THE TEAM APPROACH TO AVIATION MAINTENANCE TRAINING IN SUPPORT OF HIGH PERFORMANCE WEAPONS SYSTEMS IN THE EIGHTIES

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ABSTRACT

The aviation maintenance technicians in today's United States Navy and Marine Corps squadrons are highly motivated young men and women that bring unique demands to the training environments supporting them. The state of the art weapons systems emerging throughout the services would have been considered as fantasy or "Buck Rogers" until just a few years ago. As a result, the senior military managers can no longer rely on the ingenuity of the chief or sarge to provide the training necessary to support the military requirements for trained personnel. The young men and women are being tasked with maintaining highly sophisticated aircraft under the arduous conditions found afloat and in other adverse situations that can be found in the military environment. The F/A-18 Hornet aircraft, the LAMPS Mark III helicopter and the AV-8B Harrier are highly technical aircraft that have created exceptionally challenging maintenance training requirements. The thrust of this paper is designed to address those challenges and will use actual training strategies employed in the introduction of the F/A-18 Hornet aircraft. Major issues to be addressed include: maintenance training in a high tech environment, Computer Assisted Instruction (CAI) applications for the maintenance technician, cost benefits in the utilization of contractor support in FRAMP, and success of Instructional Systems Development strategies in the FRAMP.

A NEW ERA

Dual mission aircraft, high tech designs, multi service weapons systems, FRAMP, NAMTRA, PJT, fault insertion, instructional systems development training model manager, contractors, computer assisted instruction, Scantron and foreign military sales are but a few of the issues impacting the introduction of the F/A-18 Hornet aircraft in the United States Navy and Marine Corps.

The weapons system has achieved well over 26078 hours of mishap free flying within the fleet replacement squadron as of June 1, 1984. A major contributor to this excellent record has been the teamwork approach to training that has been delivered at both the pilot and maintenance levels.

Not being forced by the draft to enter the military environment, trainees are arriving at Navy and Marine Corps fleet replacement squadrons with high levels of capability and expectations. No longer are expressions such as "ask the chief" or "go see the sarge" sufficient to meet the challenges being dealt with.

In response to the requirements of modern weaponry and the demands of the maintenance trainee, the services have been required to reevaluate their training procedures and develop full bore training systems at the maintenance level.

This has not been accomplished without pain, goal setting, late night sessions and inordinate demands being placed on personnel at all levels.

New departments have emerged with the responsibility of interfacing with instructors, wing, type commanders and senior level commands to address and resolve issues pertinent to training requirements.

For the first time, the Navy has implemented Instructional Systems Development (ISD) procedures at the maintenance level. This implementation has not been totally smooth due to the fact that "it has never been done that way before." However, ISD has proven itself in more than one weapon system for the operators and it was time to bring the maintenance training level into the eighties by utilizing trends in the fields of education research and instructional technology that had been emerging since the sixties.

In 1976, the Force Training Officer, from the Commander, Naval Air Force Pacific staff released a letter which outlined the task descriptions for the Instructional Systems Development Department. In his letter, the officer indicated that "ISD" promises significant economies in training assets and personnel over the full life cycle of a weapons system.

While the training officer saw a great deal of promise for Instructional Systems Development, he pointed out quite clearly that the system is "not intended as a substitute for the Training, FRAMP or Operations Departments which are specifically tasked with administering and conducting the actual training."

It has been in the spirit of this guidance that the FRAMP level Instructional System Development department has functioned in introducing the F/A-18 at VFA-125, Naval Air Station Lemoore.

In developing a maintenance level ISD office, numerous factors were considered to assure validity. To begin with, the training command was tasked with conceptual and supporting manpower requirements development. To some, this may appear to be an easy task. Why not just duplicate the efforts of the operator community? However, traditions of the service and work philosophies between maintenance and operators are different in many ways. These differences were sufficient enough to require modifications to the approach in order to meet the needs of the maintenance training environment.

