WEAPONS SYSTEM TRAINER EFFECTIVENESS AS SEEN BY THE MAINTENANCE ENGINEER WORLD

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The Field Engineering Directorate and/or the Naval Training Device Center, has the basic responsibility of supporting U. S. Naval Training Devices throughout their life cycle. With your indulgence, I will briefly describe the scope and magnitude of that responsibility. Figure 145 reveals the dollar value inventory of devices under Center support cognizance. Pertinent facts, in approximate values, are:

-Devices in use during the period 1961-1967

-Devices in system stock during the period 1963-1967

-Total dollar value of inventory to be approximately $335.5 million

-Dollar value of devices in use - $310. million

-Devices in field use continually increasing

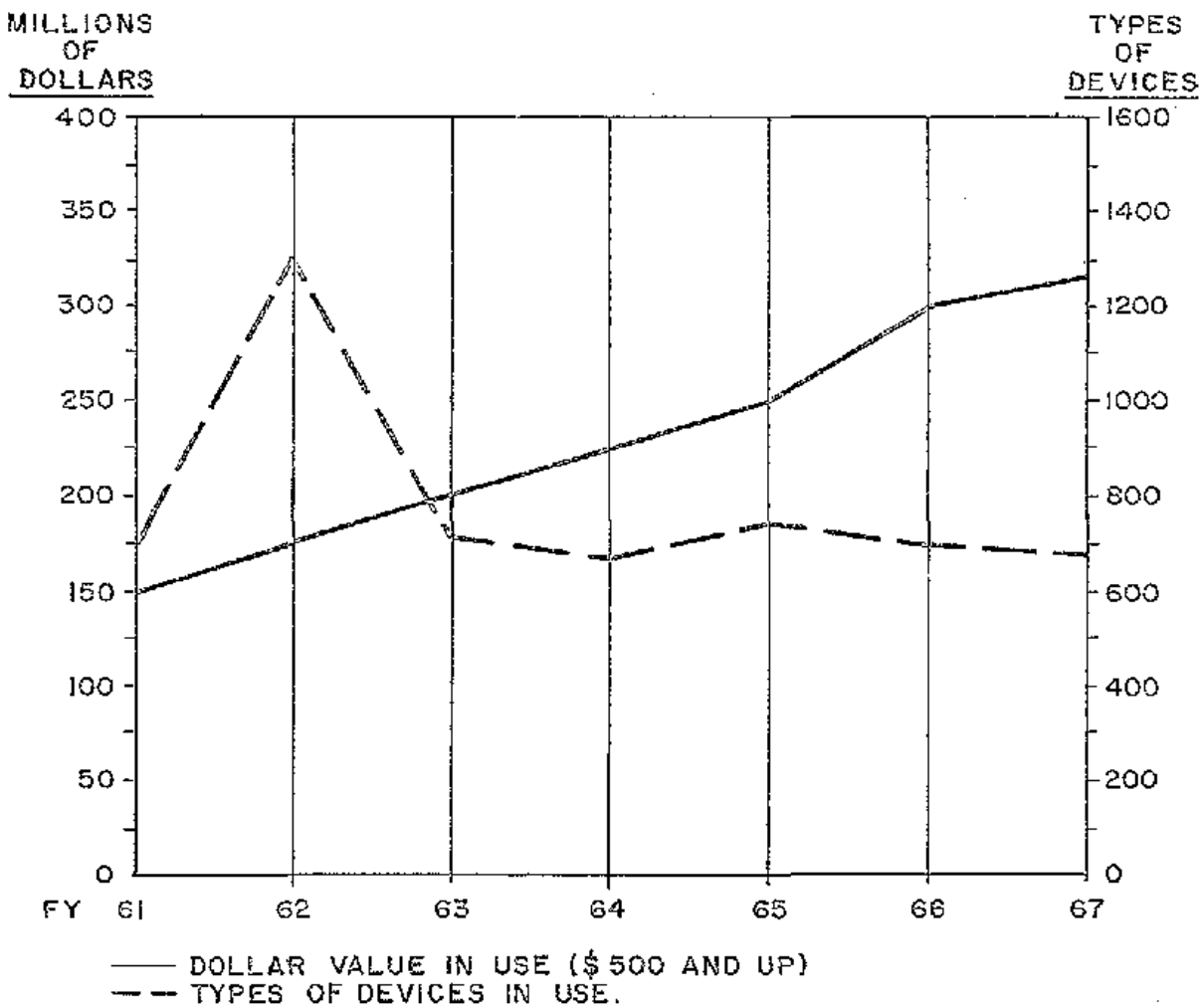

Figure 145. Training Device Inventory

