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# DEFENSE SYSTEMS MANAGEMENT SCHOOL

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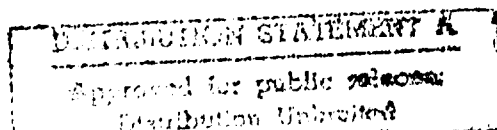
## PROGRAM MANAGEMENT COURSE INDIVIDUAL STUDY PROGRAM

APPLICATION OF THE CRITICAL PATH  
METHOD NETWORK TECHNIQUE TO THE  
INTEGRATED LOGISTICS SUPPORT PLAN  
OF THE AIM-9L PROGRAM

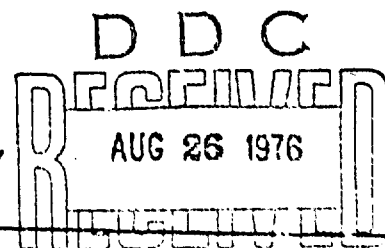
STUDY PROJECT REPORT  
PMC 76-1

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Study Project Report,  
Individual Study Program

Defense Systems Management School  
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## EXECUTIVE SUMMARY

△ The purpose of this report is to show how the logistics managers of the AIM-9L program initiated and used a Critical Path Method network to monitor and control the scheduling aspects of their program. The report begins by showing the environment in which the logistics managers were operating and the rationale for the employment of a networking technique. The selection process for the particular networking technique and computer program is shown in detail with emphasis on the selection criteria employed. The construction of the network through the use of a Precedence Diagram is then delineated. The use of the network is shown through the analysis of the output reports. This is intended to provide an example of how a network was successfully initiated and used in the AIM-9L logistics program. △

### ACKNOWLEDGEMENTS

I wish to express my appreciation to Lieutenant Commander Susan M. Anderson, USN, for her assistance and encouragement in the planning and preparation of this report. I would also like to acknowledge the assistance of Mr. Michael F. McGrath of the Naval Air Systems Command who first introduced the author to the subject.

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## SECTION I: INTRODUCTION

It's about time that this paper was written. That is, a technique for the planning and control of time.

It has been stated that the second major constraint (after cost) facing the DOD program manager is time. R. Alec Mackenzie in his book "The Time Trap" offers the following observation. "Of the thousands of managers I have polled from board chairmen and chief executives to first line supervisors, only one in a hundred has enough time. When the others have been asked how much time they would need to do the job they would like to do, one out of ten says he would need 10 percent more, four say 25 percent and the remaining half say 50 percent!"<sup>1</sup>

This quote brings up two important points, first, that time is generally given the least amount of attention of any resource in the planning process and secondly, that once a project has begun it is difficult to see the impact of decisions on the time available for completion of the program. Program managers are compelled to control cost, schedule and performance within the constraints established for their programs. If any one of these three elements is inadequately managed then the entire program is in jeopardy. The control of time requires that adequate plans be established, realistic schedules be developed and information systems set up which depict the

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1 "The Time Trap: Managing Your Way Out." R. Alec Mackenzie

status and future use of time.

Management tools, such as a critical path network provide a disciplined approach to the management of time. They are not a surrogate for good management but rather a methodology for scheduling and a means for the measurement of progress against time. Through networking the manager is forced to define the relationship between activities and to layout a logical flow of time.

The system that will be described in this report was used on the AIM-9L program for the planning and control of the logistics program. This report will describe how a Critical Path Monitoring Network was initiated and used in that program.

## SECTION II: BACKGROUND

The AIM-9L (SIDEWINDER) program is a joint service, major acquisition program aimed at providing the Air Force and the Navy with an improved "dogfight" missile. The program was started in 1971 as a rapid development program which would be in production in 1974. The program underwent several schedule changes and finally received a production decision in February 1976.

The AIM-9L missile is a follow-on to the existing USN and USAF versions of Sidewinder. The missile is composed of seven components. These are: Guidance and Control Section, Control Fins, Target Detector, Warhead, Safety and Arming Device, Rocket Motor and Wings. The missile is 119 inches long, 5 inches in diameter and weighs 195 pounds. The missile will be carried and launched from virtually all USN and USAF air superiority aircraft.

The management of the program has several unique features. The USN is the executive service for the weapon and the Program Management Office is located in the Naval Air Systems Command (NAVAIR), Washington, D.C. The USAF program manager is co-located with/and acts as a deputy to, the USN program manager. The development agency for the AIM-9L is the Naval Weapons Center (NWC), China Lake, California.