Recognizing the needs of the FRAMP department senior military and civilian officials responded by establishing the first civil service education specialist position solely dedicated to maintenance training within a FRAMP in Naval Aviation history. The individual that was sought was one that possessed a broad base of training background, curriculum development skills, the ability to interface with personnel at all levels and a maintenance training background. While a Navy or Marine Corp history was not a requirement, the individual selected was required to attend indepth training in Instructional Systems Development at Naval Training Center, San Diego.

Military Subject Matter Experts (SME) were designated to staff the maintenance ISD office. The personnel sought were senior level personnel, (E-6 or above) with extensive experience in their rate or specialty, management background at the appropriate level, an interest in training and curriculum development and the ability to interface with high level personnel while operating in a fish bowl environment.

After careful evaluation, government authorities determined that a vacuum still existed in the total team effort and made the decision to add a civilian contractor as a part of the development team.

Ongoing configuration changes to the aircraft, demands for the subject matter expert's time throughout the training environment and a lack of indepth experience were all contributing factors in determining that a contractor was required as a part of the introductory efforts for the weapon system.

Practical experience and cost effectiveness.

Not only was practical training experience objectives built into the selection of the contractor, but projections for cost effectiveness were considered very heavily.

The following cost effectiveness issues clearly pointed out the validity of using the services of an experienced contractor ON SITE in the FRAMP:

1. possessed expertise in the development of instructional material using appropriate government specifications and guides

2. be production oriented

3. provide expertise in associated skills such as artwork development, word processing and educational psychology

4. provide costing estimates through Training Support Requirements Review (TSRR) and Training Support Requirements Analysis (TSRA)

5. provide a full time motivated staff with the maturity to deal with training environment demands

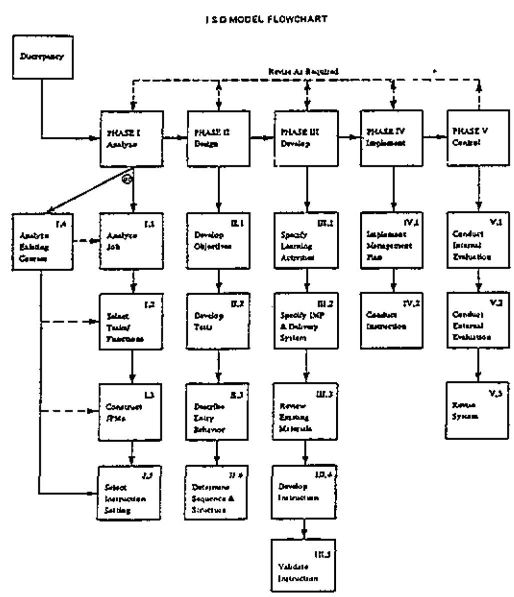
Additional areas that benefit the training command by using the services of a contractor are the ability to provide emergency supply funding and the contractor will usually possess the resources to meet equipment and limited manpower crises.

Setting the game plan.

It was determined that the F/A-18 would be introduced using a total training system, not just a lesson outline. All three sections, the military ISD, the civil service education specialist and the civilian contractor were to be active in the development of new lessons, revisions to existing material and in the determination of media support required to make the training system complete.

With the selection process complete, a full scale training system effort was launched. Interaction between civilians and military was rocky initially while roles were being defined. Once laid out however, the flow in the development of high grade training materials was successfull underway.

INSTRUCTIONAL SYSTEMS DEVELOPMENT - A MODEL



ISD Model Flowchart

Figure 1

Many recommendations might be made that could be used in establishing an ISD model. However, it is recognized that local policies and assets will determine the ultimate design of any ISD program. To start with though, the name Instructional System Development is not sacred. It would be just as appropriate to use the terms "Curriculum Development," "Academic Department," "Courseware Department," or "Plans Development Division."

Regardless of the name given, the department should be responsible to the Commanding Officer for the development, production, review and quality control of the training materials and systems used to train replacement maintenance personnel. Decision points should be established to insure a continuing review of materials for courseware application and required adaptation for training system improvement.

An Impact on the Future

Personnel selected to serve in the department must be briefed in the importance of the tasks being performed and the impact that their decisions will have on personnel in post training operational settings. The subject matter expert should also be aware that the position will require the ability to deal with a broad gamut of training to include materials, guides, media and test item construction. Without this understanding, a vacuum would continue to exist.