A second method of describing the device inventory magnitude is shown in Figure 146. The numbers of devices are shown in cycles and the total inventory is categorized relative to dollar value. This year, 1967, shows 4, 626 devices in use. Looking at the period from 1962 through and including 1967, we see an ever-increasing inventory. Needless to say, each successive increase in inventory numbers are accompanied by an ever-increasing complexity in both functions designed into the equipment and the numbers of subsystems comprising the weapon system trainer.

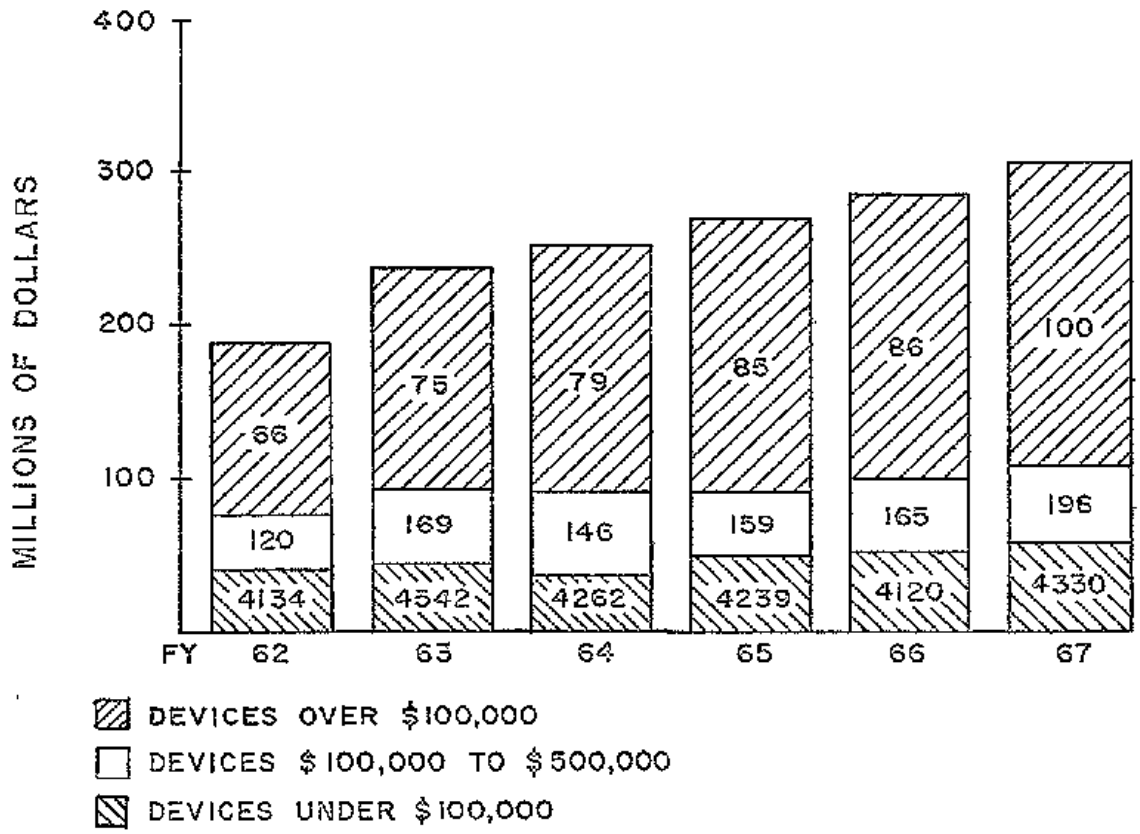

Figure 146. Device Inventory (in use, over $500)

Moving now to Figure 147, let's take a look at the geographic distribution of the many devices in inventory. From a logistic support point of view, the big problems here are recruitment, training, distribution, retention, re-training and re-locating the required numbers of technical personnel to man the ever-increasing training device inventory.

