COST EFFECTIVE ACQUISITION OF CONTRACTOR MAINTENANCE TRAINING

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ABSTRACT

This paper suggests that contractor maintenance training acquisition procedures used by Government are often not cost effective and suggests a paradigm for the development of acquisition procedures which will increase training effectiveness and reduce costs. Government often levies excessive and unnecessary restrictions on contractor by insisting that certain military standards and data item descriptions be followed even in those circumstances when such standards are both inappropriate and undesireable. This approach results in increased training acquisition costs.

INTRODUCTION

Contractor maintenance training courses for newly procured training devices are acquired for one reason only: to ensure that qualified personnel will be available to maintain the device throughout its life cycle. These courses must achieve an appropriate balance of various factors such as device maintenance concepts, performance objectives to be attained, and availability of training funds. Ideally, a course graduate will have the ability to effectively diagnose and isolate faults and repair the device within the specified mean downtime limits. The training acquisition program also procures training documentation and curricula to be used for retraining in the out years.

In the past few years, major forces have impacted heavily on the training device world. The scarcity and cost of fuel have caused an increased demand for training devices to replace training normally conducted in operational situations. To meet this need, more complex and sophisticated training devices are being developed. As technology advances, maintenance concepts change in an attempt to keep pace. Concurrently, it has become apparent that the input skill level of trainees is continually declining. Training funds are always in the vanguard of budget cuts. Given these factors as more or less permanent fixtures for the foreseeable future, it is imperative that cost effective, dynamic maintenance training acquisition concepts be developed if the training device community is to remain responsive to its overall mission.

PROBLEM ANALYSIS

Evidence which suggests that current maintenance training acquisition procedures are not cost effective can be traced to one major underlying factor: excessive Government regulation of industry. Several high level directives have been issued in an attempt to deal with this problem, four of which are expressly germane to the maintenance training acquisition process. The Defense Acquisition Regulations (DAR) set forth the basic legal doctrine defining the role of Government and contractor relationships. (1) Office of Management and Budget (OMB) Circular A-109 Major Systems Acquisitions further defines these roles and explicitly recommends that Government establish system performance objectives and allow the contractor to develop detailed design and training objectives. (7) The policies of OMB Circular A-109 are further explicated in OMB Curcular A-76, Policies for Acquiring Commercial or Industrial Products and Services for Government Use. (6) Secretary of the Navy Instruction (SECNAVINST) 4200.27A Proper Use of Contractor Personnel clearly defines the proper role of contractor personnel. (9)

In spite of these and other policy documents and legal prohibitions, current acquisition procedures continue to regulate almost every step of a contractor's maintenance training development efforts. In the initial phases of procurement, detailed overly specific Requests For Proposal (RFP) limit the creativity and resourcefulness of the contractor. (10) Once the contract has been awarded, the administration of the maintenance training acquisition element often veers away from the spirit and the letter of the directives cited above. Both of these situations are results of the current maintenance training acquisition philosophy, which has evolved into a rigidly structured process of constant control and monitoring of the contractor's efforts from program conception to contract conclusion. Government personnel from the functional areas of engineering, management, logistics, contracting, and training continually tell the contractor what and how

much training is required, how to develop the training curriculum, how to write curriculum data items, and what instructional procedures will be followed. Particularly in the curriculum development process the contractor is bound to procedures outlined and delineated in a plethora of regulations and instructions. The entire training course and curriculum development process is tied to the contents of the Military Standard governing contract training programs (MIL-STD 1379A) and various Data Item Descriptions (DIDs). (2) These standards specify that the format, content areas, and virtually all other facets of the curriculum associated documents will be developed in accordance with highly structured curriculum development models.

However, highly structured models are not panaceas for all curriculum development efforts and problems. While an instructional system development process provides excellent curriculum development guidelines and procedures for efforts on training courses of a continuing or "pipeline" nature, this process is not always appropriate for developing curricula for what are essentially one time factory training courses. Curriculum development utilizing rigidly structured procedures and models requires a substantial expenditure of time, effort, and money. Such expenditures can be justified for a "pipeline" type training course; they cannot be justified for a course that will be presented only one or two times during a device life cycle even if quality products are received.