Training for the Developer

Officers and other managers should aggressively seek out training programs for subject matter expers to participate in that continuously upgrade the individual's curriculum and training management skills. The rewards result in large dividend returns by producing a higher trained operational force.

As a minimum, the subject matter expert must receive military or civilian training that addresses the areas below:

A. Task/training analysis

B. Behavioral Objective Determination

C. Test Development/Implementation

D. Instructional Strategy Design

E. Media Selection/Design

F. Simulation and Application

G. Quality Control

H. Evaluation

With this training behind them, the subject matter experts and civilian employees should be prepared to work together in these areas as a minimum:

1. development and maintenance of current analysis of maintenance missions and develop appropriate job task inventories

2. determine knowledge, skill and performance requirements for each task in the job task inventory

3. establish and maintain appropriate documentation for specific performance and training objectives

4. determine instructional strategy, methodology, and supporting media requirements for assigned training tracks

5. establish and aggressively pursue an active feedback system

6. evaluate instruction through the analysis of tests and operational level feedback

7. develop an evaluation system for instructors that provides feedback to the Commanding Officer in the following areas:

a. planning
b. control
c. oral communications
d. training credibility
e. decision making
f. initiative
g. adaptability
h. problem solving
i. people sensitive
j. self evaluation
k. relationship to supervisor
l. work attitude
m. organizational ability
n. ability to gain acceptance
o. understanding
p. use of methods
q. ability to develop content

"BUT WE CAN NOT BREAK THE AIRPLANES"

The F/A-18 Hornet has presented a peculiar problem to the training command. In the avionics area especially, the aircraft has proven to be highly reliable in maintenance to flight hours. Simply put, the Advanced Integrated Digital Avionic System does not break.

Requests for approval to use "Fault Insertion" procedures have been disapproved at the highest levels. In addition, directives require that aircraft assigned to the FRAMP training department must be fully mission capable.

As a result, students progressing through the practical job training (PJT) segment may not meet with challenges that will face them under the arduous conditions found in the operational setting.

In reviewing the training deficiencies and projecting future operational requirements, the avionics subject matter experts, in consort with the education specialist and contractor's representatives, have reviewed the successes of the Computer Assisted Instruction (CAI) program in use in the F/A-18 operations/pilot community.

It has been determined locally that CAI has the potential to meet the requirements for enhanced training for the maintainer due to CAI's realistic capabilities, immediate feedback, growth potential, local editing and scheduling, flexibilities and hands-on student interface. Two separate micro computer systems are under current review to determine the most usable and cost effective system.

Subsystems proposed for initial development include: cockpit controls and displays, stores management system operation, mission computer logic hierarchy, subsystem interface (including memory inspect) and simulated troubleshooting.

These systems were determined to be most critical for training due to the technical aspects and the need for highly trained technicians to maintain them from military maintenance personnel resources.

In critiquing the CAI system, it has been determined that the requirement exists for the accurate simulation of sophisticated avionics systems, system integration and interface while effectively demonstrating realistic faults. The CAI system must also allow for the instructor to select the desire fault at his or her discretion.

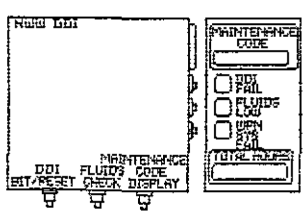
Video disc in combination with the micro computer would allow for random-access video support to any lesson at any time the student demonstrated a need for reinforcement or is prepared for a more indepth maintenance task.

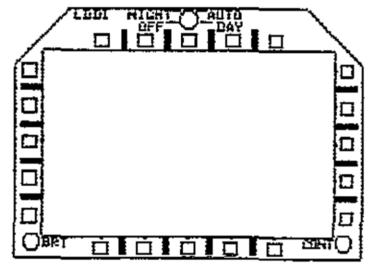
Many would question the validity of using CAI in a maintenance training environment when simulators are available. There is no question that the need for simulators is constant. However CAI presents advantages that would allow for enhanced "hands - on" training for the technician. Namely, minimal monetary investment, unlimited potential for growth within the system and the ability to keep pace with aircraft hardware and software configuration changes.