Figure 148 gives us a quick look at our present manning level for field engineering support. The figures reveal the following facts:

-On the average, the Naval Training Device Center is supplying approximately . 5 man of specialized technical services per activity supported.

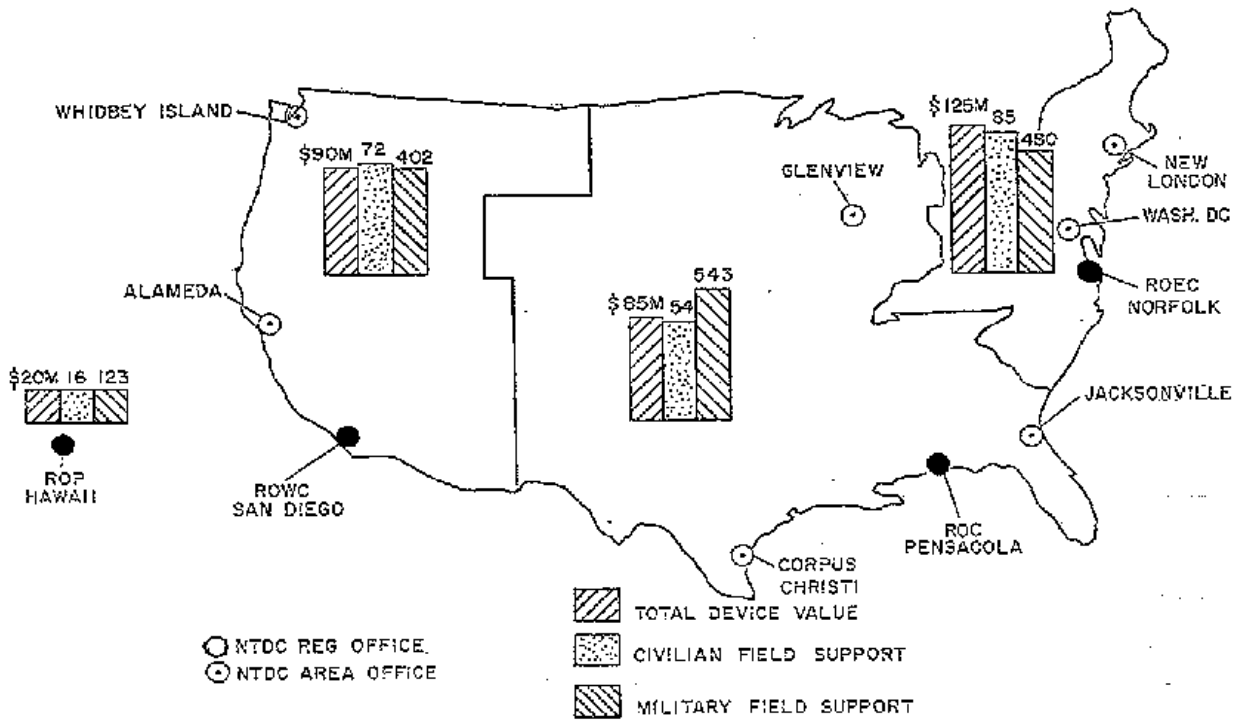

Figure 147. Training Device and Field Support Geographical Distribution

LOCATION	DEVICE VALUE	NTDCFER	MILITARY SUPPORT	ACTIVITIES SUPPORTED
RO EAST COAST	$125M	85	435	140
RO CENTRAL	85M	54	543	134
RO WEST COAST	90M	72	378	90
RO PACIFIC	20M	16	102	16
(MILITARY TRAINEES EC, WC, PAC)			90	
TOTALS	$320M	227	1548	380

Figure 148. Device Value and Support Distribution

-On the average, the Navy positions approximately 4 men of technical qualifications per activity to perform routine maintenance.

We have briefly referred to two elements of logistics support—equipment numbers and complexity, and numbers and qualifications of maintenance personnel. There are many other elements of support that originate and cause problems:

-Test equipment

-Personnel and training

-Spare parts provisioning

-Publications

-Facilities

-Contractual assistance

-Installation, re-location

-Modifications

-Miscellaneous

If the foregoing are some of the problems of support, it is only natural to ask what we are doing to solve them. We, like many others in Government, have established programs in an effort to reduce to a minimum all support elements previously listed. The more important of the programs are shown in Figure 149.

