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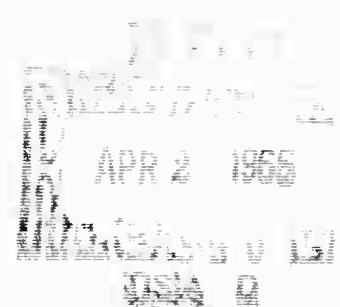
ELECTRONICS RESEARCH LABORATORIES

COST GUIDELINES FOR STUDY CONTRACTORS

TECHNICAL REPORT T-1/306

BY

C. WALSH



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October 6, 1964

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Prepared for

Director

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Washington D. C. 20301

and

Director of Physical Sciences

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PREFACE

The cost guidelines presented in this report were originally prepared for use in the ARPA Limited Attack Defense study. They are based largely on a document prepared by the Rand Corporation from the USAF cost manual "Contractor Cost Study"* which details required cost categories and procedures for procurement contracts.

Although the desired uniformity of cost reporting was not achieved by providing contractors with these guidelines, a great deal was accomplished in obtaining comparable cost figures. Thus, the problem of reducing the various costs to a common base was made manageable. Since these guidelines are not unduly restricted to types of systems or equipment, it is recommended that they be used for any future cost-effectiveness studies. Where modifications increase the usefulness or applicability, it is suggested that they be made in this document along with an explanatory note. Finally, the first experience with the use of this document suggests that a firm insistence on adherence to its form and content be exercised from the onset of a study, and that the contractors be referred to the source manual for detailed cost breakdown.

* "Contractor Cost Study" USAF Air Force Systems Command DCS/Comptroller 1962.

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AUTHORIZATION

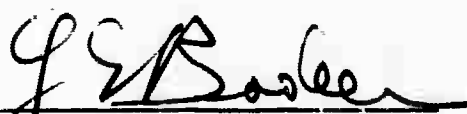
The work described in this report was performed at the Electronics Research Laboratories of the School of Engineering and Applied Science of Columbia University, and the report was prepared by C. Walsh.

This project is directed by the Advanced Research Projects Agency of the Department of Defense and is administered by the Air Force Office of Scientific Research under Contract AF 49(638)-1113.

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I. INTRODUCTION

The object of the present study is to weigh the technical system potential against economic resources in terms of effectiveness per dollar spent. The number and types of systems considered by the various contractors will be substantial. Cost guidelines are thus required to insure that the economic resources are equally measured in all cases. Since the study results will form part of the basis of executive decisions the reported costs should be based on the experience and judgment of the participating contractors, rather than developed from arbitrary rules.

The following guidelines, then, indicate the areas of substantial interest and seek to elicit supporting data to permit the proper evaluation of the stated costs.

It is not the intent of these guidelines to force rigid adherence throughout the optimization process. They should, however, be applied in the reporting of systems which appear to meet the needs of the study.

Systems which can employ potential cost-free assets (e.g., Hercules sites) should first be costed as if these assets were not available. These assets may then be assumed and a comparative cost derived. This holds true even in those cases where the lack of cost-free assets (e.g., BMEWS data) would tend to change the system configuration or cause the costs to exceed the limits of the study. When cost-free assets are assumed the appropriate guideline applies.

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For the purpose of generating reliability, manpower, and spares costs it should be assumed that the systems are required to operate on a 90-per cent operational basis.

The deployment should be assumed to be instantaneous in the first year of operation. Time phased deployment may be examined late in the study for systems of particular interest. Also of interest are costs of operation for a period of five years.

II. PRESENTATION OF COSTS

The actual presentation format is optional. Cost figures and substantiating data may, for example, be presented independently if the relations are made sufficiently clear. The following categories should, in any event, be summarized:

1. Research, development, test and evaluation
2. Initial investment
3. Annual operating cost
4. Total acquisition and five-year operating cost
5. Cost estimation of major subsystem hardware in support of the above total.

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III. SYSTEM DEFINITION AND CONSTRAINTS

The contractors' technical reports will define those system characteristics which contribute to the system effectiveness. For reasonable cost estimates, however, other characteristics are required, a number of which are listed in the table below, with some examples of the data required.

