrency are closely related. The overlapping of program phases is risky. Concurrency may reduce the time span from concept to deployment, but it involves a commitment to incur substantial costs that may be wasted should the program be redirected or cancelled. For this reason, this type of concurrency (program phase overlap) should be avoided if possible, especially if the risk is known to be high.

On the other hand, there are times where planning can make the difference between waste and delay. This may occur when a long lead time is required to obtain materials in order to avoid unacceptable delays in the shift from development to production.

Oftentimes it is difficult to differentiate between concurrency and normal progress. For example, if the fabrication of the pre-production model by hand tooling is an essential part of the development testing, it may be necessary to obtain some production tooling before development is finished. However, the

beginning of full scale work when a preceeding phase has not been completed is unnecessary concurrency.

2.1.4 Risk Reduction

As different as development projects may be, there are two general rules that usually apply to all of them.

- Each development program schedule should be scrutinized to determine if expensive work that is significantly affected by other work can be rescheduled to a later start date without adversely affecting the program completion date.
- The manager must examine the impact on the risk of wasted work as a result of slipping the total program schedule. Sometimes schedule slippage in order to meet operational capabilities may reduce the risk of costly rework caused by concurrency. This is especially true in the scheduling of initial production activities. Usually changes in the final stages of development have a firm impact on production commitments; so delaying production commitments until successful development is assured will often give a large payoff in total program cost.

Specific programs sometimes require additional structuring to reduce risk. The following approaches should be considered:

- Reasonable trade-offs between operating requirements and engineering design.
- Steering away from high risk alternatives.

- System and hardware proofing to show that risk has been reduced to a justifiable level.
- Ensuring that high risk elements of the system have back-up programs.
- Ensuring that high risk areas receive a concentration of effort early in the program.
- Ensuring that uncertainties are resolved prior to committing valuable resources to easy areas or the entire program.

2.1.5 Milestones

Milestoning is specifying the completion of some fundamental, quantifiable phase of the development cycle. When this is related to risk assessment, a milestone represents the achievement of a particular phase of the program by showing that an objective has been reached (the phase usually has a possibility of failing). Since milestones are usually associated with estimated dates, their accomplishment may also show the degree of schedule adherence. This is only secondary to the fact that progress has been proved objectively.

This objectivity is a necessary quality of milestones. Since milestones are programmed in advance, they may not be "toyed" with to fit situations. They are events whose accomplishments measure progress toward program goals. These meaningful events are usually defined in detail in advance in order to be able to conduct this measure. These milestones are key events that occur

in every program and are used at various levels and in large numbers by decision makers.

Some milestones are denoted as "key" and have special significance. They are usually used by higher levels of decision makers to provide progressive appraisal of risk reduction and to ensure that commitments are made as a result of actual, instead of planned, accomplishments. This eliminates the possibility of wasting resources and adversely affecting available program options by ensuring "accomplishment related decisions" and not decisions based on calendar dates. These risk assessment milestones (key) have two purposes:

- To structure a program during planning so that progressive commitments are made only when justified by the remaining level of program risk.
- To validate the hypothesis on which the commitments were planned before additional commitments are made (from the management point of view).

2.1.6 Changes

There are two basic ideas that are important and must be considered when possible changes are being discussed.

- Do not change just for the sake of changing.
- Innocent-looking changes may not be so innocent-looking if improperly analyzed.

The longer a program develops, the more stable it should

become because elements of high risk have been overcome and proved. Any "unnecessary" change that affects something that has already been developed upsets the whole structure. Many times it is difficult to realize what impact a minor change may have on completed, current and anticipated work.

The second idea stems from the first. Because it is difficult to estimate the extent and effects of change, changes that appear innocent may adversely affect cost and schedule objectives. There may be a requirement for redesign, introduction of new risks or resurection of previously reduced or eliminated risks.

Therefore change control suggests these rules:

- Do not make the change if in doubt.
- Conduct a detailed analysis of the direct and likely impact of a change on performance, schedule, and cost.
- Still attempt not to make the change even after the analysis.

There is still the probability that things will turn out much worse than the analysis has predicted. Even after this, numerous program managers will resist the urge to make a change and then make the change only when there is overwhelming and convincing justification for it.

2.1.7 Planning For Unknowns

Sometimes events may occur that are not under the control of

the PM. These events may be categorized as anticipated unknowns and unanticipated unknowns. An anticipated unknown could be a possible event that may be forseen such as the failure of a subsystem. An unanticipiated unknown is something totally unexpected that might range from a total loss of a critical resource to a natural disaster. The basic substance of risk analysis is planning for anticipated unknowns. Probability analysis as a tool in planning necessarily implies recognition that there is a given probability of failing to achieve some objective in the system development. Therefore some consideration must be given to the effect of a failure (either a performance objective or a scheduled target date). A "what if" plan is usually generated as a result of the possibility of failing to meet a performance objective. Alternatives may range from something very simple to program cancellation. Either may, however, be acceptable. Slippage would be the possible solution when considering the possibility of failing to meet a schedule target. Slack time or breathing room may be incorporated into the total system schedule to adjust for slippage. This slack is necessary even when external pressures demand acceleration in order to prevent devastating effects on a project that is scheduled too tightly and does not allow for slippage.

2.2 The Schedule Phase

Time probably creates the greatest strain for program

managers. There appears to be a natural law that everything takes longer to do than planned, especially when everything is under pressure and things seem to be falling apart. The likelihood is greater that unknowns will be a problem in a program schedule if there is a failure to understand program interrelationships. Experience has shown that inadequate networking (graphic representation of a project to show relations among activities), consideration of administrative processing time, and failure to adequately provide for contingencies are three basic weaknesses in schedule planning. (POLS66)

The importance of properly organizing and establishing relations among activities must be stressed, especially during the planning phase. Oftentimes there is a tendency to assume that the system used to control a program determines the kind and detail of planning which should be done. A manager may decide he does not want to graphically show activity relationships or network the project with a sophisticated system like PERT (Program Evaluation and Review Techniques). He may attempt to organize all of the details of what he is required to do in some other manner (Appendices A, B, and C discuss three networking methods). Regardless of the method used, networking is a method of relating activities and events to each other over time and is usually associated with PERT. It is good because it shows the dependency of future activities and events on previous efforts. There is a general feeling among program managers that more detailed networking would have resulted in fewer important things being

overlooked. It also improves risk analysis because the interrelationships and dependencies of events are made more visible.

Administrative processing of paperwork is an area that must be adequately considered. Many times managers do not realize how long it will actually take to "pull together" all of the pieces of a package or program, consolidate everything, and possibly obtain approvals. Functional managers play a key role in this process, but too often they underestimate their share of the burden and again things fall behind. Usually slack time between scheduled milestone events will help attain target dates, but this slack must be kept secret from the people working toward the specified time. Once discovered, the slack will usually be stretched out and it will have been of no benefit when it was really needed.

2.2.1 Honesty

The basic human trait of being honest also plays an important role in successful project management. By attempting to "paint a pretty picture", people may begin to undersell what they really know or think about the inevitable impact of a potential problem. As they sanitize their reports, their judgement is replaced by a false faith that the situation will automatically correct itself. By failing to be honest, possible options such as additional funding or program extensions may disappear. One should never deliberately obscure facts when so many other alternative courses

of action or contingency plans may be feasible.

2.2.2 Inadequate Control of Events

Oftentimes schedule problems develop inside the program office instead of being introduced from outside the office. This usually occurs as a result of engineers and scientists attempting to seek technical perfection. Due to pride, developmental capabilities, craftsmanship, etc., they are oftentimes not quite satisfied with their product. A continuing attempt is made to strive for only the very best. This may often lead to delays or rushes to meet deadlines. Schedule slippages and cost problems are usually guaranteed to transpire if you do not confront them with an absolute deadline. This will usually force them to squeeze out more work as the deadline approaches. They do not like to go with less than the best, but it stops fiddling and tinkering.

2.2.3 Management Information Systems (MIS)

In order to be able to make sound logical decisions based on methodical reasoning and good judgement,a PM must be constantly informed. A good MIS provides the PM with this capability. A simple but descriptive definition of a MIS is: "An operational set of procedures which cause the flow of required information from the proper source, process the information needed, and presents it

to appropriate managers in meaningful form and in a timely fashion for evaluation and subsequent decision-making." An information system is a very important tool for the project manager. It is the resource that can ensure that he will make the most efficient use of all available program resources. There is a requirement to produce, store, and distribute these material resources. It is important to distinguish between data and information since the management information system must be able to deliver data to the PM as information which is to be acted upon. Data is simply collected and stored facts or inputs to a system. Information represents data to which the need to satisfy a requirement has been added (data with direction). Data becomes information when a manager is conscious of the meaning associated with the data.

Two terms that can be associated with information are perishable and consumable. Information is usually not consumed when it is used, but it is perishable in the sense that it has no utility beyond the time it is needed. Information is used to inform, evaluate, persuade, or to organize other information. For management activity within an organization, information is used to search, plan, initiate actions, control, create new concepts, identify problems, and subsequently solve them.

Information is usually made up from vast amounts of data that may be organized or presented in a random manner. Many times this data may be meaningless or it may be pertinent and very often only a small amount may relate to a specific event.

Meaningful, comprehensive information must be provided by the

MIS to all levels of management in a timely manner. The system should assist with management plans and actions, facilitate in the reaching of objectives, and recognize conditions which hinder mission accomplishment. The MIS should be tailored to the requirements of the principal manager it will serve and it should not expose the manager to unnecessary information or information that is not important at a certain point in time. This information should always be pertinent for making decisions.

There are five basic elements that make up a functional MIS. They are:

- Input
- Processor
- Output
- Control
- Feedback

A management information system provides data which allow managers to focus on items they need to control. A MIS can provide too much data. This could cause control to be impossible. Advanced computer technology eliminates the problem of data storage and retrieval. It now becomes important to be able to sift thru all this data and obtain information in a manner that can be understood and used. There are four things that must be provided so the information can be useful:

- Ranking of problem areas by criticality.
- Indicating potential areas of trouble.
- Anticipating cost changes or schedule slippage.

- Determining a method which resources may be distributed to assist in more critical areas or phases.

A smart program manager will also become familiar with the methods used by contractors to gain an understanding of their MIS and ensure quality information that portrays an accurate and reliable picture. Too often, government people assume a high degree of skill and sophistication in the civilian industrial complex that may not be present with the specific contractor they are working with. "C/SCSC" (Cost/Schedule Control Systems Criteria) is a specification intended to assure completeness, accuracy, and integrity of different systems to track cost and progress.

Good use of a MIS will help a PM be prepared for funding changes if they arise. These changes will be addressed only to show that a PM must constantly track the program funds, constantly look ahead for ways to allocate these funds, and be prepared to commit them on a moments notice. Experience has demonstrated that a sure way to have money is to get rid of it. In the government, it is easy for unused funds from one program to be transferred to another program. By planning contract actions early and injecting money into these contracts, a PM may usually spend the money as planned.

2.3 The Funding Phase and Cost Problems

After the PM has so carefully planned for his project, then five factors contributing to cost growth should be considered.

They are:

- Changes in cost estimates.
- Engineering changes.
- Schedule changes.
- Economic changes.
- Support changes.

2.3.1 Changes In Cost Estimates

Changes in cost estimates may frequently be the result of price optimism by calculating a "first-pass" program cost estimate that was too low. A lack of definition and objectivity, linked with estimating skills that may be inadequate, may help to lead to this inaccuracy. Competition for military programs, funds to promote favored programs and the motivation to increase business growth usually results in overselling.

There are two considerations that appear to be inherent in program cost estimating. These are constraining beginning program requirements and repeated examination of established requirements as they relate to recent implications. Items which result in additional cost are unnecessary performance requirements, disruptive changes in requirements, concurrency of development, and production when designs are likely to change. As the program develops, achievement of performance objectives start to become more evident. When achievement becomes doubtful, cost options can be addressed more accurately. If lesser requirements are

acceptable, then the program can continue without seeking additional funds to cover costs incurred as the result of maintaining essential performance requirements. A good program information system must alert the PM that a trade-off decision is necessary where no decision is comparable to opting for certain cost increases.

2.3.2 Engineering Changes

Change control attempts to determine essential changes from unnecessary ones. It implies an examination of the effect a change will have on schedule and cost objectives prior to the decision being made. It attempts to avoid nice-to-have changes and "understands" others that may be necessary to take advantage of new technology. There is a collective group of changes called constructive changes. They are similar to the formal changes discussed earlier with the exception that their impact on cost and schedule has not been precisely addressed. They include but are not limited to:

- Demanding extra contractor work as a result of defective specifications.
- Creating contractor work not specified in the contract.
- Requiring contractor work to be done in a manner different from that specified in the contract.
- Requiring additional inspection requirements.

Constructive changes are usually handled informally in meetings

and many times by deputy managers. In order to control these type changes, the PM must establish his policy on constructive changes and adhere to it. He must also ensure active participation by his legal and contract staff.

2.3.3 Schedule Changes

Any change to a program schedule will cost money. A stretched-out program adds to fixed costs such as depreciation, management salaries, etc. Reworking production engineering and other scheduling efforts accrue additional costs as well as maintaining an engineering division or some other such function that cannot be utilized elsewhere. An accelerated program requires training of additional personnel, overtime pay, additional facilities, and equipment, and duplication of scheduling efforts. Since schedule changes are often the result of funding changes, there is little a PM can do to protect his program from major budget reallocations. Keeping higher echelon managers constantly informed of budget change consequences is about the only defense available to possibly prevent money disruptions such as this.

2.3.4 Economic Changes

Budget nearsightedness in a program office causes some concern, especially when there is a requirement to pay for

something and someone has not taken into account all of the future events necessary for an accurate estimation of the target cost. Since the actual cost of doing work is very uncertain, a cost-reimbursement contract can be utilized. One must remember that the estimated cost is not a price but an objective and could expect that the cost of the work will probably exceed the objective. There is also a related problem to disregard budgetary planning for changes and contingencies. This stems from the same tendency to view contracts as fixed dollar limits. Managers must realize that contract changes must be anticipated. There is little that can be done other than see how other managers handled their changes and attempt to benefit from these observations. Changes in the purchasing power of the dollar have some effect here.

2.3.5 Support Changes

There are numerous smaller costs that come into being that may be solved by the budget office. These range from travel funds to possible overtime work. Many times a PM will realize his limited control over these funds and he will often have to compete with other managers for the money they need. As with larger cost problems, cost control must receive continuing attention and emphasis. This is sometimes difficult when most of the excitement is centered around the actual development object and its associated performance. Changes in spare parts and testing are

also covered under smaller costs.

2.4 Project Management Requirements Summary

In this chapter, I have identified and discussed some of the areas that a successful program manager must monitor or control in order to develop a quality program. I have pointed out the areas that can be managed by utilizing either automated tools or by manual operations. Other areas must be managed based on the knowledge, experience, and capabilities of the project manager and his functiional managers.

CHAPTER THREE

SOFTWARE SYSTEMS

An ideal software system to assist program managers in the management of their day-to-day requirements should be able to address the different areas of concern discussed in chapter two. These systems are usually made up of modular, fully integrated computer programs that may be combined into one system. This allows the addition and deletion of subroutines and algorithms in order to tailor the system to the desires of the manager.

The National Bureau of Standards (NBS) maintains a relational database of software tools available today (NBSS80). The Center for Programming Science and Technology is responsible for compiling data for and updating the database. They allow information retrieval on specific features of each tool, developers, documentation, hardware and software requirements, availability, publications, and contracts. The database serves several purposes.

- Assists the NBS in the development of standards to improve federal software quality through the use of available tools.
- Allows determination of available tools and their capabilities.
- Permits tool researchers to query one central location for current tool development in order to prevent duplication of

effort.