- WEAPONS SYSTEMS TRAINING DEVICE EFFECTIVENESS
- QUANTITATIVE RELIABILITY SPECIFICATIONS
- QUANTITATIVE MAINTAINABILITY SPECIFICATIONS
  - STANDARD FORM FACTORS
  - BUILT IN AUTOMATIC TEST AND EVALUATION
  - ELECTROMAGNETIC COMPATIBILITY
  - SELECTIVE SPARE PARTS PROVISIONING RELIABILITY/MAINTAINABILITY TRADE OFFS
- LIFE CYCLE COST ANALYSIS
- COST EFFECTIVENESS
- MAINTENANCE MATERIAL MANAGEMENT (3M)
- CONFIGURATION MANAGEMENT
- PUBLICATIONS AND DOCUMENTATION
- PERSONNEL TRAINING

Figure 149. NTDC Support Programs

-System effectiveness

-Quantitative reliability specifications supported by definitive contractual assistance language with emphasis and support of rigid audit procedure from the beginning to the end of the life cycle.

-Quantitative maintainability specifications supported by contract to define and insure the appropriate emphasis on rigid audit and attainment of:

Standard form factors built for maximum accessibility and realistic reproduction of the correct environment for components.

Built-in automatic test and evaluation. This reduces test equipment requirements and lowers the skill levels required for maintenance levels.

Electromagnetic compatibility.

Selective spare parts provisioning based on failure rates to provide the degree of readiness required within the limits of the available dollar.

R/M trade-off analysis for optimum dollar investment.

Life cycle cost analysis.

Maintenance material management (3M).

Personnel requirement and training.

Configuration management.

Let's take a second look at the word "Effectiveness." Refer to Figure 150.

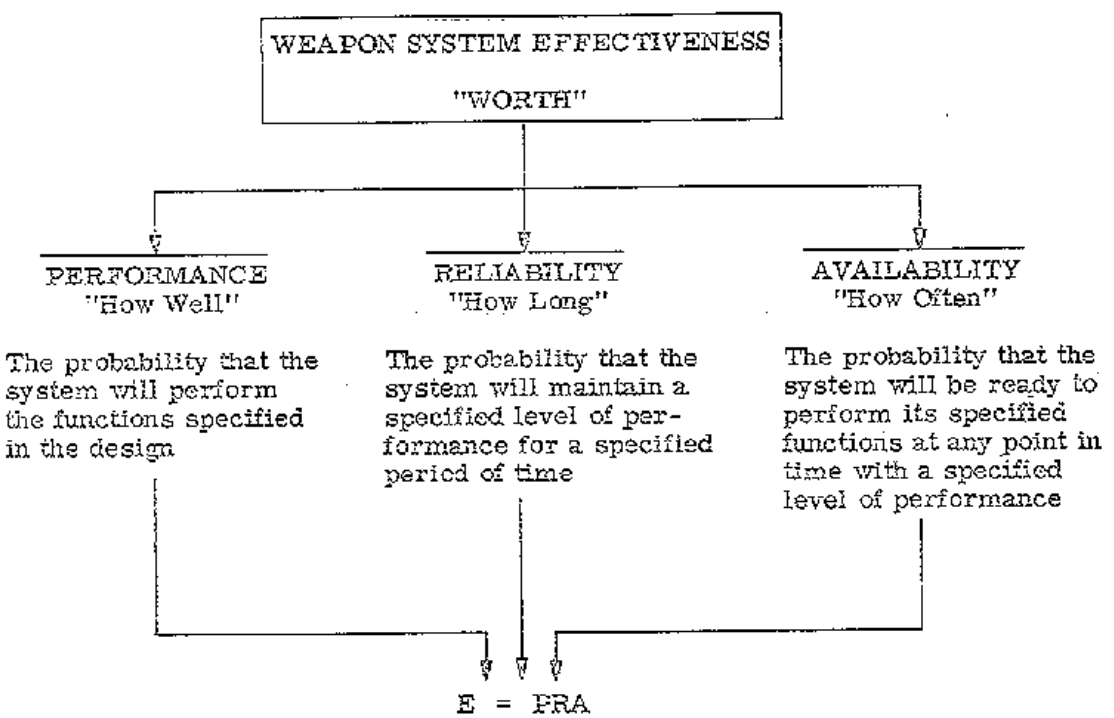

Figure 150. Weapon System Effectiveness "Worth"

Figure 151 illustrates the inner mathematical relations in the form of hyperbola family of curves for specified levels of reliability and availability. Assuming we specify a value of .9 effectiveness for a system—this imposes a very limited range or variations in values for both availability and reliability.