Fault insertion into the actual aircraft has been employed within other weapons systems. Due to the sophisticated avionics systems that are found in today's "state of the art" aircraft, a realistic fear is that damage may result to the equipment that could go undetected prior to a flight.

With these limitations in mind, the Air Training Support Manager from COMNAVAIRPAC staff provided the F/A-18 FRAMP staff with a micro computer for internal evaluation. While the jury is still out on the adaptability of the system for extensive training requirements, initial results are very promising.

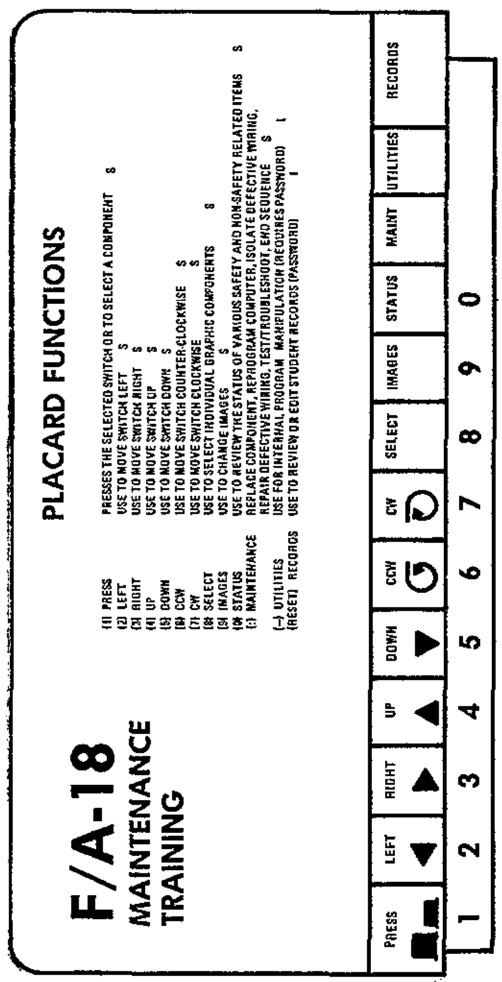
The graphics below show illustrations of the potential for training materials development using the micro computer. At this point, the model under development has solely created by military subject matter experts addressing fault insertion and fault isolation.





In order to effective simulate the cockpit controls, the SME devised the placard below to use the key functions of the micro computer.

Turn the page to the side in order to read the directions given.



Instructor CAI Lesson Request

In order to have current data to support CAI lesson development, the military Subject Matter Expert devised a form for the instructors to use in submitting data to him. While the form is subject to revision, the CAI SME has been able to glean extensive input from its use.

Instruction Sheet

Use this lesson request to provide needed information to create a CAI troubleshooting simulation. The simulation is based upon the FAULT Reporting/Isolation concept as covered in the AI-F18AC-FRM-000, Work Package 002, page 3. Be specific when answering all questions. Information generated by the lesson request is structured to flow as indicated by the following steps:

STEP 1. Identify manuals/systems
STEP 2. Categorize fault
STEP 3. Identify indications
STEP 4. Identify "Remedy Step"
STEP 5. Identify results of "Remedy Steps"

Repeat Step 4 for next sequence

OR

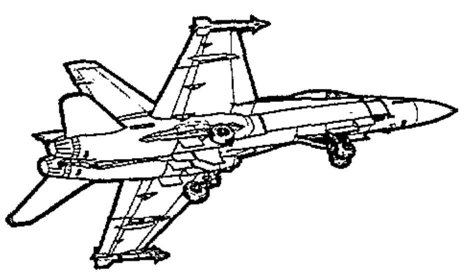
Fault isolated, repaired, and tested -

End sequence

The following is a list of Remedy Steps:

A. Component replacement
B. Computer reprogramming
C. Isolate Defective Wiring
D. Additional Testing
E. Additional Troubleshooting
F. Fault isolated, Repaired, and Tested - End Sequence

Each time a "Remedy Step" is used, a sequence *number must be included. If the sequence is the* first sequence for that "Remedy Step", circle "1". If it is the second sequence, circle "2", etc.. Steps 1,2,3,4,5a and 5b are self-explanatory. Step 5c covers all defective wiring isolation and troubleshooting. For Test Equipment required during this sequence, identify the results of each test. The actual Test Equipment simulation may not be available at present. Use steps 5 d/e for all other testing and troubleshooting procedures.



