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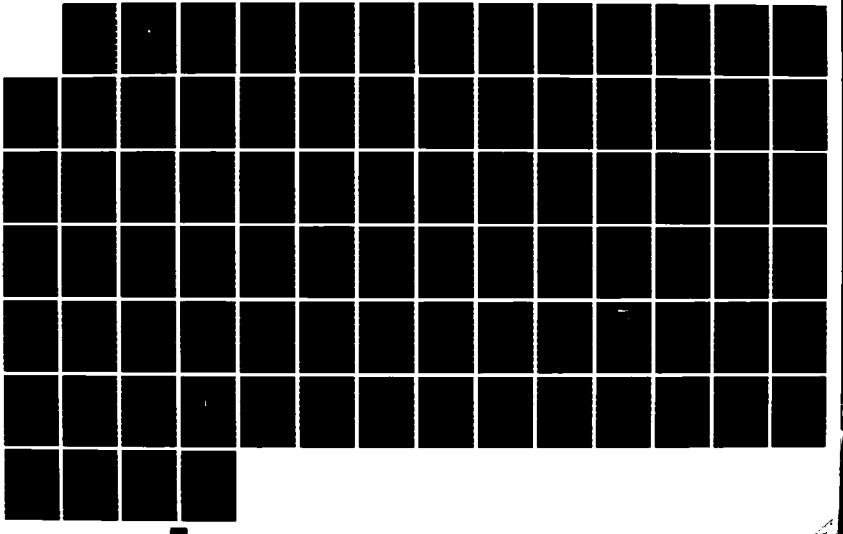

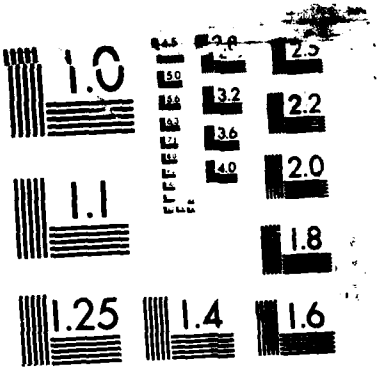

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HOW TO USE A MACINTOSH TO IMPROVE MANAGER PRODUCTIVITY

by

Mark L. Scire

March 1986

Thesis Advisor: Roger Evered

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Computerized Project Management:
How To Use A Macintosh to Improve Manager Productivity

by

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Submitted in partial fulfillment of the
requirements for the degree of

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In the interests of typographical economy, whenever the term "he" is used, it refers to he or she interchangeably.

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I. INTRODUCTION

A. BACKGROUND

Productivity is one of the central management issues of the eighties. Companies are based on it, fortunes are gained from it and managers are fired due to the lack of it. Almost daily, one reads a magazine or newspaper article that compares productivity levels of American to foreign workers.

Computerized Project Management systems are rapidly becoming major weapons in the strugglefor improved productivity. The software for these systems combines familiar management techniques with inexpensive, sophisticated personal computers to automate the tedious administrative details inherent in implementing a given project. The availability of management software allows a manager easily to model and examine the potential effects that changing resources or requirements might have for a given project.

Virtually everything that a modern miltary officer does involves project management whether it is getting a ship ready for patrol, acquiring a new weapons system or planning for the next conflict. Unfortunately, these skills were not taught at the Coast Guard academy and it is frequently difficult to learn them on the job. Management traditionally has made huge capital investments to improve blue collar productivity but it is only recently that their attention has turned to doing the same for white collar employees. "Increased productivity" is the battle cry in the war against high costs, waste and bureaucracy. In the wake of recent media attention to

excessive cost overruns, the military expectedly, must make a concerted effort to improve productivity levels across the board.

One way to do this is by using inexpensive desktop microcomputers to help implement and conduct project management at all applicable levels of the organization. Since project management consists primarily of planning, monitoring and controlling functions, microcomputers do an excellent job of alleviating much of the tedium in tracking, sorting and printing the project activity information for human management review.

B. PURPOSE OF THESIS

The purpose of this thesis is to examine how a Coast Guard (or any other military) manager might use an Apple Macintosh microcomputer, MacProject software and associated peripherials to improve productivity in the project management environment.

C. RESEARCH QUESTION

The primary question that will be addressed is as follows: "Does computerized project management using a commercially available software package called MacProject running on a Macintosh microcomputer and associated accessories, reduce costs for a given mission assignment?" If costs can be reduced using such a system, then productivity has been improved since one is therefore getting the same job accomplished at a lower total cost.

This issue recently took on new significance during a recent conversation with a colleague from Coast Guard Headquarters. He reported that starting Fiscal Year 86, the Coast Guard must show a three percent annual increase

in productivity or loose a corresponding amount of its budget. Thus if productivity improves only one percent, the service will loose two percent of its budget. How such levels will be measured and enforced could certainly be a thesis in itself but this real world example illustrates the criticality that any expenditures for productivity enhancement must be justified by improvements in the "bottom line" cost of doing business.

Some secondary questions that will be addressed include:

1. Where should such a system be used and who should be involved?

2. What problems are involved in implementing a Macintosh-based project management system?

3. What are some of the problems and pitfalls in the project management environment?

4. How might Computerized Project Management benefit the military?

D. METHOD

One of the biggest problems prior to embarking on this thesis was deciding how to prove or disprove whether using MacProject over manual methods would actually improve productivity. Several alternatives were discussed and discarded. One was the idea of putting people side-by-side and letting half the group do an assignment manually and the other half do it using MacProject. This was rejected due to lack of funding for equipment and personnel. Another idea was to design a statistical survey to be administered at Coast Guard field units. Again, this had to be discarded because one could not survey them about a machine they don not have. A third option was to examine vendor supplied data to determine productivity gains. This possibility was rejected due to the great potential for bias.

Finally, it was decided to visit a unit that had recently completed a major Change of Command using manual methods. The same data that was available to them would then be used to automate ceremony planning using MacProject. The results would then be examined for cost and time savings.

The method for this thesis consisted of three phases. First was the literature review to establish a baseline understanding of productivity and project management in general. This was followed by a case study interview and analysis of a Change of Command Cermony at the Los Angeles Coast Guard District Office. The final phase was the practical, hands-on experiment of using a Macintosh and MacProject to automate the planning data gained from the case study interview. The results of the final phase provide the answer to the primary research question.

The chosen methodology represents an useful compromise between funding, time and personnel constraints while providing a measurable result. It is recognized that the 150% planning time productivity gain achieved in this analysis would not apply to all uses of MacProject and that further testing would be required to verify even this claim.

II. PRODUCTIVITY--THE KEY ISSUE

A. WHAT IS PRODUCTIVITY?

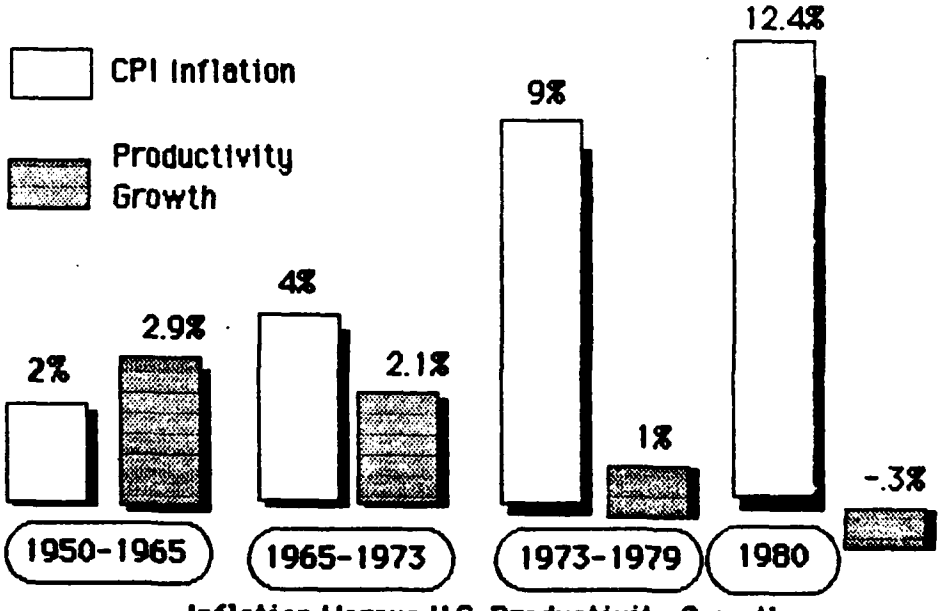
In simple words, "Productivity is the measure of how well an operations system functions." [Ref. 1] Or, as John Kendrick states, "Productivity is the relationship between output of goods and services (O) and the inputs (I) of resources, human and nonhuman, used in the production process; the relationship is usually expressed in ratio form O/I." [Ref. 2]

In different organizations, productivity measurements assume different forms. In manufacturing, it is a straightforward task to measure output per hour. In a military or humanitarian organization like the Coast Guard, it gets a little more difficult. One solution might be to track the value of rescued property versus costs.

The components that are chosen for tracking, and the method used are critical since an organization gets what it measures and rewards. For example, if performance (and consequently promotion) are based on the number of keystrokes per hour, a secretary will emphasize fast typing at the expense of something else, such as cordial telephone conversations with customers. This dual-edged sword can be particularly harmful in project management where project success is usually measured by how close the manager comes to his projected budget and schedule. If the organization bases it evaluation on these parameters, it will probably get a project that comes in on time and on budget, but the resulting product may also have deficiencies in basic quality, design or reliability. Thus while for the individuals involved, consistent measurements are important as they

indicate their level of competitiveness and efficieny, the things that those measurements consider must be an important determinant of the firm's overall strategy. For this and other reasons, "precise measures of productivity are difficult to obtain and productivity figures remain only approximations." [Ref. 1:p 234]

Nevertheless, the U.S. government does spend a considerable amount of time and money collecting statistics as shown in the graph below which illustrates inflation versus U.S. productivity growth for the period 1950-1980 and highlights some of the challenges facing the modern manager.



Inflation Versus U.S. Productivity Growth
Figure 2-1
(Source: T. Murrin "Why Industrial Productivity Is As Important As Military Arms," p. 39, Government Executive, Oct 1981.)

Although there has been some improvement since 1980, these gains seem to have been limited to the manufacturing sector. Production efficiency in

American manufacturing advanced by 5.2 percent in 1984, the biggest increase in nine years and represented an improvement over the 3.1 percent increase in 1983, which followed four straight years of declines. In two of those years, multi-factor productivity fell at an annual rate of 4.8 percent. [Ref. 3] It appears that something needs to be done to improve white collar productivity.

B. IMPEDIMENTS TO IMPROVED PRODUCTIVITY

There are four basic impediments to improving productivity. They are:

1. Technology is advancing faster than management can implement it.

2. Management may be afraid to use the new technology for fear of being replaced or unable to adjust to it.

3. Workers frequently are more interested in what the organization can do for them, rather than what they should be doing for the organization.

4. Management has a hard time quantifying the cost effectiveness of most productivity enhancements thus reducing the priority and attention such factors deserve. [Ref. 4]

C. CAN PRODUCTIVITY BE IMPROVED?

My research indicates that perhaps the best thing that management can do to improve productivity is to take more risks and to use a longer time frame (defined as being more than one year) for accomplishments. The problem of quarterly, or even annual, time frames was highlighted in a survey done by Arnold Judson, where more than 75% of all the executives surveyed indicated that their company's commitment to the objective of improving productivity was typically restricted to a time frame of a year or less. [Ref. 5] Such emphasis on the "quick fix" does not allow the individual managers

sufficient time to implement productivity enhancements consistent with the organization's long-range interests. The result is a host of uncoordinated initiatives aimed at solving whatever problem exists now, such as absenteeism, waste or poor reliability. Thus it appears that one contribution to improving productivity would be to implement more multi-year management planning.

