ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

1810.3

5/15/84

SUBJ: COST ESTIMATION POLICY AND PROCEDURES

1. PURPOSE. This order establishes cost estimation policy and procedures for FAA major system acquisitions and provides for independent review of program cost estimates.

2. DISTRIBUTION. This order is distributed to the division level in Washington, regions, and centers.

3. BACKGROUND. Order 1810.1C, Major Systems Acquisition, with related Order DOT 4200.14B, Major Systems Acquisition Review and Approval, provide for a variety of cost estimates to be undertaken for major acquisitions. Responsibilities, definitions, and requirements specified in this order are based upon 1810.1C.

4. DEFINITIONS.

a. Constant Dollar Estimate. An estimate of costs incurred in any particular year expressed in the dollars of a fixed base year. For example, costs incurred in 1982 and 1984 measured in 1979 prices. Note that constant dollar estimates are often referred to as not being escalated for inflation. Techniques for computing constant dollars are contained in chapter 7 of FAA-APO-82-1, "Economic Analysis of Investment and Regulatory Decisions--A Guide".

b. Cost Staff. A small staff which develops agency costing policy and reviews cost estimates for major systems acquisitions. The staff, which is an element of the Office of Aviation Policy and Plans, reports to the Associate Administrator for Policy and International Aviation, independent of any program manager.

c. Current Dollar Estimate. An estimate of cost incurred in any particular year expressed in the prices of that year. For example, cost incurred in 1982 measured in 1982 prices.

d. Discounted Present Value. The value of a time distributed series of costs as viewed from the present time. Calculation of discounted present values requires the use of discounting methodology, as described in chapter 5 of the reference cited in paragraph 4a.

e. Life Cycle Cost. The sum total of the direct, indirect, recurring, non-recurring, and other related costs incurred, or estimated to be incurred, in the design, development, production, operation, maintenance, support, and phase-out of a major system over its anticipated useful life span.

f. Program Cost Review. An independent review of a program cost estimate.

g. Program Cost Estimate. A life cycle cost estimate for a program.

h. Variance Analysis. A technique by which different program cost estimates prepared at different times may be compared with each other or with actual costs incurred in order to identify the causes of differences between them.

5. POLICY. FAA adheres to the acquisition management principles set out in OMB Circular A-109 and implemented by relevant Department of Transportation and FAA orders, principally Order DOT 4200.14B and FAA Order 1810.1C. These include requirements for life cycle costing. Accordingly:

a. All program cost estimates, and revisions thereof, shall be expressed in terms of life cycle costs.

b. As a minimum, a program cost estimate must be developed or updated for Aviation System Acquisition Review Committee (ASARC) review prior to each Key Decision Point (KDP) applicable to the acquisition.

6. SYSTEM DESCRIPTION.

a. A description of a major system identifies the system's scope and composition in sufficient detail to permit program cost estimates to be developed. This typically includes system quantities and locations, interface with other systems, technical specifications (military specifications when available), subsystem components and parts, integrated logistics support plans, identity of manufacturers, etc. The system description contains and is organized, to the extent possible, according to the life cycle cost breakdown structure contained in Appendix 1, Life Cycle Cost Breakdown Structure.

b. Program managers are responsible for providing the program review official with current descriptions of their systems and for updating these descriptions immediately following any system change.

7. PROGRAM COST ESTIMATES.

a. Responsibilities. Program Managers are responsible for developing program cost estimates.

b. Format. Program cost estimates shall conform to the following format and content requirements:

(1) System Description. Each program cost estimate shall include an up-to-date system description.

(2) Assumptions. Assumptions and parameters used to construct the estimates shall be identified. Rationale and justification for each shall be presented.

(3) Methodology and Data. A description of the methodology used to produce cost estimates shall be given. Data upon which the estimates are based shall also be included.

