by increasing the availability of the training device, we have less down time, and can keep the student motivated by having the equipment in an operational status a maximum amount of the time.

We must never lose sight of the end objective of keeping the prime equipment operational and available for its intended use at any time. Automation of test equipment should be considered as a valuable, necessary tool to get the job done. At no time should it be considered for the sake of automation alone, without considering its full impact on the prime equipment. We must be the masters of automation, not the slaves to it, and mastery of automation begins in the designers' approach to the problem.

3M MAINTENANCE DATA SYSTEM AND AUGMENTED SUPPORT

Mr. R. N. Underwood
Head, Field Service Support Division

A new term which is gaining greater emphasis at NTDC is 3M, Maintenance and Material Management, on overall support management. The Maintenance Data Collection System, which I will discuss first, is one very important element of the 3M system. One which provides us with essential feedback for key management decisions concerning training device procurement, reliability, and support. My discussion is not only intended to acquaint you with the Maintenance Data Collection System, but also to convey our extreme interest in you as contractors and military, playing your respective roles in support of the goals of this system. Simply stated, the Maintenance Data Collection System (MDCS) is an efficient information system for reporting maintenance actions during the reliability test and augmented support phases of a training device contract. The Maintenance Data Collection System, which embodies many exciting advantages of modern reporting methods, has projected training device development and support programs into the age of automatic data processing (ADP). Reporting under the Maintenance Data Collection System begins initially at the manufacturer's plant during the Reliability Test Phase and continues on through the on-site Augmented Support Period. Reporting ends when the contractor support period is terminated. A single, uncomplicated, Maintenance Action Form is used to convey maintenance actions back to a central processing location from which many data products are available such as: raw tabulated data, reliability data, maintainability data, historical records of failures encountered, and numerous other possible data products.

Whenever an equipment failure is identified it is reported on the Maintenance Action Form in sufficient detail to permit correlation of the maintenance and material picture. With each successive report, failure rates gradually emerge. Typical data elements, are reported on the Maintenance Action Form. All maintenance and support actions will be reported during the period of interest. The first four listed elements are simple format elements. However, following elements such as "when discovered", "type maintenance:","action taken", etc., become more descriptive of the maintenance problem. The contractor has a prime responsibility for developing the "Work Unit Code" and several other codes for the system.

The Work Unit Code Manual is prepared by the contractor as a deliverable item under the contract. This manual contains the necessary alpha-numeric identification codes for entry on the Maintenance Action Form to accommodate automatic data processing.

When discovered code - identifies when a failure or correction was effected such as during routine maintenance, or preventive maintenance.
Support action code - identifies inspections, calibration, cleaning, etc.
Action taken code - identifies reported action such as repair, or alignment.
Malfunction code - indicates burned-out, broken, overheated and similar malfunctions.
Work Unit Code - identifies the location of the maintenance action to a specific category, system, subsystem, or component.

The extent and depth of equipment coding to be accomplished is shown as follows:

Repairable Items - such as amplifiers, display panels which a technician is expected to repair and return to use.
High Dollar Value Items - such as memory drums, recorder heads, and optical decoders.
High Failure Rate Items - such as power transistors, mechanical choppers, and relays.

Generation of the Work Unit Code is a major, and an exacting task. Generation of these codes by the contractor must be the result of much study and not done in a haphazard manner. Qualified personnel must be used. This cannot be emphasized too heavily.

Reliability is one of the more important data products to be derived from the Maintenance Data Collection System. Factors necessary to determine reliability are fed into the data processing machine, the crank is turned and out comes computed reliability figures. Comparisons can readily be made of actual reliability figures against contractual goals. A low equipment reliability figure might indicate the need for a modification to preclude excessive equipment downtime and high support costs.

Availability can be computed in a similar manner to Reliability. With proper data inputs the availability computation can be made.

$$\left(\frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} \right)$$

Availability refers to the probability that equipment will be ready when needed. Availability truly is our most important product. Low availability reflects seriously upon the contractor.

To what level can factors be determined? Factors such as Reliability can be determined for any desired level, from the individual part to the complete device. A joint responsibility exists:

For the Contractor:

Contract direction is provided in the Integrated Logistic Support bulletin.
Reporting is weekly during reliability testing and bi-weekly during augmented support.
Initial processing of forms is done by the contractor.
The Work Unit Code Manual is a deliverable item.

Naval Training Device Center must:

Generate the Bulletin and give Work Unit Code Manual direction.
Accomplish final processing. (Contractor gets information also)
Coordinate program.

