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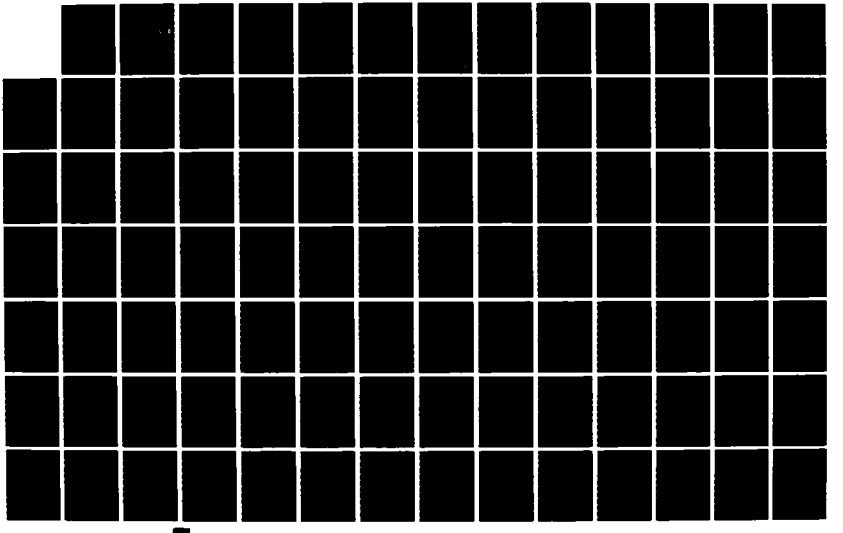

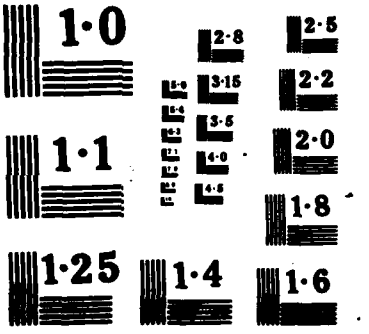
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AIR FORCE INTEGRATED READINESS MEASUREMENT SYSTEM (AFIRMS)

ECONOMIC ANALYSIS

FINAL

Prepared by

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United States Air Force
Readiness Assessment Group

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ECONOMIC ANALYSIS

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EXECUTIVE SUMMARY

Background. Since 1947, Air Force leaders have realized that a sound method of assessing Air Force capability is essential. Systems such as the Force Status and Identity Report (FORSTAT), the Unit Capability Measurement System (UCMS), and the Unit Status and Identity Report (UNITREP) are all products of this need. With the increasing emphasis on readiness, the Chief of Staff of the Air Force recognized the need for, and directed the development of, a more responsive readiness assessment system.

In 1976, the Air Force Chief of Staff developed Constant Readiness Tasking which tasked the Air Force to "...develop responsive means of assessing and reporting combat capability." The AFIRMS concept began with that tasking and has continued to evolve. Congress, through the FY78 Defense Authorization Act, tasked the Secretary of Defense to project the effect of appropriations on materiel readiness, i.e., "dollars to readiness." Defense Guidance since that time has directed the Services to develop methods to model the relationship of force readiness with associated manpower and dollar resources.

The AFIRMS Program is that system. It was initiated by the Directorate of Operations and Readiness, Headquarters United States Air Force (HQ USAF), in April 1978. The AFIRMS Program completed the Learning Prototype Phase (LPP) in 1985. This phase was used to determine the degree to which the user's readiness information requirements can be satisfied and the costs of that added functionality.

Economic Analysis Overview. The AFIRMS objectives and assumptions lead to a choice between two similar alternatives. Both feasible alternatives provide comparable support to the Air Staff and operational Major Command (MAJCOM) headquarters. The two alternatives differ in the level of hardware and overall support provided to Wings without significant unit automation. The contractor recommended alternative calls for installation of a central computer and workstations in such Wings and uses existing automation where additional hardware is unnecessary. The life-cycle cost of the recommended "Hybrid Architecture" alternative is $240 million for implementations in Headquarters, USAF; Alaskan Air Command; Pacific Air Forces; Tactical Air Command; U.S. Air Forces, Europe; Military Airlift Command; Strategic Air Command; Air Force Logistics Command; Air Force Reserve; and Air National Guard. A third alternative, the current UNITREP system, cannot meet AFIRMS objectives, but it is a benchmark for comparison.