A second contributer to improved productivity requires a broad-based commitment to executing the improved planning. This is the human factor. Management traditionally has sought to improve a person's basic skills via training and on-the-job experience. This has made the worker more *effective*. To improve productivity, the worker must be made more *efficient*. Management must seek to do this by improving the worker's internal motivation through education, understanding and incentives. This makes the worker more aware by giving him a knowledge of what is expected and fostering a belief that it is worthwhile. [Ref. 4: p. 155]

The third factor for improving productivity is automation. Once the necessary economic and psychological investments are made, automation offers numerous advantages including uniform, potential around-the-clock production, replacement of hazardous or unskilled jobs and establishment of new industries and opportunity. These advantages come at the price of displacing some workers, but the trend toward automation seems inevitable. James Baker of General Electric has said, "Any manufacturing operation of any size that is not actively pursuing productivity enhancing automation measures is on death row. It is a factory--and a business with no future". [Ref. 6]

D. WHAT FACTORS CONTRIBUTE TO PRODUCTIVITY?

A comprehensive 1973 productivity study by Hughes Aircraft surveyed 59 aerospace, consumer, educational and governmental organizations involving more than 2,000 managers, revealed the following conclusions about productivity:

1. Productivity does not positively correlate with I.Q., educational excellence, grades, age or graduate work.

2. Personal technological obsolescence is not always a function of age.

3. Stress does not always adversely affect productivity.

4. "Overall productivity is heavily dependent upon the top 5% of the organizational staff who deal primarily with innovative ideas, critical judgement and major decisions and who through their ideas and actions affect the productivity of the entire organization." [Ref. 7]

Conclusion number four has a tremendous impact on both society as a whole and this thesis specifically. Society's impact stems from the realization that upper management traditionally has looked to the importance of the first line supervisor as the primary source of worker motivation. Indeed, the popularity of such books as The One Minute Manager and the heavy use of Human Relation seminars and training programs to educate first line and mid-level managers on how to be sensitive to the needs of their subordinates, provides circumstantial evidence for this observation. In contrast, few organizations, (especially the military), have any type of program to upgrade upper management skills yet it is precisely these upper managers who according to the Hughes study, hold almost exclusive power over productivity enhancements. This becomes particularly critical in terms of this thesis where it is postulated that computerized

project management using MacProject will increase manager productivity. If it does, and the manager is not in the upper levels, then while the individual's productivity might improve, there will be little effect on the organization's overall productivity. If one further assumes that top management is not using computers because they believe that the machines are too difficult to use, then the loss is even greater since MacProject has been acknowledged by numerous sources as being one of the easiest project management programs to use.

It is important to note that the term "easy to use" should not be confused with "user friendly" which is more difficult to define. What is "user friendly" to one person, may not be "friendly" at all to someone else. For example, the gear lever of an automatic transmission is "easy to use" but it would not be very "user friendly" to someone who has no arms. The issue of how easy it is to use MacProject, especially for a non-typing senior executive, will be detailed more fully in the next chapter.

Before leaving this section, however, it is important to summarize the factors that contribute to both counter-productivity and productivity. They are:

E. FACTORS THAT DETRACT FROM PRODUCTIVITY

1. Overinflated organization structure
2. Poor psychological environment
3. Misemployment/underemployment
4. Ineffective structuring of assignments

5. Lack of effective performance appraisal and feedback

6. Ineffective reward system promoting a disparity between individual productivity and compensation

7. Lack of equitable parallel promotional opportunities along managerial and technical ladders

8. Lack of equity in operations

9. Operational/procedural overcomplexity

10. Excessive organizational politics and gamesmanship [Ref. 4: pp. 177-178]

F. SEVEN STEPS TO BETTER PRODUCTIVITY

1. Formulate statements of purpose in tangible terms to provide a sense of direction and high moral standards

2. Design the organization to stimulate growth, provide parallel paths for advancement and elimination of red tape

3. Structure individual work content to include logical subdivisions. Ensure assignments provide for mis and under employment

4. Promote individual participation in planning,formulating, executing and evaluating work

5. Continually integrate "rising stars" into senior management

6. Establish a high degreee of equity in all areas and facets of the organization and its operations. Avoid lopsided perks.

7. Ensure timely correlation of compensation with contribution [Ref. 4:pp. 178-179]

G. FACTORS CONTRIBUTING TO MANAGER PRODUCTIVITY

1. Establish high personal and performance evaluation standards

2. Delegate authority as far down the organization as possible

3. Determine specific, measurable objectives

4. Apply work elimination/simplification proceedures wherever possible

5. Encourage innovation and invest in the future. Support use of the latest technological aids

6. Look for preventive rather than corrective action

7. Don't overemphasize or shortchange any individual in the organization. Be fair

8. Provide employees with the necessary information and resources to do the job effectively

9. Keep assignments from bein overspecified by focusing on end results rather than activites

10. Make schedules tight but realistic

11. Assign work in relation to employee abilities and let them grow

12. Define assignments, roles, responsibilities and interfaces clearly [Ref 4: p. 181]

H. FACTORS CONTRIBUTING TO ORGANIZATIONAL PRODUCTIVITY

Finally, and perhaps most importantly, the following items summarize the factors for making a more productive organization:

1. Treat Productivity as an integral part of strategic planning

2 Recognize the key, distinct roles in productivity improvement of all levels of management

3. Retrain all levels of management to accept the more contemporary view of its function and its impact on the attitudes, motivations and actions of the work force

4. Continue to evaluate, assess and adjust the organization in line with the feedback obtained through the strategic planning effort [Ref 4: p. 184]

As will be shown shortly, project management is one of the best tools available to improve managerial productivity. Managers are effective based on the results they produce, not on how long it takes to produce them. Good project management focuses on goals and thus provides the necessary framework for accomplishing stated objectives in support of those goals. Computerizing the planning and monitoring steps, using an easy to use program like MacProject, contributes even more to higher productivity. This concept will be discussed at length in the next chapter.

III. PROJECT MANAGEMENT

A. WHAT IS PROJECT MANAGEMENT?

Project Management is a systematic method of planning, monitoring and controlling an assigned task to provide the best possible output for the least expenditure of time and resources. As such, project management is closely linked to productivity, an issue that was examined at length in the previous section.

Project Management involves the full exploitation of each skill at the manager's command. It requires continual juggling to satisfy schedule, budget, personnel and design constraints. It requires consummate estimating and communication skills. As a minimum, project management requires the manager to discipline him or herself to decide on each activity, graph the inter-dependencies, and figure out how long each is going to take. Until this effort is expended, there seems to be a natural tendency for individuals to under-estimate task or project duration. For example, one might have a gut feeling that a proposed activity should take about three days to accomplish. When the person examines the same task using project management techniques, such as Program Evaluation Review Technique (PERT) he may discover that the activity more realistically requires ten.

B. PROJECT MANAGEMENT ADVANTAGES

There are several things to be gained by employing project management methods. First is credibility. The manager has thought through what's involved and sequenced the activities based on more realistic time domains. If a conflict develops, the Project Manager is better prepared to defend his

position. Without such preparation, when it comes down to whether it's the worker's number or the Project Manager's number, the worker's number will probably win because they want it to happen sooner and the Project Manager is generally viewed as an obstructionist.

Another advantage is more realistic cost estimates. By breaking the undertaking into component activities, appropriate resources may be assigned and costed. Staffing levels and special equipment needs become apparent and potential bottlenecks may be rescheduled. In this manner the demand for each type of resource may be charted and adjusted to minimize the cost of hiring and firing personnel or renting special equipment. This resource leveling also helps to smooth out cash flow futher reducing costs. Computer programs that offer automatic resource leveling are very helpful. Too often no one knows what their true project costs are. With resource leveling programs the manager may play "what if" with the project. He can produce graphs of people, money and equipment needs with and without resource leveling.

A third advantage of computerized project management is for minimum cost expediting. If the manager does not know the task dependencies, resource costs or what is truly critical, the normal tendency is to expedite all activities. This can be both unnecessary and expensive. The effective Project Manager will use his float time up-front to devote to the critical paths. The automation side comes into play when the project plan is updated with clear printouts rather than a bunch of handwritten corrections.

Project Management is a highly effective management tool for planning, scheduling and controlling projects. A project is a task with a definable

beginning and end, consisting of related activities, all of which use resources subject to certain constraints. Each project has three areas in common. First there are certain operations which must be coordinated and performed for the successful completion of the project. Second, each project has a limited amount of resources such as personnel, supplies and capital that must be used efficiently. And finally, there are constraints within which the project must be completed such as technology, time and money. The overall objective of the Project Manager is to organize and use these resources to accomplish the project in the best time, at the least cost and at the lowest possible risk. [Ref. 8]

There are many management science techniques designed to aid the Project Leader in eliminating delays and cost over-runs. Some of the most successful techniques are PERT (Program Evaluation Review Technique) and CPM (Critical Path Method) which MacProject uses. PERT and CPM are similar in their approach, in fact some references consider the terms interchangable, but there are subtle distinctions. PERT is probabilistic and used primarily for planning and control systems. CPM is deterministic and is used to control both the time and cost of the project. Both PERT and CPM allow the user to manage resources in addition to time and money, to trade off resources, anaylze different types of schedules and to balance the use of resources. [Ref. 9]

C. CONSIDERATIONS FOR COMPUTERIZED PROJECT MANAGEMENT

The relationship between computerized project management and time management is binary. Computerized project management provides the manager with a tool to help him bring his project to successful completion

but it is important that the selected system fulfills the needs of the manager using it. Will it save time and money? Does the manager have to change his old way of doing business to accomodate the computerized system? Is it flexible? Does it adapt easily to changes and evolving needs? What limitations does the system have? Will it give automatic warnings about changes in critical paths and will it display any conflicts between activities or events? Will it provide suggestions for leveling demand for critical resources? Does it permit comparsions of planned versus actual expenditures for activities? Does it have cost and expense reports, like cash flow statements.? How are expenses recorded? Does the program allow the Project Manager to specify when an expense is recorded? And finally, how many resources and activities can the program track per project?

Along with the above considerations the manager must determine what types of reports are needed and whether the system can provide them. Will it produce formal reports that can be used outside the organization? The manager should not have to make dramatic changes in his routine to use the system. Remember it is an aid to the manager, it is supposed to fit his unique desires and needs. Graphics also fall into this area of reports. Are they of presentation quality and easily produced by the software?

D. KEYBOARD ANXIETY

One of the most crucial areas of concern for a manager is, "How easy will the system be to use?" According to Patricia Galagen in her article, "Treating Computer Anxiety with Training", she states that there is a common profile of individuals who are most likely to resist using

computerized systems. The profile is that of a manager, usually over age 45, who exhibits little typing ability and has been with the firm for 20 or more years. Clearly, the most significant factor in determining potential resistance is the manager's lack of typing ability. This could be a serious problem where the potential user can not type at all and the only contact between the user and program is a keyboard. Alternate input devices, such as a mouse may provide an answer to this problem. Training must also be considered, especially where the system is complicated. The next section will discuss how MacProject measures up to these requirements and concerns.

IV. MACPROJECT TO THE RESCUE

A. WHAT IS MACPROJECT?

MacProject is a graphically orientated, Critical Path Method (CPM) software package that uses a combination of CPM, Network Charts, Gantt Charts and cost schedules to allow a manager to plan, schedule and monitor any small to medium-sized project. It is designed for use on the Macintosh microcomputer from Apple Corporation.

MacProject's graphical, network display has several distinct advantages over the more common text tables or asterick charts used by other project management software.

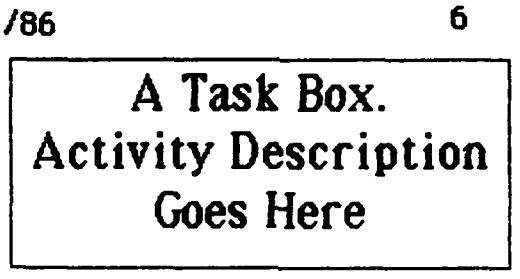
Most conventional computer/software combinations display information the way a football scoreboard does. Watching the scoreboard may tell you exactly what's happening in the present, but it's of limited value if you're trying to "forecast" a winner. Nonetheless, many business plans are still prepared using this "rear-view mirror" planning concept (projecting the future on the basis of historical trends).