I have selected two of these software systems to analyze and show how they help a program manager control and manage the different areas of responsibility within a development program. One system was developed for use by government agencies and is used on major development projects such as new aircraft, vehicles, or weapons systems. It is called the Executive Level Interactive Terminal Environment (ELITE). The other system was developed commercially and is marketed to control large or small projects. It is called the Andrew Sipos Associates Project Management System (ASA PMS). Appendix D lists 35 additional software systems that assist in program management. Information concerning these systems found either in the NBS database or Reifer Consulting.

In order to avoid confusion, I will first discuss how the ELITE system assists the project manager in the control of the project. In chapter 5, I will discuss how a commercial version of a project management system does the same job.

CHAPTER FOUR

4.1 EXECUTIVE LEVEL INTERACTIVE TERMINAL ENVIRONMENT (ELITE)

The ELITE system is a terminal based, interactive, support system designed to provide automated support for general and specific management functions in the life cycle development of major systems for the U. S. Army. It was designed and developed by the Automated Logistics Management Systems Activity of the U. S. Army Material Development and Readiness Command (ELIT81). Each ELITE system is an individual system designed specifically to meet certain requirements. It allows for teleconferencing and the shared use of information from individual tools. It is simple, straightforward, and requires very little training. It is an integrated office information system that allows immediate access to reports, correspondence, and other data and is as portable as a briefcase terminal. The system also incorporates an advanced text processing tool, a time management system, and a communication capability from anywhere in the United States or Europe.

The ELITE system utilizes a host computer located in Cupertino, California. Numerous management tools are located within this host computer and are available on a time sharing basis. These baseline tools were developed by Tymshare, Inc. (currently operational on the host computer) and have the capability to access other computers in a transparent manner. This extensive interaction yields immeasurable flexibility for the

user who has access to the system. Access is attained via telephone through an Interface Message Processor (IMP) or Terminal Interface Processor (TIP) and through the use of an advance Research Project Agency (ARPANET) and in turn to the host computer and the ELITE system. A simple humanized dialogue will then guide the user to the desired tools which then accept input or respond to queries. Additional passwords, file encodings, or identification symbols allow admission to user owned data files that are kept separate within the ELITE system. This security and privacy is as yet not enough to handle classified data.

There are numerous tools within the ELITE system that are available to the manager, which allow him to manage his project. A suspense tool follows personal and organizational suspenses. An automatic reminder is generated for both intermediate, final, open, and overdue suspense dates. A calendar tool helps coordinate and schedule meetings, appointment, etc. and acts as a time management tool. There is a milestone tool that works as a general purpose tracking tool. It is highly flexible and monitors project milestones and information about these milestones. A budget monitor tool provides current information on related money elements. It is capable of sub, vertical, and horizontal totalling. A tool that is important for military managers is the PM Regs tool. This will access government regulations necessary for use by the manager. A cost performance tool presents a historical summary and analysis of cost statistics and trends. A schedule tool graphically shows schedule information on one or

more projects. This allows a manager to see the impact of delays or changes on a project. A manager may use electronic mail whenever he has access to a telephone to coordinate, transmit, distribute, or direct by sending and receiving documents at electronic speeds. Augment provides numerous administrative capabilities such as text-editing, photocomposition and a host of graphics packages. Prior to the installation of this system, representatives from the ELITE support group will conduct an organizational analysis to determine:

- If there is a legitimate need for ELITE.
- To determine the optimum implementation approach and cost.
- To measure the probability of success within the organization.

A statistical analysis determines interfaces both within and without the organization. Higher levels of management within the organization are interviewed and an organizational profile is also established. After the analysis, a recommendation is made as to how to best implement the system. User support and a 'feed-back mechanism' is provided once the system is in use.

4.2 Planning and the ELITE System

The ELITE system can help a PM in almost all of the areas discussed in Chapter 2. In the area of planning, the PM must use some manual techniques in order to ensure complete planning; however the ELITE automated tools will provide some assistance.

Two tools that are utilized throughout the project are the SUSPENSE and CALENDAR tools. They help get the project off the ground by helping in the initial organization effort by allocating time and ensuring prompt administrative actions. They may not be the most important tools of the planning phase, but they are used from the very beginning through the end of the project.

4.2.1 The Suspense Tool

The SUSPENSE tool is another tool that may be used during the planning stage. It is especially useful during the initial phase of planning where there is a requirement to keep track of and satisfy correspondence obligations and monitor the progress of due dates, etc.

A time consumming activity within any office environment is maintaining a system of keeping track of personal and organizational suspense actions or due dates. The current manual system used throughout the army keeps track of several items:

- Suspense item due date
- Subject of document
- Type of document
- Originator
- Date of document
- Document comment section
- Date received
- Action officer
- Completion date

The ELITE suspense tool is able to coordinate the same suspense items automatically. Once a suspense item has been entered into the ELITE system, it will be on-line and easily

retrievable. When adding the item to the file, the user will specify the number and frequency of reminders they will require on specific suspense dates. Then whenever the manager enters ELITE, they will automatically receive a list of reminders of their suspense dates. Normal reminders may only be generated on workdays or their due-date and on every day thereafter when overdue, to include week-ends. With this tool a manager can add, review, modify, close out, delete, or append a comment to a suspense item.

To add to the suspense file there are certain mandatory entries to be made:

- The due date.
- The topic.
- The reminder format.

Optional entries that may be entered are:

- Suspense number.
- Date received.
- Received from.
- Reply to.
- Assigned to.
- Assignee-due-date.
- Comments.

Modification of an existing suspense file requires that the manager specifies which item within the due-date that needs a change. This relieves the requirement to display all suspense items within a specific due-date prior to selecting the items you

wish to modify.

There are two possible methods to review suspense files in ELITE. An entire suspense entry may be looked at or by topics only. By viewing an entire suspense entry, all of the information requested by a manager for a specific reminder will be delayed. Viewing by topics only will present a particular due date and the topic of all suspenses due on that day. A sub-set of topic review is the use of a keyword to identify all of the suspense items that are associated with the keyword. Other keywords such as OPEN, OVERDUE, CLOSED, and DUE-DATE will catalogue suspense items in each appropriate category.

The APPEND function simply allows you to insert additional information into an existing suspense item. Ammendment may be made in the following areas:

- Topic
- Suspense-number
- Received-from
- Reply-to
- Comments
- Assigned to

Appending differs from modification in that the MODIFY function is used to change an existing comment.

When a suspense requirement has been satisfied, the CLOSE function is utilized to flag a particular item to show that the action has been completed. Closed items may be reopened at a later date if necessary.

Closely related to the CLOSE function is the DELETE command. After a manager is confident that he has completely finished with a suspense item, the DELETE command will erase it completely from

the file. The reminder prompts for that file must be closed prior to the actual deletion of the file.

There are several other nice features that may be utilized with the SUSPENSE tool. A show function prints your entire suspense file. The SEND function will transmit selected portions of your suspense file to others who have access to the ELITE system. There is also a feature called NEWS which allows the ELITE team to broadcast changes to the SUSPENSE tool as they are implemented. This is displayed upon entry to the tool. Figures 4-1,2,&3 show exampes of SUSPENSE reports.

4.2.2 The Calendar Tool

The CALENDAR tool is a nice-to-have feature that will help the PM coordinate meetings and special events. Although used throughout the project, it will be especially useful in the beginning phases to ensure efficient use of time.

A PM has the responsibility to interface with numerous government agencies, private industry, other PMs, and other commands. This all requires extremely efficient scheduling of time. Typical manual calendar aids range from 3x5 pocket reminder cards, appointment books, 30-60-90 day calendar charts to desk top calendar pads. Coordinating changes on all of these may be a complicated measure. The ELITE CALENDAR tool is an automated office support system constructed to view a data base of chronological calendar events and itineraries. It is segmented in

```
--------------------------------------------------------------------------------
                                Due-date: 15 Aug 80
*Item number: 1
Topic: Letter From DARCOM
Suspense-number: 103-81
Date-received: Wed  8 Aug 80
Received-from: *DARCOM*
Reply-to: *TECOM*
Assigned-to: *CM* *GOODY*
Assignee-due-date: Mon 13 Aug 80
Reminders: 1; Days apart: 5
Date-closed: 19 Aug 81
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
*Item number: 2
Topic: Letter From MG Mauldings: Subject:   IG Inspection
Suspense-number: 5552
Received-from: DARCOM HQ
Reply-to: Same
Comment 1:  1 Aug 80 No Action for 1 week
Assigned-to: *DRXCO-RLS* , *JONES*
Assignee-due-date: Mon 13 Aug 80
Reminders: 1; Days apart: 3
Date-closed:  5 Oct 80
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                                Due-date: 21 Sep 80
*Item number: 1
Topic: Letter From DARCOM
Suspense-number: 123-80
Date-received: Tue 21 Aug 80
Received-from: Mr. Billings
Reply-to: Mr. Smith
Comment 1: 21 Aug 80 This letter pertains to the blueprint.
Comment 2: 21 Aug 80 Gen. Maulding wants emphasis on electronic mail.
Assigned-to: DMXAL-Z
Assignee-due-date: Wed 19 Sep 80
Reminders: 1; Days apart: 7
Date-closed: 25 Jan 81
--------------------------------------------------------------------------------
```

FIGURE 4-1

SUSPENSE REPORT

Due-date: 16 Nov 79
  *Item number: 1 Topic: Blueprint For 1980's

Due-date: 12 Dec 79
  *Item number: 1 Topic: Dugway Test For XML36

Due-date: 22 Dec 79
  *Item number: 1 Topic: Re-Survey FY-81 Training Requirements

Due-date: 15 Jan 80
  *Item number: 2 Topic: Manpower Ceiling Report

Due-date: 29 Jan 80
  *Item number: 1 Topic: Efficiency Report For Loilland, Robert

Due-date: 1 Feb 80
  *Item number: 1 Topic: CCSS Functional Course

Due-date: 14 Mar 80
  *Item number: 1 Topic: Review IDP'S

Due-date: 22 Mar 80
  *Item number: 1 Topic: Annual DARCOM Chaplain Training
  Conference/Workshop

Due-date: 16 May 80
  *Item number: 1 Topic: *DAPR* , *PM-PLRS* , *Cpt Roster*

Due-date: 29 Jul 80
  !Item number: 1 Topic: Manpower Ceiling Report

Due-date: 1 Nov 80
  !Item number: 1 Topic: DARCOM Installation And Activity Fact Sheet

Due-date: 19 Nov 80
  !Item number: 1 Topic: Automated OMA Obligation Plan

Due-date: 25 Jun 80
  *Item number: 1 Topic: Cpt Milton, Letter On Space Report.

FIGURE 4-2

SUSPENSE REPORT

```
Due-date: 25 Jun 80
  *Item number: 1  Topic: Cpt Milton, Letter on Space Report.
  Suspense-number: 3259
  Date-received: Thu 21 Jun 80
  Received-from: DARCOM HQ
  Reply-to: SGS
  Comment 1: 28 Jun 80 SEE CS note on page 1 of memo.
  Comment 2:  6 Mar 81 Discuss CS note with Col Gilliard prior to reply

Due-date: 18 Jul 80
  *Item number: 1  Topic: Review Launcher
  Suspense-number: 84884
  Date-received: Sun 15 Jul 80
  Received-from: DARCOM
  Reply-to: Same
  Comment 1: 11 Jul 80 no comments
  Assigned-to: Tom Monniker    Assignee-due-date: Sat 14 Jul 80
  Reminders: 1; Days apart: 1
  Date-closed: 25 Jan 81

Due-date: 21 Sep 80
  *Item number: 1  Topic: Letter From DARCOM
  Suspense-number: 123-80
  Date-received: Tue 21 Aug 80
  Received-from: Mr. Wilberton
  Reply-to: Mr. Smith
  Comment 1: 21 Aug 80 This letter pertains to the blueprint.
  Comment 2: 21 Aug 80 Gen. Maulling wants emphasis on electronic mail.
  Assigned-to: DRCAL-MZ   Assignee-due-date: Wed 19 Sep 80
  Reminders: 1; Days apart: 7
  Date-closed: 25 Jan 81

Due-date: 16 Nov 80
  *Item number: 1  Topic:  Blueprint For 1980's
  Suspense-number: 2
  Date-received: Thu  1 Nov 80
  Received-from: DRZTC-LO
  Reply-to: Same
  Assigned-to: King    Assignee-due-date: Mon  5 Nov 80
  Assigned-to: Ruppe   Assignee-due-date: Fri 16 Nov 80
  Reminders: 1; Days apart: 5
  Date-closed: 25 Jan 81
```

FIGURE 4-3

SUSPENSE REPORT

15 minute increments, 24 hour days, by month. The user can determine the number of months to be kept on-line. CALENDAR will display reminders, tasks, seminars, and appointments and may be supplemented by additional information such as agendas, meeting locations, participants and meeting comments, etc.

A PM may check his calendar at any time for any particular day. The calendar printout can be in several formats, eg., time and/or topic, location, participants, date, time, and topic, etc. A portable terminal allows checking and updating at any time or place where there is a phone. In order to avoid conflicts when planning meetings, a user can check the calendar of other CALENDAR users for open dates and times by utilizing the coordinate feature of CALENDAR. This feature will not disclose what is on the other person's calendar but will disclose if there is or is not a conflict. The PM may send messages to other users requesting a certain time frame for a meeting and he may send copies of his calendar to other users as he desires.

Capabilities of the CALENDAR tool are:

- Addition of items to your calendar.
- Review of calendar for specific time frame.
- Modification of calendar for a certain day or a specific item scheduled over a range of consecutive days.
- Append any entry which make up a calendar item.
- Delete calendar items.
- Coordination of meetings with other ELITE users.
- Furnish other users with a copy of your calendar.

In order to add to CALENDAR, it is mandatory to complete the date, start time, and time entries. Time periods are based on the 24 hour clock system and in increments of 15 minutes. Entry format will vary to cover specific days or a range of days and the remainder of the information is added by using a simple humanized dialogue.

Deletions are also made based on specific days or ranges of days and responds to the start time and end time of the calendar event. After a double-check of the deletion request and user input of an affirmative response, the deletion is made.

REVIEW allows the user to see or obtain a listing of the entire calendar or a specific portion, by day or range of days between certain start and end times. The listing will also be formated according to the desires of the user.

The MODIFY function of the CALENDAR tool allows the user to replace existing information currently located in an entry. Specific items are located by date and time and then modified as desired. The modification will take place between a specified start and ending time. After the proposed entry, the system will verify the entry prior to the actual change.

APPEND differs from MODIFY in that it will allow additions to existing data based on data or range of dates, and start and end times. The system will again double-check with the user prior to the actual entry to ensure a correct change is being entered.

The COORDINATE function permits multiple user synchronization and scheduling of meetings, conferences or appointments.

Coordination may be done among multiple addresses based on specific dates and times or first open time. The system will select the first common time available if given a certain range of times. If this time is agreeable with the user, a tentative appointment is scheduled with all individuals concerned and each calendar is in turn updated.

There is an OPTION function associated with CALENDAR. Within OPTION is a SEND command that allows a user to transmit desired portions of his calendar to another user or users. Comments may be added to your calendar message if necessary. Once the message format (entire calendar or by topics and times only) has been noted, the actual transmission will take place. A return message will come back to you acknowledging receipt of your message or informing you of a temporary delay for later delivery Figures 4-4 & 5 present examples of calendar formats.

4.2.3 Risk Assessment

This area of planning is really not addressed by the ELITE system. Many of the Government projects managed by a PM are the type where risk is not a key factor. Usually the system or subsystem has already been developed by civilian contractors. This is true in the case of weapons systems much of the time.

The MILESTONE tool (4.4.1) may be used to assist the PM is some risk situations since reaching a milestone means an objective has been attained that may have had a possibility of failing.