(4) Cost Estimates. Estimates of program life cycle cost shall be made (expressed in constant dollars of the year in which the estimate is made and current dollars) in the format of the cost breakdown structure contained in Appendix 1, Life Cycle Cost Breakdown Structure. Separate tables shall be prepared for costs incurred to date, remaining program life cycle cost, and their sum total costs. In addition, the discounted present value of remaining program life cycle cost, expressed in constant dollars, shall be presented. These estimates shall be supported by tables, one expressed in current dollars and one in constant dollars, showing the amount of expenditure in each year of the program's life for each category of the cost breakdown structure.

(5) Variance Analysis. Differences from earlier program cost estimates shall be identified. Each program cost estimate, other than the original one for that program, shall contain a variance analysis of the differences between it, the previous estimate, and the original estimate. The analysis shall include the amount of estimated cost differences from earlier estimates and the reasons thereto, including such factors as economic changes due solely to the operation of the economy including inflation, changes in the quantity of equipment to be procured, changes in the procurement or delivery schedule, changes in completion date or intermediate milestone for development of production, engineering changes in the system, and estimation errors.

c. Economic Parameters. Standard values and costs identified in FAA-APO-81-3, "Economic Values for Evaluation of FAA Investment and Regulatory Programs," September 1981, shall be used for program cost estimates. If not identified in that report, costs should be estimated on a case-by-case basis citing appropriate references.

d. Estimation Methodology. Program cost estimates provided for each KDP shall be based upon one of the estimation methods specified in Table 1, Cost Estimation Methodology, as appropriate for the system acquisition phase/key decision point and cost element. These methodologies are described in Appendix 2, Cost Estimating Methodology. Methodology used for an estimate should be described and documented.

e. Submission Deadlines. Program managers shall submit program cost estimates to the program review official in sufficient time for a cost review to be made. Unless the program manager and the program review official mutually agree, the program manager's cost estimate shall be submitted to the program review official at a date not later than the mid-point between the previous KDP--or, for new programs, their entry date into the acquisition process--and the next KDP, except that the submission date need not be more than 90 days prior to the next KDP.

TABLE 1. COST ESTIMATION METHODOLOGY

Acquisition Phase a/	Key Decision Point	Cost Element				
		Research & Development	Production & Installation		Operations & Support	Termination
			Hardware	Software		
Concept	1	A,P	A,P,C	A,P	A,P	A,P
Demonstration	2	A,P	A,P,C	A,P	A,P	A,P
Full Scale Development	3	P	P,C,B	P,B	P	P
Production	4	n.a.	C,B,I	P,B	P	P

a/ Denotes acquisition phase which follows key decision point in next column.

Key
A = Analogy Method
P = Parametric Method
C = Component Part Method
I = Industrial Engineering Method
B = Vendor Bid
n.a. = Not Applicable

8. COST REVIEW.

a. A cost review is a formal check to determine that program cost estimates have been prepared following prescribed FAA cost policy and procedure. At a minimum, the cost estimate shall be assessed for conformity with requirements established by this order, internal consistency, accuracy, adherence to generally accepted economic and accounting principles, and other relevant factors.

b. Program cost estimates developed for Designated Major System Acquisitions (DMSA's) by program managers will be independently reviewed by the cost staff. Results of this review shall be provided to the program manager, the cognizant associate administrator, the program review official, and the ASARC. Program cost estimates for other categories of programs, such as Major System Acquisitions, will be independently reviewed upon request of the ASARC, the program review official, or the program manager.

c. At least 2 weeks prior to its general release, the cost staff shall provide a draft of the cost review to the program manager for comment. Program manager comments received by the cost staff which remain unresolved at the time of general release will be appended to the cost staff report forwarded to the cognizant associate administrator, program review official, and the ASARC.

9. INDEPENDENT PROGRAM COST ESTIMATE.

a. The cost staff will prepare independent cost estimates as directed by the ASARC, cognizant associate administrator, or the program review official; it may also prepare independent cost estimates upon request of the program manager or at its own initiative.

b. At least 2 weeks prior to its general release, the cost staff shall provide a draft of the independent cost estimate to the program manager for comment. Program manager comments received by the cost staff which remain unresolved at the time of general release will be appended to the cost staff report forwarded to the cognizant associate administrator, program review official, and the ASARC.