INSTRUCTOR CAI LESSON REQUEST SHEET (0)

STEP 1. Identify all technical manuals and systems required for this simulation.

____

STEP 2. What category does the fault come under? (X through the letter below)

(A) MMP CODE
(B) WARNING, CAUTION, ADVISORY, OR FAULT DISPLAY
(C) FAULT DESCRIPTOR
(D) CIRCUIT BREAKER TRIPS
(E) DISPLAY SYMBOLOGY

STEP 3. Identify fault and related indications

MMP CODE ____________________

WARNINGS ____________________

CAUTIONS ____________________

ADVISORIES ____________________

FAULT DISPLAY ____________________

FAULT DESCRIPTION ____________________

CIRCUIT BREAKER TRIPS ____________________

____

DISPLAY SYMBOLOGY ____________________

____

STEP 4. In accordance with the AI-F18AC-FRM-000, Work Package 002 00, pages 3 and 4, which remedy step does the fault require?

(A) Component Replacement
(B) Computer Reprogramming
(C) Isolate Defective Wiring
(D) *Additional Testing*
(E) Additional Troubleshooting
(F) End Sequence - Fault Isolated, Repaired and Tested

If - A - go to Sheet (1) Step 5A
If - B - go to Sheet (2) Step 5B
If - C - go to Sheet (3) Step 5C
If - D - go to Sheet (4) Step 5D
If - E - go to Sheet (5) Step 5E
If - F - STOP

INSTRUCTOR CAI LESSON REQUEST SHEET (1)

STEP 5A COMPONENT REPLACEMENT

CIRCLE SEQUENCE # 1 2 3 4 5 6 7 8 9

1. What system does the component belong to?

____

2. Identify the component to be replaced.

____

3. Identify the applicable technical manual and work package for component replacement

____

4. Identify any discrepancies discovered during component replacement.

____

5. Are there any tests required after component replacement?

If - Y - go to Sheet (4) Step 5D

If - N - go to the applicable "Remedy Step" that is shown or Continue

6. Are there any additional troubleshooting required after component replacement?

If - Y - go to Sheet (4) Step 5E

If - N - go to the applicable "Remedy Step" that best describes the next sequence.

INSTRUCTOR CAI LESSON REQUEST SHEET (2)

STEP 5B Computer Reprogramming

CIRCLE SEQUENCE # 1 2 3 4 5 6 7 8 9

*NOTE * This procedure assumes there will be no errors during OFP loading

*NOTE * This procedure is assumed to be done using the following manual: OPERATION OF MLV AN/ASM-607(v)5 starting at section 3.

1. Identify which computer is to be reprogrammed

MC 1 2 or both

2. Identify the numbers (xxxx) to be used during the following steps of these procedures:

4d
f
i
l
5g
i
j
k
l (identify with file number)
m
p

3. If only one computer is being loaded go to STEP 5B.5

4. Identify the numbers (xxxx) to be used during the following steps of these procedures:

4u
w
x
y
z (identify file number)
aa
ad

5. The "Loading" procedure is now complete.

6. If there are NO abnormal indications during the BIT (Built In Test) check which follows the loading procedure, go to the applicable "Remedy Step" that best describes the next sequence and answer all questions.

7. If there ARE abnormal indications during the BIT check go to Sheet (4) STEP 5 D/E

INSTRUCTOR CAI LESSON REQUEST SHEET (3)

Step 5C Defective Wiring Isolation/Troubleshooting

Circle sequence # 1 2 3 4 5 6 7 8 9

1. Identify the applicable technical manual and work package to Isolate or Troubleshoot the defective wiring. _______________

2. Is step 5C.1 a wiring schematic?

If - Y - go to Step 5C.8

If - N - go to Step 5C.3

3. Identify the Table to be Used

____

Identify all indications for each procedural step.