But there is a radically different planning process--one that can be compared to the football game plan rather than to a scoreboard. The process includes:

- Setting goals.
- Determining the end item necessary for success.
- Defining and logically placing milestones.
- Identifying and interconnecting tasks.
- Estimating time and costs. [Ref 16]

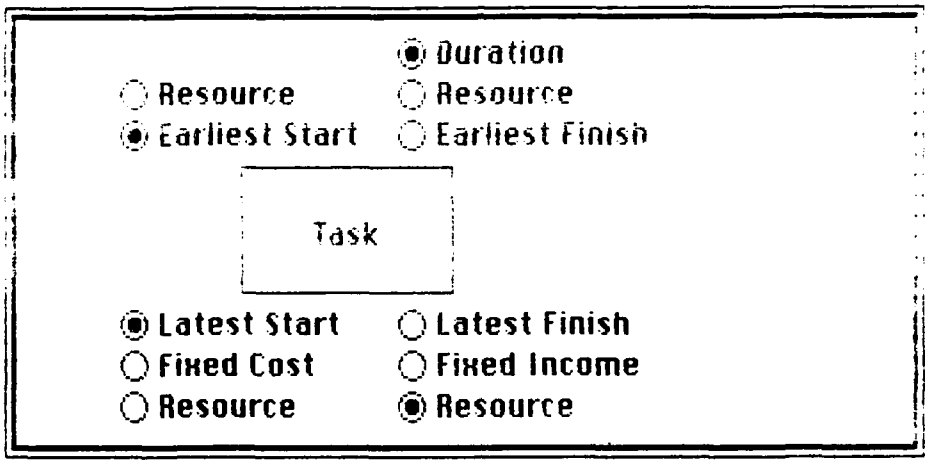
The program retails for $125 and runs on both the 128 and 512 kilobyte Random Access Memory (RAM) Macintosh systems where the only major difference is in the number of tasks or activities that may be stored. The limits are 200 for the 128K RAM system and 2,000 for the 512K RAM machine. Otherwise, the restrictions are the same for both machines with 6 resources per task and a total of 50 resources per project. The program is single layered in the sense that one cannot break a task into a more detailed lower level chart attached to the main chart. There is nothing to prevent a user, however, from manually transferring the information from a separate, highly detailed sheet. There simply would not be any automatic updating between the two. This might make the program unsuitable for a highly complex project such as putting a man on the moon. Additionally, once a time unit is chosen, be it minutes, hours, days, weeks, months, quarters or years; that same unit applies to all activities. For example, you can not have some activities listed in days and others in hours.

Data input is about as simple as can be. Project tasks are organized in flow chart like boxes as shown below.



An Enlarged Activity or Task Box Example Showing Dates and Resource
Figure 4-1

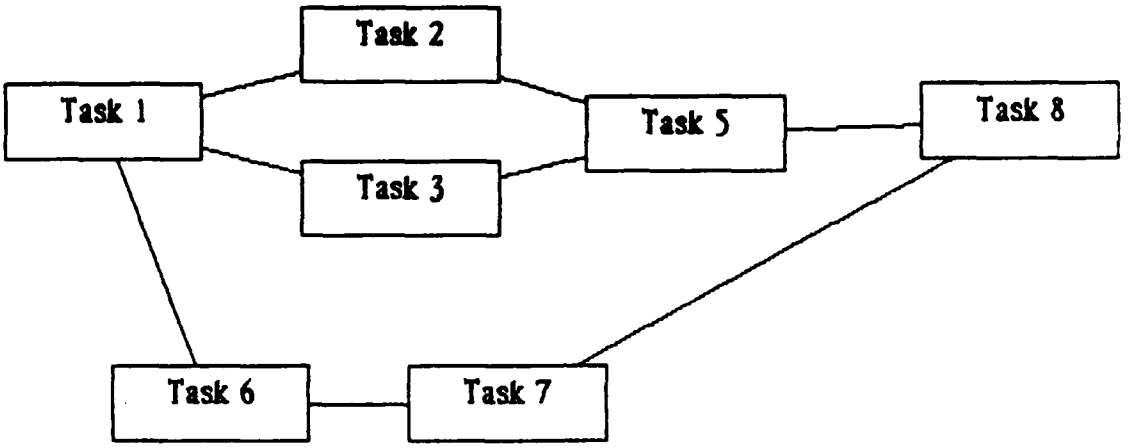
The user has several options of what to display in each of the four corners of the task box depending on which of the "buttons" that are selected in the "Display Dates" submenu. The choices that resulted in the output of Figure 4-1 are shown in Figure 4-2 below:



A Listing of What Factors may be Displayed in Each Corner of a Task Box
Figure 4-2

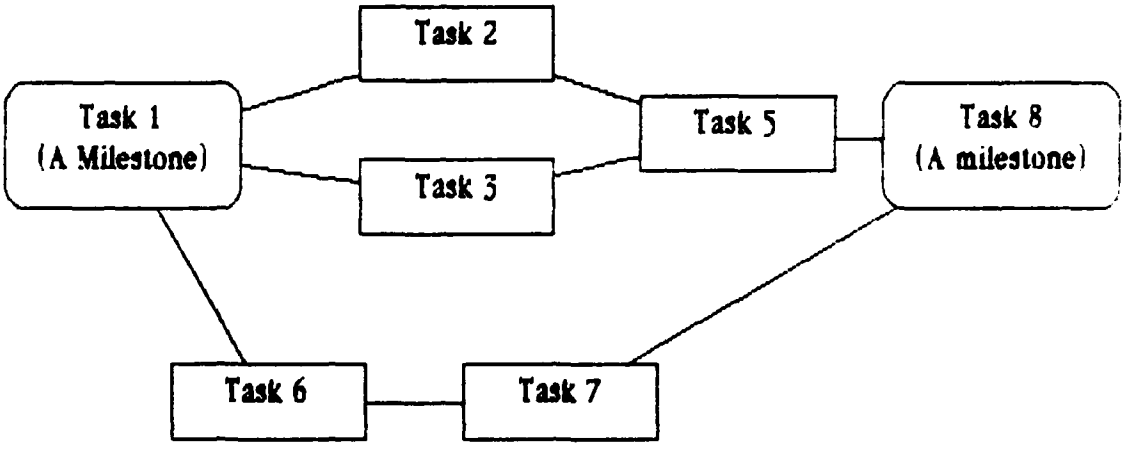
The "Earliest Start" dates indicate the earliest time each activity may be started so that the project may be completed as soon as possible. The "Latest Start" is the latest date an activity may be started and still finish the project on time. If a user enters an "Earliest Start" or "Earliest Finish" date (using the DATE menu), then these become constraints on the system which the program will use for calculating the critical path, slack time and all other schedules. MacProject indicates such restrictions by underlining them in the network.

The Macintosh mouse is used to select what you want to do and then to draw the boxes and dependency lines for the activities. The keyboard is used only for chart notation and numeric input. A "hunt and peck" typist should have little difficulty using this program. Additional task boxes may be drawn and connected with dependency lines to form a network as shown in Figure 4-3 below.



A Simple Network of Task Boxes
Figure 4-3

Most networks have a definite starting and finishing event that is viewed as a milestone. By hitting a few keys in MacProject, a task box may be turned into a milestone as shown with the rounded corners in Figure 4-4. The milestone boxes also show up differently in the Resource and Task Timeline charts which will be discussed and demonstrated in full in Chapter six.



A Network that shows Milestones
Figure 4-4

B. TRACKING A PROJECT

After studying the needs, concerns and wants of more than 10,000 top American executives, Halcomb Associates determined:

> We concluded that most management or executive activity occurs as a group-directed effort. We also concluded that the right system should be based on its functioning with workgroups in an optimum conference command center environment, complete with computer graphics--not just in a conference room or a board room.
>
> To enhance this "war room" approach to management planning and project management, we coupled an optional and highly desirable large-screen display (Vivid Systems Limelight computer projector) to the Macintosh. This allows each member of the planning team to view the project plan simultaneously and to participate face to face, using optical or switched mouse pointers for generating the common plan.
>
> Each manager "buys into the plan" by giving verbal instructions to a common keyboard operator as to precisely what is to appear on screen . . . .

In recent weeks, the system has been enthusiastically welcomed during our demonstrations to executives of RCA, ARCO, Magnavox, Bank of America, Lockheed, General Electric, Masonite, Schlumberger, SOHIO, USAF, US ARMY, NASA, TVA and the city of Portland, Oregon. [Ref 16]

The program offers six ways to track a project. They are the Schedule, Resource and Task charts or Resource Cost, Cash Flow and Project tables. Input is provided on the Schedule (or Network) Chart, Task Info Box or Resource Cost Table. All the other items are automatically updated. As with all Macintosh application programs, data and graphs may be "cut and pasted" wherever it makes sense among the word processor, spreadsheet or drawing program using the built-in clipboard or scrapbook. While there are other computers that offer higher resolution or color output, the Macintosh has generally become acknowledged as the graphics leader for its price class. Since output quality is largely a matter of personal taste and business need, it should be left up to each potential user to decide if MacProject would satisfy them in this area.

MacProject eliminates much of the painstaking administrative effort required by project management. Since it has the flexibility to change costs, durations, dates and resources with an automatic updating of the output charts. This feature is very useful in the very early planning stages where many changes are constantly being made. It also gives the program a "What-if" capability. Several scenarios may be demonstrated, printed-out and distributed for comments prior to actual project design. A tremendous amount of time can be saved by not having manually to redraw diagrams, charts and refigure costs.

The ease of using the mouse eliminates much of the tedious typing chores and should dissipate the fear associated with using a keyboard for those people who might have difficulty with such devices.

C. MACPROJECT LIMITATIONS

Still, there are other considerations in addition to the memory limitations discussed earlier. While the program allows printing of all charts and tables to be as large as 96 by 48 inches, it is up to the user to trim and tape the individual 8.5" by 11" pages into proper sequence. Similarly, the 9" Macintosh video screen can display only a small portion of what can be printed out. It is fairly easy to get lost on the screen as you move around and forget which tasks are where.

The software lacks several features that a manager might need to track a complex project under less than ideal conditions. They include the inability to track more than one project at a time, no overlapping activities, the lack of multiple calendars, no reverse logic events for "first arrival" scheduling, no resource variability and no sorting ability in any of the various reports.

Finally, one might also complain about the lack of automatic resource leveling where the program would detect peak resource usage and recommend alternatives. In fact, there is not even any restriction on scheduling an individual for a workday that is greater than 24 hours! While it's beyond the scope of this thesis to include a complete utility program to do such automatic resource leveling, the chapter six case study does include a brief example of using a data base management program to provide additional manipulation of data "cut and pasted" from MacProject. For an actual application, a user could probably write a Multiplan™ or BASIC program that

would further expand this capability. On the other hand, the 80/20 rule probably comes into play here where 80% of the projects encountered might never require such a feature. Considering how much power has already been packed into such a small program, it is not unreasonable to expect that something had to be left out. As long as the user is aware of these limitations, major blunders must be avoided by manual observation.

D. WHO SHOULD USE MACPROJECT AND WHERE?

In short it looks like MacProject could be an inexpensive solution for a large portion of managers (military or civilian) who are looking for an extremely easy to use, practical and fairly versatile computerized project management system. In fact one enthusiastic user has gone so far as to say, "Yet in may respects MacProject outperforms all other project management software, including some that sell for as much as $700,000" [Ref 16]. The program requires a minimum of input while allowing the flexibility to generate numerous "what-if" situations. The built-in Macintosh graphics are exploited to their fullest. Operating on the premise that a picture is worth a thousand words, MacProject output can certainly replace considerable text in a powerful and convincing way. Its ability to provide presentation quality reports at every stage is a plus for both tracking the project and justifying any additional resources.

When output is directed to the Laserwriter, one gets "print shop" quality results without the expense and delay of visiting a print shop. The user now has complete control from data input to final destination. The Laserwriter™ has spawned a new phase in office automation known as "Desktop Publishing". Graphics may be freely mixed with text, thereby

giving the user total control over the expression of his ideas. It is still too early to access the final impact of this new form of communications but the implication is clear. Several industries such as print shops, copy centers, book publishers, facsimile and copy machine makers, messenger services and even the U.S. Postal Service could be affected as users turn to their desktop microcomputers to provide such services in-house. The result will be faster turn-around, shorter deadlines and more up-to-date data for decision making. MacProject is but one tool in the automated office, but its potential application is very widespread. In fact, based on ten years of military experience, there is probably not a single assignment that would not have benefitted from using MacProject. While such a statement won't apply to everyone in the military, the lesson is the same for any tool. Use it when applicable, but use it properly. In the case of MacProject, the bigger problem may be that many people do not even know that it is available, let alone how to use it to its fullest potential.