This is the calendar of Jane Q. Doe

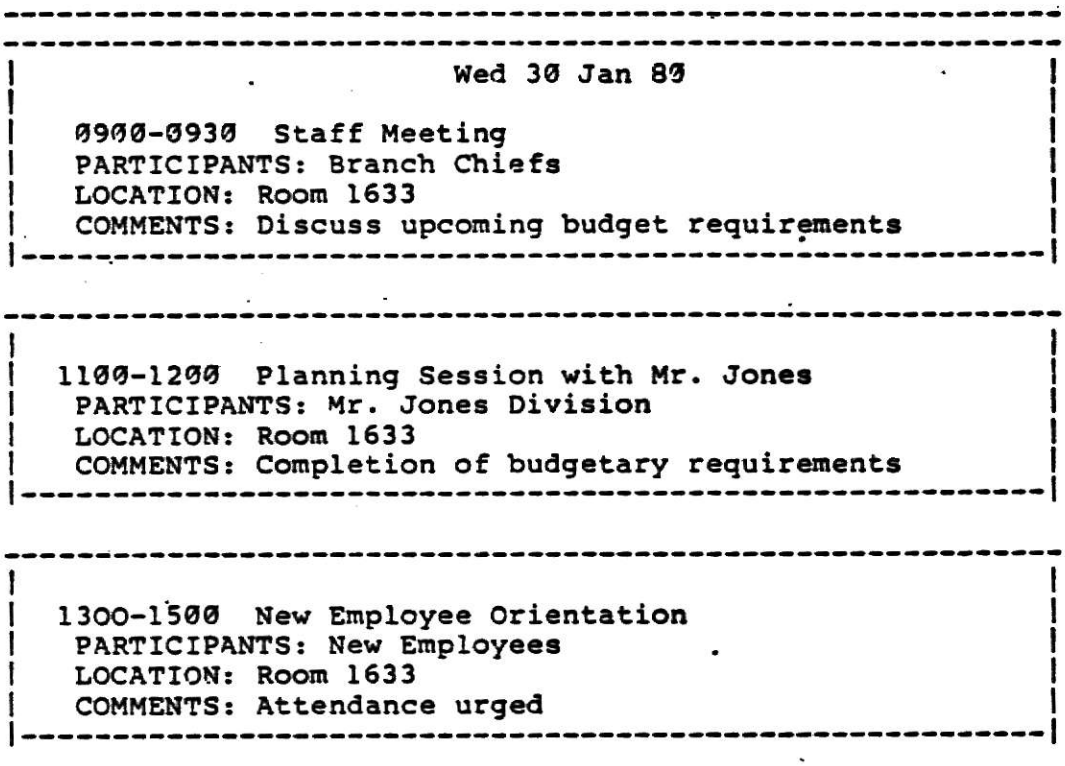


FIGURE 4-4

CALENDAR FORMAT

This is the calendar of V. W. Berns

Wed 30 Jan 8

0900-0930 Staff Meeting
1300-1500 Planning session with Mr. Stanford
1500-1600 Release Management Briefing

Example 2-2. Review that shows Times and Topics for a specific Calendar date.

This is the calendar of Jane Q. Doe

Wed 30 Jan 80
0900-0930 Staff Meeting
1100-1200 Planning session with Mr. Jones
1300-1500 New Employee Orientation

FIGURE 4-5

CALENDAR FORMAT

4.2.4 Concurrency Reduction Phase

This is an important phase that must be monitored. Although ELITE does not provide a networking tool to assist in this area, manual methods such as PERT are utilized. One particular PM office utilizes a locally fabricated tool to track activities in order to help eliminate concurrency. The ELITE tool that will provide assistance in the reduction of concurrency is the MILESTONE tool. This tool will provide the PM with an overall view of the project and allow him to track milestones and related information about them.

4.2.5 Milestone Phase

This phase in planning can be automated by one of the ELITE tools. The MILESTONE tool allows the PM to monitor phase progression accurately; the PM can reduce concurrency and be better able to access risk prior to going into the next phase. This type tool is almost non-existent in a majority of PM offices today. Many PMs either receive milestone updates from their contractors or via their local DMIS. Therefore, MILESTONE was developed to allow a PM to utilize his own tracking tool. Any number of files may be in each file. The current MILESTONE tool has been field prototyped and accepted by the Project Managers for Training Devices. The tool has since been enhanced and is often used as a general purpose tracking tool. It is very flexible and

can be tailored easily, but requires careful advance planning. The general format is an event/task and status arrangement that can be modified to suit user needs. The capabilities of this tool are:

- Establish one or more milestone files through the use of a standard set of 11 information "fields" and 15 user designated "fields".
- Insertion of standard milestone files (specific milestone items) into new files.
- Ability to rename an event/task field.
- Establishment of a reminder system to inform you of upcoming milestones.
- Assignment of dependencies between milestones.
- Ability to slip milestones by either a constant amount or by varying slack time between dependent milestones.
- Method to add additional information to both standard and user designated fields without retyping the entire field.
- Establishment of an audit trail of status changes of a particular milestone.
- Ability to track sub-milestones within a milestone.
- Capability to review milestone file by several methods (subject keyword, status, etc.).
- Ability to delete a file, an entry, or multiple entries within a file.
- Method to utilize more than one milestone file during the same meeting.

- Capability to send files to another user and access files belonging to him.

In order to establish a milestone file, a user may elect to insert a standard set of milestone information items such as event, task, start date, phase, etc. after the name of the new file is determined. The subject is then entered in the event-task section followed by the beginning and ending dates of the event. The status field allows the entry of comments such as man hours expended, funds expended, percentage of completion, etc. This again is in a humanized dialogue and must be combined with an "as-of-date". The DELETE and MODIFY functions are similar to those already discussed on previous tools. It is important to remember now that there may be other sub-milestones stones or dependencies associated with this task that will need to be altered. As-of-dates must also be changed. Old information that has been modified is now erased; whereas in the APPEND function added text becomes new information and the old information (status) is stored for later review and tracking. When it is necessary to review all of the milestones, a selection must be made as to which format is desired, i.e. entire entry, topics only or topics with dates. A keyword search may also be utilized to locate similar files, that are related by some keyword. A review may also be conducted according to two distinct levels (level one or level two). Level two milestones are sub-milestones of a higher milestone. The status field may be used to keep track of all the changes to the status of a particular milestone. This is

very useful for the manager to be able to track a particular phase of a project. The options function of MILESTONES provides the flexibility and capability through the use of 15 additional user fields utilized by the PM to tailor a particular profile to suit desired needs. Examples of these fields would be schedule of delivery, contractor, cost per item, etc.

By assigning dependencies between milestone entries, the PM has the capability to ensure that a particular milestone has been completed before another one begins. The system will prevent the new event from beginning. If a completion date must be changed, dependent milestone start dates can be automatically slipped a fixed or constant amount of days or slipped to fit (takes up slack). Review of milestones will be printed in the particular format of your choice. Figures 4-6,11 depict examples of MILESTONE print-outs.

4.2.6 The Changes Phase

Once a project has started, changes become very important. If the wrong change or a bad change is made, it would have detrimental effects on the entire project. The SCHEDULE tool (4.9) allows a manager to see the impact of delays or changes on a project. It will not make an automatic decision for him, only provide him with information to allow him to make it.

4.2.7 The Planning for Unknowns Phase

Production Phase Milestones with Start Date and Status

Project Name: ZULU
User name: Waugh, Goree E. Current date: 27 Feb 80

Event/Task	Start Date	Status
Material Fielding Plan (MFP)		As of 1 Feb 80: Completed as scheduled
Request for Proposal		As of 10 Nov 80: Complete
Procurement Package		
Government Furnished Equipment (GFE)		As of 8 Dec 80: Waiting for proposal
Proposals Received	4 Nov 80	As of 15 Dec 80: Completed on schedule
Contract Award	4 Nov 80	As of 27 Feb 80: It looks like the contract will be awarded on time.
First Article Preprod Test	4 Nov 80	As of 20 Feb 80: In process
Complete Transition to MRC	15 Jun 80	As of 20 Feb 80: none
First Unit Equipped	4 Nov 80	As of 20 Feb 80: No status at this time.

FIGURE 4-6

MILESTONE PRINTOUT

Production Phase Milestones by Completion Dates and Status

Project Name: ZULU
User name: Waugh, Goree E. Current date: 27 Feb 80

Event/Task	Completion Date	Status
Material Fielding Plan (MFP)	1 Feb 80	As of 1 Feb 80: Completed as scheduled
Request for Proposal	10 Nov 80	As of 10 Nov 80: Complete
Procurement Package	15 Nov 80	
Government Furnished Equipment (GFE)	10 Dec 80	As of 8 Dec 80: Waiting for proposal
Proposals Received	15 Dec 80	As of 15 Dec 80: Completed on schedule
Contract Award	10 Apr 80	As of 27 Feb 80: It looks like the contract will be awarded on time.
First Article Preprod Test	15 Jun 80	As of 20 Feb 80: In process
Complete Transition to MRC	1 Oct 80	As of 20 Feb 80: none
First Unit Equipped	30 Jun 81	As of 20 Feb 80: No status at this time.

FIGURE 4-7

MILESTONE PRINTOUT

Production Phase Milestones with ALL Status

Project Name: ZULU
User name: Waugh, Goree E. Current date: 27 Feb 80

Event/Task	Status
Material Fielding Plan (MFP)	As of 1 Feb 80: Completed as scheduled
Request for Proposal	As of 10 Nov 80: Complete
Procurement Package	
Government Furnished Equipment (GFE)	As of 8 Dec 80: Waiting for proposal
Proposals Received	As of 15 Dec 80: Completed on schedule
Contract Award	As of 27 Feb 80: It looks like the contract will be awarded on time. As of 20 Feb 80: none
First Article Preprod Test	As of 20 Feb 80: In process
Complete Transition to MRC	As of 20 Feb 80: none
First Unit Equipped	As of 20 Feb 80: No status at this time.

FIGURE 4-8

MILESTONE PRINTOUT

Three Different Headings

Project Name: ZULU
User name: Waugh, Goree E. Current date: 27 Feb 80

Phase	Event/Task	Status
Initial	Material Fielding Plan (MFP)	As of 1 Feb 80: Completed as scheduled
Initial	Request for Proposal	As of 10 Nov 80: Complete
Production	Procurement Package	
Production	Government Furnished Equipment (GFE)	As of 8 Dec 80: Waiting for proposal
Production	Proposals Received	As of 15 Dec 80: Completed on schedule
Production	Contract Award	As of 27 Feb 80: It looks like the contract will be awarded on time.
Production	First Article Preprod Test	As of 20 Feb 80: In process
Production	Complete Transition to MRC	As of 20 Feb 80: none
Final	First Unit Equipped	As of 20 Feb 80: No status at this time.

FIGURE 4-9

MILESTONE PRINTOUT

Milestone by Phase

Project Name: ZULU
User name: Waugh, Goree E. Current date: 27 Feb 80

Event/Task	Phase
Material Fielding Plan (MFP)	Initial
Request for Proposal	Initial
Procurement Package	production
Government Furnished Equipment (GFE)	production
Proposals Received	production
Contract Award	production
First Article Preprod Test	production
Complete Transition to MRC	production
First Unit Equipped	Final

FIGURE 4-10

MILESTONE PRINTOUT

Production Phase Milestones With Event/Task Numbers

Project Name: ZULU
User name: Waugh, Goree E. Current date: 8 May 80

Event/Task	Start Date	Completion Date	Status
3058: Material Fielding Plan (MFP)		1 Feb 80	As of 4 Nov 80: None
3065: Request for Proposal		10 Nov 80	As of 4 Nov 80: None
3072: Procurement Package		15 Nov 80	As of 4 Nov 80: None
3080: Government Furnished Equipment (GFE)			As of 4 Nov 80: Waiting Proposal
3180: Proposals Received	4 Nov 80	15 Dec 80	As of 4 Nov 80: None
3187: Contract Award	4 Nov 80	10 Apr 80	As of 4 Nov 80: None
3194: First Article Preprod Test	4 Nov 80	15 Jun 80	As of 4 Nov 80: None
3201: Complete	4 Nov 80	1 Oct 80	As of 4 Nov 80: None
3208: First Unit Equipped (IOC)	4 Nov 80	30 Jun 80	As of 4 Nov 80: None

FIGURE 4-11

BUDGET REPORT FORMAT

There is no automated tool to help the PM in this area of the planning phase. The PM must identify what possible areas are suceptible to drastic changes or unexpected events. Once the project is under way, tools such as MILESTONES, SCHEDULE, BUDGET MONITOR, and COST PERFORMANCE will provide information to help cope with and solve an unexpected happening.

4.2.8 The PM REGS Tool

A nice-to-have tool in the planning phase is the PM REGS tool. The PM REGS tool will be used frequently during the planning phase to ensure compliance to military and Department of Defense regulations that set forth administrative, legal, and operational guidelines and requirements. It will be referenced throughout the project as the need arises.

It is an automated office support tool that allows easy access to all of the Army regulations that relate to the project management environment. There are vast amounts of regulations that prescribe guidelines and set aside requirements for use by project managers. A manual search of these regulations would require an extensive working knowledge of them in order to ensure that all of the pertinent regulations had been checked. This search would have to be done by subject or regulation number. The PM-REGS tool can access by keywords, regulation number, or subject area. The present PM-REGS tool only contains the title, regulation number, publication date, and current changes in force.

It does not contain the text of the regulation.

There are only two commands associated with this tool. The RECALL command will allow the user to obtain a list of all regulations that pertain to a keyword. The LIST command has two functions. It may be used to obtain a list of the regulations in the file or it will produce a list of the necessary keywords associated with the regulations in the file.

4.2.9 Planning Summary

The planning phase is made much easier by the use of the planning tools found in the ELITE system. They assist the PM and his staff by organizing many of the administrative requirements such as suspense files, calendars, agendas, and appointments. These automated tools provide instant reminders and access to information that would not be so accessable with manual systems. Correspondence preparation and distribution are made easier through electronic means. Preparation for the scheduling phase is simpler because many of the general phases and activities have now been identified and placed in a simple order.

4.3 SCHEDULING and the ELITE System

The PM may use several automated tools to help with schedule problems. In order to organize project schedule information, the PM will use the SCHEDULES tool. This tool will graphically

portray schedule information on one or many projects. Alternative schedules may be created to show impacts of delays or changes on a project. This will help the PM to make any decisions if there is a requirement to make one. The following is a list of typical uses for the SCHEDULES tool:

- To organize project schedules.
- To organize training schedules.
- To organize travel schedules.
- To organize leave schedules.

The three primary tools that are available to assist the PM in scheduling problems are:

- The MIS tool
- The SCHEDULE tool
- The MILESTONE tool

There are many tools that may be combined to provide the PM with a MIS that is effective and functional. The SUSPENSE tool provides constant reminders of upcoming office transactions. The MILESTONE tool will provide reminders of upcoming key events to help keep the project on schedule. The SCHEDULE tool furnishes timetables that cover the project, training, travel, leave, etc. ELECTRONIC MAIL may be considered a distribution system by the way in which it sends and receives messages and documents electronically. An AUGMENT tool may be used for document forms, letter, and memorandum preparation. This is especially helpful in the preparation of briefings and for dissemination of information. The CALENDAR tool can quickly display upcoming meeting and

appointments. This feature can help schedule around important events or re-schedule events and meetings, etc., if necessary. These combined tools help pull together many of the administrative areas necessary for efficiently scheduling office information processing.

4.3.1 Scheduling Summary

The tools that were discussed in this section will prove to be effective in the project scheduling phase. They help identify each activity and all of the necessary information that must accompany that activity. From this analysis a more complete project network or diagram may be constructed. Schedules such as the project, training, travel, etc. may now be graphically preseted as necessary. Information is easily presented to the PM and his staff through the automated tools of the MIS. Proposed changes may be easily analyzed in this phase. When the information provided by all of these tools is combined with information from the funding phase, a complete project schedule will be available.

4.4 Cost Problems and the ELITE System

As shown in chapter two, most of the areas that concern the PM in the area of cost are changes in the different areas of development, once the project has started. These areas are cost

estimates, engineering, scheduling, economic and other changes.

The proper use of the SCHEDULE tool can help the PM to organize project schedule information in order to monitor and control events. Alternative schedules will help show the impact of inadequate control that will result in delays and changes.