PROCEDURE STEP (from Manual)	RESULT
1.	_______
proceeding down to step	
10.	_______

5. Does any procedural step require the use of Test Equipment?

If - Y - go to Step 5C.6

If - N - go to Step 5C.7

6. ** IN DEVELOPMENT **

7. Identify the applicable technical manual and work package to isolate the defective wiring _______________

8. Identify the " from - to " location of the defective wiring to be tested. (Ref.Des.&Pin)

____

9. Identify the defective wiring _______

10. Identify the discrepancy.

A. shorted to _______ B. Open

11. During this step the student will "Repair" the discrepancy.

12. Do to the applicable "Remedy Step" that best describes the next sequence and answer all questions.

INSTRUCTOR CAI LESSON REQUEST SHEET (4)

Step 5D/E Additional Testing and Troubleshooting

Circle sequence # 1 2 3 4 5 6 7 8 9

Circle procedure type Testing Trouble

1. Identify the applicalble technical manual work package, table number and step for this procedure.

2. If this is a "Testing" sequence and there are *NO* abnormal indications, go to the applicable "Remedy Sign" that best describes the next sequence and answer all questions.

** NOTE * If the next "Remedy Step" is F,* enter same here and STOP ___________

3. If this is a "Testing" sequence and there ARE abnormal indications, fill in the Table for the abnormal indications only.

4. If this is a "Troubleshooting" sequence, fill in the "Table" with the results of each procedural step.

PROCEDURAL STEP TABLE

Procedure Step (From Manual) ABNORMAL RESULT(T/S)

1. ___________________________________

DOWN THROUGH

14. ___________________________________

If "Testing", go to the applicable "Remedy Step" for each abnormal indication

If "Troubleshooting", go to the applicable "Remedy Step" for next sequence.

This material has been totally developed, along with the computer authoring and graphics development by a military Subject Matter Expert from the United States Marine Corps. Staff Sergeant James Willey has been totally involved in the research and development activities as a part of his assignment in VFA-125 Framp Instructional Systems Development Department.

The eighties have produced weapons systems with reduced vulnerability, higher levels of maintenance reliability, more efficiency with greater *fire power, and state of the art technology which* has provided a quantum leap beyond the capabilities of previous weapons systems.

Dual mission, high tech, multi service adoption, FRAMP, NAMTRA, Practical Job Training, fault insertion, instructional systems development, training model manager, contractors, computer aided instruction and foreign military sales are but a few of the issues impacting the introduction of the F/A-18 Hornet aircraft.

*Through cost effectiveness analysis, the evol*ution of effective interface techniques and product delivery, the TEAM APPROACH TO AVIATION MAINTENANCE TRAINING IN SUPPORT OF HIGH PERFORMANCE WEAPONS SYSTEMS IS proving to be very positive in meeting the demands of the high tech environment in today's all volunteer military.

ABOUT THE AUTHORS

Dr. Gary F. Goddard has had extensive experience in the field of training and adult education. He currently is serving as an Education Specialist for the United States Navy in the introduction of the F/A Hornet aircraft. He has also served on the COMNAVAIRPAC staff where he was responsible for aviation training support system management as well as providing consulting services to FRAMPs throughout the AIRPAC community. He holds the Doctor of Philosophy in Education, the Master of Education in Human Resource Development, and the Bachelor of Arts in International Relation. He has presented numerous seminars in adult training procedures and in 1976 was recognized as one of the Five Outstanding Educators in California.

Mr. James W. Willey, Computer Assisted Instruction Subject Matter Expert, United States Marine Corps. For the past nine years he has served as a Fire Control Radar Technician in the F/4 and F/A-18 communities. Widely read, Willey has mastered programming procedures and has been responsible for the development of the software data supporting the maintenance level computer assisted instruction currently under review in VFA-125. He is assigned to the Instructional System Development division of the FRAMP Department.