10. AUTHORITY TO CHANGE THIS ORDER. The Director of Aviation Policy and Plans is authorized to issue changes to this order which do not affect policy, or assignment of responsibility, or delegate authority.

Donald D. Engen
Administrator

APPENDIX 1. LIFE CYCLE COST BREAKDOWN STRUCTURE

1. INTRODUCTION. Table 1, Cost Breakdown Structure, presents the life cycle cost breakdown structure required for use by FAA program managers for program cost estimates. Costs are organized under four general headings: non-recurring cost, recurring cost, termination cost, and salvage value. Costs are also divided into those incurred by the Government directly and by the Government through contractors. Direct Government costs consist of services that are provided directly by Government employees, such as program management, agency research and development work, and acceptance testing of equipment prior to delivery. They also include items such as Government furnished equipment, and the use of Government facilities, such as the FAA Technical Center. Contractor costs consist of all funds paid to program contractors and may include anything which the Government procures by contract.

2. RELATIONSHIP TO BUDGET APPROPRIATIONS. To facilitate tracking of program cost estimates with budget and planning documents, program cost estimates should indicate the budget appropriation(s) to which each cost item in the life cycle cost breakdown structure is to be charged. Such information is not provided in this appendix because it is likely to vary from project to project.

3. NON-RECURRING COST. These costs are incurred in the beginning of a program. They include the costs of designing, building, installing, and planning for the operation and support of the system. Because these costs are incurred during the period of time when the program is subject to the acquisition process, the cost structure is constructed to reflect costs incurred following each key decision point and prior to the next, as defined in Order 1810.1C.

a. Research and Development. This category includes all program costs from inception to KDP#4--the commitment to full scale production. It is divided into four components.

(1) Requirements Definition. This component includes most costs incurred prior to KDP#1. These costs arise from activities such as defining mission need, preparing system requirement statements, and selecting program sponsors and managers. These costs are incurred, for the most part, directly by the Government.

(2) Concept Analysis. This component includes all costs incurred after KDP#1 and prior to KDP#2. These costs are incurred to identify alternative system concepts and design approaches. They include hardware, software, and support planning considerations. These costs will consist of direct Government expenses and contractor costs.

(3) Design and Demonstration. This component includes all costs incurred after KDP#2 and prior to KDP#3. From a hardware viewpoint, costs are

incurred to design and produce alternative engineering models, test them to verify the feasibility of selected approaches, and plan for their logistical support. Software also may be designed during this phase for each alternative but, in most cases, the required program code is not produced. These costs consist of direct Government costs and contractor costs.

(4) Full Scale Development. This component includes most costs incurred after KDP#3 and prior to KDP#4. For software, these costs are incurred in the actual writing and testing of program code. For hardware, costs are incurred to refine selected approach(es), produce equipment for testing, and continue logistical support planning. The costs of testing, whether conducted by the contractor, developer, or the operator, are also included here. Costs in this category consist of direct Government expenses and contractor costs. Note that because limited production may be authorized at KDP #3, certain costs incurred at this time may be production rather than research and development costs. These should be included under the production and installation rather than the research and development cost category.

b. Production and Installation. These are the initial costs of acquiring and installing a system.

(1) Program Management. These costs include the technical and administrative efforts by the government and contractors to manage the investment phase of a program. Examples of such activities are contract management, cost-schedule management, data management, and program coordination.

(2) Land. This element includes all interests in land which are acquired for a program and for which a non-recurring payment is made. Such interests include purchase, easements, air rights, mineral rights, and leaseholds. Interests in land for which recurring payments are to be made are considered below under operating and support costs.

(3) Real Property Improvements. This element consists of improvements to real property such as buildings, roads, grading, or parking lots. It may encompass new construction, modifications to existing facilities, or the purchase of existing real property improvements.

(4) Prime Mission Equipment. This element includes production costs of the key equipment of a program. It also includes transportation of the equipment to the first destination, factory inspection, and similar such items.