4.4.1 The MILESTONE Tool

The MILESTONE Tool may also be utilized here to help prevent inadequate control of events. This tool will always provide selected milestone information plus provide general tracking. Some things such as honesty cannot be automated and everyone concerned must realize the importance of presenting a current and correct picture, whether it is good or bad.

There are several tools that are available to assist the PM in the management of cost and funding problems. Budget areas can be tracked by the use of the BUDGET monitor tool. This tool may also be used in the planning phase, but would be more of an asset to assist in the monitor of expenditures. It is also used for smaller cost problems.

4.4.2 The BUDGET MONITOR Tool

The BUDGET MONITOR tool is an automated support system that provides current interoffice budget information. A PM usually has two manual budget systems. One is a formal comptroller budget

made up of daily input transactions to provide a monthly output product. Another is a manual status of funds document used to show the day-to-day transactions. With this manual system, it is difficult to ensure accurate, immediate budget information. This is especially true if the information is required at another geographical location.

The ELITE budget tool allows a PM to establish an unlimited number of files and be able to monitor elements of expense and categories contained within the file. It may be tailored to fit the individual needs of each particular manager. There are seven standard categories of information that are basic to this tool. They are:

- Approved program
- Received program
- Committed
- Uncommitted program
- Obligated
- Unobligated commitment
- Program unobligated

These normally make up the horizontal titles for a budget printout based on the format desires of the PM. The Elements of Expense are listed vertically down the left side and are expense items that the PM desires to monitor. This tool can also accommodate eight additional categories of user prerogative.

The capabilities of this tool are numerous and are summarized as follows:

- Establishment of multiple budget files.
- Flexibility with 15 categories of information. (7 standard, 8 users' own).
- 50 elements of expense.
- Computing three of the seven standard category fields for an element of expense when creating a file.
- Ability to modify a standard category field or add additional category fields.
- Capability to review budget files in any desired format or sequence. May be queried by element and category.
- Ability to delete files or portions thereof and access multiple files during a session.
- Capability to grant READ ONLY access to others and dispatch file to them as desired.
- Ability to generate horizontal and vertical totals, subtotals, decimals and commas (for readability) in dollar amounts.

It is helpful to plan the files of the BUDGET tool in detail before their actual creation in order to ensure understandability and simplicity. A mental picture of the file is most useful. This may be done by visualizing a grid showing categories across the top and elements of expense down the margin. Where the vertical and horizontal lines that extend from these headings intersect, the user will find the particular amount resulting from these categories. This advance planning allows the manager to establish his reports as he best understands them. A file is

established simply by constructing it with the desired categories, elements of expense, and corresponding dollar amounts.

In order to utilize the BUDGET tool it is again important to plan ahead and understand what each function will do to a file. The ADD function will allow a user to add an element or a category to an existing file. Care must be taken to ensure each addition is or is not included in the correct TOTAL grouping when a review by format command is given, so as to produce accurate results. This system allows the PM to include or exclude the new category when computing horizontal and vertical totals. These options of groupings are horizontal, vertical, both or none. This also applies to the MODIFY function. The DELETE function will allow the user to eliminate an element, a category, or a complete budget file. In order to add text to an existing file, the APPEND function may be used. This may be used to append new comment lines at the end of the comment section of the budget file. The REVIEW function enables a user to view a file by either of two methods: FORMAT or by QUESTIONS. In order to review by format, the user must decide whether to review all categories or pick them individually. By listing the desired individual categories, the PM will be able to tailor the report so as to produce only the items necessary for the report. The QUESTIONS review technique grants two types of questions: How much...? and what is...? Attached to the BUDGET tool is the OPTION function. This will allow the PM the opportunity to take advantage of some enhanced capabilities such as SHOW, SEND, CHANGE, etc. The PM may allow

others to review his file in a read only status and he may send the file to others on the system. Figures 4-12,13,and 14, show various BUDGET report formats.

4.4.3 Cost Performance Report (CPR)

The COST PERFORMANCE REPORT tool will help the PM maintain a historical summary and analysis of contractor cost performance. It will provide performance statistics and trends and show statistics for the latest revised estimates.

The CPR tool allows a PM to consolidate monthly contractor cost performance data into a historical summary. The consolidation is then simplified and is used to assist in the analysis of CPR statistics and trends. Cumulative and noncumulative data are presented on statistical graphs and cost performance statistics are presented in table form. There is a time series analysis capability that will give statistics for the latest revised estimate. The PM may use this tool for:

- Manpower analysis
- Time Series Analysis
- Graphical portrayal of trends
- Trend analysis
- Statistical analysis
- Consolidation of historical cost performance data

Other areas of concern related to cost are changes to the project schedule or to the item being developed. The BUDGET

Example #1 9 Jan 80

FY: 79 AMCMS:
As of 9 Jan 80 Fund Type: Misc
PRON:

ELEMENT		AUTHORIZED *V	OBLIGATED *B	%OBLIGATED	COSTED *B
Munitions & Mat	*B	1200000	1188211	99	355755
D204 Test Criteria	*B	800000	698668	87	441879
DE82 Testing Mat	*B	2819000	1644719	58	637017
DO73 CLGP	*B	10000	0	0	0
Executive Training (OMA)	*B	208600	171925	96	162669

Totals: *B - Both; *H - Horizontal; *V - Vertical;

FIGURE 4-12

BUDGET REPORT FORMAT

ELEMENT		%COSTED
Munitions & Mat	*B	30
D204 Test Criteria	*B	63
DE82 Testing Mat	*B	39
DO73 CLGP	*B	0
Executive Training (OMA)	*B	95

COMMENT 1: DO73 CLGP: ISSUED TO CSL; OBLIGATION SHOULD BE REFLECTED IN AUGUST.

**** END OF REPORT ****

FIGURE 4-12

BUDGET REPORT FORMAT

Example #2 9 Jan 80

FY: 79 AMCMS: 8NJ,8ZC,8ZD
As of 9 Jan 80 Fund Type: RDTE
PRON:

ELEMENT		Approved program *B	Received program *B	Committed *B	Uncommitte program *B
Personnel Comp	*V	948,800.00	848,000.00	848,000.00	0
TDY	*V	105,000	125,000	122,198.53	2801.47
*** SUBTOTALS		1053800	973000	970198.53	2801.47
DNLS Station	*V	0	4,509	4509	0
Computer Spt	*V	97,000	40,107.43	40,107.43	0
*** SUBTOTALS		97000	44616.43	44616.43	0
*** SUBTOTALS		1150800	1017616.43	1014814.96	2801.47
NLS Training	*V	0	15,555	15,555	0
Training	*V	1000	1,030	1030	0
*** SUBTOTALS		1000	16585	16585	0
Supplies	*V	4000	7000	7000	0
*** SUBTOTALS		4000	7000	7000	0
*** SUBTOTALS		5000	23585	23585	0
*** SUBTOTALS		1155800	1041201.43	1038399.96	2801.47
Installation of TI kit	*V	0	60	60	0
CATEGORY TOTALS		11155800	1041261.43	1038459.96	2801.47

Totals: *B - Both; *H - Horizontal; *V - Vertical; Page 1a

FIGURE 4-13

BUDGET REPORT FORMAT

ELEMENT		Obligated *B	Unobligate commitment *B	Program unobligate *B	DISP/EXP *V
Personnel Comp	*V	827,447.44	20552.56	20552.56	827,447.44
TDY	*V	122,198.53	0	2801.47	120,464.03
*** SUBTOTALS		949645.97	20552.56	23354.03	947911.47
DNLS Station	*V	4509	0	0	0
Computer Spt	*V	40,107.43	0	0	40,107.43
*** SUBTOTALS		44616.43	0	0	40107.43
*** SUBTOTALS		994262.4	20552.56	23354.03	988018.9
NLS Training	*V	15,555.00	0	0	0
Training	*V	1030	0	0	1,030.00
*** SUBTOTALS		16585	0	0	1030
Supplies	*V	6644.05	355.05	355.05	6,527.86
*** SUBTOTALS		6644.05	355.05	355.05	6527.86
*** SUBTOTALS		23229.05	355.05	355.05	7557.86
*** SUBTOTALS		1017491.45	20907.61	23709.08	995576.76
Installation of TI kit	*V	60	0	0	60
CATEGORY TOTALS		1017551.45	20907.61	23709.08	995636.76

Page 1b

FIGURE 4-13

BUDGET REPORT FORMAT

ELEMENT		REMARKS	TOTALS
Personnel Comp	*V	CH-008	0
TDY	*V	CH-003	0
*** SUBTOTALS		0	3993352.56
DNLS Station	*V	CH-032,035	0
Computer Spt	*V	9,20,23,22	0
*** SUBTOTALS		0	230849.29
*** SUBTOTALS		0	4224201.85
NLS Training	*V	CH-031,033	0
Training	*V	1,2,024	0
*** SUBTOTALS		0	50755
Supplies	*V	CH-007	0
*** SUBTOTALS		0	25354.15
*** SUBTOTALS		0	76109.15
*** SUBTOTALS		0	4300311
Installation of TI kit	*V	CH-028	0
CATEGORY TOTALS		0	5296127.76

COMMENT 1: This Example demonstrates the use of subtotaling. A maximum of three subtotals may follow any one element of expense.

**** END OF REPORT ****

FIGURE 4-13

BUDGET REPORT FORMAT

Example #5 7 Jan 80

FY: 80 AMCMS: 846
As of 7 Jan 80 Fund Type: OMA
PRON: 8854336RB63C5

ELEMENT		Approved program *B	Received program *B	Committed *B	Uncommitte program *B
Munitions & Mat	*V	1200000	0	355755	-355755
Test Criteria	*V	800000	800000	441879	358121
CATEGORY			800000		2366
TOTALS		2000000		797634	

Totals: *B - Both; *H - Horizontal; *V - Vertical;

Page 1a

FIGURE 4-14

BUDGET REPORT FORMAT

ELEMENT		Obligated *B	Unobligate commitment *B	Program unobligate *B	TOTALS
Munitions & Mat	*V	1188211	-832456	-1188211	0
Test Criteria	*V	698668	-256789	101332	0
CATEGORY TOTALS		1886879	-1089245	-1086879	3310755

Page 1b

COMMENT 1: Will set access list to include GEW2 and JBS5

**** END OF REPORT ****

FIGURE 4-14

BUDGET REPORT FORMAT

MONITOR tool can be used in conjunction with the SCHEDULE tool to help make decisions concerning schedule changes. Both tools provide information that must be analyzed to determine the overall effects of changing the schedule. When the COST PERFORMANCE tool is added to the BUDGET MONITOR and SCHEDULE tool, the resulting information will help the PM make decisions concerning engineering changes.

4.4.4 Cost Summary

The ELITE tools just discussed all provide the PM with essential funding information. Numerous methods are provided for cross checking and cross referencing expenditure possibilities with a complete funding analysis. Consolidation of previous cost data provides historical information to be used in trend analysis. All of these tools greatly assist the PM in money management and provide automated support for what would otherwise be a very tedious and time consuming process.

4.5 Elite Conclusion

The entire ELITE system is written to allow a humanized dialogue between the user and the system. The inexperienced user need only know how to 'LOGIN' and, if necessary, the system will assist in the identification, location, and use of required files. A front-end "menu" will now guide the user through until the

completion of his task. First character recognition saves the user time by requiring only the first letter of commands to be entered. Should the user become totally lost, the command HELP will provide complete online information about most aspects of the ELITE tool. The user also has the ability to select a prompting mode based on their experience. VERBOSE will give full prompting whereas TERSE will allow for short prompting. The ELITE system provides a NEWS feature for each tool. This provision allows the ELITE team the capability to disseminate changes or augmentations to a particular tool as they occur. The user will have this "new" news presented to him upon entry to the tool. It will now become "old" news to be viewed again by request only. The news will remain "new" news to others who have not recently utilized the tool.

All of the tools of the ELITE system provide assistance to the PM during all phases of the project development. There are tools that may be used from the very beginning to perform simple reminder tasks to tools that accomplish more complicated tasks such as resource and money management. Because of its modular construction, a manager need only incorporate the automated tools necessary to do a particular job. The ELITE system does satisfy the requirements and needs of the project manager that were described in chapter two.

CHAPTER FIVE

5.1 Andrew Sipos Associates Project Management System

The Andrew Sipos Associates Project Management System (ASA PMS) is another made-to-order system that is marketed for commercial use in civilian industry. The ASA PMS is a project management system made up of modular, fully integrated computer programs (ASAP81). It is designed to provide a comprehensive method of project scheduling and control. This system is designed to accompany a project from inception to completion. It is designed to direct time scheduling cost analysis, resource allocation, and multi-project scheduling. Computer-generated network graphics programs are also available. ASA PMS offers multi-level sophistication, which provides for a greater range of users from experienced engineers to junior personnel. This system offers the user a choice of network techniques: the Critical Path Method (CPM), the Precedence Diagram Method (PDM), and the Project Evaluation and Review Technique (PERT). Each of these techniques offers the full capabilities of the system. The system is designed to work on most computer systems, whether mini, small, large, old or new. No additional software is necessary.

This entire system was designed from the 'Human' point of view. It has been redesigned over the last 12 years to allow a user to operate the system with only a brief training period instead of the previous detailed study of a several-hundred-page

user's manual. Simple English commands are utilized to perform any desired task from data entry to calculating a schedule or producing a final report. The system can be modified to match any specifications. Capabilities based on user logic can be added or the system can modify its own logic to suit user needs.

The modularity of ASA PMS makes it exceedingly valuable. This allows an effective system to be designed that is flexible and can be adjusted to meet operational changes. This allows a manager to fabricate a system to accomplish desired tasks and not waste money on unnecessary features. As management requirements become more difficult or requirements are altered, the ASA PMS can be transformed to satisfy these new needs. A user may purchase a simple system to begin with and modify it later to meet other specifications. Capabilities can be added that are based on user developed logic or ASA PMS logic can be modified to suit user needs.

5.2 ASA PMS System Requirements

There are certain minimum requirements necessary for the ASA PMS to function. It currently operates on the following systems:

IBM 360; 370; 303X; 42XX

CDC 6600; 7600

PDP 10/20; 11 Series; VAX

The system software requirement is for a FORTRAN IV compiler. The minimum hardware requirements are listed below:

- 28K/16 bit core
- Disk or floppy disk storage
- Input device (CRT, hardcopy terminal, or card reader)
- Output device (printer, or hardcopy terminal)

The ASA PMS will operate on either a large main frame or small self contained stand-alone computer. For the main frame, the user terminal may be located anywhere as long as interface with the main computer is possible by telephone. Both on-line (timesharing) and batch processing modes are available. A CRT or terminal input/output device gives direct, interactive access in the timesharing mode. Both the ASA PMS and the data are stored in a central computer where the calculations are done. Mandatory hardware is:

- A main frame computer.
- Disk storage.
- Communication devices (modems) to and from the computer.
- A terminal.

Optional hardware is:

- A printer.
- A plotter.
- Additional terminals.

Input data is transmitted to the computer by a card reader for operation in the batch mode. Cards must be punched, read into the computer and printed on a printer. In addition to the main computer with disk storage, a key punch machine, local card reader, and local printer are required. A plotter is optional.

Figure 5-1 portrays a main frame systeM (FN-ASA 4).

The stand-alone system only requires electricity to operate. On-site project management work is possible in this manner (with the exception of very large projects). This includes processing, storage and printouts. A computer with disk storage and an input/output terminal are the only hardware requirements. A printer and graphics plotter are optional. Figure 5-2 depicts this system.

5.3 ASA PMS Capabilities

The ASA PMS can provide project scheduling, cost information, resource management, and comprehensive status reporting. Any long term or short term project that has been expressed in the form of a network can be managed by this system. Examples of other areas in which ASA PMS can be used (other than Research and Development) are outlined in APP B.

The ASA PMS is designed to assist in the management of the interrelated and hard-to-schedule phases of a research and development project. In the PERT mode, this system can provide these time estimates:

- Most pessimistic time.
- Most probable time.
- Most optimistic time.

