

We can sum up this entire presentation by stating that high quality drawings are the result of a team effort. Everyone involved in the procurement, production, quality assurance and revision of engineering drawings must constantly aim at producing and maintaining high quality drawings for the Center. We must all keep in mind the basic reasons why we require the drawings: To permit us to procure and maintain training devices at a minimum cost to the Government.

MAINTAINABILITY, MAINTENANCE ENGINEERING ANALYSIS
RECORDS AND CONTRACTOR AUGMENTED SUPPORT AS A PART
OF THE INTEGRATED LOGISTICS SUPPORT SYSTEM

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The effectiveness of a training device is a measure of "how well" the device performs its mission, "how long" the device will maintain a specified level of performance throughout a given mission, and "how often" the device is ready when it is needed. The Department of Defense has stated by the issuance of Department of Defense Directive 4100.35, that material readiness, or "how often" and equipment is available, can best be achieved through effective integrated logistic support.

With the increasing amount of money required to support the training devices in the field and realizing the relatively poor availability of them in the past, the Naval Training Device Center recognized the need for more definitive, cost effective, logistic support requirements, and in June of 1966 the Center issued Bulletin 40-1 entitled "Integrated Logistic Support for Training Devices." Bulletin 40-1 contains all of the contractual requirements necessary to provide for effective support of training devices for their programmed life cycle.

The elements comprising the Center's integrated logistic support requirements, and each element shown represents a separate section of Bulletin 40-1. The sections and titles of Bulletin 40-1 are as follows:

- Section 1 - Maintainability of Training Devices
- Section 2 - Preparation of Maintenance Engineering Analysis Records for Training Devices
- Section 3 - Site Preparation and Contractor Augmented Support
- Section 4 - Contractor Conducted Training
- Section 5 - Provisioning Technical Documentation and Repair Parts
- Section 6 - Technical Publications

Bulletin 40-1 requires that the contractor establish a program to implement the requirements of each section, in entirety or in part, as determined by the dollar value, criticality, complexity, original design, or number of units of the particular procurement. The requirements of Bulletin 40-1 constitute the total support requirements necessary to assure the effective support of training devices by the Government at the earliest point in time. The Maintenance Engineering Analysis Records, required by Section 2, will be one of the primary instruments for the contractor to insure the coordination of his support groups. I will discuss the requirements of Section 2 a little later.

Bulletin 40-1 requires a maximum of four support control stages during the life of the contract:

Stage 1 is the Planning Conference where the contractor presents the data submitted in the proposal, updated as appropriate. Incidentally, the integrated logistic support portion of the contractor's proposal becomes the preliminary integrated logistic support program plan upon award of contract.

Stage 2 is the Breadboard of Mock-up whereby the contractor evaluates accessibility, simplicity, equipment size, working environment, maintenance resource requirements and human engineering considerations. The initial maintainability predictions will be updated during this stage.

Stage 3 is the Contractor Demonstration and Validation. This stage is initiated on a periodic basis as soon as possible on the prototype training device. Progressive validation is made of the support documentation, including the MEARS, maintenance handbook, maintenance requirement cards and maintenance drawings.

Stage 4 is the In-Service Verification. This verification will normally take place at the installation site of the prototype training device at a time set forth in the approved verification plan. I will discuss the verification in detail in Section 1.

Within the integrated logistic support program the contractor must conduct a maintainability program. Section 1 of Bulletin 40-1 outlines the qualitative and quantitative maintainability requirements for training devices. In addition to the design for maintainability, one major output of the maintainability program is a realistic and effective preventive maintenance program. This preliminary preventive maintenance program will be the basis for the planned maintenance system for the device. The implementation of the preventive maintenance program will reduce the support cost of the device in the field.

Recently, Military Standards 470 and 471 were issued, superseding several maintainability specifications. These two standards are concerned with maintainability program requirements and maintainability demonstration requirements and were made mandatory for use by all agencies and departments within the Department of Defense; they will be a part of Bulletin 40-1 with the next revision. The maintainability prediction technique stipulated in Section 1 of Bulletin 40-1, MIL-M-23313, has since been superseded by MIL-HDBK-472, with the issuance of MIL-STD-470. The maintainability prediction will provide statistically valid estimates of the mean and maximum active maintenance times through the analysis of the planned design configuration. The time estimates will provide criteria upon which judgement can be made concerning adequacy of design to meet the qualitative and quantitative maintainability requirements of the device contract.