Assumptions. The most important assumptions used in this analysis are:

a. AFIRMS implementation will use standard computers and communications, to the maximum possible extent.

b. No major changes in facilities are required.

c. AFIRMS capabilities must be available for deployed units.

d. Hardware and software technology changes over the economic life of AFIRMS will reduce costs and make more computing power available to end users.

Alternatives. A broad range of alternatives was screened for feasibility. Appendix C lists some of these alternatives. The feasible alternatives that are analyzed in detail in this document are:

1. Current UNITREP C-rating system.

2. Single Microcomputer at each Wing - Implementation of AFIRMS in all operational MAJCOMs, with minimal AFIRMS hardware at Wing level.

3. Hybrid Architecture - Implementation of AFIRMS in all operational MAJCOMs, with AFIRMS hardware appropriate to the deployment mission and automation environment of the Wings.

Comparison of Alternatives. The analysis of costs includes non-recurring and recurring costs of computer and communications facilities, hardware, software, and Air Force personnel. The analysis of benefits includes the factors of utility, manageability, and timely implementation schedule.

Alternative #1 incurs the least costs and benefits. The second alternative is an improvement over the present readiness assessment systems, but does not meet the Air Force's current requirements. By putting a classified microcomputer system at every Wing, Alternative #2 provides the Wings and higher command levels with a substantial readiness assessment capability. However, squadrons do not have separate, deployable equipment, as in Alternative #3. Nor does Alternative #2 provide a high degree of integration with other automated information systems at the Wings, since there

is only one microcomputer per Wing. Alternative #3 provides deployable equipment to squadrons that require it, and integrates AFIRMS with other Air Force standard and MAJCOM unique systems as fully as possible. The additional hardware in this alternative has the secondary effects of greater benefit to the users and higher availability during crises.

Contractor Recommended Alternative. Alternative #3, Hybrid Architecture, is recommended by the contractor primarily because it provides the highest degree of integration, availability, deployability, and user benefits of the three alternatives.

SECTION 1. GENERAL

1.1 Purpose of the Economic Analysis. The Economic Analysis for the Air Force Integrated Readiness Measurement System (Contract No. F49642-83-C-0022) is written to provide:

a. A clear statement of AFIRMS objectives and assumptions;

b. Examination of alternatives, including those which were considered inadequate and subsequently eliminated before a complete economic analysis was conducted on them;

c. Expected costs and benefits for alternatives carried forward from step b.;

d. A comparison of the feasible alternatives from which the preferred alternative will be recommended;

e. A review of data sources, methods, and tests for sensitivity used to reach the conclusions presented; and,

f. A summary of key analysis factors which presents and supports the recommended alternative.

1.2 Role of the Economic Analysis. The analysis of alternatives in this document applies to the long range direction of AFIRMS, the expected costs, and the expected benefits. AFIRMS will develop incrementally. The AFIRMS Evolutionary Implementation Plan provides the detail associated with each phase of implementation.

Normally, in a system implementation, a single system design is established, alternatives are costed, and one system alternative is chosen for development. However, detailed design and implementation of AFIRMS for all MAJCOMs are not known at this time because of the evolving nature of AFIRMS. Even though the overall objectives and functions of AFIRMS will be the same for the entire system, the implementation in each MAJCOM will be modified to fit with the MAJCOM specific automated data system, computer hardware, communications, and deployment environment. In addition, upgrades will be planned and implemented so that AFIRMS can evolve with new requirements and technology. This evolution can be predicted but with less accuracy than the more traditional single design approach. Therefore, this document addresses the assumptions and alternatives that will apply over the defined ten year economic life of AFIRMS.