Figure (1) depicts the organizational relationships which exist between the typical NAVAIR project offices and the functional support organizations within NAVAIR. The organi-



# NAVY PROJECT ORGANIZATIONAL RELATIONSHIPS

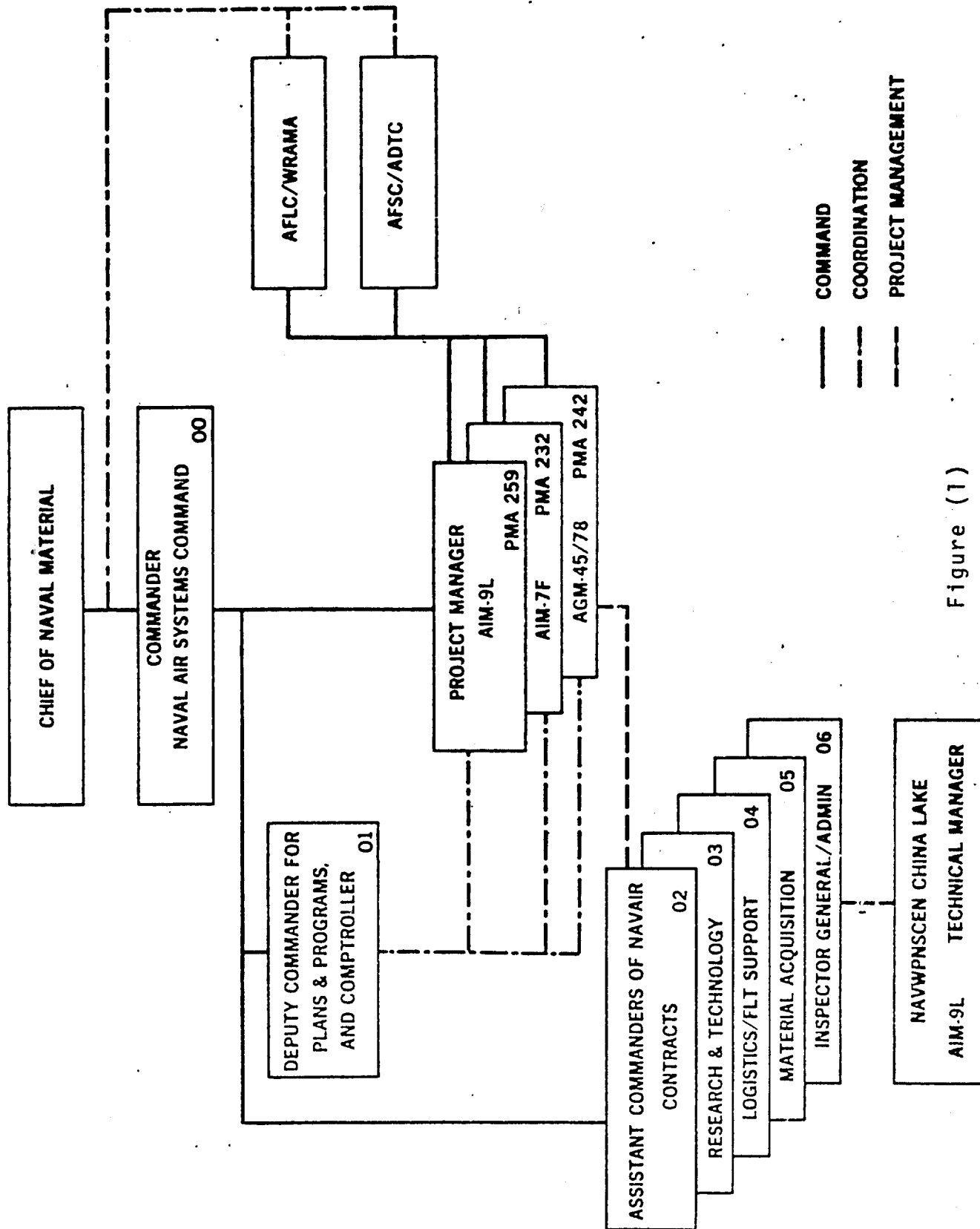


Figure (1)

zation is a lean matrix in which the project office is highly dependent upon the functional support organizations. The project offices are, consequently, very small. The AIM-9L project office consists of six USN and six USAF personnel.

The management of the Integrated Logistics Support program was the responsibility of two managers (one USAF and one USN). To control the program the logistics managers formed an Integrated Logistics Support Management Team (ILSMT) which they headed. The ILSMT was comprised of approximately sixty people from some thirty different organizations. The ILSMT met on a yearly basis and updated the Integrated Logistics Support Plan. There was heavy reliance on telephone communications and message traffic to keep the members of the ILSMT up to date on program changes and status of activities.

It became apparent at the third ILSMT conference that the ILS plan contained the general direction and scope of activities necessary to complete the program, but the scheduling information contained in the plan was completely out-dated. The members of the ILSMT were, because of the dynamics of the program at this time, working to several different revisions of the basic program schedule. In short no one really knew where they were, where they should be or what their relationship to the development program was. Consequently, each logistics element monitor briefed a schedule for his activities which he thought to be current but which was out-of-phase with the master schedules. The conference was characterized by

heated discussion, confusion and the virtual disintegration of what had, for two years, been a fairly close-knit joint service team.

A great deal of discussion ensued on how to make the ILS plan a more viable document. Suggestions ranged from publishing a revised plan quarterly to conducting bi-monthly status reviews. The idea of quarterly revisions of the ILS plan was discarded due to the lack of manpower which could be assigned to the task and the cost of the update of the rather voluminous document. (At that time complete revisions to the plan cost approximately \$15,000.)