E. COST, TRAINING AND INCOMPATIBILITY ISSUES

It has already been stated that the program costs $125. A 512K Macintosh currently retails for around $2,000 and includes a free word processing and graphics programs. A second floppy disk drive is $500 and a dot matrix printer is also about $500. The Laserwriter™ is the most expensive item at $6,000. Of course it may be shared among many Macintoshes™ using the Appletalk™ local network at $50 per connection. Thus a full system will cost somewhere between $3,125 to $9,125, less an expected 35% Government discount yielding a cost in the $2-6,000 range. Regarding training, it has previously been discussed that the ease of use

issue probably has the biggest impact on training. If it's easy to use, it's easy to train. Citing a few years experience with an Apple II prior to upgrading to the Macintosh, it only took a few hours to feel comfortable with the new machine. As far as learning MacProject, the basics were grasped in about an hour and assimilated the rest over a few more hours. Having had considerable prior experience teaching people how to use the Coast Guard "Standard Terminal" microcomputer for word processing, spreadsheet and data base programs, it appears that teaching MacProject would be easier, probably by a factor of ten. This is not to imply that the program is simplistic. On the contrary, it seems deceiving sophisticated by the intuitive elegance with which it accomplishes its task. It is similar to making a new friend where one learns a little more about that person during each meeting, so do you learn a little more about MacProject each time you use it.

Since the military, like corporate America, continues to make a large investment in microcomputers, the issue of compatability should be mentioned. Without getting bogged down in the technical details, MacProject provides little data compatability with other machines. The graphic network picture currently is totally incompatible with any machine other than the Macintosh or Macintosh XL™ (The revised Lisa™ machine). The user may easily capture the text and numeric data in an ASCII file wherein each data element is separated by a TAB character. As long as the receiving machine and software is configured to handle such a file, they could then import MacProject data into their own application. It will probably take some programming talent to accomplish this, however.

Putting this all into perspective, one must remember that since that most military managers already earn more than $20 per hour including benefits, the non-Laserwriter™ system would only have to save about 100 hours of labor before it pays for itself. Thus if someone has even one project that is going to take more than say 200 hours to plan and monitor manually, he would probably be better off using this system.

F. POTENTIAL IMPLEMENTATION PROBLEMS

In addition to the cost factors cited above, there are other potential implementation problems for a MacProject-based system. First is procurement authority. Some organizations only allow certain microcomputers to be bought and even if this restriction is not in force, the organization might not provide any support for a Macintosh.

Second is to determine if MacProject is capable of solving the user's problem. Some systems analysis work may be required to address this issue.

Last is compatability with existing systems, both hardware and software. In most startup situations this won't be a problem, but if the organization already has some sort of project management system installed, the user must ensure that MacProject augments rather than duplicates the current system.

V. PROBLEMS AND PITFALLS IN THE PROJECT MANAGEMENT ENVIRONMENT

A. OVERVIEW

Probably the two biggest problems in the Project Management environment are "Who's in charge?" followed by the conflict generated as the people involved struggle with the realities of budget constraints, worker selection, organizational problems, personality conflicts, schedule pressures and other bottlenecks. The purpose of this section is to describe, examine and recommend solutions to some of the most pressing problems that might be encountered before one tries to computerize a program in the Project Management environment. As pointed out in the introduction, there is no value in trying to automate a project that already has problems before the first keystroke is entered. Specific items of examination include:

1. Problems with the Project Manager, functions and selection.
2. Similiar problems with the Functional Manager functions and selection.
3. The impact of project management on the organization.
4. Management pitfalls, traps and bottlenecks

B. PROJECT MANAGER FUNCTIONS AND RESPONSIBILITIES

The Project Manager by definition and design is responsible for the overall successful completion of the project. Three key issues determine successful project management. They are:

1. Production of a working product
2. Production within Budget
3. Production within Schedule

Of these, the first is generally considered to be the most important and most affected by individual efforts. While it may be noted that good people certainly help to make a given project successful, a good team alone cannot guarantee success. Thus we come to the first and perhaps most important function of the Project Manager, Leadership. Through action and deed he must make all project team members feel equally important and that their contributions are vital to the assignment. He does this by communicating the goals of the project, thus educating each member of the team. He strives to build esprit to the program while not alienating individual members from their original functional associations. By definition, the project will not continue indefinitely so the Project Manager has the added burden of balancing program versus functional loyalities. This is a delicate task that requires extreme tact and finese. Company and military political realities being what they are, the Project Manager must be constantly on the alert for undermining influences. There are several solutions to this problem including financial incentives, job seniority protection and continued communication and association with functional peers. [Ref. 4:p. 54]

The Project Manager must display high levels of honesty, integrity, alertness, a good command of the project terminology, and the ability to make quick decisions. Due to the temporary nature of a project, the Project Manager's position is more tenuous than that of the Functional Manager. The Project Manager therefore, must obtain more of what he needs through persuasion rather than through formal positional authority. This requires a distinctive personality that is flexible, goal-directed and versatile. He

must have a thick skin and be outgoing. He must not let problems prevent him from attaining his ultimate goal. Instead of looking at problems as dead ends, he must view them as simply hurdles to be noted and overcome on his road to ultimate success. "Project Management is change management", [Ref. 10] so the Project Manager must constantly be ready to change.

The Project Manager must also command four basic skills in order to function effectively. First, he must be an excellent planner and scheduler. Experience has shown that in general, the number of problems encountered are inversely proportional to the amount of planning conducted. The more planning the fewer problems. Project Managers have several tools available to them to help planning including milestone tables, Gannt Charts and Network analysis. [Ref. 4:p. 110] When coupled with an inexpensive yet powerful microcomputers like the Macintosh running MacProject, the proper planning reports may easily be generated for all levels of management.

The second skill is financial control. This includes basic accounting, budgeting, estimating and application of learning curves. While military managers usually do not have to worry about raising capital, they do have to be concerned with basic cash flow and the varities of congressional funding.

Third, he must be skilled in contract administration. Contracts are the lifeblood of a program. Their specifications form the entire foundation for the project and provide the ultimate yardstick for measuring success. There's probably no greater trap awaiting an unwary manager, than the one that can be sprung for failing to understand the implications of proper contract management.

Finally, he must be familar with behavior science and leadership. Although the importance of leadership has already been discussed, its effect cannot be divorced from individual behavior since it takes motivated and concerned individuals to make an effective team.

C. PROJECT MANAGER SELECTION

Given all these functional and skill requirements, what should or should not be the factors deciding how to select a person to be a Project Manager?

On the positive side, he should be selected based on past, proven performance. He should be a generalist yet have some experience in the program area. Since he'll be relying on the power of persuasion to accomplish much of his work, he needs to be fairly well known (and tacitly approved) by the majority of the key players. He obviously must demonstrate all of the factors and skills enumerated above including leadership, adroitness, flexibility, intelligence and dedication. The selection of the Project Manager must "be done by general management--and very carefully." [Ref. 10:p. 233]. There is simply too much importance riding on the project to allow haphazard Project Manager selection.

D. FUNCTIONAL MANAGER FUNCTIONS AND RESPONSIBILITIES

A major problem with project management is the impact of creating another boss for the functional manager. There's an old saying that a man can not be a slave to two masters, yet in effect this is what may occur each time we assign a functional manager to a project. As a minimum, he now must report to both the Project Manager and the senior functional head. The results, if not implemented carefully can be disasterous as discussed below.

> The situation calls for exceptional balance and good judgement on the part of the functional manager. Not only must he find a way to satisfy both men, but he cannot do so by adopting a shabby short-run compromise that really satisfies no one in the long run. . . .He must scrupulously avoid the coward's choice of telling each superior what he wants to hear. In particular he must never play one boss off against the other; that is sufficient cause for his being replaced forthwith. [Ref. 10:p. 37]

Like any problem, there are two sides the the story and it must be remembered that the bosses themselves, are also undergoing a certain amount of trauma for if they are reasonable men, they must realize that the Functional Manager is being split between them. The most obvious shortfall of such a situation is the tendency for all involved to develop divided loyalities. The Functional Manager is probably going to maintain a stronger allegiance to his functional boss since that's where he'll be returning after project completion. To solve this problem, many organizations have traditionally used a matrix form of management for their programs that require project management. Such a solution has not worked for all, however, and in the realm of Management, matrix organizational structures seem to be on the top of just about everyone's 'Use with extreme caution' list. As author James Stoner explains:

> Not everyone adapts well to the matrix system. An effective matrix structure requires flexibility and cooperation in the people at all levels. . . .To protect individuals who have functioned well in traditional structures but who have difficulty adjusting to a matrix structure, many companies make special efforts to retrain personnel before they are assigned to project teams, or select only volunteers for the teams. [Ref. 1:p. 273]

When properly implemented, matrix organizations need not be that complicated and if examined in the proper light, it does not have to violate the one boss, one worker concept. The functional manager need only look in one place for direction at any given time. He looks to the Project Manager for what and when to do something while looking to his functional superior for how to do it and with whom. As long as the Functional Manager is competent enough to maintain this separation in guidance, he should succeed without conflict. It's when he mixes his sources that he usually gets into trouble. It appears, therefore, that the problems experienced in matrix management may be due more to the inabilities of the individuals involved rather than to any flaw in the basic organizational structure.

Another source of problems between the Program and Functional manager concerns funding. Specifically, how does the Project Manager ensure that the Functional Manager spends project funds only on the designated project? *In large organzations with numerous projects and overhead accounts running* simultaneously, this concern can be a big one. A good solution would be to do what Lawyers always recommend to avoid misunderstandings; write things down in a formal agreement. In this instance, the Project Manager should have the Functional Manager draft a functional plan for the assignment. Such a document would list both the tasks and expected costs anticipated by the Functional Manager. This 'contract' forms an excellent basis for understanding between both people. Since the Functional Manager drafted it and the Project Manager approved it, they both now have some ownership rights in the overall success of the project, while making any future modifications a shared responsibility.

E. FUNCTIONAL MANAGER SELECTION

It's vital that the Project Manager is selected and formally appointed by the general management prior to picking any Functional Managers. The Functional Manager selection process thus may begin with discussions between the designated Project Manager and the senior Functional Vice President. At this point the Project Manager may request that specific individuals be considered or avoided as candidate Functional Managers. Such discussions should be considered confidential between the two individuals. After devising a list of mutually agreeable nominees, the candidates involved may or may not be given the opportunity to refuse appointment, depending on the urgency of the project and normal company policy. Once the Functional Managers are in place, recruitment of the remaining team members may begin. [Ref 10: pp. 238-9]

F. ORGANIZATIONAL IMPACT

As Peters and Waterman point out in their landmark book, In Search of Excellence, one of the most critical success factors is the need to stay close to the customer; to anticipate his needs and move to fulfill them. [Ref. 11] Project management is fundamentally no different than any other business. Each project has a customer and the overall success of the project is vitally dependant on satisfying that customer. [Ref. 11]

"When a project is undertaken to achieve an objective internal to an organization, it is easier for people, including the project team, to lose sight of the customer. If a project is established to build a new manufacturing facility, then the new plant manager is the customer, not the

facilities engineer." [Ref. 10:p. 9] Thus the first impact on the organization is the clear need to have a well-defined customer for each project.

It was mentioned earlier that project management is change management and this change is strongly felt throughout the *entire* organization. A good Project Manager is a strong leader, who's team oriented to the goals of the project, not to optimizing a certain department. Division managers, accustomed to maximizing the performance of their division, suddenly find themselves receiving direction, not just requests from the Project Manager. This results in complicated interpersonal and interdepartmental relationships that frequently ripple to the top of the organization. Large organizations have developed effective bureaucracies whose sole purpose it is to maintain the status quo. Since project management is generally used to develop something that has never existed, it has no steady state. Project management encourages innovation not continuity. Mildly better results are not good enough. Fueled by the need to attain a big success or none at all, the Project Manager is probably going to take bigger risks and has the resources to make such attempts. The Project Manager creates new organizational alignments and is a new player in the political power structure. Program management encourages pragmatic problem solving while sometimes creating divided loyalties.