Unfortunately, quality products are rare. A large number of curricula are accepted by Government because they meet all the legal requirements of the contract, not because they are of high quality. While in the process of preparing and responding to RFPs, neither Government nor industry pays proper attention to the difficult nature of applying the instructional systems development process specified by MIL-STD 1379A. As a result, contractors often misjudge the effort required to meet standards specified by MIL-STD 1379A and associated DIDs. A recent study has partially documented some of the curricula development problems encountered by a professional training development firm using these Government mandated procedures. (3) These problems and others can reasonably be expected to pose major concerns for hardware oriented contractors, particularly those who rarely employ personnel with instructional systems development experience. Contractors usually appoint engineers, technical writers, publication specialists, or personnel from a public school or university background to head and staff their training departments.

The acceptance of mediocre and marginal quality curricula is also influenced greatly by the delivery schedule of curricula data items. These items are normally delivered toward the end of the acquisition cycle. Shrewd contractors realize that at this stage of the cycle, hardware oriented Government program managers are growing weary of problems, especially if device delivery has been delayed one or more times and cost overruns have occurred; they are anxious to close the contract. All too often, various pressures cause curricula data item discrepancies, which threaten further delays, to be inadvertantly overlooked.

Over the years, various management policies have evolved which seldom allow training acquisition personnel to simply reject an unsatisfactory product; a detailed justification explaining why the product was rejected must be provided. Astute contractors are aware that if these detailed justifications are not provided, low quality curricula data items can be produced at a sizable cost savings. Once detailed comments are provided, all the contractor need do is incorporate these comments into his own format and resubmit. This editing function constitutes a very time consuming process for training acquisition personnel. Situations thus tend to develop wherein Government personnel provide detailed instruction in curriculum development prior to the delivery of final data items simply to preclude becoming a contractor's proofreader and editor.

As a result, in many instances, training acquisition personnel perform a significant portion of the contractor's work in order to receive an acceptable, quality product. This process keeps these personnel from performing more important functions, such as maintenance training needs analysis, development of performance objectives, and training evaluation. It is also in direct violation of various policies and directives.

Still another problem inherent within the current training acquisition philosophy is the procurement of unnecessary curriculum data items. The typical curriculum acquired for a maintenance training course consists of a Training Course and Curriculum Outline, an Instructor's Guide, a Student Guide, Audio Visual Aids, Tests, Evaluation Forms, and an On-The-Job Training Handbook. The average cost for these data items is $64,000. with an upward range of well over $250,000. Yet it is seldom questioned whether all of these items are actually required to achieve an acceptable maintenance training course.

Curriculum data items produced for a maintenance training course consist of maintenance documentation packaged in an instructional systems format. This same documentation is also delivered under another contract line item. Since both line items are priced out as original development effort, in effect Government is paying twice for one product, namely technical maintenance documentation.

As an example, an On-The-Job Training Handbook is little more than a guide and a supplement to device maintenance documentation. Still, Government pays up to $65,000. and over to acquire On-The-Job Training Handbooks. Perhaps this expenditure might be justified if Instructor

Guides, Student Guides, Audio Visual Aids, and Text materials were not also acquired. Some Government agencies are beginning to deal with overprocurement problems such as these by establishing Maximum Data Lists and Data Review Boards. Although such tactics produce limited results, they are in effect well meaning attempts to "fix" a system that appears to require a major overhaul. There is no rational justification for procurement of all these curriculum items in addition to the required maintenance documentation.

Further, contracts normally require that the person designated as the maintenance training course instructor be a member of the team that develops maintenance and other device documentation. During this process, the instructor necessarily has to compile notes, diagrams, and other materials that will be used in teaching the course. Prior to the application of an instructional systems development process to almost every curriculum development situation, effective maintenance training courses were conducted using the instructor's personally prepared lesson plans, professional knowledge and expertise, and the maintenance documentation.

The only logical rationale for paying the contractor to restructure all of this technical knowledge and information into a specific instructional systems format appears to be that the curriculum data items will be required for retraining efforts in the out years. However, this rationale does not hold up under close scrutiny. By the time retraining is required either device modifications have made the training material obsolete or the material has been lost. Although one or two curriculum data items may be used in retraining, the entire curriculum package will be used only once or twice in a fifteen year period, if used at all. *More often than not, situational* requirements dictate that personnel who conduct retraining develop their own materials and methods to meet current needs. In essence, a qualified instructor and a well developed and up to date maintenance documentation package are the only elements required to conduct formal retraining courses. Moreover, individualized learning programs such as Technical Hands On Training (THOT) packages are finding greater acceptance and application in the retraining effort. Since Government personnel have the ability to develop THOT type programs from high quality and complete maintenance documentation, *the requirement to procure* fully developed, rigidly formatted curriculum is obviated.