The qualitative maintainability requirements are listed in Section 1 of Bulletin 40-1. The quantitative requirements will be numerically stated for each procurement. The quantitative requirements will be based on the "Plan for Use" of the device. Normally, the quantitative requirements will be Availability, Mean Time to Repair and/or a Maintainability Index expressed in maintenance man-minutes per utilization hour. The contractor will conduct his maintainability program with the specified goals in mind and with the understanding that the training device will be subjected to a field verification at a later date.

The contractor will submit a Verification Plan, describing the details and criteria for accomplishing the maintainability verification. The actual verification will be accomplished by the Government at the installation site, using only those tools, equipment, data, training, personnel and material which have been programmed for the device. In other words, not only will the maintainability characteristics of the device be verified but all of the support resources will also be verified. All maintenance action times will be recorded in the Verification Report and the measured values will be compared to the contractual requirements to determine if the contractor satisfied the maintainability requirements of the contract.

Perhaps the heart of the integrated logistic support program and the single element that influences all of the deliverable support items is the Maintenance Engineering Analysis Record (MEAR). It is utilized for management and control of the maintainability program and the integration of the maintenance resources. The MEAR information serves as the input to the maintenance handbook, maintenance requirement cards, number and skill levels of the maintenance personnel, training course provisioning and support equipment.

MEARS will be prepared for the end article (training device), its functional systems, assemblies and special support equipment. Each MEAR consists of a maximum of seven exhibits. These exhibits are as follows:

Exhibit I	Summary
Exhibit II	Maintenance Concept
Exhibit III	Maintainability Evaluation
Exhibit IV	Reliability and Design Data
Exhibit V	Personnel Planning Data
Exhibit VI	Maintenance Requirements and Tasks
Exhibit VII	Support Equipment Requirements

Those of you who are familiar with Weapons Requirement 30 will notice that Bulletin 40-1's MEAR requirements are much abbreviated as compared to Weapons Requirement 30. The exhibits have been reduced in number and the content of the MEARS is training device oriented, requiring only necessary information. We at the Center will revise the MEAR forms and content as we gain experience with this concept. Our only actual experience with MEARS to date was with the A-7A Weapon System Trainer. The A-7A was procured with Integrated Maintenance Management and it was through this successful program that the Center elected to simplify MEAR preparation.

Figure 15 shows the maintenance engineering analysis as we would expect it to take place at the contractor's plant. From the preliminary data, a preliminary MEAR requirements list is developed and a maintenance concept established. The establishment of the MEAR requirements list permits a data list to be made and check prints developed. Upon completion of both the reliability analysis and the maintainability analysis the MEAR item is released for production with the maintainability/reliability predictions and analysis completed. A maintenance concept is determined and compared to the end article maintenance concept. From the maintenance concept evolves the maintenance requirements and tasks, and from these the material, training, personnel and data requirements are definitized. Also, the actual maintenance task times are compared to the allowable parameters. This is developed the MEAR exhibit information.

Figure 16 depicts the MEAR Flow from the contractor after the MEAR has been completed. The MEAR is submitted to the NTDC Engineering Representative at the contractor's plant and he, in turn, forwards it to the Chairman of the MEAR Review Team. The Chairman of the MEAR Review Team then distributes copies of the MEAR to the members of the MEAR Review Team which includes the NTDC Maintenance Engineer, Training Specialist, Publications member, Support Liaison member, the Inventory Control Point member (ESO) and the Fleet Representatives. The MEARS are reviewed and returned to the contractor with comments as shown in Figure 16. MEAR Review Team meetings will be held at the contractor's plant periodically to review selected MEARS. At the MEAR Review Team meetings, potential support problems are discussed and hopefully resolved at a time when action can be taken to resolve the problem.