Achieving a high availability is our No. 1 goal. During Reliability Testing and Augmented Support we must gain a better equipment appraisal. In addition, the Maintenance Data Collection System is a prime tool to verify contractual maintainability factors.

What about Product Improvement? Earlier assessment of prototype problems can result in earlier corrections. Also follow-on or future procurements should gain many benefits from documented maintenance historical data. Knowing the trade-off of various design approaches from either the maintainability or economics aspects is important.

A more accurate Support Evaluation can be made both from the supply and maintenance standpoints.

Fellow members of the Industry - NTDC Team.

----The goals are before us.

----The need for more maintainable devices, is apparent.

----The urgency of military preparedness is here.

----Defense dollars must be conserved.

Through effective implementation of the Maintenance Data Collection System outlined, we can materially promote these goals, resulting in a happy, satisfied, military customer, using equipment we all can be proud of as a team.

The second part of my talk will be concerned with Augmented Support and the Pipeline Sequence. The Pipeline Sequence to be covered deals with the period of preparation and training of NTDC civilian technicians and engineers, for eventual assumption of all training device specialized support, thus displacing the contractor field engineers completely. The Augmented Support Period refers to the length of time after device acceptance that contractor assistance is utilized. Although Augmented Support generally refers to the contractor support interval, we feel again that this is a team effort with both NTDC and Industry sharing in the overall responsibilities which will be discussed further.

The span time for the Augmented Support Period, may vary considerably; however, it will not exceed 12 months duration, in keeping with the intent of recent DOD directives. As we progress through the Augmented Support Span the specialized maintenance load is transferred from Industry to NTDC. Major accomplishments during this period fall under the headings of Maintenance, Training, Indoctrination, and Evaluation.

Once the training device has reached operational status, primary contractor support is oriented toward Maintenance, Operational, and Material Support.

A Software Review of handbooks, computer programs, maintenance plans, and schematics is accomplished in a mutual effort by the contractor and the Navy. Training of Navy military and civilian technicians by the contractor is a necessity in order to properly transfer the device maintenance responsibility.

Maintainability verification is the "proof-of-the-pudding" where the capability of the Navy Tradevmen to maintain the device is tested. Other maintainability factors such as time required to perform maintenance actions, and device availability are also evaluated. The Maintenance Data Collection System is a valuable tool in this verification.

The successful transition from full contractor support, to full Navy support is vital.

Reporting will consist of Maintenance Data Collection System Reports, and the Field Service Reports (oriented to contractor on-site activity).

The Navy civilian representative on-site, in pipeline training, will not only prepare for the eventual take over of the contractor's specialized assistance role, but will also provide an NTDC Quality Assurance monitoring function, for all program elements. For example, he will verify that all software is adequate and correct. Industry must "home-in" on their main objective early in order to achieve the desired transition. Ammunition such as test equipment, tools, qualified personnel, software, etc., must be applied to the task. Everything must point to the day of device transition from contractor support to Navy selfsufficiency.

Specialized assistance, which is over-and-above the technical capability of the Tradevman, must eventually be provided by the Navy civilian field representatives; therefore, a timely transition from the contractor is required here too. This Navy field representative comes well qualified both through experience and training. In fact, he will typically enter his Pipeline Training or preparation phase 3 or 4 months prior to equipment delivery. He will usually be at the factory, under the cognizance of the NTDC Project Engineer during final check out and Reliability testing.

As you may realize in the short time permitted for the two-part presentation on the Maintenance Data Collection System and Augmented Support; the device contractor, to successfully discharge his responsibilities, must be capable, highly motivated, and interested in the achievement of overall NTDC goals, as well as his own.

PRODUCT IMPROVEMENT

Mr. John Regan
Modification Engineering Program Manager

Up to this time the conference discussion has highlighted the acquisition or procurement phase of the training device. Let us now consider the operational phase, the changes that occur to the device during this phase and the part NTDC and Industry play in incorporating these changes into the devices.

For the purpose of this discussion let us assume that the operational phase is that phase which begins when the production contract coverage ceases and extends throughout the operational life of the device.

Changes to the original device occur to:

a. Correct deficiencies in Performance, Maintainability and Reliability

b. Incorporate additional training requirements

c. Keep the device current with operational equipment changes

d. Update the device from one operational equipment model to another

e. Convert the device from one type of operational equipment to another

f. Modernize the device by employing hardware current with the state of the art. (This could also be considered a reliability or maintainability improvement.)