Another dubious cost factor can be found under the heading "Instructor Preparation Time." As noted earlier, the instructor is normally required contractually to be a member of the team which develops maintenance documentation. Still, contractors insist upon an instructor preparation time within a ratio of 2 to 6 times course length. This means that if a maintenance course is scheduled to be 6 weeks long (240 hours), a contractor may submit charges for preparation time that range from 480 hours up to 1440 hours. At an average conservative rate of $35. an hour cost to Government, this translates into a price range of $16,800. to $50,400. for preparation time. Since the instructor is required to be intimately familiar with the device under the terms of the contract, it would appear that in many instances Government is charged twice for the same product, namely the instructor's knowledge of device operation and maintenance procedures.

No satisfactory explanation has been advanced to explain why, after spending between 9 and 18 months as a member of the team which develops maintenance documentation and curriculum data items, an instructor would require anywhere from 12 to 36 weeks to prepare to teach a 6 week course. This reasoning is even more incongruous when it is realized that at least 3 of the 6 weeks will be devoted to student hands-on training in the laboratory, with the instructor serving in an observer/advisor capacity. This leaves only 3 weeks of actual instruction time for which preparation is required.

DATA ANALYSIS

Maintenance training acquisition costs are defined as dollars provided to the contractor to develop and present maintenance training. These costs include the cost of instructor services and development costs for curriculum data items. Because of the infinite number of variables present in maintenance training acquisition programs which extend over a period of two to three years, and because of the variations in individual contracts, precise data, especially for curriculum data items acquisition, are not available. However, from the accessible data, it is possible to ascertain that maintenance training costs are steadily increasing.

The periods chosen for this study coincide with the introduction of instructional systems development models to the maintenance training acquisition process in 1973 - 1974, and the issuance of MIL-STD 1379A in 1976. Although a portion of the increased costs of training acquisition can be attributed to inflation, the data strongly suggests that inappropriate curriculum development standards and over-regulation of the contractor's development efforts have contributed greatly to this increase.

Curricula data items are not normally priced separately in a contract but by lot with other written materials. Available information indicates that for a contract in the $2,000,000. range, the average cost of training data items is $65,000. or approximately 3.3% of the total contract price. As has been shown earlier, many

of these data items are unnecessary, thereby adding to the overall non-cost effectiveness of the maintenance training acquisition process.

A cost analysis of Instructor Services (preparation, presentation, and other associated costs) indicates a major increase in the weekly cost of maintenance training beginning in 1974. The average cost per week for the period 1969 through 1973 was $2700. while for the period 1974 through 1979, the average cost per week was $5100. This represents an increase of 93%. A second comparison shows that the average cost per week for the period 1974 through 1976 was $4600., while for the period 1977 through 1979, costs averaged $5700. per week, a 24% increase. A comparison of the average costs per week for the 1969 - 1973 period with the 1977 - 1979 period shows an increase of 111%.

To examine maintenance training costs from a different perspective data was gathered from a random sample of 30 maintenance training acquisition programs; 15 from the period 1972 - 1975, and 15 from the period 1976 - 1979. The data gathered from the first period were used in establishing a baseline with which to compare the costs of procurements under MIL-STD 1379A, which was issued in 1976.

A summation of the gathered data indicates that in the period 1972 - 1975, 220 weeks of maintenance training were procured. Total procurement costs for the 15 training programs were:

(Costs shown in millions of dollars)

Contract	Hardware	Maintenance Training
31.8	23.4	.70

In comparison, during the period 1976 - 1979, 156 weeks of maintenance training were procured. Total procurement costs for the 15 training programs were:

(Costs shown in millions of dollars)

Contract	Hardware	Maintenance Training
27.9	20.8	.92

The average cost per maintenance training hour for the 1972-1975 programs was $80. For the post 1975 programs the average cost per maintenance training hour was $147. This is an increase of $67. or 84% per training hour.