Aside from actually delivering the hardware, I feel that the next item of importance on the part of the contractor is Contractor Augmented Support. Section 3 of Bulletin 40-1 defines Contractor Augmented Support as "An interim arrangement whereby the contractor is obligated to furnish to the Government materials and services for support of the equipment, on an as-required basis to keep the equipment operative and available for Government use in accordance with the utilization schedule provided in the

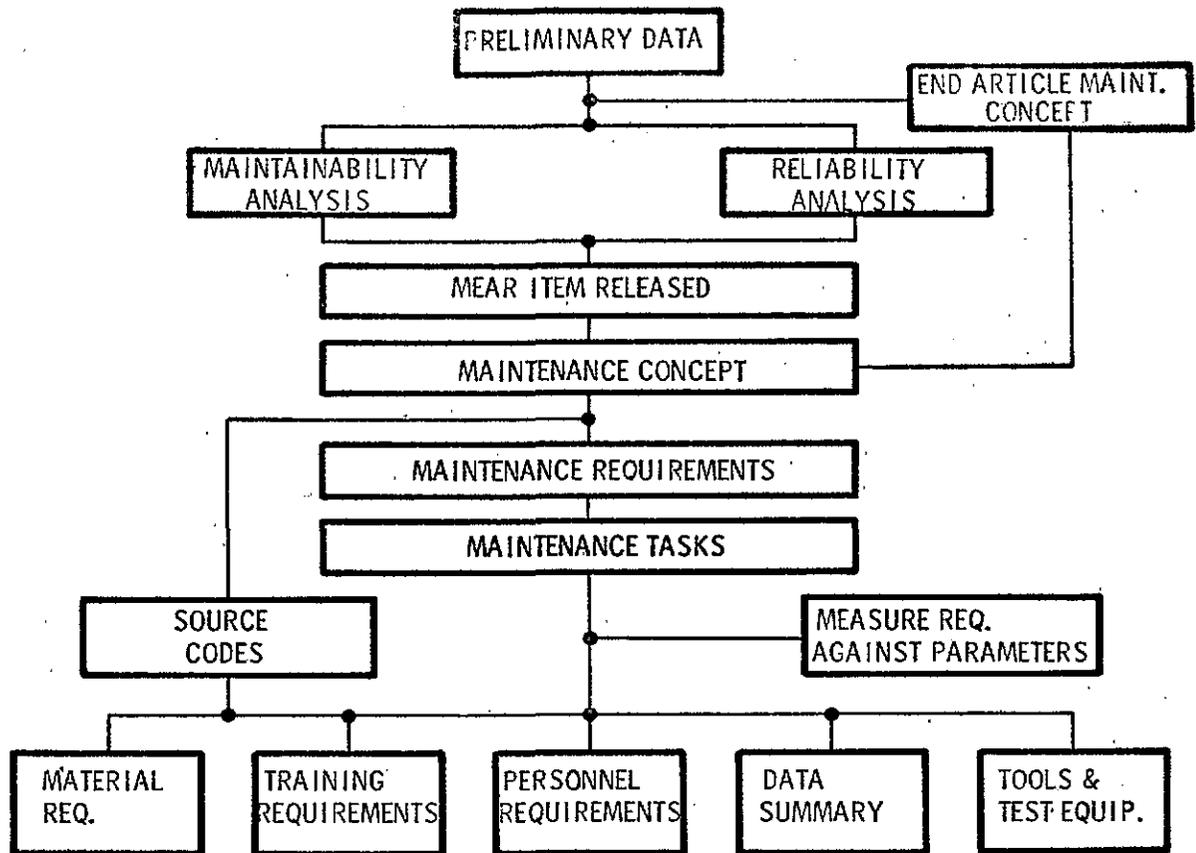


Figure 15. MEAR Development

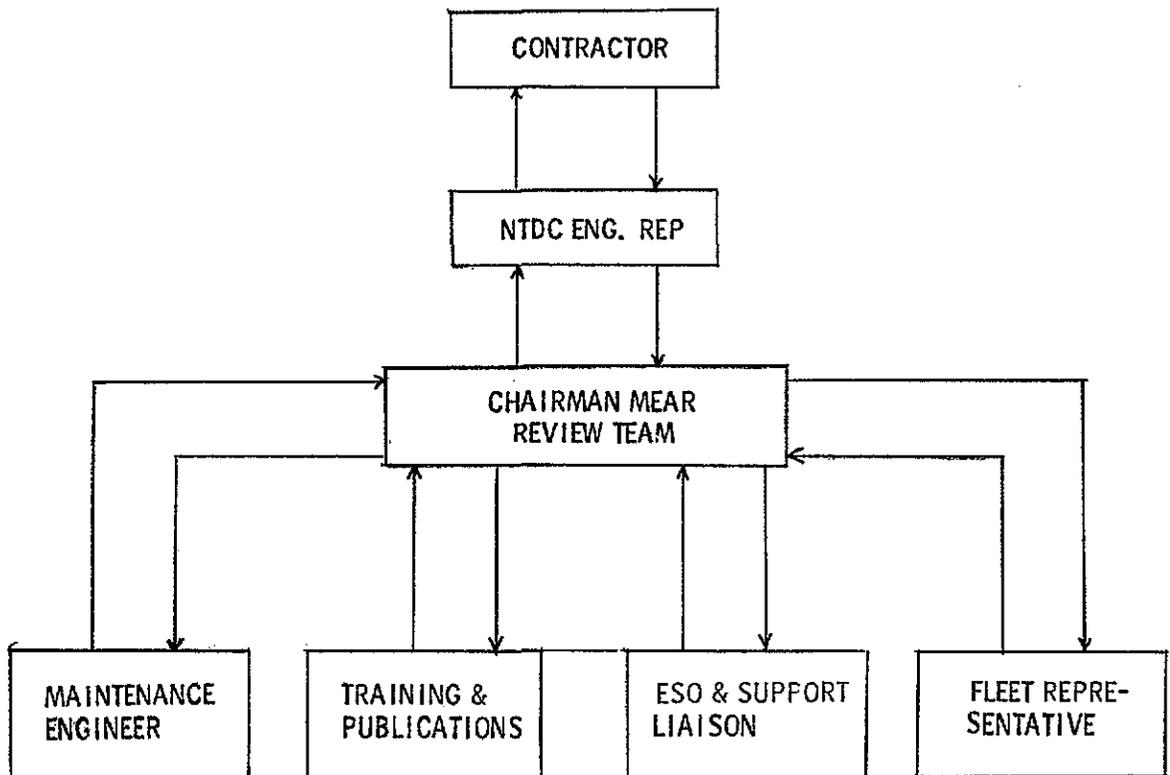


Figure 16. MEAR Review

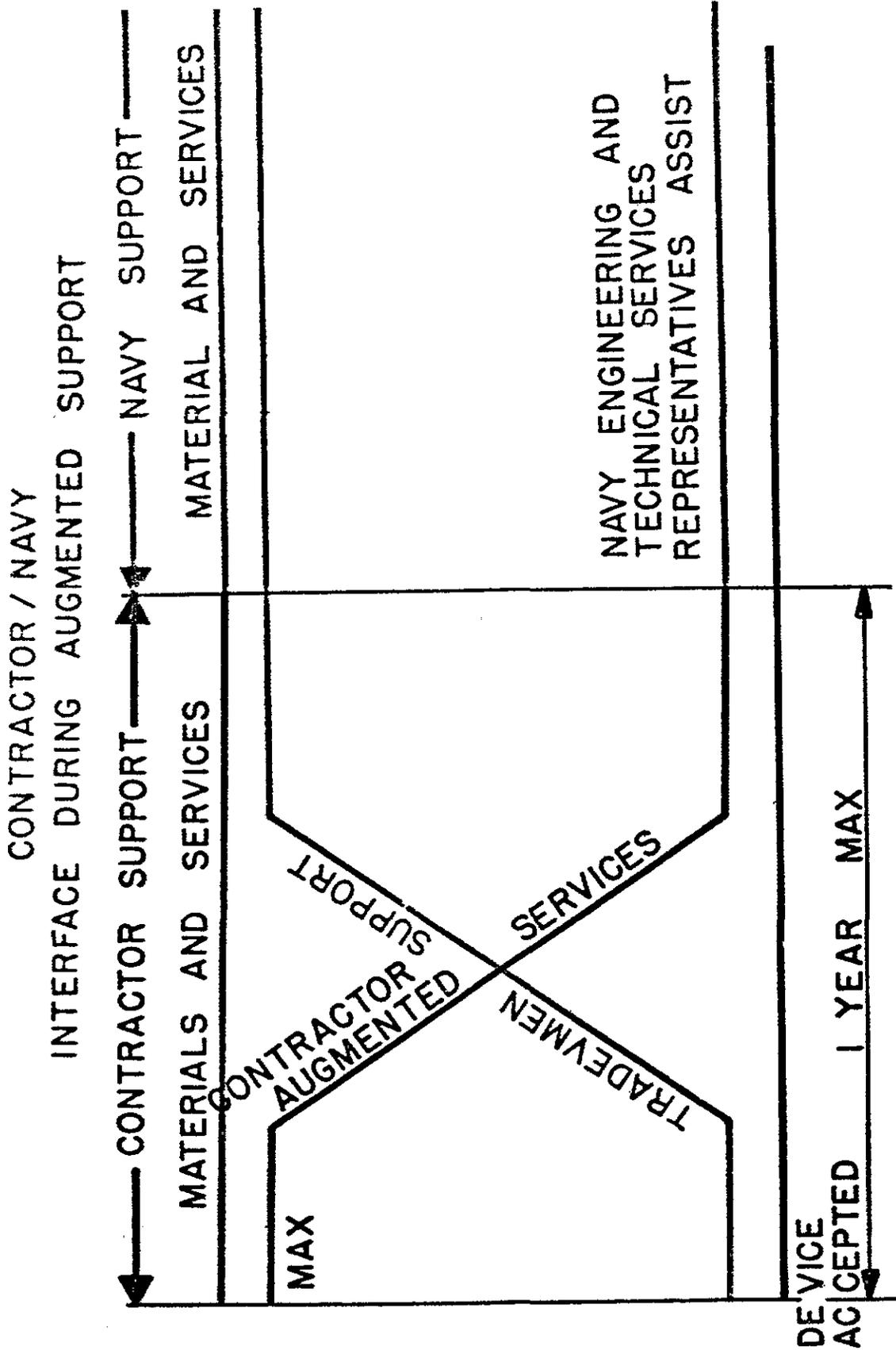


Figure 17. Augmented Support

contract, pending assumption of support responsibility by the Government." The period of augmented support, Figure 17, begins at the time the device is accepted at the installation site and this is the point in time when device availability is most critical. Ideally, delivery of the device occurs prior to the delivery of the operational equipment and the need for training is greatest. Also, the support resources of the Government are at a minimum at that time. The Electronics Supply Office and the Aviation Supply Office have not had sufficient time to provision for spare parts to be available and the Navy Technicians have not been trained to maintain and operate the device; therefore, the contractor bears the responsibility