All assumptions of cost-free assets should be clearly defined. This includes equipment, facilities and trained manpower. The intended use of existing facilities (e.g., launch and range facilities of AMR and PMR, Hercules bases) should also be stated.

Implicit in the estimation of RDT&E is an evaluation of the state of the art of all major subsystem hardware - the present technological level and the effort needed to advance to required capability should be discussed and quantified.

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CATEGORY	TYPICAL ITEMS	REQUIRED CHARACTERISTICS
Major Subsystem Hardware	Missile/booster Radar/sensor Data processing equipment Communications/command and control	Significant characteristics of the hardware in sufficient detail to show cost sensitivity. Cost quantity relationship.
Facilities	Physical area required Operational buildings Support buildings Utilities	Number and size of buildings required. Estimating factors. Hardness. Land area.
Manpower	Operating personnel Military and/or civilian training	Number of personnel per shift. Capability of military to operate.
Deployment	Geographic and site layout Number of sites Communications	Inter-site communication requirements, for example, might represent a significant operating cost.
Maintenance	Major hardware spares Reliability/life time Contractor requirements	The factors used for the generation of spares and spare parts should be stated.

IV. COST CATEGORIES

The following section lists cost categories appropriate for summarizing the cost of a system. The coverage for each element is stated. Illustrative factors and/or relationships are given where applicable.

Where the contractor elects to estimate costs by means of a factor or other relationship, the factor and the base against which it is applied or the relationship should be given. Documentation of major subsystem hardware cost estimation (including cost/quantity curves where applicable) should be included separately.

A. RESEARCH DEVELOPMENT TEST AND EVALUATION

Costs of development of the system to the point where it is ready for introduction to operational use, including testing and prototype development:

1. Management. Costs of over-all management to develop and test the system, where management is defined as the centralized direction of the effort in the specific areas of system management, planning, development, program administration, etc.
2. Prime Mission Equipment. Costs of development engineering, testing, and manufacture of prime mission equipment, hardware and parts to be used in the R&D program. Number of test articles should be specified.
3. Ground Support Equipment (GSE). Costs of research, development, testing, and manufacturing of GSE and spare

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parts to be used in the R&D program. Number of test articles should be specified.

4. Personnel and Training. Costs of developing maintenance trainers, operator trainers, quantitative and qualitative personnel requirements, and other costs such as personnel equipment data, human engineering, technical training publications, etc.

5. Technical Data. Costs of preparing engineering data and engineering technical orders and manuals required in support of the development and test phase of the program.

6. Industrial Facilities. Costs of industrial facilities required in support of the development and test phase of the program.

7. Other. Costs of other major RDT&E elements. This could include prototype site construction, modification of government test facilities, unusual transportation costs, demands upon other government agencies, etc.

B. INITIAL INVESTMENT

Costs of producing operational prime mission and ground support equipment, initial spares, and other efforts such as training, technical data, site activation, updating, facilities, and personnel costs:

1. Management. Costs of over-all management to manufacture the operational hardware and other related effort. Management is defined as the centralized direction of the effort in the specific areas of system management, planning, development, program administration, etc.

2. Prime Mission Equipment. Costs of production of complete units to be used as either installed units or spare

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complete units for delivery to operational sites. Examples of prime mission equipment are: missile/booster, radar/sensor, data processing equipment, communications/command and control equipment. Present unit costs of major items and whatever backup data felt necessary to substantiate costs. State number of spare complete units included.

3. Prime Mission Equipment--Spares. Costs of manufacturing and other effort associated with the initial spare parts (bits and pieces) for pipeline and stock for prime mission equipment. Describe how the spares requirement was determined.

4. Ground Support Equipment (GSE). Costs of production of complete units to be used as either installed operational equipment or spare complete units for delivery to operational sites. Present unit costs of major items and whatever backup data felt necessary to substantiate costs. State number of spare complete units included.

5. GSE Spares. Costs of manufacturing and other effort associated with the initial spare parts (bits and pieces) for pipeline and stock for GSE. Describe how spares requirement was determined.

6. Training Equipment and Services. Costs of producing training equipment and providing training services by the contractor.