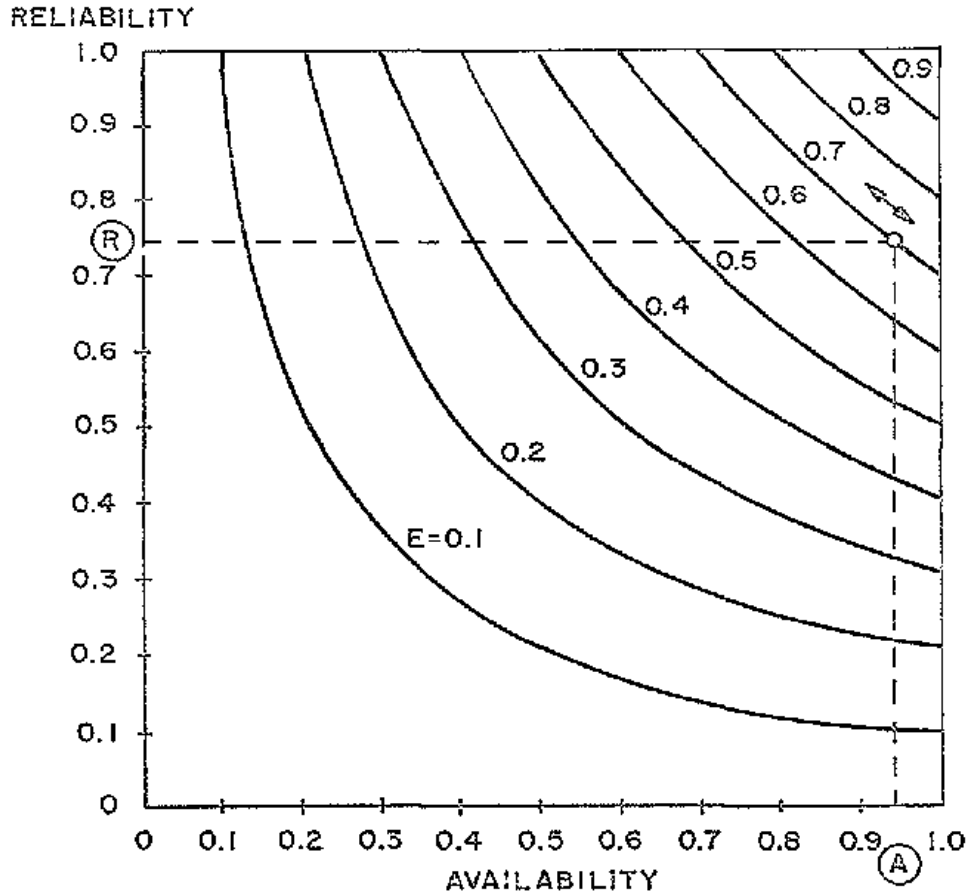

Figure 151. Conditional Effectiveness Hyperbola, E, for Specified Levels of Reliability and Availability, Conditional on Performance Capability = 1.0

Figure 152 reveals the importance of "Reliability" considerations in the overall "Effectiveness" of the system.

The primary concern of field engineering support is maintaining a given "Availability." Figure 153 depicts the availability possible as a function of the MTR/MTBF ratio. Halving MTR is equivalent to doubling the MTBF.

In summation, we invite (encourage) Industry to assist in implementation of programs with the following objectives:

-Produce simple equipment.

-Make it effective (low failure rate parts).

-Use standard "form factors."

-Eliminate the need for peripheral test equipment.

-Optimize MTTR commensurate with R/M/U (E) requirements.

-Give us optimum, useful software.

-Provide spare parts provisioning based on optimum failure rate components to effect the specified "readiness."

-Establish foolproof progress audits from design freeze to delivery.