1.3 Project References. The Program Management Office (PMO) responsible for contract management of the AFIRMS LPP and this Economic Analysis is the Data Systems Design Office (DSDO/XO), Gunter Air Force Station (AFS), Alabama; the Office of Primary Responsibility (OPR), is the United States Air Force Readiness Assessment Group (AF/XOOIM). Three operational centers were used as Learning Prototype Phase (LPP) testbed sites: The Pentagon, Washington, D.C.; HQ United States Air Forces Europe (USAFE), Ramstein Air Base (AB), Germany; and, the 52nd Tactical Fighter Wing (TFW), Spangdahlem AB, Germany.

References applicable to the history and development of the AFIRMS Program are listed in this section, along with references concerning documentation and programming standards.

a. AFIRMS Data Requirements Document, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

b. AFIRMS Economic Analysis, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

c. AFIRMS Evolutionary Implementation Plan, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

d. AFIRMS Functional Description, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

e. AFIRMS HQ USAF Database Specification, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

f. AFIRMS HQ USAF Subsystem Specification, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

g. AFIRMS HQ USAFE Database Specification, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

h. AFIRMS HQ USAFE Subsystem Specification, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

i. AFIRMS Product Descriptions, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

j. AFIRMS System Specification, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

k. AFIRMS Transform and Model Descriptions, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

l. AFIRMS Wing Database Specification, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

m. AFIRMS Wing Subsystem Specification, Final, SofTech, Contract No. F49642-83-C-0022, 31 May 1985. (Unclassified)

n. System Interface Design for the AFIRMS LPP and the Combat Fuels Management System (CFMS), SofTech, Contract No. F49642-83-C-0022, 28 February 1985. (Unclassified)

o. AFR 700-5, Information System Requirements Board, 9 November 1984. (Unclassified)

p. System Interface Design for the AFIRMS LPP and the Air Force Operations Resource Management System (AFORMS), SofTech, Contract No. F49642-83-C-0022, 2 November 1984. (Unclassified)

q. AFR 700-2, Information Systems Planning, 26 October 1984. (Unclassified)

r. Automated Data Processing (ADP) Security Policy, Procedures, and Responsibilities, AFR 205-16, 1 August 1984. (Unclassified)

s. AFR 300-4, Vol. 4, Air Force Data Dictionary, 1 May 1984. (FOUO)

t. Automated Data Systems (ADS) Documentation Standards, DoD-STD-7935.1, 24 April 1984. (Unclassified)

u. Department of Defense Dictionary of Military and Associated Terms, JCS Pub 1, 24 April 1984. (Unclassified)

v. AFR 700-1, Managing Air Force Information Systems, 2 March 1984. (Unclassified)

w. AFIRMS LPP ADP Security Plan, SofTech, Contract No. F49642-83-C-0022, 13 February 1985. (FOUO)

x. AFR 300-4, Vol. 3, Air Force Data Dictionary, 15 August 1983. (FOUO)

y. Sustainability Assessment Model (formerly CAC) Functional Description, Contract No. F33700-83-G-00200570l, 8 April 1983. (Unclassified)

z. Planning, Programming, Budgeting, and Funding Communications - Electronics Requirements, AFR 100-5, 15 February 1983. (Unclassified)

aa. MIL-STD-480 Configuration Control-Engineering Changes, Deviations, and Waivers.

bb. MIL-STD-483 Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs.

cc. USAF Operational Major Command Functional Area Requirement (FAR), SofTech, Contract No. F49642-82-C-0045, 15 December 1982. (Unclassified)

dd. Unit Combat Readiness Reporting (C-Ratings) (Unit Status and Identity Report (UNITREP), RCS:HAF-XOO(AR)7112(DD)), AFR 55-15, 22 November 1982. (Unclassified)

ee. USAFE Annex to USAF FAR, SofTech, Contract No. F49642-82-C-0045, 20 August 1982. (Unclassified)

ff. AFIRMS FAR, SofTech, Contract No. MDA-903-76-C-0396, 14 March 1980. (Unclassified)

gg. AFIRMS Data Analysis, SofTech, 15 February 1979. (Unclassified)

hh. User's View of AFIRMS, SofTech, 1 November 1978. (Unclassified)

ii. Computer Programming Languages, AFR 300-10, 15 December 1976. (Unclassified)