A statistical analysis program allows ASA PMS to compute the probability of meeting project deadlines.

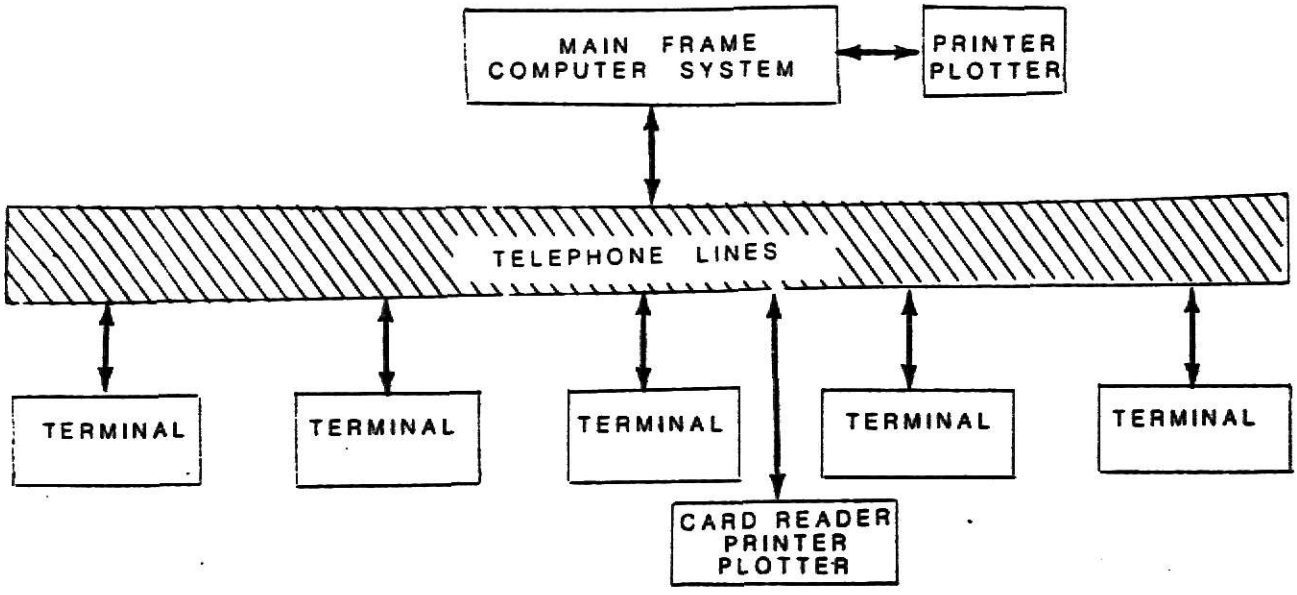


FIGURE 5-1

MAIN FRAME SYSTEM

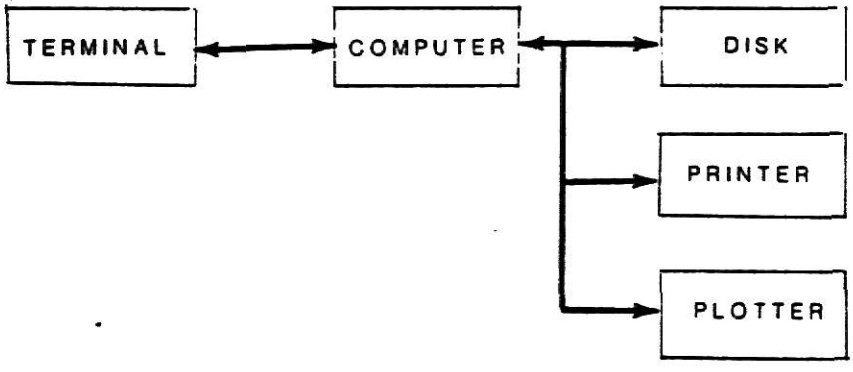


FIGURE 5-2

STAND ALONE SYSTEM

5.4 Establishment of the ASA PMS System

The ASA PMS data base which stores all of the project data is called the PROJECT FILE. It contains such information as project code, description, calendar, activity data, and report specifications. This file stays with the project for the entire time and there is a requirement for one file per project. It is initiated by the NEW PROGRAM tool (page 78) and modified by the OLD PROGRAM tool (page 78). As data in the PROJECT FILE is modified, the original data is eliminated and the new data immediately becomes current. A duplicate PROJECT FILE may be temporarily created to allow the PM to study possible solutions to problems encountered during the course of the project. By evaluating different modifications and computing their effects, the PM may change the network logic, modify resource availability, or delay certain activity beginnings, etc. The alternate file permits the evaluation of a change before implementing it. This is very helpful when dealing with risk analysis or probability analysis. A single PROJECT FILE has the following advantages:

- Multiple editing is eliminated because all data is in one location.
- Data loss is reduced through a single access method of editing for the one file.
- Less space is needed to store information.

There are four programs that make up the simplified data entry system of the ON-LINE EDITING PROGRAMS tool. This data

entry system does much of the data preparation by placing the data in the proper sequence and format. This is automatically done when a PROJECT FILE is created and when it is updated.

When a new project begins, the PM must initiate a PROJECT FILE in which to store all data. In order to create this new file, function NEW PROGRAM may be used. This is a series of questions, sequenced logically, and in a humanized dialogue that guide the user through the entire process. NEW PROGRAM will go through the entire list of questions required to open a PROJECT FILE, therefore, it is very difficult to omit data.

Function OLD PROGRAM is used to modify a PROJECT FILE. Data items may be added or deleted or modified in other ways. A product of OLD PROGRAM is a Project File list that may be updated with the the progress of each activity. This list is then used to enter data into the project file. All updating is accomplished through OLD PROGRAM. To safeguard the project file, all input data must be verified before it is stored.

The last two functions are used to display the contents of the project file. Function PRINT PROGRAM displays on the system printer and function TYPE PROGRAM displays on the computer terminal.

In order to remain operational and reliable, these on-line editing functions preclude the user from entering an error that may erase the project file or halt the program.

5.5 Planning and the ASA PMS

There are several automated tools available to the PM to help him in the planning phase. Once a work breakdown structure has been determined, a PROJECT CALENDAR tool is established to help computer feasible project schedules and create calendar reports. A calendar can be an infinite number of time-unit combinations. The standard time unit is a "day". Optional time units may be seconds, minutes, hours, half-shifts, weeks, etc. Work days, non-work days and holidays are then specified. The normal calendar is 1000 workdays (about four years) and an optional one is 9,999 work days (about 40 years).

One of the most important tools in this system is the selected network technique tool that graphically represents a project in terms of relationships between various activities. To assist in the planning phase, three network techniques have evolved and are most often used in project management. They are:

- The Critical Path Method (CPM)
- The Precedence Diagram Method (PDM)
- The Project Evaluation and Review Technique (PERT)

Either one of these techniques may be utilized with ASA PMS and still obtain the full capabilities of the system. In order to use this tool, the chosen network must have a single start point and a single end point.

Multiple start and end points are an available option. Specification of milestones and hammock activities are also options. Hammock activities allow the production of a condensed version of the project schedule for use by high-level managers and

executives.

Networking is also important during the scheduling area of program management because it will help keep the whole project in perspective. Changes and decisions can be made much more safely when the entire project is accurately portrayed with time estimates, etc.

5.5.1 Risk Assessment and the ASA PMS

The analysis of available resources is an important step in the planning process. The ASA PMS RESOURCE PROGRAM tool is capable of doing this and computing a project schedule based on resource availability. The following capabilities are built into this tool:

- Project completion time based on available resources.
- Project completion time based on a given amount of resources.
- Determination of the quantity of resources necessary to complete the project in the shortest time.
- Determination of the quantity of resources necessary to complete the project by a given date.
- Effect of overtime work on a certain resource.
- Impact if fewer (or additional) resources are used.

This program will present the amount of resources required as a function of time in order to analyze project schedule feasibility. It may also present a revised project schedule based

on management objectives and resource availability. The resource analysis is based on an estimation of resource requirements. Each activity must be given required resources and it is assumed they are required until activity completion. Each resource must be identified, given an amount level, and relative importance or priority. Computations may be made for either early or late completion and resource utilization curves show alternatives that consider time or resource constraints or both. Figure 5-3 shows examples of RESOURCE reports.

5.5.2 Concurrency Reduction and the ASA PMS

Another tool to help the PM during the planning phase is the TARGET PROCESSING ROUTINE. This tool performs calculations necessary for the production of variance reports. Although targets are usually specified in the planning phase, they may be entered at anytime. The following target information may be specified:

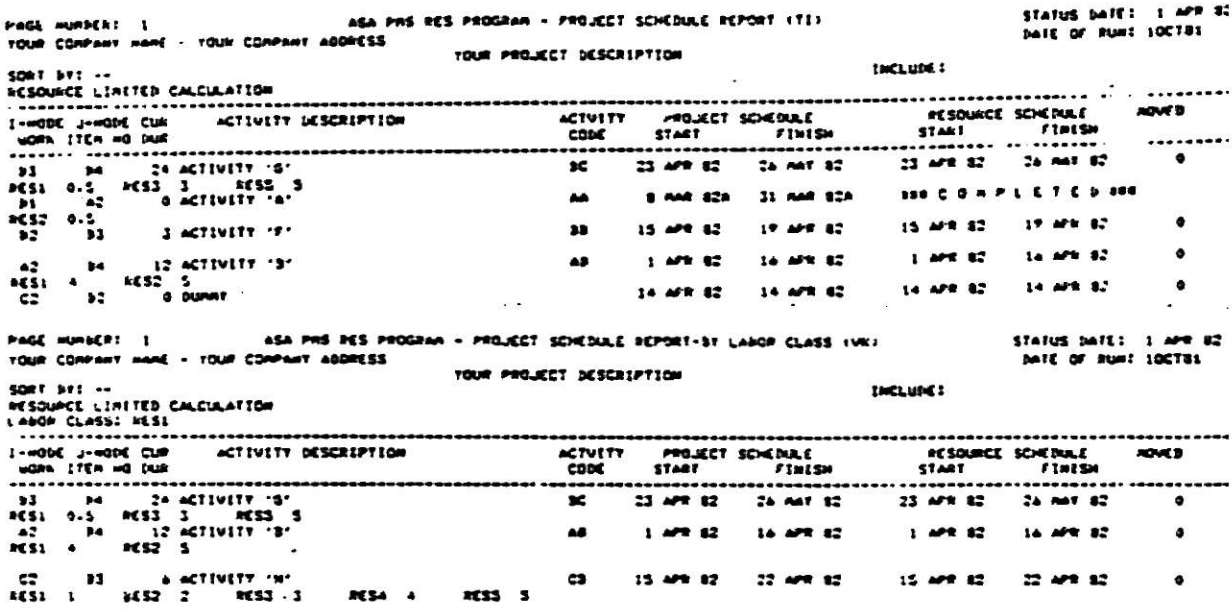
- Target start: Proposed activity begin date.
- Target finish: Proposed activity finish date.
- Budget cost: Total money allocated for all activity work.
- Resource: Type and number of persons allocated for each activity.

From this information, separate, time-phased, time, cost, and resource performance measurement baselines are generated. This is then compared with actual performance. Three types of variance

RESOURCE TIME REPORT (TI) and RESOURCE VARIANCE REPORT (VR)

This report compares the early start/finish date project schedule (as computed by the SCHEDULING PROGRAM) with the project schedule calculated by the RESOURCE PROGRAM. The difference between the two is shown in the 'Moved' column.

The Resource Variance Report (VR) is the same as this report, except that the VR is sorted by occupation type (name).



PAGE NUMBER: 1 ASA PMS RES PROGRAM - PROJECT SCHEDULE REPORT (TI) STATUS DATE: 1 APR 82
YOUR COMPANY NAME - YOUR COMPANY ADDRESS DATE OF RUN: 10CT81
YOUR PROJECT DESCRIPTION
SORT BY: -- INCLUDE:
RESOURCE LIMITED CALCULATION

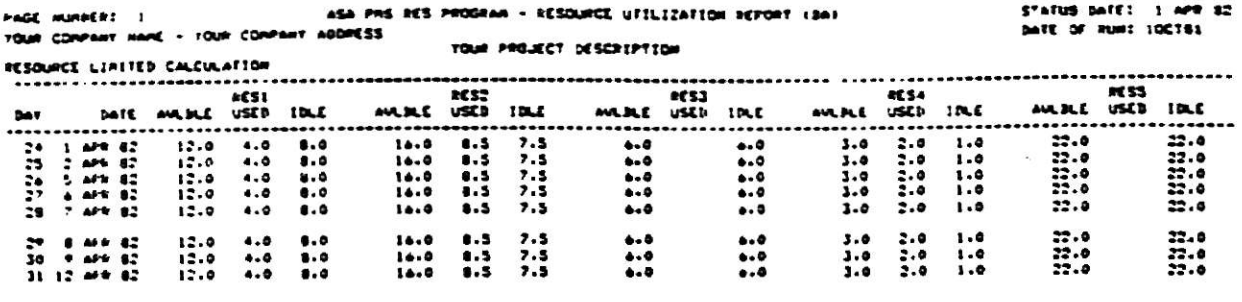
I-NODE J-NODE CUR WORK ITEM NO DUR	ACTIVITY DESCRIPTION	ACTIVITY CODE	PROJECT SCHEDULE START	PROJECT SCHEDULE FINISH	RESOURCE SCHEDULE START	RESOURCE SCHEDULE FINISH	MOVED
B3 B4 24	ACTIVITY 'G'	BC	23 APR 82	26 MAY 82	23 APR 82	26 MAY 82	0
RES1 0.5 RES3 3 RES5 5							
B1 A2 0	ACTIVITY 'A'	AA	8 MAR 82A	31 MAR 82A	*** C O M P L E T E D ***		
RES2 0.5							
B2 B3 3	ACTIVITY 'F'	BB	15 APR 82	19 APR 82	15 APR 82	19 APR 82	0
A2 B4 12	ACTIVITY 'B'	AB	1 APR 82	14 APR 82	1 APR 82	14 APR 82	0
RES1 4 RES2 5							
C2 B2 0	DUMMY		14 APR 82	14 APR 82	14 APR 82	14 APR 82	0

PAGE NUMBER: 1 ASA PMS RES PROGRAM - PROJECT SCHEDULE REPORT-BY LABOR CLASS (VR) STATUS DATE: 1 APR 82
YOUR COMPANY NAME - YOUR COMPANY ADDRESS DATE OF RUN: 10CT81
YOUR PROJECT DESCRIPTION
SORT BY: -- INCLUDE:
RESOURCE LIMITED CALCULATION
LABOR CLASS: RES1

I-NODE J-NODE CUR WORK ITEM NO DUR	ACTIVITY DESCRIPTION	ACTIVITY CODE	PROJECT SCHEDULE START	PROJECT SCHEDULE FINISH	RESOURCE SCHEDULE START	RESOURCE SCHEDULE FINISH	MOVED
B3 B4 24	ACTIVITY 'G'	BC	23 APR 82	26 MAY 82	23 APR 82	26 MAY 82	0
RES1 0.5 RES3 3 RES5 5							
A2 B4 12	ACTIVITY 'B'	AB	1 APR 82	14 APR 82	1 APR 82	14 APR 82	0
RES1 4 RES2 5							
C2 B3 6	ACTIVITY 'H'	CB	15 APR 82	22 APR 82	15 APR 82	22 APR 82	0
RES1 1 RES2 2 RES3 3 RES4 4 RES5 5							

RESOURCE REQUIREMENT REPORT (BA)

This report displays the utilization of the various resources, grouped according to the type or name of the resource. Information on the report includes: workday number, date, and specific information on five different resources (available, used, and idle). No report control instructions are in effect on this report.