(5) Peculiar Support Equipment. This element contains the costs of equipment required to support and maintain the system or portions of it which must be specially designed. It also includes items such as, factory inspection and transportation of this equipment to its first destination. The category is subdivided into equipment required on site and equipment required at maintenance depots only.

(6) Common Support Equipment. This element contains the costs of equipment required to support and maintain the system or portions of it which may be readily purchased in the open market. It also includes items such as factory inspection and transportation of this equipment to its first destination. The category is subdivided into equipment required on site and equipment required at maintenance depots only.

(7) Equipment Installation and Test. These are the costs required to put equipment in place. These include installation costs, training for installation, travel, transportation from first destination to installation site, and certification and commissioning costs including flight test costs.

(8) Software Installation and Test. By the production and installation phase, software production is complete. Upon equipment installation, it must be installed in the hardware and tested. This category includes these costs. It also includes the costs of software problems that may arise upon installation.

(9) Initial Stocks. To establish a new system, an initial inventory of consumables and spares required must be established. Consumables are materials consumed in the operation of a system. Examples of some typical items are oils and lubricants, copier paper and toner, paper rolls and tapes used with teletypewriter equipment, magnetic recording tape, and photographic supplies. Initial spares include initial stocks of spare parts, special tools, technical documents, and similar items. These items differ from consumables in that while they may wear out, they are not consumed directly by system operation.

(10) Maintenance Training. This element involves the training of the original group of people who will be responsible for the new system. It consists of three parts. The first is the training of a cadre of instructors to train the actual maintenance people. This training is usually provided by the manufacturer of the new system. The second is the training of the first generation of technicians that will be responsible for maintaining the new system. The third category includes equipment, supplies, facilities, and other items not included elsewhere that are required for training.

(11) Operations Training. This element involves the training of the original group of people who will be responsible for operating the new system. It consists of three parts. The first is the training of a cadre of instructors to train the actual system operators. The second is the training of the first generation of operators that will actually operate the system. The third category includes equipment, supplies, facilities, and other items not included elsewhere that are required for training.

(12) Data. This element pertains to the costs required to record and preserve information concerning the new system. It includes technical publications, engineering data, management data, and support data. Technical publications are formal manuals and other publications pertaining to the installation, training, operation, maintenance, hardware, and software of the system. Engineering data consists of such items as engineering drawings,

specifications, test data, and computer programs. Management data includes contractor cost reports, cost performance reports, schedules, milestones, networks, integrated support plans, etc. Support data refers to supply and general maintenance plans and reports, data to support the provisioning process, and transportation, handling and packaging information.

4. RECURRING COST. These are the on-going costs required to operate and maintain the proposed system. These costs may occur annually or periodically every so many years.

a. Operations Cost.

(1) Personnel. This category includes all compensation, including benefits and paid absences, paid to employees whose services are required to operate the system. It encompasses not only the costs of direct labor but also compensation paid to employees during recurring training and during travel time.

(2) Consumables. This element contains the cost of materials consumed in the operation of the equipment. Examples of some typical items and materials are oil and lubricants, copier paper, toner, paper rolls and tapes, magnetic recording tape, and photographic supplies.

(3) Energy and Utilities. Included here are the costs of electricity, gasoline, diesel fuel, natural gas, water, etc.

(4) Real Property Leases. This category represents the recurring rental payments made in conjunction with leases of real property.

(5) Equipment Leases. These costs arise in conjunction with the recurring rental payments made in conjunction with leases of equipment.

(6) Recurring Training. This category represents training costs to maintain operating employees' skills and to train new operating employees needed to replace departing employees. For current employees, this category includes training, specific travel costs, and FAA Academy costs. For replacement operating employees who are not yet engaged in operating the system, it also includes compensation paid to employees being trained.

(7) Recurring Travel and Transportation. This item represents the direct costs of travel and transportation necessary to operate a system. It consists of such items as airfares, subsistence payments, lodging, and depreciation and operating costs of Government vehicles. It does not include wages or salaries paid to employees while in travel status; these are defined to be included in personnel costs above.