Because of the problems involved in attempting to correct for the effects of inflation, data were primarily analyzed as ratios of maintenance training costs to total contract and hardware costs:

	Hardware to Contract	Maint. Trng. to Contract	Maint. Trng. to Hardware
Baseline 1972-1975	73.5%	2.2%	3.0%
Current 1976-1979	74.9%	3.3%	4.4%

During the 1972 - 1975 period maintenance training costs were 2.2% of total contract costs. During the 1976 - 1979 period, maintenance training costs rose to 3.3% of the total contract cost, an increase of 50%. The maintenance training to hardware cost ratio has also risen by 47%, although hardware costs have increased by a ratio of only 1.9%. Results similar to these have been found in a separate study recently conducted on 20 other maintenance training programs. (4)

The last decade has seen advances in maintenance aids such as software diagnostics for troubleshooting, more modularized equipment which calls only for isolation to board level, and card testers which expedite and facilitate component isolation. Still, maintenance training programs have become more expensive both in true dollar value and as a percentage of contract cost.

RECOMMENDATION

Fresh thinking is sorely needed in the general area of life cycle device maintenance and the specific area of maintenance training if the above trends are to be reversed. Although many arguments can be made in support of current methods of maintenance training acquisition, little data exists to support these arguments. It must also be remembered that cost effectiveness and training effectiveness are not synonomous terms. (8) Even if it could be proven that current acquisition procedures are effective, this does not exclude the very strong probability that other procedures may be equally effective and may cost considerably less.

Contractor developed maintenance training may be acquired more cost effectively through the implementation of a Criterion Referenced Systems Approach (CRSA) to maintenance training acquisition. This approach is based on three premises:

a. maintenance training is an integral part of device procurement, and the contractor should be tasked with the full and total responsibility for providing training that will produce qualified device maintenance personnel.
b. given the proper motivation, contractors can acquire the resources and expertise required to provide high quality maintenance training in a cost effective manner.
c. Government can provide this motivation by stipulating in the contract that a significant portion of total payment will be withheld until satisfactory training is received and by allowing the contractor to accomplish this without the burden of excessive Government restrictions and directions.

CRSA in the training acquisition process consists of three components: INPUT-PROCESS-OUTPUT. Neither the CRSA model nor the CRSA concepts are new or unknown in the training field. What may be unique is that CRSA is based on the premise that if Government furnishes the required input and defines the required output, and holds industry totally accountable for the process, high caliber, cost effective maintenance training will result.

The INPUT component is the responsibility of Government. Skill and knowledge profiles have been developed for each Navy rate and rating. It is up to Government to determine from what skill and knowledge level the contractor must start developing his training. Prospective students should be pretested to ensure that Government and contractors are aware of the actual skill and knowledge levels of these students. If remediation is required, it may prove more cost effective to procure remedial training through some other source than to have the contractor develop a longer training course to accomodate deficiencies in student input levels. This component also contains performance objectives which have been derived from a training requirements analysis. (11) Again, it is Government's responsibility to determine what level of performance is required of a course graduate and to define these requirements clearly and succinctly.

The ultimate cost effectiveness of the training will depend in large part on what skill and knowledge levels have been selected, on how well training requirements have been analyzed, and on how skillfully performance objectives have been constructed. In effect, Government is establishing criterion referenced inputs and certifying that the contractor should base his cost proposal on these inputs. If for some reason Government should deviate from these inputs, the contractor can easily measure the deviation and rightfully claim a commensurate amount of consideration.

The PROCESS component is the sole responsibility of the contractor. After receiving all the required input data, the contractor is tasked with the total freedom to develop a training curriculum that will satisfy the performance objectives. Since satisfactory completion of training will be based on criterion referenced performance objectives and measurements, it becomes the responsibility of the contractor to develop an accurate cost proposal. If the contractor underestimates the effort involved, he will no longer be able to claim his problems have been caused by Government demands and changes, as currently occurs all too often. Since there will be no provisions for "get well" clauses at Government's expense in the contract, contractor mistakes or ineptitude will affect only the contractor. He will still be required to provide what he said he would or suffer the loss of a significant portion of the overall contract price.