Bi-monthly design reviews were being held by NWC, China Lake and the project manager. The level of logistics information contained in these design reviews was increased but this did little to improve the situation. Travel funds were scarce which limited participation and the level of logistics information disseminated was still inadequate for in depth discussion. Additionally, the only permanent records of the design reviews were copies of the presentations given and memoranda reflecting significant decisions reached. Since the design review was given by NWC, China Lake it did not necessarily reflect the opinions and most recent decisions of the logistics managers.

The problem that the logistics managers faced then was how the two of them could disseminate current information in a meaningful format which would show the assignment of responsibilities and the time frame for accomplishment of the tasks.

The information had to reflect that which was shown in the ILS plan. The logistics managers were not looking for another ILS plan but were looking for a way to depict the time sequencing, task assignments and the relationship of events and activities in the present plan. Once this was assembled this new device had to be updated on at least a monthly basis.

So it was decided that a control manual which would be devoted solely to establishing and updating baseline schedules would be developed. A computerized network of some kind was desired but resources were limited. Any system which was adopted at this point would have to be inexpensive and require a minimum of time from the logistics managers.

### SECTION III: SELECTION OF THE NETWORK

It's probably not obvious why, at this point, the logistics managers elected to use a network as the framework for their control manual, certainly, there were less complex methods of achieving their goal. They could have, for example, simply published and maintained a series of milestone charts. The reasons for their choice were:

1. Because of the limited amount of time they could spend monitoring and updating the control manual they needed a system which would be nearly an exception type report. These reports, or updates, however, had to be consistent within the framework of the ILS plan.
2. The network would provide a method of quickly determining the impact of program changes upon the logistics program.
3. They needed a system which would accurately depict the relationship of events and activities in the ILS plan.
4. A network would provide them with a method of analyzing the total time involved in the logistics program.
5. Through a network they would be able to determine the phasing of logistics events to the overall program. That is, which tasks could start, stop or be delayed without impacting the program goals.
6. This method would provide a means of determining if the scarce resources available to them had been properly

allocated.<sup>2</sup> Having made the decision to use a network the logistics managers turned their attention to the selection of the technique which they would employ. There were several computerized, network based monitoring and tracking programs available to them. Essentially their choice boiled down to a decision of whether to use a PERT (Program Evaluation and Review Technique) or a CPM (Critical Path Method) network.

The PERT network which was being considered was the MARK 3 system in use at NWC, China Lake. The network itself is constructed and depicts relationships by using the typical node and arrow structure. The nodes represented an event or completion of an activity and the connecting arrows represented the activity to be completed.

Three time estimates are required, as in all PERT programs. These are an optimistic, most likely and a pessimistic estimate for each activity. Through these estimates a basis for determining uncertainties is derived and a probability of occurrence for a given event is also derived. The expected value (or mean) for the time duration is found by the use of the formula:

$$t_e = \frac{a + 4M + b}{6}$$

6

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2 There are several more generalized reasons for the employment and criteria for selection of a network. Two references which address this subject are: Barnetson, Paul, Critical Path Planning, Present and Future Techniques, Brandon/Systems Press, Inc. Princeton N.Y. 1970 and Klaver, R.P., Selecting a Project Management Technique, Defense Management Journal, Vol. 12, No. 2, April 1976.

where:

te = expected time duration  
a = optimistic estimate  
m = most likely estimate  
b = pessimistic estimate

Once the expected value is found it is portrayed on the network. A forward pass and a backward pass are then made through the network to determine the slack (or float) time contained in the network.<sup>3</sup>

The basic outputs of this program were relatively complex milestone charts and graphs which depicted actual work accomplished against the expected level of accomplishment.

The CPM system which was also being considered was developed and operated by NAVAIR, ILS SERVICE CENTER, CODE: AIR-4105B. The network technique employed here differs in construction from that previously discussed in that a precedence diagram format is used.<sup>4</sup>

The most significant difference from the PERT system in the employment of this technique is the method of time estimation. Here only one time estimate is used. That is the

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3 The forward and backward and definition of float will be explained in greater detail in later sections of this report.

4 Precedence diagramming will be explained in greater detail in later sections of this report.

duration of the activity which the manager, through his judgement, determines to be most appropriate for that activity. Since the time estimate is deterministically derived no further mathematical manipulation of the estimate is required. A backward and forward pass is then performed through the network and the total float is determined along with the identification of the most critical paths in the network.

The outputs of the CPM system are milestone charts and a unique status report which compares baseline estimate with the actual work performed to date. It should be noted that, as will be shown later, this status report makes its comparisons on a line item basis rather than in an aggregated graphic. Additionally, the critical path and critical items are identified.

Both of these systems were computerized and essentially met the requirements of the logistics managers. The selection decision was based primarily on five elements. These were:

1. Accuracy: Essentially both systems were judged to be equally capable of providing reliable accurate reports on a monthly basis. Additionally, both systems were equally capable of handling the range and number of tasks which were to be programmed.

2. Updating: The CPM system was judged to be easier to update and also more adaptable to change. This was due primarily to the network construction - the precedence diagram and the method of time estimating.



3. Control: The CPM system was superior to the PERT system only because the MARK 3 system was located at NWC, China Lake and a remote terminal could not be provided within the cost allocated for the network.