General management must recognize the potential disadvantages and support the advantages if it truly wants success. The net result is that they must be equally careful in selecting only those endeavors that genuinely require the special attention inherent in project

management and simply won't otherwise work in the normal environment.

The criteria indicating that a project organization is warranted (or required) are:

1. Projects requiring significant contribution by two or more functional organizations.

2. Projects of an advanced nature--advanced studies and development--even though only one functional organization is involved.

3. Projects of a system nature, involving system analysis, development, production and ancillary items, even though the major end item may be in production quantities. [Ref. 12]

Once a candidate project has met the requirements listed above, management should then answer the following questions for each potential project:

1. Why is this project important?

2. What are the effects if the system is not implemented?

3. How much will it cost to develop/run?

4. What improvements will it make in the business?

5. When can those improvements be obtained?

6. When will additional investment be required to sustain the improvements? [Ref. 13]

Project management should not be looked at as a panacea for poor general management or as a solution to working around poor performers. In some instances, management won't have much choice depending on the union

or other work rules in effect at their organization. They simply do not have the latitude to arbitrarily assign workers to various projects, regardless of urgency. Thus the basic structure of the workforce is impacted by project management regardless of whether it's being used or not. Those entities that frequently use project management are certainly going to be less amenable to being hampered by organized labor restrictions.

Management's most important decision, therefore, centers around how they organize and staff their projects. Once an organizational attack is chosen, be it general matrix, task force or project management, it is extremely difficult to reorganize in the middle of the assignment. Some of the basic questions that must be answered upfront include:

1. How much organizational independence should be given to the project?
2. Where should the project fit in the organization?
3. How should people assigned to the project be managed?
4. What directive authority should the project manager have? [Ref 10:p. 65]

Since each situation is different, it is difficult to offer any recommended solutions to any of the above questions other than the general observation that project management appears to be particularly useful when numerous divisions must work together yet there is not a strong enough need to switch to a permanent matrix organizational structure.

G. MANAGEMENT PITFALLS

The inability to say no has probably gotten more managers in trouble than any other shortcoming they might have. Too often, managers will assume that they are jacks-of-all-trades and think that can do anything that's assigned, lest their superiors think them a failure. This tendency can be particularly fatal in the project management environment where task accomplishment is frequently measured in man-years. The astute manager must recognize his limits and make effective use of his support staff and outside consulting agencies.

Another common pitfall is getting so hung up in meetings and minutiae that there is no time left for actually doing the job. (Some time management techniques are discussed below.) This problem may take several forms including upper management briefings, status reports and individual document approval. Again, the solution appears to be the ability to say no to needless reports and paperwork as well as more dependence on support staff.

A third pitfall is managing versus doing. This problem frequently takes the form of a subordinate who asks for assistance in solving a problem and the manager ends up actually doing the work to solve the problem. This is the old monkey on the back trick where the subordinate in the guise of asking for help actually is transferring a monkey to the shoulders of the senior. The best defense here is to constantly be on the lookout for those monkeys and to not let them leap from the subordinate to senior. It's the subordinate's job to do the actual work to solve the problem and hopefully he will learn something in the process.

A fourth pitfall is ineffective communications. Work is not done or is botched because either the subordinates did not know what they were supposed to do, or they thought they were supposed to do something else, perhaps at a different time. Solutions here vary with the severity of the problem but can range from simply starting each day with a quick review of what's expected, posting same on a centrally located bulletin board, all the way up to a full fledged, real-time computerized activity tracking system. Certainly it's implied that someone in the organization has already done some careful planning and scheduling and actually knows what is supposed to be done and when. [Ref. 14]

The fifth and perhaps most important pitfall is time management. There are of course, entire books written on this topic, but the nice thing about this problem is that it is generic. The time management techniques that work for people's personal and business life, also apply to the project management environment. Thus, the highlights of some of the better time management books will be summarized below:

1. Log your time for a week or two and examine how it's spent.
2. Plan solid blocks of time for important things.
3. Establish priorities.
4. Calculate opportunity cost on activities
5. Practice calculated neglect
6. Practice delegation
7. Practice management by exception
8. Focus on opportunities--not problems. [Ref. 14:p. 463]

Another author's views include:

1. Get up earlier.
2. Gather all supporting data prior to starting a task.
3. Schedule your plan for the day and stick to it.
4. Keep an idea log.
5. Close out activities at the end of the day.
6. Know who your interrupters are.
7. Have your secretary really screen your calls.
8. Establish a quiet hour.
9. Form objectives, know how much time you waste and how much you'ld like to save.
10. Assign work to constant interrupters.
11. Keep calls and visits brief.
12. Do not sit down when visiting someone. [Ref. 15]

H. MANAGEMENT BOTTLENECKS

The final pitfall is management bottlenecks. In many projects there is a communications bottleneck where all discussions between the customer and the parent organization must pass through the project office. This causes two problems. "First, requiring that all information pass through the project office may be a necessity but develops slow reaction times. Second, regardless of the qualifications of the project office members, the client always fears that the information which he receives will be 'filtered' prior

to disclosure." [Ref. 14:p. 467] Again, it's difficult to recommend a solution. If communications are not routed through the project office, then the customer will be calling all over the organization, probably talking and making various requests to several different people, who all present several different versions of the project status. This hearkens back to the question in the very beginning of this chapter where it's stated, "Who's in Charge?". It is very important that the organization present single, unified communications point and that that point should be the project office. It does not necessarily have to be the Project Manager himself, but it should be someone in authority. The customer naturally wants to deal with people as high in the organization as possible, so it is important that the Project Manager be on guard against this subsidary problem as well. Thus there may not be a better overall solution to the problem of communications bottleneck other than to be aware that it exists and must be minimized.

Another bottleneck is when authority is not delegated low enough. This can result in delays as work is stopped or not started while awaiting high level approval. A properly screened and well trained project management staff should be given sufficient authority at low enough levels to prevent these problems.

The final bottleneck is too many (and in some cases, too few) meetings. The question of meetings was discussed earlier in this pitfall section, but the implication here is more serious. Again, if work can not proceed or discovered problems ca not be corrected short of holding a meeting for all concerned, then the project will undoubtedly be delayed and costs will increase. The solution involves a combination of delegating authority to the

proper level while maintaining a project policy for the "right" number of meetings, perhaps by mixing informal, impromptu meetings with formal ones.

I. CRITICAL SUCCESS FACTORS

Given these problem and pitfall potentials in project management, what are the factors that measure and make for success? A Baumgartner et all, study of 52 successful projects [Ref. 12] revealed that "works well when fielded" was the most important measurement of success, followed by meeting technical and cost objectives. They also identified eight critical success factors for project managers. They are:

1. Establish a teamwork relationship of mutual trust between the government and contractor program management.
2. Understand the program objectives.
3. Have good visible program plans.
4. Get accurate and timely information
5. Note deviations between planned and actual resource expenditures.
6. Take corrective actions.
7. Make friends for the program.
8. Establish total program definition at the start of the program. [Ref. 12:p. 36]

Several of these success factors will be enhanced by the computerized project management ideas expressed in this thesis. It is well recognized that project execution difficulty is inversely proportional to the

level of planning. That is, the more planning, the less difficult the project should be to execute. Computerized project management allows the manager to model many different potential outcomes by merely changing a few inputs. It appears therefore that success factors 2,3,4 and 5 would all be aided by using MacProject.

VI. A MACPROJECT CHANGE OF COMMAND CASE STUDY

A. BACKGROUND

Change of command ceremonies are held at every military unit that has a Commanding Officer. The ceremony is steeped in tradition and is a formal affair that reaffirms to all assigned personnel, the responsibility and privilege of command. Since the ceremony involves all unit personnel, any reduction in wasted time or effort should make a marked improvement in productivity. Depending on the size of the command, advance planning may vary from one to about six months. As will be detailed later, the ceremony involves a myraid of details and lends itself well to the project management environment. The project officer has a definite completion (ceremony) date, limited resources, and a specified goal or product to produce. Since change of command ceremonies take place at all the different services, the expected audience of this thesis should be familiar with the ceremony and be able to identify with the example presented.

Therefore, the Eleventh Coast Guard District Commander change of command ceremony at Long Beach, California will be detailed. The District Commander is a one or two star officer and is the third highest level in the Coast Guard chain of command coming as it does after the Commandant and Area Commanders. There are 12 District Commanders throughout the Coast Guard. The average district consists of about 2-3,000 people assigned to various rescue stations, vessels, air stations and support staffs. These people and resources are responsible for carrying out the major Coast Guard

missions, including search and rescue, aids to navigation, pollution control, merchant marine safety, law enforcement and drug patrols.

Access was available to the Eleventh District's change of command records for their last two ceremonies. It was also possible to interview the project officer for the 31 May 1985 ceremony. He indicated that he did not use any formal project management techniques. Unfortunately, this non-emphasis on using project management techniques was not limited to this example. In the course of doing research, it was discovered that most Coast Guard offices that were contacted were not familiar with any formal techniques. Thus while one might consider "Computerized Project Management" to be a rather mundane thesis topic, the fact that most actual Coast Guard workers are not taking advantage of the available technology, confirmed the need for this research.

The starting point for this automated comparision will be the list of "things to do" as compiled by the original Eleventh District project officer.

B. MANUAL "TO DO" LIST

Draft Operation Order	Foul Weather Plans
Parking Plan	Video Tape of Ceremony
Get Drivers and Vehicles	Rehearsal
Saluting Gun Battery	Arrival Honors
Garden Reception	Departure Honors
Establish Uniform requirements	Overnight Accomodations for guests
Secure Chaplain	Get Honor Battalion
Print Programs	Designate Overall Coordinator

Establish locations

PA System

Platform and Bunting

Podium

Master of Cermony

Radio Communications

Aircraft flyover

Band

Seating Plan

Chairs

Security/Traffic control

Ushers

Flag Hoist/Breakout

Rest Rooms

Full Dress Ships

Script

Press/TV/Media

Officer Reception

First Aid

Assign extra Aides

Decide on Menu

Pre Ceremony Dinner

List of accomplishments

Order Liquor for Receptions

Color Guard

Portable Flag Poles

Guest list and invitations

Aiguillettes

Photographers

Corsages

Bugler

Escorts

District Commander Approval

Guest House preparations

Budget and Funding

Diplomatic Corps

Other Flag/General Officers

General Bunting

Enlisted Reception

Change of Command Committee

Letter of Thanks

Gift for Outgoing District Commander

Set Date and Time

Decide on Cake design

Additional Plants

Write Arrival Remarks

Medal for outgoing Distri Commander

Cover Sprinkler heads

The above list of things to do was next run through a program called "Thinktank" by Living Videotext. By using "headlines" and "indented heads," Thinktank allows the user to collapse or extend written thoughts through various levels of view and importance. Thinktank has been billed as both an outline generator and idea processor. It is probably somewhere in between. It was used to brainstorm ideas for this thesis and later to create outlines for the final version. Its brainstorming capability comes from the ability to type down ideas as they occurr without worrying about order or level of detail. By using indented headlines, detail is added. The Macintosh mouse is used to "grab" and move a headline (and its subordinate details) to virtually any other place in the document. That feature is most useful. Thus in this Change of Command example, Thinktank was used to rearrange and add some tasks from the original list. The results are as follows:

C. COMPUTERIZED "TO DO" LIST

TO DO FOR CHANGE OF COMMAND
- Draft Operation Order
- Set Date and Time
- Estab uniform requirements
- Designate Overall Coordinator
- Establish locations
- Master of Ceremony
- Foul Wx plans
- Seating Plan
- Full Dress Ships?
- Aircraft flyover?
- District Commander Approval
- Budget and Funding
- Project Officer
- Script
- List of accomplishments
- Medal for outgoing Distri Commander

- Change of Command Committee
- Gift for Outgoing District Commander
- Saluting Gun Battery
- Rehearsal
- Get Honor Battalion
- Secure chaplain
- Parking plan
- Color Guard

Base Responsibilities
- Flag Hoist/Breakout
- Radio Communications
- Chairs
- Pa System
- Cover Sprinkler heads
- General Bunting
- Rest Rooms
- First Aid
- Podium
- Portable Flag Poles
- Platform and Bunting

Guest list and Invitations
- Honored Guests
  - Other Flag/General Officers
  - Guest House preparations
  - Overnight Accomodations for guests
  - Diplomatic Corps

Public Affairs to do the following:
- Print programs
- Photographers
- Press/TV/Media
- Band
  - Bugler
- Additional Plants
- Video Tape of Ceremony

Personnel Assignments
- Assign extra Aides
- Escorts
- Ushers
- Security/Traffic control

Receptions

Decide on Menu
Decide on Cake design
Order Liquor for Receptions
Officer Reception
Enlisted Reception
Garden Reception
Aide Responsibilites
Arrival Honors
Corsages
Aiguillettes
Write Arrival Remarks
Departure Honors
Letter of Thanks
Drivers and Vehicles
Pre Ceremony Dinner

D. DRAWING THE NETWORK

After printing out the new list of things to do, it's time to take a step backwards and leave the automated world for a while. While the Macintosh is more than capable of allowing the user to develop his network directly on the machine, in fact the program documentation encourages this, it was discovered during research, that such an approach is usually not the best. The tiny nine inch video screen simply does not reveal enough of the big picture to allow efficient placement of the various task boxes. The user spends too much time scrolling around the screen looking at all the activity nodes that need connecting.