PAGE NUMBER: 1 ASA PMS RES PROGRAM - RESOURCE UTILIZATION REPORT (BA) STATUS DATE: 1 APR 82
YOUR COMPANY NAME - YOUR COMPANY ADDRESS DATE OF RUN: 10CT81
YOUR PROJECT DESCRIPTION
RESOURCE LIMITED CALCULATION

DAY	DATE	RES1 AVAILBLE	RES1 USED	RES1 IDLE	RES2 AVAILBLE	RES2 USED	RES2 IDLE	RES3 AVAILBLE	RES3 USED	RES3 IDLE	RES4 AVAILBLE	RES4 USED	RES4 IDLE	RES5 AVAILBLE	RES5 USED	RES5 IDLE
24	1 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0
25	2 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0
26	5 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0
27	6 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0
28	7 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0
29	8 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0
30	9 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0
31	12 APR 82	12.0	4.0	8.0	16.0	8.5	7.5	6.0	6.0		3.0	2.0	1.0	22.0		22.0

FIGURE 5-3

RESOURCE REPORT

analysis may now be computed:

- Schedule variance analysis.
- Cost/schedule variance analysis.
- Resource/schedule variance analysis.

Figure 5-4 presents a diagram of how the TARGET PROCESSING routine works.

5.5.3 Planning Summary

The ASA PMS tools discussed above perform numerous planning functions and help acomplish tasks that are normally done manually. Keeping track of office administrative requirements such as meetings, conferences, and appointments are done in an automated manner. Report generation and correspondence and information dissemination is made easier through the use of these automated tools. A choice of networking methods provide overall project planning and tracking and when combined with the RESOURCE tool, a project overview is provided to help during the schedule phase.

5.6 Scheduling and the ASA PMS

The following tools may be used to help the PM solve scheduling problems.

5.6.1 Management Information System

There are several tools within ASA PMS that may be combined to help keep the PM constantly informed of current activities and upcoming events. One of these is the NETWORK GRAPHICS tool(Figures 5-5,5-6). This tool presents a diagram that displays project activities and their interrelationships. The diagrams are provided on large-size digital or electrostatic plotters. A special five character identification system enables the exact location of every activity to be pinpointed to sheet number, row number, and column number. After the SCHEDULING PROGRAM has been run, a 30" by 54" project network diagram may be run. The user may draw additional messages or lines to augment the current information. Portions (certain sheets diagram sheets) may be produced. diagram sheets. Two types of diagrams are produced. One is based on logic and all activities are shown in their proper positions. The other is a time scaled diagram that shows the network diagram in the form of a time phased project.

The REPORT WRITER tool allows the user to design any desired report format and print any desired amount of reports. The user may specify not only the contents and layout of the report, but the header and column titles also. This capability allows the manager to tailor reports to suit his needs. These custom designed reports present the correct amount of information to the various levels of the organization such as condensed long-time-span reports for executives and short-time-span, detailed reports for the working level.

Another ASA PMS tool that helps to ensure that ASA PMS

TARGET PROCESSING ROUTINE

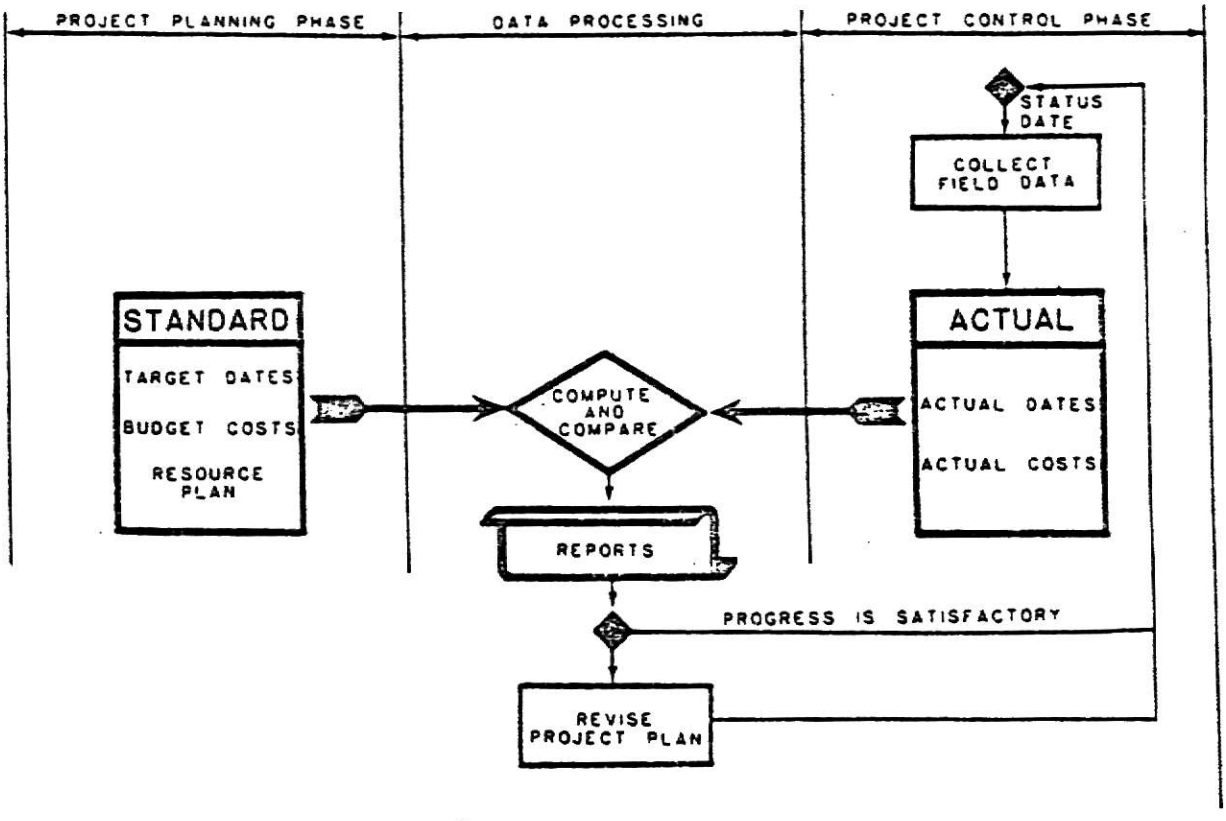


FIGURE 5-4

TARGET PROCESSING

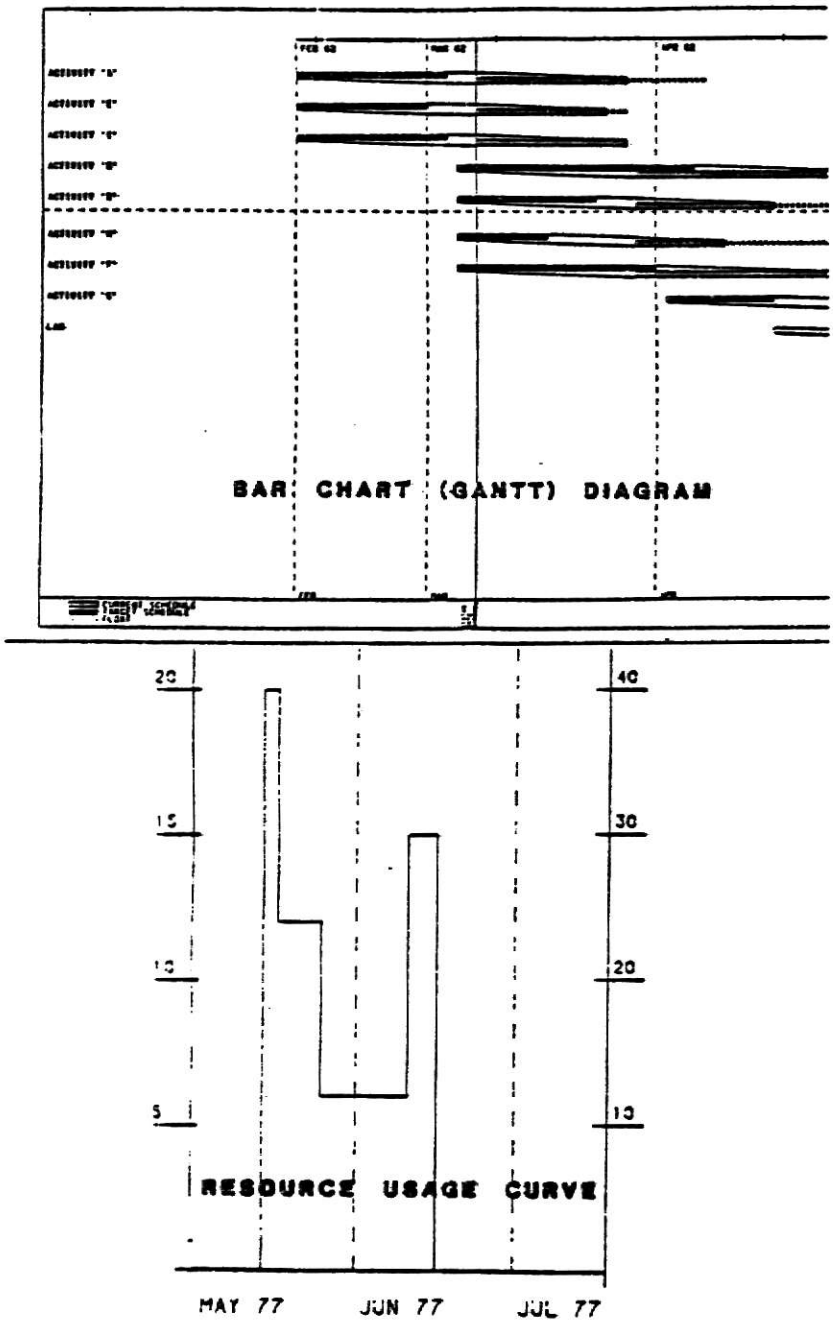


FIGURE 5-5

NETWORK GRAPHICS ACTIVITIES REPORT

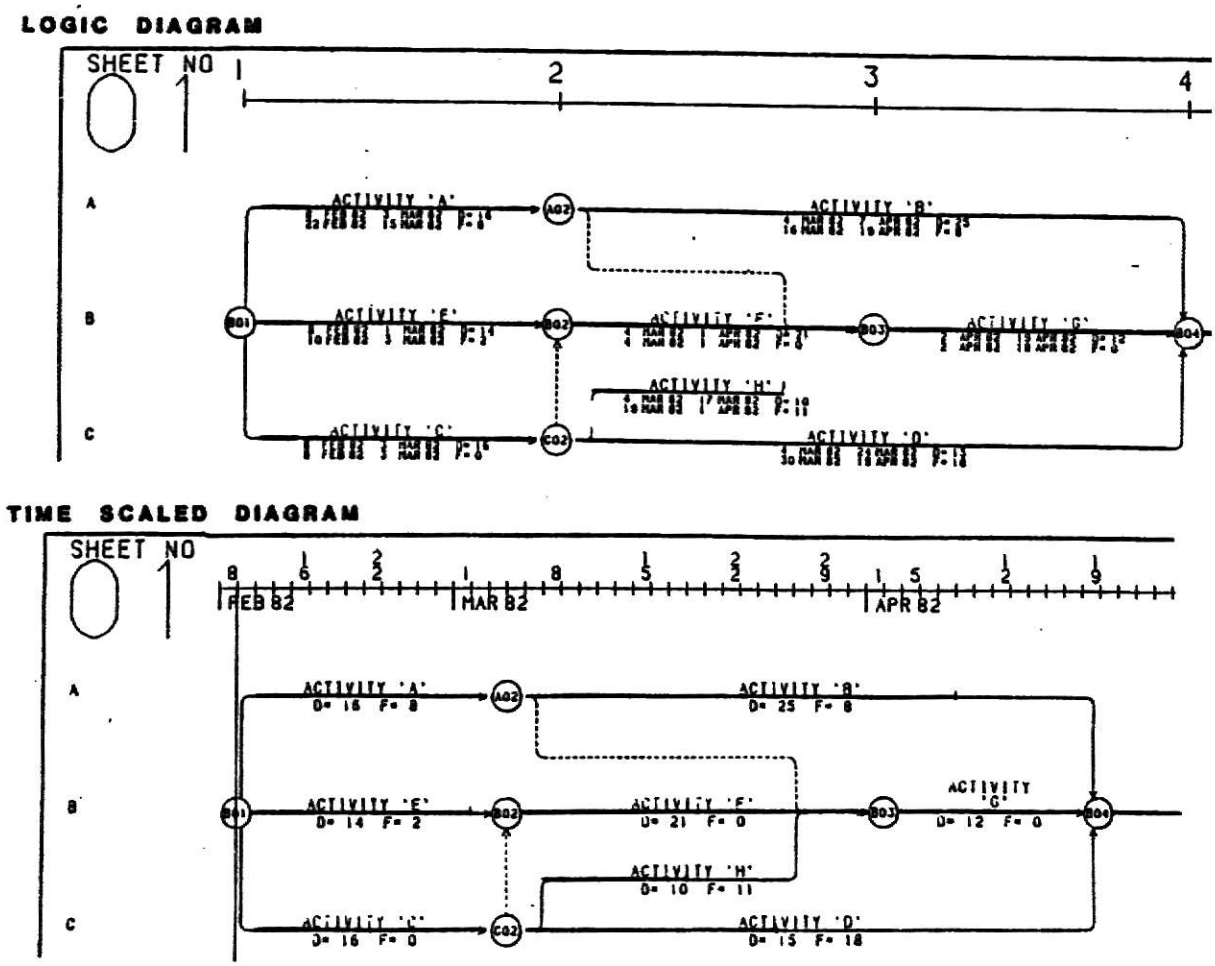


FIGURE 5-6

NETWORK GRAPHICS ACTIVITIES REPORT

remains accurate is an ERROR DIAGNOSTIC tool. This helps ensure that the results of computations are valid. Errors will be displayed either at entry time (as input data) or after calculations have been run. Entry time errors are usually things like incorrect dates, inconsistent numbering, etc., and may be corrected immediately. Errors that appear after calculations are made must be corrected by the use of OLD PROGRAM (page 78). Examples of this type error may be:

- Two or more project start nodes.
- Parallel activities.

In either case, the error statements are displayed in easy to understand terminology. Errors not programed to be deleted by the system are still easily corrected by OLD PROGRAM.

5.6.2 The ASA PMS Schedule Tool

In order to help the PM properly manage time, a SCHEDULING PROGRAM tool is utilized. This tool performs a time analysis and then computes a project schedule. Because CPM, PDM, and PERT each require different approaches to computing a schedule, different routines are used for each. The SCHEDULING PROGRAM obtains data directly from the project file and provides calculations to the COST and RESOURCE programs so they may compute specific scheduling tasks. The following operations are performed by the scheduling tool:

- Data checks: There must be a logical consistency of dates

where actual dates occur prior to status dates and other external dates must occur after the status date.

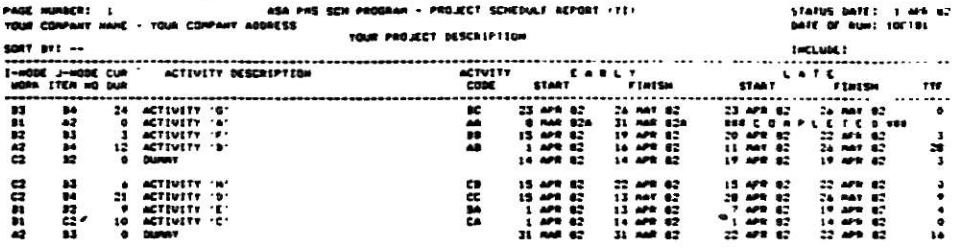
- Network consistency check: This checks the project network for parallel activities, dangling start and finish activities, etc.
- Assemble project calendar: A project calendar is produced based on the number of workdays the PM has specified.
- Project schedule computation: Upon completion of the above activities, the project schedule is mathmatically computed.
- Printing schedule reports: After the schedule has been completed, it may be called for and produced in three formats:
  - A Time Schedule Report presents the entire project schedule.
  - A Scheduling Bar Chart Report presents the project schedule graphically.
  - A Variance Report presents the difference between targeted and actual performance.

The user may design other types of reports that contain different activities and in different sequences. Figure 5-7 depicts the three methods of displaying schedule reports.