jj. U.S. Air Force Glossary of Standardized Terms, AFM 11-1, Vol. 1, 2 January 1976. (Unclassified)

kk. AFIRMS Data Automation Requirement (DAR), Final, SofTech, Contract No. MDA-903-76-C-0396, 14 March 1980. (Unclassified)

ll. AFR 700-3, Information Systems Requirements Processing, 30 November 1984. (Unclassified)

mm. AFR 178-1, Economic Analysis and Program Evaluation for Resource Management, 14 December 1979. (Unclassified)

nn. AFR 173-13, U.S. Air Force Cost and Planning Factors, 1 February 1985. (Unclassified)

oo. AFP 178-8, Economic Analysis Procedures Handbook, 19 May 1981. (Unclassified)

pp. JCS Memorandum of Policy #172, 1 June 1982. (Unclassified)

1.4 Terms and Abbreviations.

1.4.1 Abbreviations and Acronyms.

AAC	-	Alaskan Air Command
AB	-	Air Base
AD	-	Air Division
ADP	-	Automated Data Processing
AF	-	Air Force
AFDSDO	-	Air Force Data Systems Design Office
AFWIS	-	Air Force WWMCCS Information System

AF/XOOIM	-	United States Air Force Readiness Assessment Group
AFIRMS	-	Air Force Integrated Readiness Measurement System
AFLC	-	Air Force Logistics Command
AFORMS	-	Air Force Operations Resource Management System
AFP	-	Air Force Pamphlet
AFR	-	Air Force Regulation
AFRES	-	Air Force Reserve
AFS	-	Air Force Station
AIS	-	Automated Information System
ALC	-	Air Logistics Center
ANG	-	Air National Guard
CAC	-	Combat Assessment Capability
CAFMS	-	Computer Assisted Force Management System
CAS	-	Combat Ammunition System
CFMS	-	Combat Fuels Management System
COMPES	-	Contingency Operations/Mobility Planning and Execution System
CONUS	-	Continental United States
CRT	-	Cathode Ray Tube
CSMS	-	Combat Supplies Management System
DAR	-	Data Automation Requirement
DBMS	-	Database Management System
DDN	-	Defense Data Network
DOC	-	Designed Operational Capability
DoD	-	Department of Defense
EDS	-	European Distribution System
EIFEL	-	NATO Command and Control System
FAR	-	Functional Area Requirement
FORSTAT	-	Force Status and Identity Report
HQ USAF	-	Headquarters, United States Air Force
HQ USAFE	-	Headquarters, United States Air Forces Europe
JCS	-	Joint Chiefs of Staff
JOPES	-	Joint Operations Planning and Execution System
LAN	-	Local Area Network
LCMS	-	Logistics Capability Measurement System
LPP	-	Learning Prototype Phase
MAC	-	Military Airlift Command

MAJCOM	-	Major Command
MTBF	-	Mean Time Between Failures
MTTR	-	Mean Time To Repair
NACE	-	National Automatic Communications System
NAF	-	Numbered Air Force
NCA	-	National Command Authority
O&M	-	Operations and Maintenance
OPCON	-	Operational Control
OPlan	-	Operation Plan
OPR	-	Office of Primary Responsibility
PACAF	-	Pacific Air Forces
PMO	-	Program Management Office
POL	-	Petroleum, Oil, and Lubricants
POM	-	Program Objectives Memorandum
RAM	-	Random Access Memory
SAC	-	Strategic Air Command
SCL	-	Standard Conventional Load
TAC	-	Tactical Air Command
TAF	-	Tactical Air Force
TFS	-	Tactical Fighter Squadron
TFW	-	Tactical Fighter Wing
UCMS	-	Unit Capability Measurement System
UNITREP	-	Unit Status and Identity Report
USAF	-	United States Air Force
USAFE	-	United States Air Forces Europe
WIN	-	WWMCCS Intercomputer Network
WIS	-	WWMCCS Information System
WMP	-	War Mobilization Plan
WSAM	-	Weapon System Assessment Model
WSMIS	-	Weapon System Management Information System
WWMCCS	-	World Wide Military Command and Control System