(8) Telecommunications Cost. These are the costs of electronic communications services provided the system by another organization. The other organization can be part of the FAA, other parts of the Government, or the private sector. Examples are commercial and FTS telephone service or satellite communications. This category does not include telecommunications

services produced within the system being costed; these enter cost estimates through equipment acquisition and rental costs, personnel costs, utilities cost, etc.

(9) Time Sharing Cost. These are the costs of computer services provided the system by another organization. As with the telecommunications costs, the other organization can be part of the FAA, other parts of the Government, or the private sector. This category does not include computer services produced within the system being costed; these enter cost estimates through equipment acquisition and rental costs, personnel costs, utilities cost, etc.

b. Support Cost. These are the costs required to support and maintain the system. As shown in Table 1, they are incurred at each level of maintenance. The following defines each cost category that is found at each support level. Note that the various support levels are explicitly recognized to facilitate the costing of alternative support approaches. It is intended that these levels be expandable or collapsible to accommodate alternative support concepts.

(1) Personnel. This category includes all compensation, including benefits and paid absences, paid to employees whose services are required to support the system. It encompasses not only the costs of direct labor but also compensation paid to employees during recurring training and during travel time.

(2) Replenishment Spares. These costs represent the recurring cost of inventory. Inventory already purchased as initial spares and repair parts is not included.

(3) Repair Materials. Repair material cost is the cost of materials utilized to repair equipment which has failed.

(4) Support Equipment Maintenance. This is the cost associated with the support of common and peculiar support equipment. Acquisition costs for support equipment are included under the investment category. Spare and repair parts for support equipment are also included.

(5) Inventory Management and Holding. These costs relate to the control and storage of inventory required to operate the system. They include inventory management, maintenance and supply catalogs, storage charges, losses during storage such as deterioration, obsolescence, and theft.

(6) Recurring Transportation and Packaging. This cost element includes packaging, handling and transportation of spares, repair parts, and other material between supply points and equipment to be maintained.

(7) Recurring Training. This category represents training costs to maintain support employees' skills and to train new support employees needed to replace departing employees. For current employees, this category includes training, specific travel costs, and FAA Academy costs. For replacement

support employees who are not yet engaged in operating the system, it also includes compensation paid to employees being trained.

(8) Recurring Travel. This item represents the direct costs of travel and transportation required to support a project. It consists of such items as airfares, subsistence payments, lodging, and depreciation and operating costs of Government vehicles. It does not include wages or salaries paid to employees while in travel status; these are defined to be included in personnel costs above.

5. TERMINATION COSTS.

a. Dismantling Costs. These are the costs, if any, required to dismantle, disassemble, remove, and dispose of old buildings, equipment, spare parts, etc. at the end of the system's lifetime.

b. Transportation and Packaging. These are the costs, if any, required to package and ship old equipment, spare parts, etc. from the dismantled site.

c. Site Restoration. This is the cost, if any, to restore the site on which the old equipment was located to its original or near original condition. It may involve grading of earth, reforestation, or landscaping.

d. Storage and Materiel Management. These are the costs required to store, maintain, and manage equipment, parts, etc. which are removed from a site but not yet disposed of.

6. SALVAGE VALUE. Salvage value is the value, if any, of the project buildings, structures, equipment, spares, etc. to the Government at the end of the expected project life. Note that it is treated here as an offset to termination costs.

TABLE 1. COST BREAKDOWN STRUCTURE

Cost Element	Government	Contract	Total
NON-RECURRING COST			
Research and Development			
Requirements Definition			
Concept Analysis			
Hardware			
Software			
Other			
Total			
Design and Demonstration			
Hardware Design			
Software Design			
Other			
Total			
Full Scale Development			
Hardware Development			
Software Coding			
Other			
Total			
Total Research and Development Cost			

TABLE 1. COST BREAKDOWN STRUCTURE

(Continuation)