4. Cost: The CPM system was less expensive while providing nearly identical services.

5. Simplicity: This was the single most important criteria. The logistics managers simply did not have much time which they could spend interpreting complex output runs or the relationship expressed in the network. Additionally, the members of the ILSMT had to be given reports which were direct and required no interpretation on their part. In this respect the CPM system was clearly superior.

Consequently, the logistics managers chose to pursue the CPM system. The task at hand now was to construct, with the able assistance of the NAVAIR, ILS SERVICE CENTER, a network for the AIM-9L program.

#### SECTION IV: THE NETWORK

The initiation of the AIM-9L logistics network began with the education of the logistics managers. They had to first understand the logic employed in the construction of the network and then the treatment of the data by the computer before they could proceed.

The heart of this, or any network, is the logic diagram. The logic diagram is the framework of the network. It is the method of construction used to connect (or show the relationship of) events and activities within the network. There are many different types of logic diagrams used in the preparation of networks. The logic diagram employed by the AIM-9L logistics managers was a precedence diagram.

The basic concept of the precedence diagram is that activities are placed entirely within the circles and dependencies between activities are then shown by lines or arrows which connect the circles (or boxes). The difference between the precedence diagram and the classic logic diagrams can be seen in figure (2). This figure illustrates how activities, represented by letters, are portrayed along the connecting arrows in the classic concept (part (a) of figure (2)). In the precedence diagram (part (b) of figure (2)) the activities are completely contained within the boxes while the arrows simply show dependence. It can be seen in either diagram that activity D cannot begin until activity B is completed. Activity C, however, is dependent upon both activity A and B. In part (a)

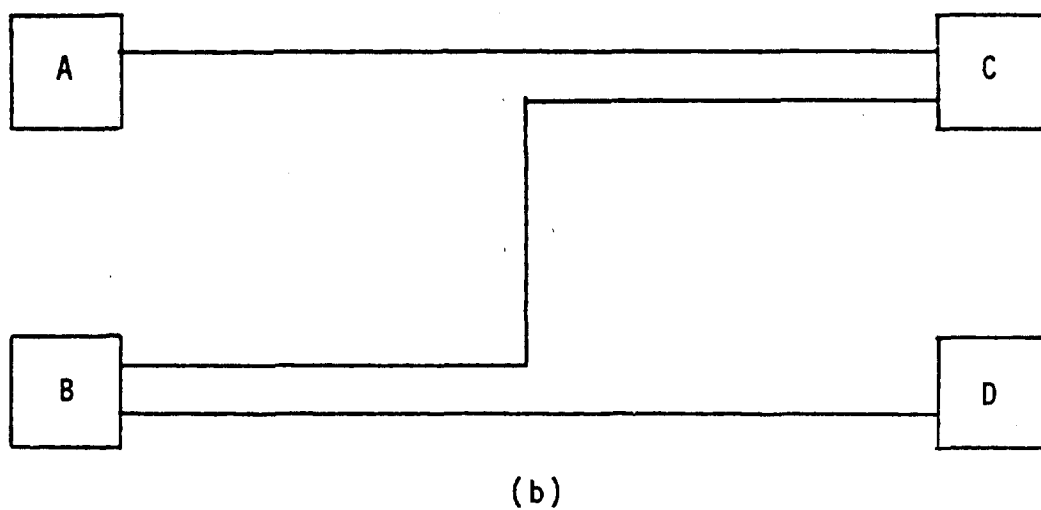
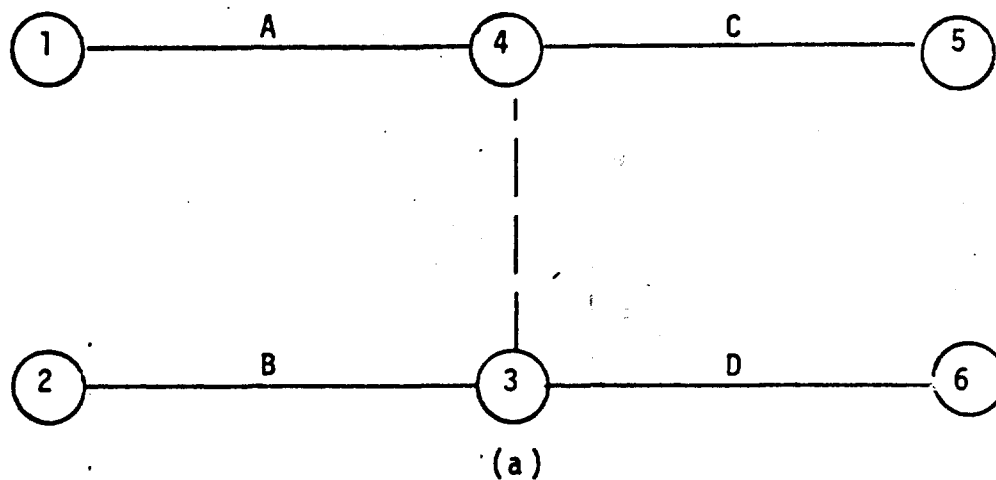
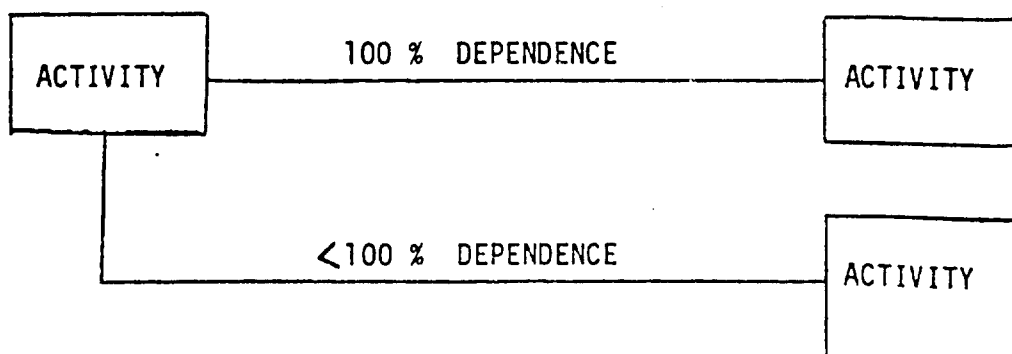