A far better technique is to get a large sheet of paper, (some continuous computer paper, or even brown butcher paper), a pad of 3M "Post-it" notes, scotch tape, pencils and a large work table. The user then takes the list of things to do and transfers each activity to a Post-it note which is in turn placed on the paper in a position relative to where it should be in the

network diagram. Some people may prefer to cut up a duplicate copy of the computer generated things to do list and tape or paste them directly to the large paper. The Post-it notes appear to be more convienent. Their thin adhesive strip make them easy to move without tearing and one may use their different sizes and colors for coding purposes.

After placing the Post-it notes, task dependencies are connected by pencil. A light hand is required to allow easy modifications. Of course activities to the left must be completed prior to the ones on the right and this dependency must be considered in the initial design.

After examining the hand-written chart for logical consistency and work flow, the user may now go back and make notes about the following items for each activity:

1. Who is responsible.
2. What resources are required.
3. How much will it cost.
4. How much income will be generated.
5. How long will it take.
6. Any special date restrictions, such as work ca not start before a certain date, or it must be finished by the 15th, etc.

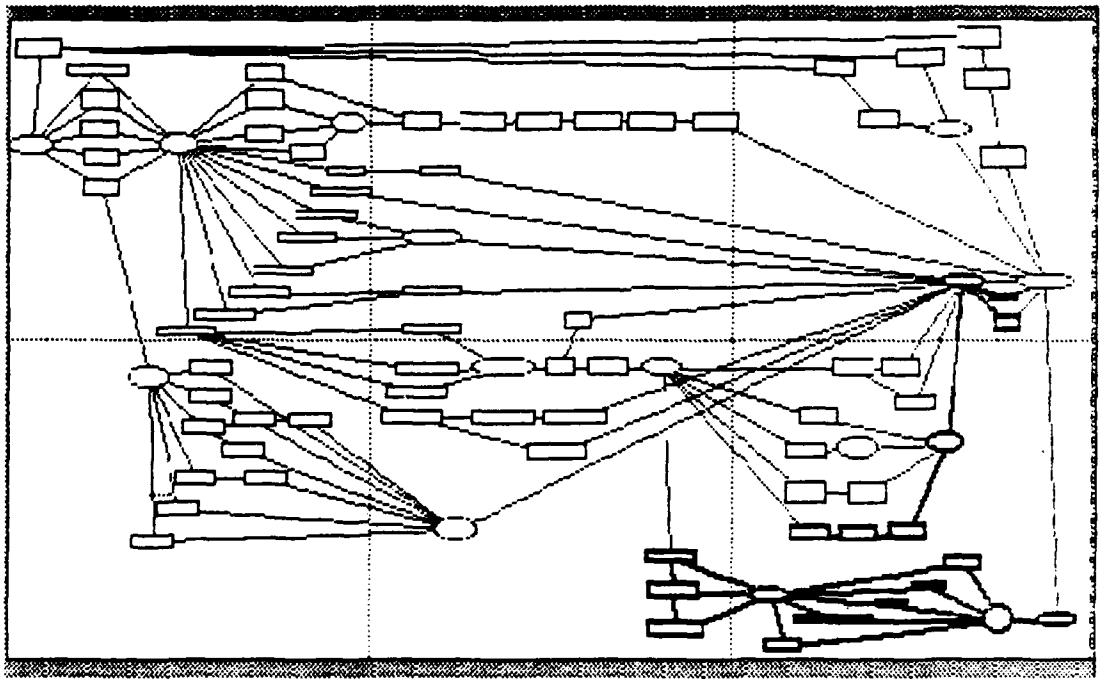
All of this information should be listed directly on the activity slip or Post-it note so that if the activity is latter moved, all of the supporting notations will move with it.

Once the manager is satisfied with his rough draft, he may now begin entering it into the MacProject program. The manager then adds his date restrictions and known costs and income. While MacProject may not be

suited for a highly complex project, it is flexible and powerful enough for the majority of projects that the average Coast Guard officer will encounter in his career. The Change of Command is a good example and is fairly typical of the type of assignment an officer might expect. It involves several hundred people spread over several commands and outside organizations; it will take 60-180 days to execute; it has a modest budget and it's a high visibility event. Even so, it entails less than 100 activities and about 15 resources, well within MacProject's limitations of 2,000 activities and 50 resources.

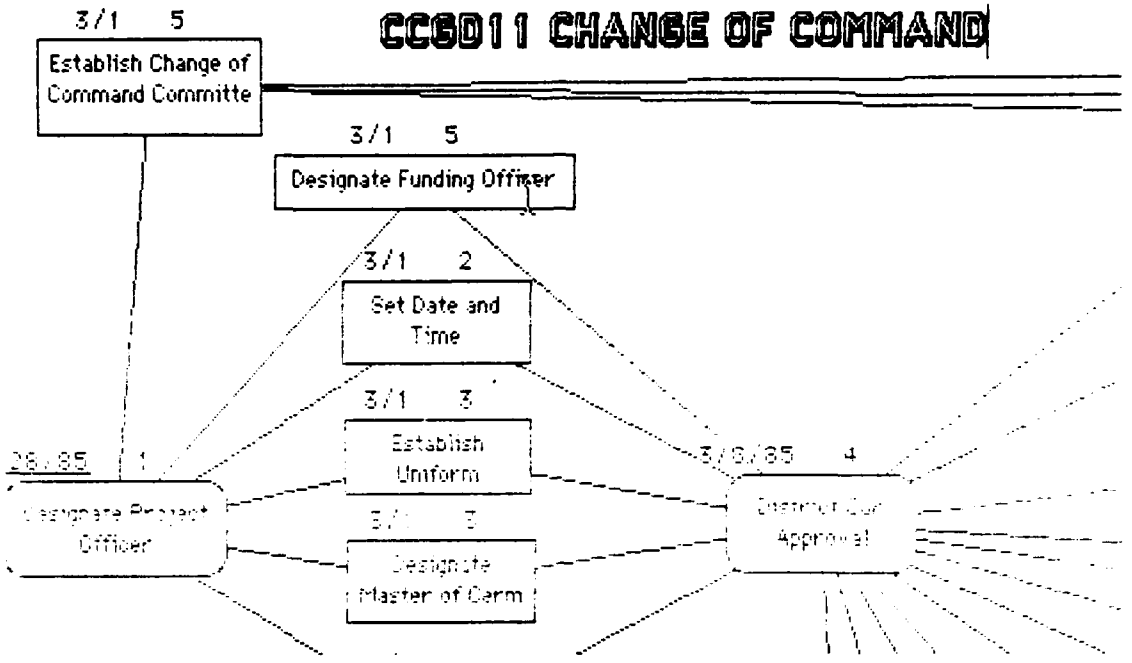
It took about eight hours to design, make the paper draft and then enter the details into MacProject. As will be discussed later, this represents the bulk of the effort, since once the data is entered, it is simple, almost trivial to make date or resource changes. The computer will automatically generate schedule and task charts, so the only time required is spent waiting for the new printouts. Spending eight hours, or one solid work day planning for something as important as a Change of Command seems reasonable and actually represents a considerable time savings compared to how the Eleventh district actually did it. The Project officer there indicated he worked for about half-a-day for one or two weeks on his initial planning. Additional time was used by his secretary to type up notes, rough drafts, memos and revisions. MacProject eliminates this extra effort by producing the final network and supporting schedules directly from the inputted planning data. In this manner, productivity is greatly improved and the project becomes almost self-documenting.

Transferring the rough draft into MacProject required six pages of 8.5" by 11" paper for a full-sized drawing. A miniature rendition of the entire network is shown below in Figure 6-1. The dotted lines in the miniature signify the demarcation for each page in the full size drawings.



Miniature of the Entire Network for the Change of Command Ceremony
Figure 6-1

Figure 6-2 shown below is a sample rendition of what the full size drawing segments would look like. It represents a small portion of the normal 8.5 by 11 inch paper panel.



Sample Rendition Of A Full-Sized Drawing Panel
Figure 6-2

E. NETWORK ACTIVITY CHART

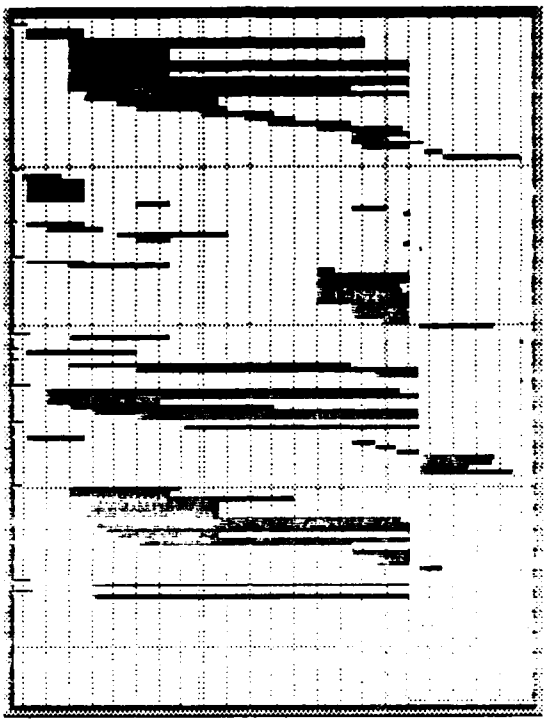
As was discussed in Chapter IV, the ultimate method for creating the network would be to get all the major players into one room at the same time. Then using a video projector connected to the Macintosh running MacProject, each person could provide their input and immediately see the results on screen, thereby "buying-in" to the project as the network is being created. Such a method allows instantaneous exchange of ideas, immediate resolution of conflict and a graphic demonstration of the interplay between resources and tasks.

If a video projector is not available, the involved managers may be able to huddle around the Macintosh screen, but its small size precludes more than about five or six observers at once. A third alternative would be to print

out the network. The project manager would then route draft copies to the major players who had initial involvement. This shows them how their effort will interact with the overall program and gives them one last chance to provide planning input before embarking on the project. Such consideration should prove helpful in avoiding some of the conflict discussed in the "Problems and Pitfalls" section of this thesis.