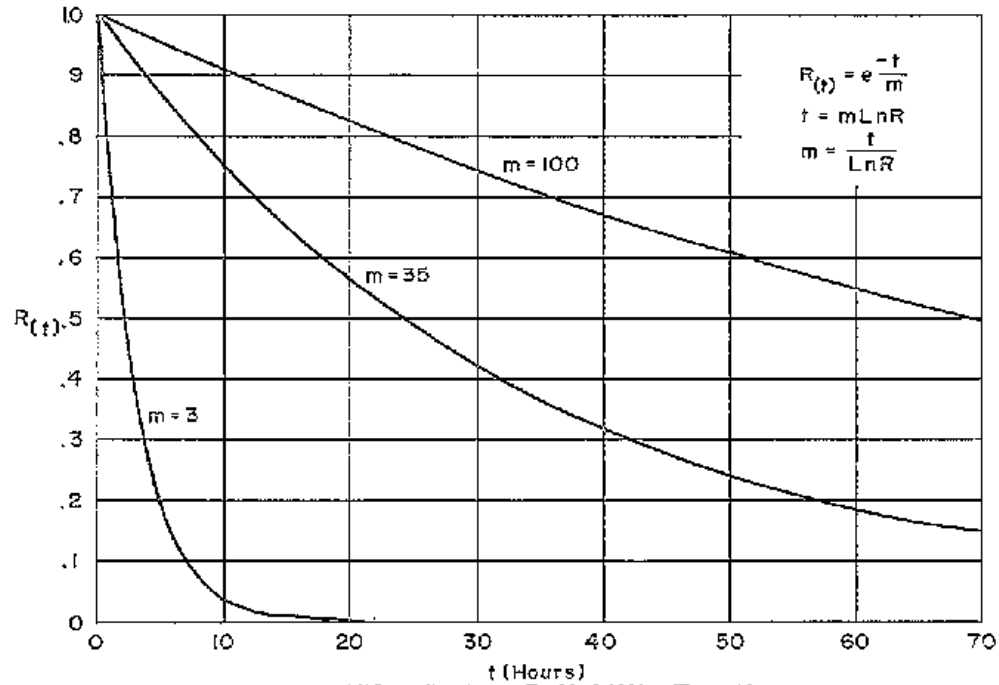

Figure 152. System Reliability Function, Showing the Effect of MTBF

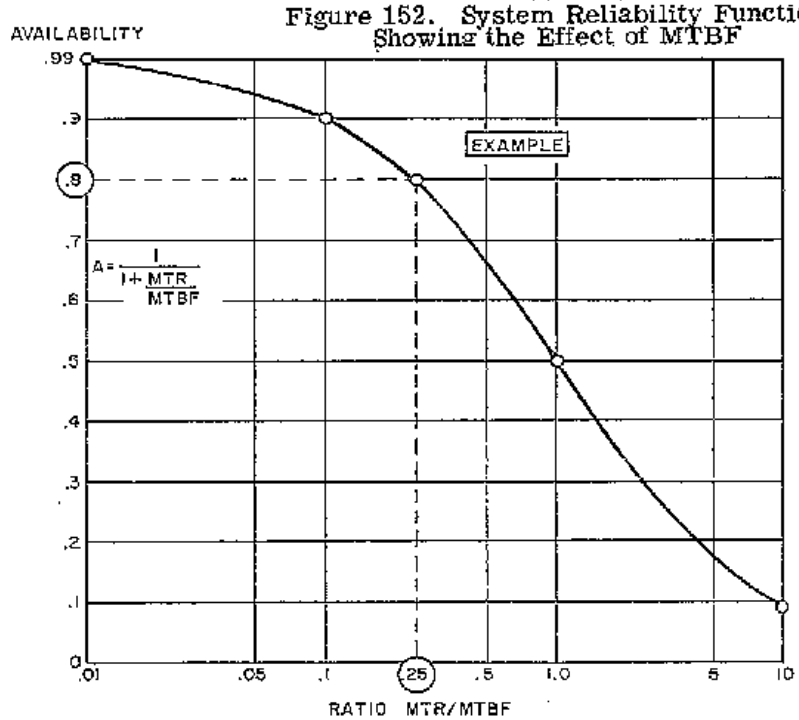

Figure 153. Relationship Between Availability and MTR/MTBF