Figure (2). Comparison of event-activity network with precedence diagram.

of figure (2) this constraint is shown through the use of a dummy activity depicted by the dotted line between events 3 and 4. The dummy activity is an artificial line which shows constraint only and has no resources associated with it. In part (b) of the figure this dummy activity is eliminated and the bent line is substituted to show that at least part of the activity C is dependent upon completion of activity B. This elimination of dummy activities allows for a smoother logic flow and more closely approximates the thinking process of the manager.

Events are not excluded from this network as they are from other precedence diagrams. The definition of an activity is expanded to include any event which has a measurable time duration. Thus an important event, like a DSARC III decision, can be depicted as a one day activity. The particular computer program used for this network is capable of handling activities with durations of one-tenth of a week which is certainly a smaller unit of measure than required for any activity important enough to appear on the network.

A convention used in this network which simplifies even further than the logic used in figure (2) is illustrated here.



Essentially this illustration shows that any activities on a straight line or any activities connected by a line emanating from and ending in the side of the activity box are 100% dependent upon one another. No resources may be committed or tasks accomplished until the preceding activity has been completed. A connecting line which starts or ends in the bottom or top of an activity is less than 100% dependent. This greatly simplifies the thought process and logically accomodates complex activities.<sup>5</sup>

In summary, the precedence diagram offered three distinct advantages to the logistics managers. These were: (1) The logic was easy to understand and communicate to the ILSMT members; (2) events and activities now became a single concept and only that which could be measured in time would be planned for; (3) there was no need to break up activities or use dummy activities merely for the purpose of constructing the network. The precedence diagram more closely approximates the logic of the managers in conceptualizing the real world program which they were directing.

Now that the logistics managers had a basic understanding of the network construction they felt that they should learn something of the computer operations. The programming techniques

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<sup>5</sup> For an expanded treatment of precedence diagraming see: "Network based Management Systems (PERT/CPM) by Archibald and Villoria. Appendix B.

were left completely in the hands of the personnel of the ILS Service Center. The logistics managers concerned themselves essentially with the treatment of the data by the computer after it was programmed.

Since the time estimate in this method is simply assigned by the manager the only critical computer operation performed is the identification of the critical path. This is done through two sets of calculations termed the forward and the backward pass.

On the forward pass, the computer uses the logic of the network and the durations of the activities, plus any overriding date constraints entered by the user, to compute the earliest date each activity may start and finish based upon what precedes it in the network. On the backward pass, the computer "backs off" from the finish date for the last activity in the network, or from fixed finish constraints imposed by the user, to calculate the latest date each activity is allowed to start and finish without delaying the end activity or violating a fixed constraint. The difference between the latest allowed finish and the earliest possible finish dates for each activity is the "total float" or "slack time" of that activity. Total float is the allowable slippage for each activity, and, in cases where preceding logic make it impossible to meet a fixed finish constraint, this allowable slippage may be a negative quantity. Activities with zero or negative total float are called "critical", and the path

through the network containing the set of activities with minimum total float is the "most critical path".<sup>6</sup>

The analysis of the total float is a simple process and afforded the logistics managers with the management by exception tool which they sought. The appearance of zero or negative float alerted the managers to situations which would require attention and positive action. The amount of negative float serves to prioritize the critical areas. At the same time, positive float is not always desirable (although, generally always welcome!) for this could show that resources have been programmed too far in advance. A balance must be struck between positive and negative float if resources are to be properly allocated.

Having gained an understanding of the network logic and computer operations the logistics managers proceeded to put the network together. The first step was to identify the activities which would be depicted on the network. A work breakdown structure did not exist for the AIM-9L program and the logistics managers did not construct one per se. The process of identifying the activities for the network which the logistics managers went through is the same as that was used in construction of a work breakdown structure.

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6 McGrath, Michael F., ILS Scheduling and Control - A Network Approach, An excerpt from the paper presented to the Society of Logistics Engineers planning symposium. 1974.