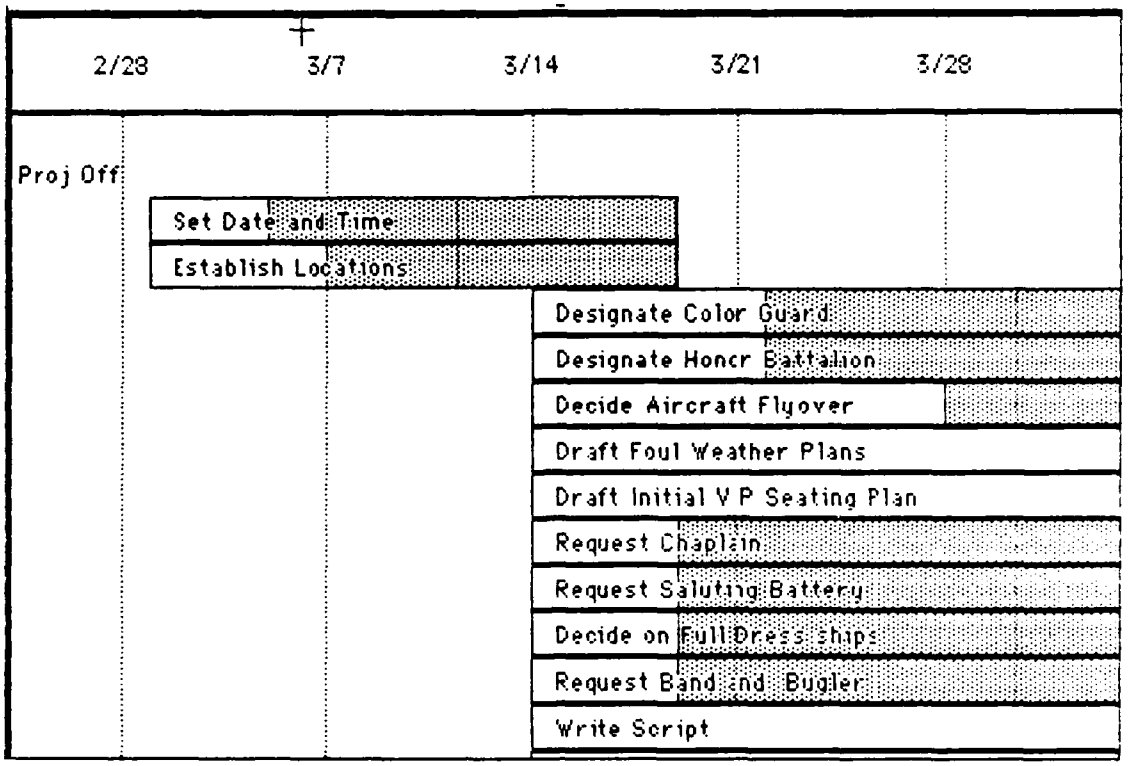
F. RESOURCE CHART

In addition to distributing the complete network, the Project Manager should also provide the Resource Chart by individual resource (Gantt charts), that is generated automatically by MacProject as shown on the following pages. This chart lists all tasks for each resource. Unfortunately, MacProject does not allow any sorting so the resources appear in order of their entry into the network task boxes. The project manager would probably want to take a duplicate set and cut the chart up by resource, thereby providing only the necessary information to each resource. A miniature of the complete resource chart is shown in Figure 6-3 below.



Miniature Resource Timeline Chart
Figure 6-3

A sample of the full-sized section of the Resource Timeline Chart showing some of the entries for the Project Officer is shown below in Figure 6-4.



Sample Resource Timeline Panel
Figure 6-4

G. TASK, RESOURCE COST AND PROJECT CHARTS

The Project Officer has access to four additional charts provided by MacProject. They are the Task Cost, Resource Cost, Task chart and Project Chart. These reports may or may not be useful to the Functional managers so it would be up to the Project officer to decide if any of them need to be further distributed. Samples for the Change of Command Ceremony follow:

TABLE 6-1
TASK COST CHART

	Task Name	Fixed Cost	Fixed Income
1	Designate Project Officer	0	0
2	Establish Change of Command Committe	0	0
3	Designate Funding Officer	0	0

4	Set Date and Time	0	0
5	Establish Uniform	0	0
6	Designate Master of Cerm	0	0
7	Establish Locations	0	0
8	Commence Base Preparations	0	0
9	Establish First Aid Stations	0	0
10	Install Portable Toilets	50	0
11	District Cdr Approval	0	0
12	Commence Guest List	0	0
13	Landscape and Paint as Nec'y	100	0
14	Install Platform	100	0
15	Install Portable Flag Poles	0	0
16	Draft Radio Comms Plan	0	0
17	Designate Color Guard	0	0
18	Install Bunting	0	0
19	Install Podium	25	0
20	Designate Honor Battalion	0	0
21	Decide Aircraft Flyover	0	0
22	Draft Foul Weather Plans	0	0
23	Draft Initial VIP Seating Plan	0	0
24	Cover Sprinkler Heads	0	0
25	Request Chaplain	0	0
26	Request Saluting Battery	0	0
27	Decide on Full Dress ships	0	0
28	Install PA System	0	0
29	Request Band and Bugler	0	0
30	Write Script	0	0
31	Write Program	0	0
32	D/Dcs Approval	0	0
33	Confirm Comandant as Guest Speaker	0	0
34	Compile Flag/Vip list	0	0
35	Draft Initial Operation Plan	0	0
36	Compile Diplomatic Corps	0	0
37	Confirm all	0	0
38	Practice and Drill	0	0
39	Designate Honored Guests	0	0
40	Print Programs	75	0
41	Finish Base Preparations	0	0
42	Print and Distribute Oporder	0	0
43	Inform AirForce VIP Arrival Section	0	0

44	Compile Complete list	0	0
45	Get Feedback	0	0
46	Write Change Of Command Remarks	0	0
47	D Approval	0	0
48	Confirm Arrival/Departure Honors	0	0
49	Write Thank-yous	0	0
50	Revise Oporder	0	0
51	Design, Print + Mail Invitations	50	0
52	Distribute Final Version	0	0
53	Receive RSVP's	0	0
54	Decide on VIP Reception and Menu	250	0
55	Decide on Officer Reception and Menu	100	0
56	Decide on Enlisted Reception and Menu	150	0
57	Advise Media and Press of Event	0	0
58	D Approval	0	0
59	Prepare Garden For VIP Recpt	50	0
60	Draft Seating Plan	100	0
61	Determine Number of Ushers + Escorts	0	0
62	Draft Parking Plan	0	0
63	Prepare Guest House	0	0
64	Collect Gift Donations	0	0
65	Order Food, Flowers + Plant	45	0
66	Designate Additional Aides	0	0
67	D/DCS Approval	0	0
68	Designate Traffic Control	0	0
69	Designate Ushers and Escorts	0	0
70	Decide + Buy Gift	0	0
71	Design Cake	40	0
72	Get Aiguillettes	0	0
73	Print+ Distribute Parking Plan	0	0
74	Get Cars and Drivers	200	0
75	Plan Retirement Dinner	0	0
76	Order Liquor	175	0
77	Finish Guest Preps	0	0
78	Hold Dinner	0	0
79	Hold Rehersal	0	0
80	Get Additonal Cooks	0	0
81	Compile list of D Accomplishments	0	0
82	Write up Award for a Medal	0	0
83	Make Final Reception Preparations	0	0

84	Commandant Approval	0	0
85	Flyover	0	0
86	Video Tape Ceremony	0	0
87	Change of Command	0	0
88	Hold Receptions	0	0

The task cost entry chart shown above provides an initial cost tracking mechanism for the project manager. If additional capability is needed, then the table may be "cut and pasted" into a spreadsheet program like Multiplan or a data base management program. There, the data may be manipulated using Multiplan's built-in sorting, mathematical and statistical functions.

The Project Manager is next able to assign cost data for each resource. Again, the options are somewhat limited. The manager may assign a cost factor to each resource. It is important to note that the program uses the same time factor as *initially set* into MacProject's project duration scale. Thus if the duration is set for one week, the resource cost entry will be tracked on a weekly basis. If the manager later changes the duration scale to daily, MacProject will automatically divide the cost entries by seven. Finally, the manager indicates if the accrual or accounting method should be single or multiple. If single, each occurence of the resource will be charged the full rate. If multiple, then the cost is split among all the occurences of that resource.

TABLE 6-2
RESOURCE COST ENTRY TABLE FOR THE CHANGE OF COMMAND CEREMONY

	Resource Name	Cost/Day	Accrual Method
1	Proj Off	0.00	Multiple

2	Dcs	0.00	Multiple
3	D	0.00	Multiple
4	Base	0.00	Multiple
5	Air Station	0.00	Multiple
6	Dpi	0.00	Multiple
7	Dpa	0.00	Multiple
8	Committee	0.00	Multiple
9	Comdt	0.00	Multiple
10	F	0.00	Multiple
11	Aide	0.00	Multiple
12	Honor Batt	0.00	Multiple
13	Color Guard	0.00	Multiple

The cash flow table shown below in Table 6-3 is generated automatically by MacProject. It shows the incremental and cumulative costs for the project. Once again, the timeframe for the incremental listing is determined by setting the project duration scale. In the example below the scale is set for monthly. Like the task cost chart above in Table 6-1, the cash flow table may also be cut and pasted to a spreadsheet or data base program for further analysis This table shows that the total costs for the ceremony will be $1,510. It also shows at which points in time the money will be needed. This could be very helpful in determining an operating budget.

TABLE 6-3
CASH FLOW TABLE

Starting	Costs	Income	Ending	Cumulative
1/2/85	250.00	0.00	1/30/85	-250.00
1/30/85	0.00	0.00	2/27/85	-250.00
2/27/85	0.00	0.00	3/27/85	-250.00
3/27/85	125.00	0.00	4/24/85	-375.00
4/24/85	0.00	0.00	5/22/85	-375.00
5/22/85	1135.00	0.00	6/19/85	-1510.00
6/19/85	0.00	0.00	7/17/85	-1510.00

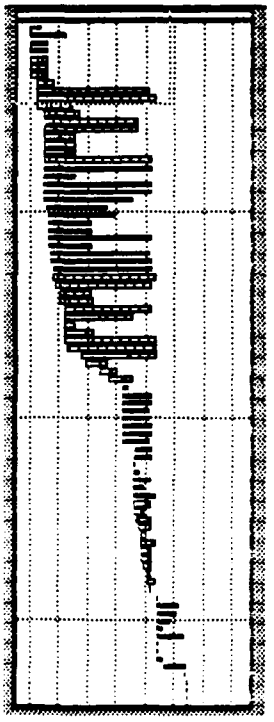
7/17/85 0.00 0.00 8/14/85 -1510.00

The task project table as depicted in the sample shown in Figure 6-5 shows the big picture. Like a telephone bill that lists dates, time, number called, rates, etc; the project table is a consolidated listing of virtually everything that MacProject "knows" about the project. Perhaps the biggest advantage of this report, especially for large projects, is when the information is cut and pasted to a data base program. There the information may be sorted and analyzed to the manager's content. Unfortunately, it takes a considerable amount of time and memory to perform such an operation. The manager may resist doing this for each and every schedule change thereby losing this analysis opportunity.