It is in this component of the CRSA that strict adherence to the directives and instructions cited earlier is required. SECNAVINST 4200.27A is specific in defining the required Government/contractor relationship:

> The Government may...obtain the (required) work by contract, providing two conditions are met: (1) the contract itself must ask for the finished product, only, and (2) the contract must be administered in such a way that control and supervision over the work and discretion as to the techniques which will be used remain solely with the contractor....

The intent of this statement is made explicit in the very next sentence.

> ...In other words, if the Government wants a building painted (or personnel trained), it defines the job, lets the contractor paint the building (train the personnel) as he sees fit, and then accepts it or rejects it solely on the basis of whether the completed job meets the contract specification....

The OUTPUT component is the responsibility of Government, which must determine what it expects the student to be able to accomplish upon completion of maintenance training. These expectations must be stated in terms of effective performance as established by criterion based performance objectives. In order to accomplish this, a thorough maintenance training requirements analysis must be commenced as soon as the engineering specifications are formulated. From this analysis, functional training specifications are written by Government. These specifications set forth the performance objectives and assessment methods which Government intends to use to accept or reject the contractor's training effort.

The performance objectives and methods of assessment become part of the input component. Once these items are defined, Government is able to write an RFP which will enable contractors to develop effective, competitively priced cost proposals. After a proposal has been accepted and a contract awarded, the data therein is used to develop a definitive assessment design and specific performance measurements with which to measure the contractor's maintenance training performance.

The preferred method of assessment is a comprehensive performance examination which might also serve as a maintainability demonstration. Such an assessment instrument would assure that the trainees are actually capable of fully maintaining the device to the level required by the contract. If a written assessment is deemed desireable, the Solomon design is an excellent method of determining the value

of the instruction received in comparison to the general knowledge that the trainee may posess from experience or by association with other training devices.

SUMMARY

The rising costs of contractor developed maintenance training are decreasing the cost effectiveness of current training acquisition procedures. Given the austere funding climate of the predictable future, this situation is intolerable. Preliminary research indicates that several underlying causes contribute to the unwarranted escalation of maintenance training costs. When these causes are examined, it becomes apparent that adherence to inappropriate acquisition policies results in inadequate definition of needs, improper utilization of Government personnel, unnecessary procurement of data and services, and loss of contractor ingenuity and resourcefulness.

Obviously, there is no one perfect method which will ensure cost effective acquisition of maintenance training. The method recommended in this paper is just as susceptible to inept application as is the current method. However, the authors believe that given equal amounts of conscientious attention by maintenance training acquisition personnel, the Criterion Referenced Systems Approach will prove more cost effective than have the current methods of maintenance training acquisition.

REFERENCES

1. Department of Defense. Defense Acquisition Regulations. Washington, D.C., 1976.

2. Department of Defense. MIL-STD 1379A. Military Standard Contract Training Programs. Washington, D.C., October, 1976.

3. Gwise, T.E. Improving Task Oriented Curricula: Discrepancies Occurring in Job and Training Task Analysis. Unpublished Manuscript, 1980.

4. Gwise, T.E. Direct and Indirect Costs of Maintenance Training Acquisition Methods. Unpublished Manuscript, 1980.

5. Morris, T.E. An Analysis of the CNET Support Command Role in Support of Navy Simulators. Unpublished Manuscript, 1976.

6. Office of Management and Budget. Circular No. A-76 Revised: Policies for Acquiring Commercial or Industrial Products and Services for Government Use. Washington, D.C., 1976.

7. Office of Management and Budget. Circular No. A-109: Major Systems Acquisitions. Washington, D.C., April, 1976.

8. Orlansky, J. and String, J. Cost Effectiveness of Flight Simulators for Military Training. Ist Interservice/Industry Training Equipment Conference, Orlando, FL., 1979, pp. 9-18.

9. Secretary of Navy. SECNAVINST 4200.27A: Proper Use of Contractor Personnel. Washington, D.C., 1976.

10. Taylor, A. B. Keeping Down the Cost of Training: A Challenge to the User. Ist Interservice/Industry Training Equipment Conference, Orlando, FL., 1979, pp. 45-48.

11. Vaughan, J.J. Training Requirements Determination During Early Phases of Weapon System Acquisition. Ist Interservice/Industry Conference, Orlando, FL., 1979, pp. 437-448.

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