The major areas that the logistics managers wished to monitor were identified first. The areas that they chose were: external program milestones (external to the logistics portion of the program), logistics' support analysis, supply support, container development, training, publications, facilities and ground support equipment development. These major activities were then further broken down into greater detail.<sup>7</sup>

Once the activities were identified and the level of detail defined, the ILS Service Center prepared an activity list. Each activity on the list was assigned a time duration. This was accomplished primarily through the use of existing milestone charts and rough estimation by the logistics managers of the duration of activities which had not been previously planned.

Next, the logistics managers, still working from the activity list identified the relationship between the activities. This crucial phase in the construction of the network was less tedious than it would appear. After having gone through a rigorous identification of activities this process was relatively simple: A work breakdown structure, however, would have made

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<sup>7</sup> The level of detail included in the network can be seen by examining the network figure (4) and also through the example status reports contained in the next section.



these relationships obvious and reduced even further the time spent in this phase of network construction.

Having established the necessary relationships the logistics managers next defined the nature of the activity and the agency responsible for the conduct of the activity. By nature of the activity it is meant whether the activity was required by both services, a joint activity, or simply required by one service. The vast majority of activities were already assigned to an agency for completion through the ILS plan. So the later portion of this phase was really task assignment for the purpose of identifying which agency would report on the activities listed.

Now that the activity list was completed the ILS Service Center could prepare a draft network with activity labels. The activity label is an important feature of this network for it identifies at a glance the major area of the logistics program, network location, responsible agency and nature of the activity.

The activity label is a six character code assigned to each activity contained in the network. The first character identifies the major program category into which the activity falls. The second character identifies the sub-network of the major category to which the activity applies. The third and fourth characters are control numbers which identify the location of the activity in the network. The fifth character identifies the nature of the activity. The sixth character identifies the responsible agency.

ACTIVITY LABEL LEGEND			
<u>1ST CHARACTER</u>	<u>2ND CHARACTER</u>	<u>5TH CHARACTER</u>	<u>6TH CHARACTER</u>
E = EXTERNAL PROG. MILEST	A = GENERALLY APPLICABLE	A = AIR FORCE	A = AIR FORCE PROJECT MGT.
F = FACILITIES	D = TD TEST SET	N = NAVY	B = 2ND SOURCE CONTRACTOR
G = GROUND SUPPORT EQUIP	E = GCU-26/E	J = JOINT	C = NWC CHINA LAKE
L = LOGISTIC SUPPORT ANAL	F = ASM-11		E = EGLIN AFB
M = MISSILE DESIGN/PRODUC	G = SM-419		N = NAVAIR SYSCOMHQ
P = PUBLICATIONS	L = MAINT MANUALS		P = PRIME CONTRACTOR
S = SUPPLY SUPPORT	M = AIRCRAFT MANUALS		S = SPCC
T = TRAINING	K = DSM-78		W = WRAMA
C = CONTAINERS	H = ASM-447		
	J = GCS TEST SET		
	L = LAU-7		

Figure (3)

A legend for interpretation of the activity label codes is shown in Figure (3). Through the use of this legend an activity label such as GK 96 NC can be seen to be part of the Ground Support Equipment program, specifically related to the DSM-78/Guidance and Control Unit test set, a Navy peculiar portion of the program and the responsibility of NWC, China Lake for accomplishment and reporting.

The assignment of the activity labels was the last step in the preliminary preparations. A rough network was then drawn by the ILS Service Center. The rough network was then reviewed by the logistics managers and key members of the ILSMT. Changes were made and the network was updated, entered into the computer and finally, after three months of preparation, presented to the entire ILSMT. The finished product can be seen in Figure (4).

## SECTION V: USE OF THE NETWORK/REPORTING

The network provides the framework for depicting the relationship of the activities and their identity. Time assignments are not transcribed on the network due to the lack of space and the fact that the basic activities and relationships expressed change less frequently than the scheduled time intervals. Time is the variable within the framework of the network. Consequently, the output reports become the actual management tool. The two most important reports issued in this program are the Network Progress Report (Figure (5)) and the Baseline/Current Schedule Comparison Report (Figure (6)).

Moving across the Progress Report (Figure (5)) from left to right it can be seen that the activity is fully defined in terms of its' label, reporting responsibility and description. The status of the activity simply shows whether it is current, completed or to be completed in the future. The estimated and actual duration of the activity is shown in weeks. This feature of the report serves several purposes. It keeps a historical record of the actual time involved in completing each activity and provides the manager with a check on his capability to accurately forecast completion times. The remainder of the report shows scheduled and actual start and finish dates.

The Baseline/Current Schedule comparison report (Figure (6)) uses the same format for identification that the Progress Report uses. The comparisons which are made in this report are the

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NAVAL AIR SYSTEMS COMMAND  
NETWORK PROGRESS REPORT  
REVISED BASELINE SCHEDULE FOR THE AII-9L ILS PROGRAM—UPDATED 5 MARCH 1976