Cost Element	Government	Contract	Total
Production and Installation			
Program Management			
Land			
Real Property Improvements			
Prime Mission Equipment			
Peculiar Support Equipment			
Common Support Equipment			
Equipment Installation and Test			
Software Installation and Test			
Initial Stocks			
Maintenance Training			
Operations Training			
Data			
Other			
Total Production and Installation Cost			
TOTAL NON-RECURRING COST			

TABLE 1. COST BREAKDOWN STRUCTURE

(Continuation)

Cost Element	Government	Contract	Total
RECURRING COST			
Operations Cost			
Personnel			
Consumables			
Energy and Utilities			
Real Property Leases			
Equipment Leases			
Recurring Training			
Recurring Travel and Transportation			
Telecommunications			
Time Sharing			
Other			
Total Operations Cost			
Support Cost (Site Level)			
Personnel			
Replenishment Spares			
Repair Materials			
Support Equipment Maintenance			
Inventory Management and Holding			
Recurring Transportation and Packaging			
Recurring Training			
Recurring Travel			
Other			
Total Support Cost (Site Level)			

TABLE 1. COST BREAKDOWN STRUCTURE

(Continuation)

Cost Element	Government	Contract	Total
Support Cost (Intermediate Level)			
Personnel			
Replenishment Spares			
Repair Materials			
Support Equipment Maintenance			
Inventory Management and Holding			
Recurring Transportation and Packaging			
Recurring Training			
Recurring Travel			
Other			
Total Support Cost (Intermediate Level)			
Support Cost (Depot Level)			
Personnel			
Replenishment Spares			
Repair Materials			
Support Equipment Maintenance			
Inventory Management and Holding			
Recurring Transportation and Packaging			
Recurring Training			
Recurring Travel			
Other			
Total Support Cost (Depot Level)			
Total Support Cost			
TOTAL RECURRING COST			

TABLE 1. COST BREAKDOWN STRUCTURE

(Continuation)

Cost Element	Government	Contract	Total
TERMINATION COST			
Dismantling Cost			
Transportation and Packaging			
Site Restoration			
Storage and Materiel Management			
Other			
TOTAL TERMINATION COST			
SALVAGE VALUE			
TOTAL LIFE-CYCLE COST			

APPENDIX 2: COST ESTIMATION METHODOLOGY

1. Paragraph 7d of this order specifies one or more cost estimation techniques to be appropriate for each system acquisition phase/key decision point and cost element. These methodologies are described below:

a. The analogy method estimates the cost of a new system by taking the cost of a similar existing one and adjusting it to reflect the differences between the two systems. This adjustment can be made either analytically or judgmentally. The analogy method is applicable to all elements of life cycle costs. Because it depends on a comparison with an existing system, its application with respect to radically new systems is limited.

b. The parametric method estimates costs based upon various characteristics or attributes, called parameters, of the system being costed. It depends on the establishment of a functional relationship between system costs and these parameters. Such relationships, known as cost estimating relationships, are typically estimated from historical data using statistical techniques. Examples would be estimating costs as a function of such parameters as equipment weight, vehicle payload or maximum speed, number of units to be produced, or the number of lines of software code to be written. This method is applicable to all elements of life cycle costs.

c. The component part method determines cost by summing the costs of all component parts which are known. Components for which costs are unknown are estimated by one of the other cost estimating methods and added to the sum of known component costs. Finally, assembly and overhead costs such as, design and support engineering, inspection and test, quality control, and production control are added to obtain total cost. The component part method is primarily applicable only to hardware production.

d. The industrial engineering method, also known as the piece part method, is similar to the component part method except that it proceeds at a greater level of detail. First, a detailed list of parts be developed. The cost of each of these parts is then determined and all parts costs summed to determine total parts cost. Assembly and/or manufacturing costs and overhead costs are added to total parts cost to yield total cost. The industrial engineering method is primarily applicable only to hardware production.

e. The vendor bid method utilizes the cost proposals or bids submitted by vendors in response to a request for production proposals. Use of this method is limited because cost estimates are usually required prior to receipt of bids. However, previously developed contractor estimates may be utilized at times, provided they are judged and found to be reasonable.