The RESOURCE PROGRAM tool must be used to closely monitor the scheduling phase of program management to ensure that current resource availability and allocation information is convenient for decision making.

SCHEDULE TIME REPORT (TI)

This report displays the entire project schedule.



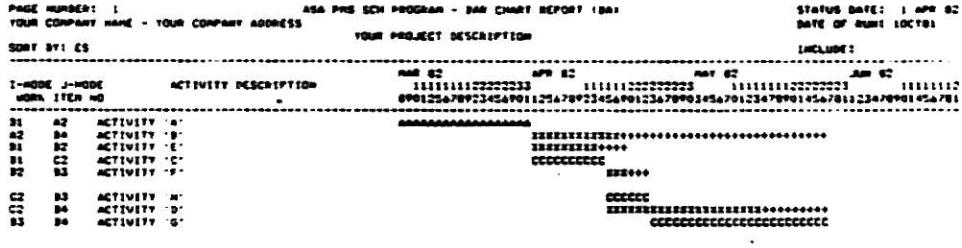
PAGE NUMBER: 1 ASA PMS SCH PROGRAM - PROJECT SCHEDULE REPORT (TI) STATUS DATE: 1 APR 82
YOUR COMPANY NAME - YOUR COMPANY ADDRESS DATE OF RUN: 10CT81
YOUR PROJECT DESCRIPTION
SORT BY: -- INCLUDE:

I-NODE	J-NODE	CUR	ACTIVITY DESCRIPTION	ACTVITY	EARLY		LATE		TTF
WORK	ITEM	NO DUR		CODE	START	FINISH	START	FINISH	
B3	B4	24	ACTIVITY 'G'	BC	23 APR 82	26 MAY 82	23 APR 82	26 MAY 82	0
B1	A2	0	ACTIVITY 'A'	AA	0 MAR 82A	31 MAR 82A	*** C O M P L E T E D ***		
B2	B3	3	ACTIVITY 'F'	BB	15 APR 82	19 APR 82	20 APR 82	22 APR 82	3
A2	B4	12	ACTIVITY 'B'	AB	1 APR 82	14 APR 82	11 MAY 82	26 MAY 82	26
C2	B2	0	DUMMY		14 APR 82	14 APR 82	19 APR 82	19 APR 82	3
C2	B3	6	ACTIVITY 'H'	CB	15 APR 82	22 APR 82	15 APR 82	22 APR 82	3
C2	B4	21	ACTIVITY 'D'	CC	15 APR 82	13 MAY 82	28 APR 82	26 MAY 82	9
B1	B2	9	ACTIVITY 'E'	BA	1 APR 82	13 APR 82	7 APR 82	19 APR 82	4
B1	C2	10	ACTIVITY 'C'	CA	1 APR 82	14 APR 82	1 APR 82	14 APR 82	0
A2	B3	0	DUMMY		31 MAR 82	31 MAR 82	22 APR 82	22 APR 82	16

SCHEDULE BAR CHART (GANTT) REPORT (BA)

This report displays the project schedule in the form of a graph. The BAR CHART REPORT can be used as is (separate sheets of paper), or its pages may be secured end-to-end to produce a continuous bar chart diagram.

The report prints the activity schedule from the time scale early start or actual start date and ends at the time scale early finish or actual finish date. Critical activities are denoted by a 'C,' non-critical activities are shown with an 'X,' and actual duration is designated by an 'A.' The positive float is indicated with a plus sign (+), and negative float is indicated with a minus sign (-).

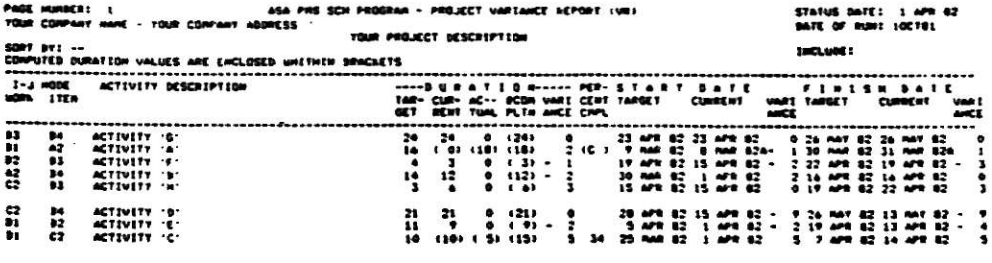


PAGE NUMBER: 1 ASA PMS SCH PROGRAM - BAR CHART REPORT (BA) STATUS DATE: 1 APR 82
YOUR COMPANY NAME - YOUR COMPANY ADDRESS DATE OF RUN: 10CT81
YOUR PROJECT DESCRIPTION
SORT BY: ES INCLUDE:

I-NODE	J-NODE	ACTIVITY DESCRIPTION
WORK	ITEM	NO
B1	A2	ACTIVITY 'A'
A2	B4	ACTIVITY 'B'
B1	B2	ACTIVITY 'E'
B1	C2	ACTIVITY 'C'
B2	B3	ACTIVITY 'F'
C2	B3	ACTIVITY 'H'
C2	B4	ACTIVITY 'D'
B3	B4	ACTIVITY 'G'

SCHEDULE VARIANCE REPORT (VR)

This report gives a complete examination of the time performance of each activity in three sections: duration variance, start date variance and finish date variance. In addition to the standard sorts, this report may be sorted by each class of variance.



PAGE NUMBER: 1 ASA PMS SCH PROGRAM - PROJECT VARIANCE REPORT (VR) STATUS DATE: 1 APR 82
YOUR COMPANY NAME - YOUR COMPANY ADDRESS DATE OF RUN: 10CT81
YOUR PROJECT DESCRIPTION
SORT BY: -- INCLUDE:
COMPUTED DURATION VALUES ARE ENCLOSED WHITHIN BRACKETS

I-J MODE		ACTIVITY DESCRIPTION	DURATION					PER-	START DATE			FINISH DATE		
WORK	ITEM		TAR-GET	CUR-RENT	AC-TUAL	SCDN PLTN	VARI ANCE	CENT CMPL	TARGET	CURRENT	VARI ANCE	TARGET	CURRENT	VARI ANCE
B3	B4	ACTIVITY 'G'	24	24	0	(24)	0		23 APR 82	23 APR 82	0	26 MAY 82	26 MAY 82	0
B1	A2	ACTIVITY 'A'	16	(0)	(18)	(16)	2	(C)	9 MAR 82	8 MAR 82A+	1	30 MAR 82	31 MAR 82A	1
B2	B3	ACTIVITY 'F'	4	3	0	(3)	- 1		19 APR 82	15 APR 82	- 2	22 APR 82	19 APR 82	- 3
A2	B4	ACTIVITY 'B'	14	12	0	(12)	- 2		30 MAR 82	1 APR 82	2	16 APR 82	16 APR 82	0
C2	B3	ACTIVITY 'H'	3	6	0	(6)	3		15 APR 82	15 APR 82	0	19 APR 82	22 APR 82	3
C2	B4	ACTIVITY 'D'	21	21	0	(21)	0		28 APR 82	15 APR 82	- 9	26 MAY 82	13 MAY 82	- 9
B1	B2	ACTIVITY 'E'	11	9	0	(9)	- 2		5 APR 82	1 APR 82	- 2	19 APR 82	13 APR 82	- 4
B1	C2	ACTIVITY 'C'	10	(10+	(5)	(15)	5	34	25 MAR 82	1 APR 82	5	7 APR 82	14 APR 82	5

FIGURE 5-7

SCHEDULE REPORT

5.6.3 The PROGRESS REPORTING Tool

Another tool that is used to help the manager in the schedule phase is the PROJECT PROGRESS REPORTING tool. This tool is necessary to ensure the accuracy and timeliness of the system generated reports. Other tools within the system use the field data obtained here to make calculations and print reports. This data is presented in order to update the project file by associating it with the three stages of development.

- Not started: Activity has had no work done on it.
- In progress: Work is continuing.
- Completed: Activity has been completed.

The first stage shows that the activity has no actual date; the original duration and the remaining duration are the same, and the percentage of completion is zero.

There are three ways to depict progress in the second stage. They are:

- To specify the actual start date. Remaining duration and percentage of completion will be computed.
- To specify the remaining duration. The percentage of completion will be computed.
- To specify the percentage of completion. The actual and remaining durations will be computed.

For the final stage a completed activity may be indicated:

- By specifying an actual finish date.
- By showing remaining duration as zero.

- By specifying percentage of completion as 100%.

All three of these methods of updating data may be used for all the activities of any project.

5.6.4 Schedule Summary

The tools discussed in this section all provide automated support to show the overall flow of the progress of the project. All project activities are portrayed and other timetables are instantly available. The tools of the MIS give the PM required information concerning any phase of the project to assist in decision making. By constantly comparing the different schedules against the project plan, actual job performance and project progress can be measured. When the time and resources measured in this phase are combined with the information provided by the COST CONTROL tool, the PM will have all the information necessary to manage the project.

5.7 Cost Problems and the ASA PMS

The following tools may be used to help the PM solve cost problems.

5.7.1 The Cost Program Tool

In order to assist the PM in the management of funding or cost problems, the ASA PMS provides a COST PROGRAM tool to assist

in expenditure control. It offers effective monitor capabilities that enable the user to properly evaluate the effectiveness of different cost control measures. Based on the current accounting procedures of the user, this tool will summarize, total, and report items such as cost figures, budgets, or actual and computed parameters. COST PROGRAM features:

- An integration feature which allows it to interface with the project file which then allows it to work in conjunction with the entire system.
- A report capability in order to stay well informed about project costs.
    - Cost Time Report shows the total project schedule with cost information and percentage completed to date.
    - Cash Flow Report presents the monthly cost requirements of each activity.
    - Cost Variance Report provides budgeted costs, earned value, and actual costs. Variances for cumulative costs to date and predicted variances are provided for the remaining duration of both the activity and the entire project.
- The capability to report available information on a weekly, monthly or annual basis, and in different degrees of detail for different levels of management.
- A management evaluation feature to compute the

resulting effect of proposed schedule changes as an alternate method to correct cost overruns or shortages.

- A priority scheduling feature based on costs and available finances which allows you to work around a budget instead of create a new one.

Through the proper use of this tool, the PM can be ever mindful of the status of available and required funds. This will allow decisions that are based on fact more than speculation. Figure 5-8 presents COST reports.

5.7.2 Cost Summary

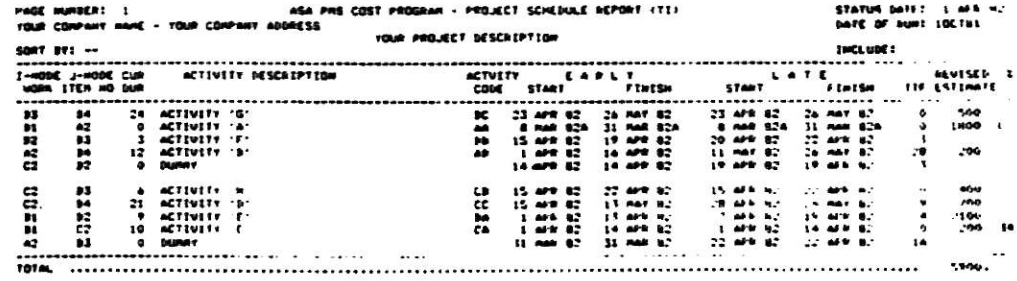
The tool used for the management of project funds provides numerous types of money management information for the PM. Funds are presented in a manner to show authorized budget costs, latest revised estimates, and actual cost of the work performed. Reports present information related to cost/time, cash flow, and cost variance. Manual methods of computation are no longer required and a complete funds analysis may be quickly and easily presented with this automated tool.

5.8 The Multi Project Tool

One final tool found in the ASA PMS allows for multi-project management. This MULTI-PROJECT tool provides for the creation of a single project file for several interrelated jobs. It may be

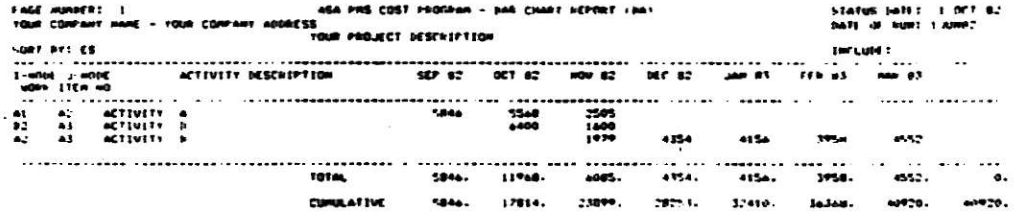
COST TIME REPORT (TI)

This report displays the total project schedule with cost information and percentage completed to date.



CASH-FLOW REPORT (BA)

This report displays the monthly cost requirements of activities in the project. Total project costs during the planning phase and remaining cost requirements during the implementation phase are given. The budget requirement can be displayed either by early-date calculation or by late-date calculation. The top of the report contains the month and year with a maximum of eight months per page. If the project duration is longer than eight months, the report will be printed in two or more parts. The bottom line of the report lists the monthly total cost and the cumulative cost for all activities listed.



COST VARIANCE REPORT (VR)

This report provides a through examination of the cost of each project activity and the project as a whole, and displays the budgeted costs, earned value, and actual costs side-by-side. Variances are calculated for cumulative costs up to the status date, and a predicted variance is computed for the remaining duration of both the activity and the entire project.

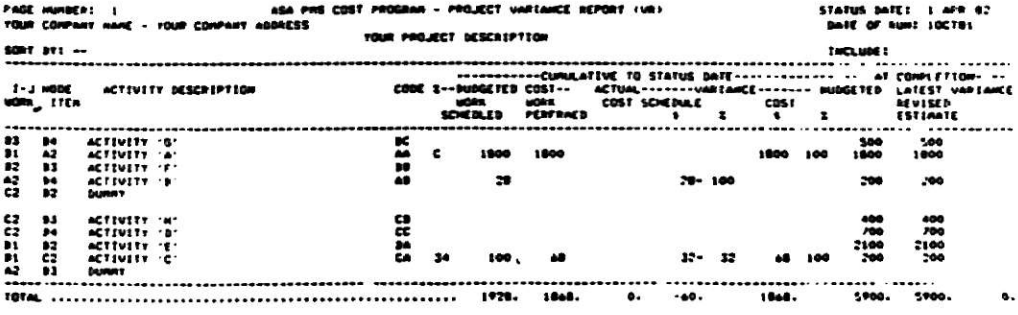


FIGURE 5-8

COST TIME REPORT

applied to small projects that overlap, share a common labor pool, and share the same financial base. In order to provide project analysis and reporting, all of the small projects are treated as a single big project. The tool may also be applied to a large project that has been sub-divided where each sub-division is treated as a project. This saves computer time and is good for small-scale, people oriented management.

5.9 ASA PMS CONCLUSION

The ASA PMS is designed to be used as a single management system that may be applied to the entire project management process. This system is very flexible and capable of providing a manager with a multitude of interrelated information. It is well suited for small projects as well as major development projects and may be used by personnel with very little computer experience. This system provides for simple incorporation, use, and maintainability. It fulfills the needs of the PM as outlined in chapter two in a manner that is simple and easy to understand. This system allows for simple and easy planning. The different networking possibilities permit the manager to plot project activities in a manner that is more comfortable to him. This makes scheduling much easier. The funding phase is easily planned for and monitored by the use of the COST PROGRAM tool. This system does provide the PM with the necessary automated tools to properly manage a project.