PAGE 1  
SORTED BY: ACT. LABEL  
\* = REPORTING REQ'D

\*\*\*MAJOR PROGRAM MILESTONES\*\*\*

ACTIVITY REPORTING LABEL RESPONSIBILITY	ACTIVITY DESCRIPTION	STATUS	DURATION EST. ACTUAL	START SCHEDULED ACTUAL	FINISH SCHEDULED ACTUAL
EA16JA AIRFORCE	DELIV PROTO HDR TO F-15 CAT II TEST	-COMPLT-	9.0	11/ 4/75	1/ 5/76
EA28JA AIRFORCE	CONDUCT IOT&E (OPEVAL)	-CURRNT-	59.8	1/15/75	3/ 8/76
EA32JN NAVAIR	VENDOR QUAL PROGRAM	-CURRNT-	58.0	12/15/75	1/21/77
EA40JN NAVAIR	OSD PROGRAM REVIEW (DSARC III)	-COMPLT-	.2	1/29/76	1/29/76
EA48JC RMC C.L.	CONDUCT FIRST ARTICLE TESTING	-FUTURE-	9.0	4/15/77	6/16/77
EA50NN NAVAIR	NAVY INITIAL SUPPORT RQMT DATE	-FUTURE-	4.0	3/15/78	4/11/78
EA85AA AIRFORCE	AIR FORCE INITIAL SUPPORT RQMT DATE	-FUTURE-	4.0	3/15/78	4/11/78
EA90JN NAVAIR	CONDUCT FOT&E	-FUTURE-	17.0	12/30/77	4/27/78
EA99JN NAVAIR	GOV'T SUPPORT DATE	-FUTURE-	1.0	12/20/79	12/26/79

Figure (5)

currently estimated start and finish dates against the baseline dates. The baseline dates are those which were entered into the computer during the last update (the month previous). The change column shows the difference, in weeks, between the current estimates and the baseline. The most important column is the total float column. It is here that the manager can determine the allowable slippage for the activity.

In Figure (6) it can be seen that there is a great deal of positive float in the activities listed at the top of the report (TA 20 JC through TA 28 NC). These activities are the results of actions taken in activities TA 36 AA through TA 92 AA and their relationship can be seen by consulting the network. TA 36 AA and TA 36 NN (shown in the network as a single block labeled TA 36 --) have experienced a change of four weeks which has caused a reduction of the total time available for completion of TA 40, TA 92 and TA 94. The change is causing a day for day reduction in time available for completion of these activities. The manager now knows that he has a potentially critical situation developing which, in this case, will effect the establishment of resident training capabilities within both services.

A full network trace is done for each activity which produces a change of over two weeks. The results of the trace are depicted at the bottom of the report in narrative form. In the example (Figure (6)) the results of this trace showed that the change in TA 36 AA and TA 36 NN was due to a slip in

REV 2 RUN 2  
3/ 5/76

NAVAL AIR SYSTEMS COMMAND  
BASELINE/CURRENT SCHEDULE COMPARISON REPORT  
REVISED BASELINE SCHEDULE FOR THE AIN-9L ILS PROGRAM--UPDATED 5 MARCH 1976

PAGE 1  
SORTED BY: ACT. LABEL  
\*-2 WEEK CHANGE OR MORE

\*\*\*TRAINING\*\*\*

ACTIVITY REPORTING LABEL	RESPONSIBILITY	ACTIVITY DESCRIPTION	EARLIEST START CURRENT	BASELINE	CHANGE	EARLIEST FINISH CURRENT	FINISH BASELINE	CHANGE	TOTAL FLOAT CURRENT	MAX
TA20JC	NAC C.L.	PREPARE PILOT TRAINING FILM	4/ 1/76	4/ 1/76	0.	3/30/77	3/30/77	0.	50.6	0.
TA21JC	NAC C.L.	PREP MAINT GRAPHIC AIDS/SLIDES (NAVY)	4/ 1/76	4/ 1/76	0.	3/30/77	3/30/77	0.	49.4	0.
TA25JC	NAC C.L.	TRAIN PERS. FOR FORGE	11/15/77	11/15/77	0.	12/12/77	12/12/77	0.	88.4	0.
TA26JC	NAC C.L.	TRAIN NAVY INSTRUCTIONS	12/31/76	12/31/76	0.	4/28/77	4/28/77	0.	49.4	0.
TA28JC	NAC C.L.	UPDATE & DELIV NAVY GRAPHIC AIDS	4/ 1/77	4/ 1/77	0.	4/ 1/77	4/ 1/77	0.	49.2	0.
*TA36AA	AIRFORCE	ORDER AF TRAINING HARDWARE	4/ 1/76	3/ 4/76	4.0	4/28/76	3/31/76	3.6	33.0	-3.6
*TA36AN	NAVAIR	ORDER NAVY TRAINING HARDWARE	4/ 1/76	3/ 4/76	4.0	4/28/76	3/31/76	3.6	33.0	-3.6
*TA36AJ	AIRFORCE	PROD & DELIV AF TRAINING HARDWARE	4/27/76	4/ 1/76	3.6	4/25/77	3/30/77	3.6	33.0	-3.6
*TA36AJ	NAVAIR	PROD & DELIV NAVY TRAINING HARDWARE	4/27/76	4/ 1/76	3.6	4/25/77	3/30/77	3.6	33.0	-3.6
*TA92AA	AIRFORCE	ESTAB AF RESIDENT TRNG CAPABILITY	4/26/77	3/31/77	3.6	7/25/77	6/29/77	3.6	33.0	-3.6
*TA92AN	NAVAIR	ESTAB NAVY RESIDENT TRNG CAPABILITY	4/26/77	3/31/77	3.6	7/25/77	6/29/77	3.6	33.0	-3.6
*TA94AA	AIRFORCE	CONDUCT AF RESIDENT TRAINING	7/26/77	6/30/77	3.6	8/22/77	7/27/77	3.6	33.0	-3.6
*TA94AN	NAVAIR	CONDUCT NAVY RESIDENT TRAINING	7/26/77	6/30/77	3.6	8/22/77	7/27/77	3.6	33.0	-3.6
*TA94AJ	AIRFORCE	ESTAB FIELD TRNG CAPABILITY (AF)	3/10/77	3/10/77	0.	4/ 6/77	4/ 6/77	0.	52.6	0.
*TA94AN	NAVAIR	CONDUCT DEPT TRAINING	5/10/79	5/10/79	0.	11/14/79	11/14/79	0.	32.0	0.