7. Technical Data. Costs of preparing engineering data and engineering technical orders and manuals required in support of the production phase of the program.

8. Site Activation. Costs of the contractor's efforts associated with integration, construction surveillance, installation and checkout of ground equipment, acceptance

testing and other related services. Excluded are costs of installation and checkout of trainers which will be included in Training Equipment and Services. Site activation costs have ranged from 75 to 200 per cent of GSE costs for ballistic missile systems and 25 to 30 per cent of prime hardware costs for electronic systems.

9. Industrial Facilities. Costs of industrial facilities required in support of the production of operational prime mission and ground support equipment.

10. Updating. The estimated total costs for updating a system to the approved configuration. Updating changes by definition are those retrofit changes approved prior to or as a result of the test program. A typical allowance for updating is 5 per cent of the basic equipment cost.

11. Military Facilities. Costs of new installations required for operational sites to include land acquisition; operations, support, and administrative facilities; access roads; utilities; etc. Land acquisition is not a significant cost in rural area, the average being about \$1000/acre. In urban areas it can be important, however, and the cost per acre should be stated.

12. Personnel Support. Costs of military personnel training, organizational equipment, initial stocks of fuel, personnel supplies, and initial personnel travel, etc. The contractor should estimate the number of operations personnel required (including maintenance). Studies have revealed:

Administrative personnel is 10 per cent of operating and maintenance manpower

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Support personnel is 25 per cent of (O&M + Adm.)

Over-all figures for initial personnel-related costs =
\$3000/man (excluding training)

Initial training of O&M personnel approximately \$6000/
man

C. ANNUAL OPERATING COSTS

Recurring annual outlays needed to operate and maintain a system after it has been accepted for operational use:

1. Prime Mission Equipment - Replacement. Costs of annual attrition of primary mission equipment. Attrition rates and methods used to compute annual replacement requirements depend upon the type of equipment under consideration. Estimated attrition rates should be supplied by the contractor.

2. Ground Support Equipment - Replacement. Annual replacement cost of GSE is usually computed by taking a percentage of the initial investment cost of GSE. The method of determining GSE replacement costs should be described by the contractor.

3. Facilities - Replacement. The cost of replacement of wornout facilities. A factor of 5 per cent of the initial investment in facilities should be satisfactory.

4. Prime Mission Equipment - Maintenance. The annual cost of material used for the maintenance of primary mission equipment, plus the cost of off-site labor. Usually estimated as a percentage of the initial investment cost of the prime mission equipment. The method of estimation used should be described.

5. Ground Support Equipment - Maintenance. The annual cost of materials used for the maintenance of GSE, plus the cost of off-site labor. Usually estimated as a percentage of the initial investment cost of the GSE. The method of estimation should be described.

6. Training. Costs of annual training, including (1) the cost of training replacements for personnel leaving a unit, and (2) the cost of any material expended for training purposes. A turnover of 15 per cent per year for officers and 20 per cent for enlisted men is typical.

7. Personnel. Costs of pay and allowances, annual travel, organizational equipment, supplies and services. A composite figure for officers is \$12,000 and for enlisted men \$6,000.

8. Fuels, Lubricants, and Propellants. These costs should be included if applicable.

9. Other. Cost of other recurring requirements applicable to the system. Included in this category could be such costs as leased communications, annual programming and continuing contractor services.

V. APPENDIX

The real estate costs shown in the Table have been found to be representative of the land prices paid by the United States Government. The costs are ranked by the corresponding Standard Metropolitan Statistical Areas as defined by the Bureau of the Census. (See, for example, "Statistical Abstract of the United States, 1961" U.S. Government Printing Office).

REAL ESTATE COSTS

<u>SMSA RANK</u>	<u>REAL ESTATE COSTS PER ACRE WITHIN THE SMSA</u>	<u>REAL ESTATE COST PER ACRE NEAR TO THE SMSA</u>
1 - 5	\$80,000	\$27,000
6 - 10	50,000	17,000
11 - 15	35,000	7,000
16 - 20	20,000	5,000
21 - 30	15,000	5,000
31 - 40	10,000	5,000
Over 40	5,000	5,000

Rural areas far from SMSA's \$1,000 per acre