CHAPTER SIX

COMPARISONS AND CONCLUSIONS

Both the ELITE and The ASA PMS allow the PM to use automated tools to make the job of project management much easier. They both may be utilized separately or in conjunction with other automated tools or manual methods to ensure that optimum management and administrative resources are at the disposal of the PM and his staff. They both may be used from the beginning to assure ease of planning, establishment of the proper sequence of milestones, distribution of resources, and control of financial obligations. Each system has simple methods to present the PM with desired changes in order to show different effects of each change and possible outcomes. Multiple administration functions allow numerous report, schedule, and writer possibilities which allow the PM to produce written documents in any desired format. Each system was designed with the user in mind, is simple to understand, use, and apply to daily management functions. The ELITE system is oriented more toward the military manager and is utilized on larger projects. The ASA PMS appears to be targeted toward almost any type manager and would be suitable for any job. It is simple to change the tools within each system and tha ASA PMS logic may be altered more easily to adjust to different situations. Each system provides adequate means of presenting the necessary information to the PM to assist in decision making

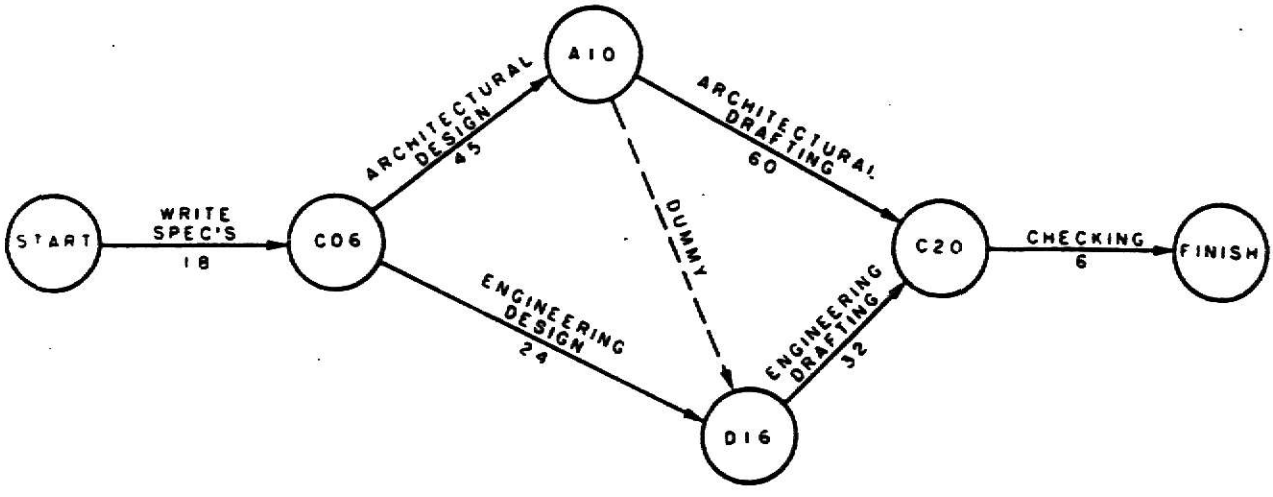
(either major or minor). The ELITE system is not as portable as the ASA PMS in the sense that the ASA PMS may be purchased complete and utilized anywhere that software and hardware compatibility exists. The user of ELITE merely has the use of the system. Appendix F lists approximate expenditures for installation and operational costs for each system. I feel the ASA PMS is more flexible and could be used in more situations than the ELITE. Both systems are valuable assets to the project manager and save large amounts of time, money, and resources that would have to be spent working with manual systems.

APPENDIX A

CRITICAL PATH METHOD

The CPM may be referred to as the Arrow Diagram Method. Activities and nodes are the two elements that make up a CPM diagram. An activity represents a job that must be done that has a duration time that is more than zero. In order to maintain logical continuity in this diagram, dummy activities (duration times of zero) are used. Nodes are used to indicate the start point or end point of an activity or group of activities. They establish the technical ordering of the activities.

When the diagram has been completed, there will be several paths (logical sequence of activities) through the project. When all of the necessary information is in place, a critical path analysis is conducted. This is nothing more than computing the earliest possible completion date, based on the longest path through the project. Since the other paths are shorter, they have slack time or float. Float is defined as the amount of time an activity can be delayed without affecting the start or finish times of other activities (ASAP81). As long as a delay does not exceed the estimated float time for that portion, the project will not be delayed. Figure A-1 depicts the critical path method.



CRITICAL PATH METHOD (CPM) DIAGRAM

FIGURE A-1

CRITICAL PATH METHOD

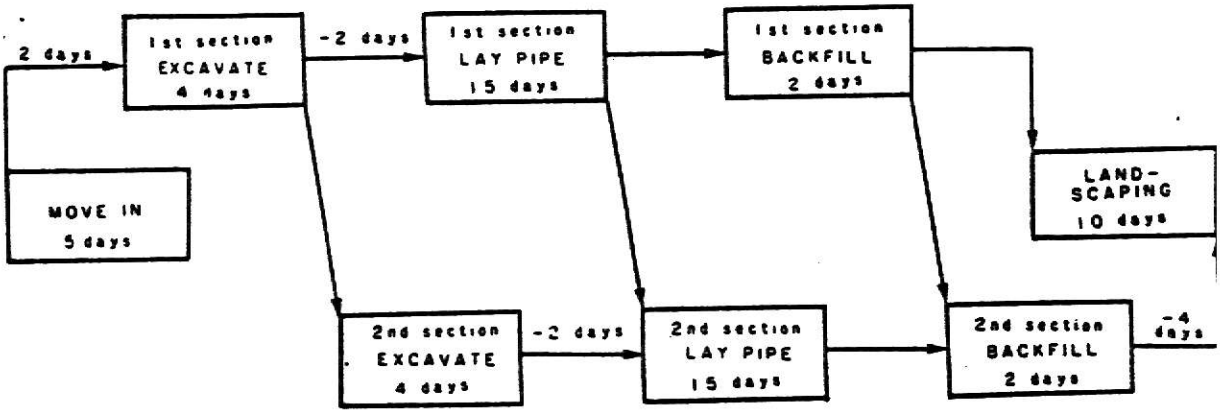
APPENDIX B

PRECEDENCE DIAGRAM METHOD

The PDM diagram is composed of two elements also. They are nodes and lags. Each node contains a specific work item and is given a specific identification code number which contains the work item parameters (description, costs, etc.) Arrows, known as lags, connect these nodes and help display the logic relationship of the work items. Lags may have zero, positive, or negative duration and are of four types as shown below:

- Finish-to-start: Completion of predecessor work item, plus lag duration, must occur before successor work item can begin.
- Finish-to-finish: Completion of predecessor work item, plus lag duration, must occur before successor work item can be completed.
- Start-to-start: Predecessor work item must start and the lag time must be completed prior to the beginning of the successor work item.
- Start-to-finish: Predecessor work item must start and the lag time must be completed before successor work can be completed.

Figure B-1 shows the precedence diagram method.



PRECEDENCE METHOD (PDM) DIAGRAM

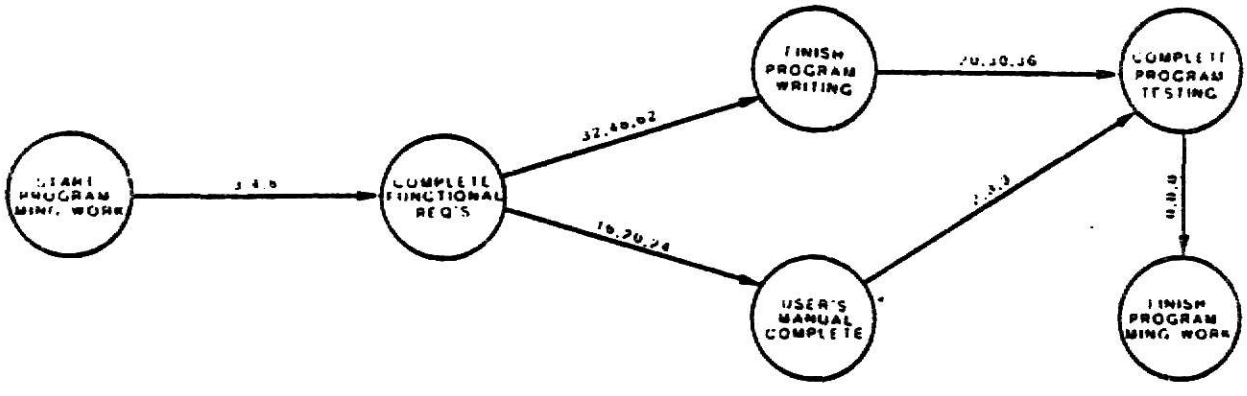
FIGURE B-1

PRECEDENCE DIAGRAM METHOD

APPENDIX C

PROJECT EVALUATION AND REVIEW TECHNIQUE

PERT is a statistical method of project scheduling used on projects that are made up of activities with duration times that vary considerably. Activity duration is usually affected by unpredictable incidents such as weather, personnel experience level or equipment failure. Usually inexperience with the activities (no historical time-estimates available) is the most difficult to deal with. In the PERT technique, every node is called a milestone and is a point of time with zero duration. Each milestone shows either the beginning or end of an activity. Connectors join each milestone and their duration is given as either most pessimistic, most likely, or most optimistic times. Statistical interpretations based on previous performances of like activities are used to determine these calculations. The unweighted average of the three-time estimate (mean duration) is then used as the duration in computing the project schedule. Now the probability of meeting the scheduled finish can be found. Figure C-1 presents the project evaluation and review technique.



PROJECT EVALUATION and REVIEW TECHNIQUE (PERT) DIAGRAM

FIGURE C-1

PROJECT EVALUATION AND REVIEW TECHNIQUE

APPENDIX D

*	CPAT	*	PDSS
*	CPM	.	PFS
*	E-Z PERT	*	PLATO
*	IWBS	.	PPP
*	MTS	*	PREMIS
*	NASA PERT	.	PRONET
+	NETWORK PLANNER	*	READINET
*	OLSFMS	*	SLIM
*	OLSSAS	.	SPC
*	ORBIS	.	SPREAD
*	OSCAR	*	TEX
*	PAF	*	VISION
		*	WBS

.1980 +1981 NBS DATABASE

*1980 ED., REIFER CONSULTING

APPENDIX E

OTHER USES FOR ASA PMS

The ASA PMS is an extremely flexible system that can be used in any industry where there is a need for project scheduling, cost information, resource management, and comprehensive status reporting. This system can be used to manage almost any type of project that has been expressed in the form of a network from projects of long duration (nuclear power plants), to projects of short duration (daily computer room schedules). Projects may also have a large number of activities (a mining operation) or a small number (TV commercial production). The following examples illustrate how ASA PMS can be used in various industries:

CONSTRUCTION

These projects require a sophisticated project management system because each project is unique as well as expensive. ASA PMS can be used to calculate an efficient work schedule. In the construction field, the project plan and the project status will never coincide; there are too many unpredictable events that alter a project schedule. This creates the need for a system that can produce updated schedules quickly enough to keep the project running smoothly. The ASA PMS can do this, and it can also help locate the causes of delays within the project itself.

UTILITY INDUSTRY

These businesses require day-to-day scheduling of the various jobs to be done and the types of equipment and manpower needed to do them. The schedule can be interrupted by emergencies, machine breakdown, worker illness, etc., so flexibility is a strong requirement.

MANUFACTURING

This industry requires the most efficient use of men and machines. In this case the projects are sequentially repetitive (repeated time after time). However, a factory is not always going to be producing the same item forever, or it may be engaged in producing many different items. The ASA PMS can balance the workload to utilize both men and machines efficiently.

GOVERNMENT RELATED PROJECTS

The major problem with these projects is large volume of work sub-contracted in various parts of the country. In order to manage this type of project, ASA PMS can be used with a 'remote entry' feature that allows satellite inputs into a central working area; this feature can be used on any project that is geographically dispersed over a large area.

MINING OPERATIONS

These applications can be used in any business that has many projects or activities occurring simultaneously. The ASA PMS allows management to monitor the progress of each project in order to make the best use of manpower, resources, and machines. If, at a certain time, it becomes necessary to expedite the progress of an activity, ASA PMS can help calculate efficient reallocation of

available resources to accomplish this objective.

APPENDIX F

SYSTEM COSTS

The installation and operational costs of each system will vary based on the hardware and equipment that is already present in a particular office environment. Since each system basically deals with software, I will only discuss software costs.

The installation costs for the entire ASA PMS package is approximately $60,0000. Different discount rates are offered depending upon the number of tools purchased. Individual tool prices range from $9,000 to $14,000 with an average of about $7,500. Operational costs will be based on time sharing arrangements (ASA PMS claims faster execution times than other systems). The smallest functional package would be the RESOURCES, SCHEDULE combination ($18,000).

The ELITE user does not purchase the software. Access to ELITE will cost $3,600 per year for the use of a directory (750 disc pages of storage). The average PM requires two directories. This price allows access to all of the ELITE tools. The PM must decide if the size of the project warrents the cost.

APPENDIX G

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This presents methods to handle risk and how managers in defense contracting deal with it.

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This presents a model which can be used to set up a planning and control system in the program office. The evolution of the model is presented and then it is combined with networking to show how to track performance, schedule, and cost.

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The basic question was addressed of whether or not it is feasible for Headquarters, Department of the Army (HQDA) to manage automated information as a resource.

ASAP81 "ASA PMS". New York, N.Y.. Published by Andrew Sipos Associates, 1981.

This was a publication explaining the main features of

this particular management system.

BEAU77 Beaureguard, A.N., Hilcoff, P., James T.A., Williams H.E.. "Software Systems Reliability: A Raytheon Project History". Report prepared by Raytheon Company for Rome Air Development Center, Griffiss Air Force Base, N.Y.. June 1977.

This is a description of the collection of software data from the records of a development of a large Department of Defense ground-based system to show software development processes, characteristics, tools, and test methods.

BURK74 Burk, James D., Miner, John K.. "Information Requirements of a MIS Relating to the Budgetary Decisions of a Coast Guard Project Manager". Dec 1974. Thesis, Naval Postgraduate School, Monterey, Ca.

This thesis proposed information requirements to a MIS data base to be utilized by project managers when making budgetary decisions.

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The purpose of this report is to familiarize a user with the various phases of weapon system development and procurement. This is practiced in decision making under conditions of risk when faced with constraints of cost, time, and performance.

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Paper presents an overall concept of his needs to guide him or his staff in creating an information system.

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NBSS80 "NBS Software Tools Database". Department of Commerce National Bureau of Standards NBSIR 80-2159. Washington, D. C. Government Printing Office. Oct 1980.

POLS66 Polski, James R.. "Managing Risks for More Effective Program Control". Cleland and King, op.cit., p. 356. Reprinted from G. E. Company, Missile and Space Division, Aerospace Management. Vol. 1, No. 1, Spring 1966.

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Project Managers Under C/SCSC". Aug 1976. Project Report, Project Management Course, Fort Belvoir, Va.

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THED80 "The Design of an Information Management Program for Headquarters, Department of the Army Phase 2". Detailed Report prepared by Arthur Young and Co.. Feb 1980.

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THOM77 Thomas N.. "VERT-A Risk Analysis Technique for Program Managers". Dec 1977. Project Report, Project Managers Course, Fort Belvoir, Va.

Project Managers are continuously faced with making decisions without complete certainty of their impact. These decision situations involve certain risks or probabilities concerning the time, cost and technical performance effects. New techniques have been evolving to assist decision makers in this risk environment. VERT (Venture Evaluation and Review Technique) is a network simulation modeling technique recently developed to provide this assistance.

VASI75 Vasilopoulos, John A.. "The Application of CIAPS as a Management Tool". May 1975. Report, Air Command and Staff

College, Maxwell AFB, Alabama.

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A SURVEY OF QUANTITATIVE MANAGEMENT METHODS

by

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ABSTRACT

This is a survey of some of the tools and resources available to Project Managers to assist in the management of complicated development projects. These tools, resources, and methodologies effectively guide managers throughout the length of their projects to provide efficient administrative, planning and documentation support.

A short overview will show the basic desires and needs of a project management system. Many different requirements and desires have collectively led to the development of these management tools. Managers have always sought efficient methods to monitor the proper mix of time, money, and resources to achieve optimum production or results.

A discussion of two separate systems shows how they are made up of many of these tools. One system is primarily for use by the military and the other was developed for commercial use. Each system shows how different tools are used to manage the three phases of a project (planning, scheduling, and budgeting).