	Task Name	Days	Earliest Start	Earliest Finish	Latest Start
1	Designate Project Officer	1	2/28/85	3/1/85	3/11/85
2	Establish Change of Command	5	3/1/85	3/8/85	3/29/85
3	Designate Funding Officer	5	3/1/85	3/8/85	3/12/85
4	Set Date and Time	2	3/1/85	3/5/85	3/15/85
5	Establish Uniform	3	3/1/85	3/6/85	3/14/85
6	Designate Master of Cerm	3	3/1/85	3/6/85	3/14/85
7	Establish Locations	4	3/1/85	3/7/85	3/13/85
8	Commence Base Preparations	0	5/30/85	5/30/85	6/5/85
9	Establish First Aid Stations	3	5/30/85	6/4/85	6/25/85
10	Install Portable Toilets	5	5/30/85	6/6/85	6/21/85
11	District Cdr Approval	4	3/8/85	3/14/85	3/19/85
12	Commence Guest List	3	3/14/85	3/19/85	4/15/85
13	Landscape and Paint as Nec'y	14	5/30/85	6/19/85	6/5/85
14	Install Platform	7	5/30/85	6/10/85	6/17/85
15	Install Portable Flag Poles	4	5/30/85	6/5/85	6/24/85

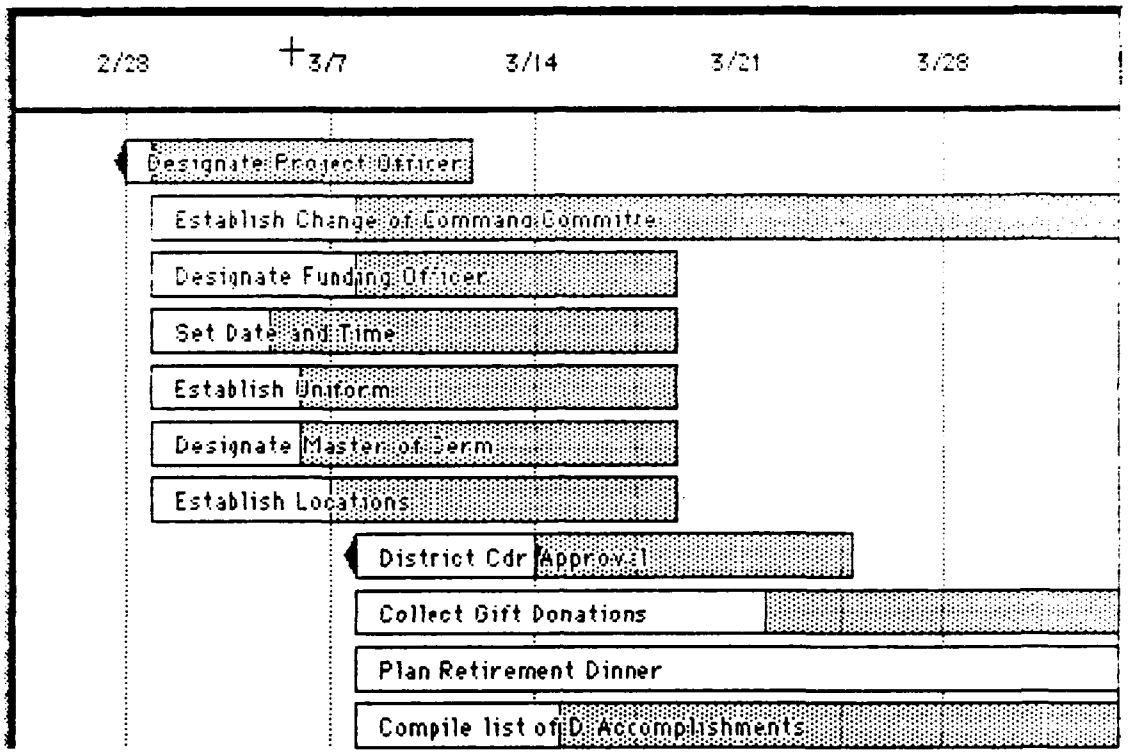
Sample Full-Size Project Table Listing
Figure 6-5

Similar to the Resource Timeline Chart, the Task Chart lists all of the tasks in a Gannt chart format. Individual responsible resources are not shown. This chart is most useful as a graphical overview of the entire project. The duration scale may be set for a variety of intervals. A miniature example is shown in Figure 6-6.



Task Timeline Miniature
Figure 6-6

Figure 6-7 shows a partial full-size sample of the total Task Timeline Chart. It is most useful for seeing the complete project in Gantt Chart format without all the extra detail shown in the Resource Task Timeline.



Sample Full-Size Task Timeline Partial Panel
Figure 6-7

H. SCHEDULE CHANGES OR HOW TO PLAY "WHAT IF"

We now come to the most powerful feature and most critical reason for using MacProject to computerize projects. That feature is "What-if", an insidious little creature that breaks the back of manually maintained project management. What-if takes many forms such as, "What if it takes ten days instead of seven to install the platform? What will happen to our schedules." Or, "What if we change the RSVP due date from 10 June to 15 June? Will we have enough time to order food and design our seating plan?" There are as many permutations of the "What-if" game as there are activities and as we know from Statistics, such a number can get very

large, very quickly. Fortunately, with MacProject we need simply change the cost or date of the activity in question, hit the return key and watch the changes ripple across the screen. New critical paths may develop as signified by a heavy dark line that means the path in question will not be completed on time given the other currently set restrictions. Something will have to be skipped, expedited, contracted-out or started earlier.

Skipping might affect a latter activity, depending on the dependencies, and it could result in a cost as well as time saving. In project management, however, "skipping" is a contradiction in terms, since if the activity was important enough to be on the network in the first place, it should be a difficult one to skip without creating some sort of impact. The other three alternatives all involve additional money which may not be available in the budget. Thus it is time for the Project Manager to earn his salary, by playing "What-if", until he finds the best solution to his problem. Since MacProject automatically generates a neat new solution to each change of input, the tedious administrative details inherent in a manual system are done away with. *This feature alone improves manager productivity almost 100%* and challenges the folk saying that, "you can't get something for nothing". Surely, we have the costs for machine, software and operator, but we do get the revised schedules without having to draw or even think about them ourselves. As an aside, managers must be careful that they do not overdo the "What-if" game thereby finding themselves trying to model every possibility to the point of not getting anything done. MacProject is a tool to be used as an adjunct to management, not a replacement for it.

Along these lines it's important that the Project Officer use the same time increment for monitoring as he does for the task breakdown. In other words, if task completion is measured in days, monitoring should be daily; if measured in months, he should monitor monthly. Monitoring may take several forms. It could be required written reports, scheduled progress meetings, walking around or telephone updates. Regardless of the form used, it is critical that the Project Manager (or his staff), keep the MacProject information up-to-date. Normal backup proceedures must also be in force to prevent catastrophe from loss of data. Finally, the Project Manager should always maintain a copy of his original planned network to compare with the actual results of the project. In this manner, he may improve his estimating skills, while keeping sufficient documentation for audit purposes.

I. ADDITIONAL USES FOR THE MACINTOSH SYSTEM

In addition to using the Macintosh for planning and monitoring the Change of Command ceremony, the system could be used for several other chores. First, the free word processing program, MacWrite, which comes with the machine could be used to draft all the the notes, memos, thank you letters and any other correspondence regarding the ceremony.

Second, the other free program, MacPaint, could be used to design the cake decorations, seating plan, parking plan, platform party layout and even the invitations. In some instances, the $150 MacDraw program would be preferable to MacPaint. If the invitations are designed on the Macintosh and the super high quality Laserwriter printer is also available, then there should be some additional cost and time savings over sending same out to a

print shop. Of course, once such an invitation is designed, it can be used for the next ceremony since the only changes should be to the names of the participants and date. Thus productivity gains will multiply as the foundatation of reusable plans, graphics and ideas are built.

J. TOWARD AN "EXPERT-BASED" SYSTEM

There is an interesting concept that developed as the research for this thesis concluded. For example, when it comes to major equipment maintenance, the "corporate" Coast Guard has been doing basically the same thing for years. In other words, it knows what's required to overhaul a certain class of vessel, or rebuild an aircraft or rennovate a Communications center, etc. Unfortunately, there is no central repository for this information other than in senior people's head or scattered in various documents. What's needed is to develop an electronic "Standard Project File" which would be similiar in concept to the "Flat Rate Manual" automobile shops use when repairing a car. That book lists all parts and the standard time necessary to do a variety of jobs and the shop charges its customers based on those standard time estimates regardless of how long or short the job actually was.

For the Coast Guard it could be a rather straight-forward, although nontrival task to develop a similiar system for its major projects. For example, there could be a listing of subphases by vessel class for each item that might be repaired during an overhaul. Thus there would be a standard subphase listing in MacProject format for a diesel overhaul, turbine engine center section overhaul, small boat overhaul, gun re-barrelling, radar maintenance, etc. These subphases could be listed in a database, tied

together with a rule-based, expert system (i.e. if your small boat engine is more than 15 years old, replace it, do not overhaul) to form a master system that would take the subphase projects and put them all together into one big project for whatever job one was trying to accomplish. In essence, the program or user would be selecting and integrating individual project subphases just as a secretary might select standard "boilerplate" paragraphs to form a letter. The concept is intriguing and could offer some sizeable long term productivity gains to meet the Coast Guard three percent productivity improvement goal that was discussed in the introduction.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. DOES MACPROJECT IMPROVE PRODUCTIVITY?

Based strictly on the results of the experiment described in Chapter six, it appears that the null hypothesis, which says that using MacProject does increase productivity, has been upheld. The ceremony was planned in about 8 hours when using MacProject, while it required more than 20 to do manually. This represents a 150% improvement in planning time productivity. Furthermore, if dates were later changed or a resource became unavailable, an entire new set of revised schedules could be created using a few keystrokes in MacProject, whereas they would have be redrawn by hand in the manual method. Similarly, when the additional MacProject Gantt charts were discussed with the original Eleventh District Project Officer, he agreed that such aids would have been useful. While there is obviously no statistical significance based on only one experiment, it nevertheless has important practical implications. It means that for about $2,000 a military manager can be provided with a tool that will assist him to be more productive. The Coast Guard currently spends $3,000 to buy a graphics interface board to allow monochrome graphics on its $5,500 Standard Terminal. For the cost of one such graphic terminal, it could buy four Macintoshes™.

B. OTHER CONCLUSIONS

This thesis has examined numerous issues of practical concern to the military manager. It has looked at the issue of productivity and listed signs to look for and ways to improve it. It discussed project management in

general and showed one specific way to implement it using MacProject. It took an extended look at the critical roles of the Project and Functional managers, described how those individuals should be selected and pointed out some important problems and pitfalls to avoid.

This thesis demonstrated that a relatively inexpensive yet powerful project management system may be implemented using MacProject. The easy to use Macintosh is especially suited for those who have minimal typing skills and do not want to invest the training time required for some other competitive systems.

Regarding the Coast Guard, it discovered that few managers are using any form of project management techniques, thus making the following recommendations even more important.

C. RECOMMENDATIONS FOR THE COAST GUARD

1. Place a greater emphasis on using computerized project management techniques.

2. Be aware of the problems inherent in selecting Project and Functional managers for a program and make such assignments accordingly.

3. Exploit its corporate experience by creating a set of "standard" project sub-phases that may be cut and pasted into a project network like paragraphs in a word processing document. Such a system would be similar to the "flat rate manual" used in automobile repair shops that list resource and time requirements to effect virtually any repair.

4. Work to implement the steps and factors to promote productivity as listed in section F, G and H of Chapter 2 of this thesis.

5. Allow suitably equiped Macintosh systems to be purchased by any comm.and that has a need for an easy to use project management system.

6. Acquire project management software for it's Standard Terminal system recognizing that such programs will probably lack the graphics capability and ease of use/training inherent in the MacProject solution.

D. SUMMARY OF FINDINGS

1. MacProject is relatively easy to use.

2. MacProject provides an easy to learn framework for project management at all levels.

3. MacProject saves managerial time. There was a 150% improvement in planning time productivity in the example cited in the Thesis.

4. MacProject requires a minimum of typing, thus making it a product of choice for people with low typing ability.

5. The program allows "what-if" modeling for schedule, resource or cost changes.

6. Useful, additional tracking schedules are generated automatically from initial input.

7. The Coast Guard does not appear currently to be taking full advantage of available project management software.

8. "Standardized" MacProject templates may be created for repetitive projects such as a vessel overhaul. This avoids re-inventing the wheel and would improve productivity.

9. Conflict between Functional and Project managers may be controlled using simple techniques.

10. The effective Manager must monitor the project using the same timeframe as used in the duration scale (e.g. a week scale requires weekly monitoring).

11. The Laserwriter™ printer allows "print shop" quality output, thereby avoiding the time and expense of sending out invitations to be printed. This further improves productivity.

12. MacProject has some severe limitations for monitoring complex projects. Primary among them are: no resource leveling, no minimum cost expediting, no ability to track multiple projects simultaneously, no task or slack time suppression, no sorting ability, only six resources per task, and no multiple calendars.

13. Gathering all affected managers in one room around a video projector equiped Macintosh, allows them to provide immediate input and lets them "buy-into" the project.

14. Using an "idea generating" program, like ThinkTank™, improves the input to MacProject, thus improving overall productivity.

15. Additional productivity software, such as word processor, spreadsheet or data base programs may be coupled with MacProject to work around virtually all of the discovered limitations. In the worst case, the user may write his own utility program(s). This alternative limits MacProject's™ ease of use feature.

16. Upper management has the biggest impact on determining overall productivity. They should be the focus of any improvement efforts.

17. Additional research is required to determine a statistically significant value for any potential productivity changes when using MacProject.

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