(TA36AA) (TA36NN) - Order Air Force/Navy Training Hardware

These activities are dependent on activity NA20JN - Award of Missile Production Contract (Prime Contractor) - which has slipped an additional 4.4 weeks to 31 March 1976. This has caused a delay in the commencement of these activities and their dependent activities (TA40AA, TA40NN, TA92AA, TA92NN, and TA94NN). Although there is sufficient cushion at this time it is recommended that the training hardware to be procured be defined and ordered as early as practical to avoid impact on the Air Force/Navy Initial Support Date.

Figure (6)

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activity MA 20 JN which is the award of the production contract to the prime contractor. It follows that training hardware cannot be ordered until a contract is awarded for the missile.

This narrative block is also used to disseminate information to the ILSMT members. In the example it is implied that the training hardware will be ordered almost immediately upon award of the contract. This serves notice to the ILSMT members that their requirements in this area should have been definitized by now.

These two reports are sent to all members of the ILSMT on a monthly basis. Their use, in concert with the network, constitute the control, monitoring and primary management information system of the logistics portion of AIM-9L program.



## SECTION VI: CONCLUSION

The network and monitoring system delineated in this report was an effective management tool. It was effective because it was simple and the logistics managers were determined to make it work.

There were many benefits derived from this network. Principal among these benefits were the monthly reviews which the logistics were now forced to make jointly. Prior to the initiation of the network the logistics managers met infrequently and generally discussed only the most immediate problems facing them. Once the network was established the logistics managers met at least once a month to discuss and reflect on the entire program and the direction that it was taking. These meetings improved the coordination within the program and fostered a "team spirit" which is essential in programs of this nature. Additionally, the objectives of each service became clearer and problems were now solved mutually.

This "team spirit" was once again evidenced at the fourth ILSMT Conference. It was at this conference that the network was first presented to the sixty members of the ILSMT. Each member of the ILSMT was given a comparison report and a network. Every sub-network and activity was then reviewed for accuracy in every detail. The results were an expanded network, a feeling of participation on the part of the ILSMT members and a very productive meeting.

The reports generated by the network became the principal means of disseminating current schedule information throughout

the program. Because of this, the AIM-9L program manager was, at the time of this report, attempting to increase the scope of the network to encompass all scheduled activities within the program. The network would then represent the Program Master Plan and not simply the ILS plan.

The network and its output reports fulfilled all of the basic requirements of the logistics managers. It provided them with a method of graphically depicting the ILS plan and the relationship of activities within the plan. It served as an effective management information system. This technique brought about closer coordination between the ILSMT members and gave the members a sense of participation in the planning process.

This approach to logistics planning has provided the managers with a highly disciplined, goal oriented ILS plan. The techniques of baseline schedule monitoring and control are invaluable in assisting the logistics managers to ensure timely and adequate delivery of the required logistics support.

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DEFENSE SYSTEMS MANAGEMENT SCHOOL

**STUDY TITLE:** Application of Critical Path Method Network Technique to the Integrated Logistics Support Plan of the AIM-9L Program.

**STUDY PROJECT GOALS:**

To provide an example of how a Critical Path Monitoring Network assists in the management of a logistics program.

To illustrate how a network of this type is selected, established and used in Integrated Logistics Support Planning.

**STUDY REPORT ABSTRACT:**

This report illustrates how a Critical Path Method Network using Precedence Diagramming techniques was established as a control device for the management of the Integrated Logistics Support (ILS) portion of the AIM-9L missile development program. The report traces the steps of the logistics managers involved through the selection, preparation and use of the network. The benefits derived and unique features of this network are also shown.

**KEY WORDS:** Critical Path Method Network  
Precedence Diagramming  
ILS Management

**MORE KEY WORDS**    **MATERIEL**    **MISSILES**    **SIDEWINDER 1-C**  
                         **MANAGEMENT**    **INTEGRATED LOGISTICS SUPPORT**    **CRITICAL PATH METHODS**  
                                         **PROJECT MANAGEMENT**

**PROGRAM MANAGEMENT**  
**NETWORK ANALYSIS**

<b>NAME, RANK, SERVICE</b> Wallace T. Bucher, CAPT., USAF	<b>CLASS</b> PMC 76-1	<b>DATE</b> May 1976
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