for keeping the device available until the Government is in a position to completely support it. In the development of a plan for augmented support, the contractor must also realize that he will gradually phase himself out of total responsibility for maintenance. He must reduce his direct maintenance effort while the Navy Technicians increase theirs, until such point in time when the Navy will assume all of the maintenance of the device.

The contractor must also plan ahead for the repair of repairables and the replacement of items that fail during the augmented support period; this includes contractor acquired operational equipment. The contractor should explore every possible method of supporting all of the equipment used in the device, whether it be a digital computer, an item of unmodified operational equipment, a plotting board, power supply, etc. For critical items, such as primary operational indicators he may elect to provide spares in the form of a kit on site for rapid replacement in the event of failure. He may elect to enter into a call-type contract with the vendor of a particular component, such as a digital computer, or he may decide to utilize his own in-plant repair facilities. The possibilities are numerous and will vary from trainer to trainer; however, his goal should be to develop a plan to provide reasonable assurance that in the event a part fails it can be repaired or replaced in the shortest amount of time.

What we are striving to achieve through integrated logistic support is 100% availability of training devices. If we cannot support our training devices, the training devices cannot support the fleet, and consequently our military power will be weakened. We must plan our support as early as possible and then we must support our plan.

CONTRACTOR-CONDUCTED TRAINING AND TECHNICAL PUBLICATIONS REQUIREMENTS

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My presentation deals with two sections of Bulletin 40-1. I shall first address myself to Section 4, which covers contractor-conducted training courses. This will be followed by Section 6, which spells out publications requirements. As I present the information I will emphasize areas of general deficiencies on the part of the Government and on the part of contractors, and indicate in-work or possible solutions.

Section 4 is the requirement for the contractor to conduct operation and maintenance training courses. The objective of these courses is to train the minimum number of Government personnel to assume device maintenance, operation and programming responsibility from the contractor at the earliest possible date.

This requirement for the contractor to conduct operation and maintenance training courses is a two-edged sword because it also obligates the Government to supply the students for the course. I'd like first to discuss the Government's handling of its