1.4.2 Terms and Definitions.

Alternative	-	An approach or program that is another possible way of fulfilling an objective, mission, or requirement. The status quo is usually an alternative to a proposed course of action. (AFR 178-1)
Analysis	-	A systematic approach to problem solving. Complex problems are made simpler by separating them into more understandable elements. Involves identifying purposes and facts, the statement of defensible assumptions, and the derivation of conclusions therefrom. (AFP 178-8)
Assets	-	Property, both real and personal, and other items having monetary value. (AFP 178-8)
Assumptions	-	Judgements concerning unknown factors and the future made in analyzing alternative courses of action. (AFP 178-8)
Average	-	A quantity or value that represents the magnitude of a set (usually a population or a sample) of quantities or values related to a common subject. Popularly refers to arithmetic mean. (AFP 178-8)
Base Period or Year	-	The time selected to determine the base values of variables for use in the analysis. Also, the time to which index numbers relate. Usually the base year is the first year in which there is an expenditure for the project. (AFP 178-8)
Benefit (1)	-	Result attainment by the goal or objective rather than output. (AFP 178-8)
Benefits (2)	-	Objective measures of an alternative's effectiveness. Benefits should be presented for each year of the program. When a dollar value cannot be placed on comparable programs or projects benefits, other objective measures may be available and useful for comparing alternative means of achieving specified objectives on the basis of their relative present value costs. (AFR 178-1)
Benefit Analysis	-	Analysis to identify, measure, and evaluate the benefits for each proposed alternative; part of program analysis. Sometimes this is termed "benefit determination." (AFP 178-8)

Benefit, Direct	-	Result attained that is closely related to the program in a cause and effect relationship. For example, an increase in literacy because of a reading program. (AFP 178-8)
Benefit, Indirect	-	Result attainment circuitously related to the program. (AFP 178-8)
Bias	-	An effect that deprives a statistical result of being representative by systematically distorting it. Bias may originate from poor design of the sample, from deficiencies in carrying out the sampling process, or from an inherent characteristic of the estimating technique used. Often the degree of bias related to an estimating technique may be so small as to be of no practical importance, but in other instances it may be significant enough to invalidate the usefulness of the analysis.
Capital	-	Permanent assets having continuing value. Examples are land, buildings, and other facilities including equipment. (AFP 178-8)
Combat Capability	-	The readiness status of a unit to perform its tasked combat mission and its ability to sustain a required level of tasking for a specified number of days. The terms "Combat Capability" and "Readiness and Sustainability" are used interchangeably throughout AFIRMS documents.
Commercial or Industrial Activities	-	Activities generated and managed by Air Force inservice personnel to provide for Government use, products, or services obtainable from private commercial sources. (AFR 178-1)
Constant Dollar	-	Computed values that remove the effect of price changes over time. Derived by dividing current dollar values by their corresponding price indexes based on a base index. The result is a series as it would presumably exist if prices were the same over time as in the base year. (AFP 178-8)
Constraints	-	Limitations of any kind to be considered in planning, programming, scheduling implementing, or evaluating programs. (AFP 178-8)
Correlation	-	Statistical technique used to determine the degree to which variables are related. It is based on the assumption of a joint probability distribution. (AFP 178-8)

Cost	-	The value of things used up or expended in production of goods or services. Also, what must be given up to adopt a course of action. Includes depreciation charges, insurance premiums, allowances for contingencies, and other indirect costs attributable to an operation. (AFP 178-8)
Cost Allocation	-	The portion of support assets assigned to a particular objective. (AFP 178-8)
Cost Analysis	-	Determining the actual or estimated costs of relevant spending options. A basic part of program analysis. The translation produces direct cost comparisons among alternatives. (AFP 178-8)
Cost-Benefit Analysis (1)	-	A comparison of the costs and benefits of proposed alternatives. (AFP 178-8)
Cost-Benefit Analysis (2) or Cost-Effectiveness	-	An analytical approach to solving problems of choice. It requires the definition of objectives, identification of alternative ways of achieving each objective, and identification of that alternative which yields the required level of benefits at the lowest cost for each objective (see "Economic Analysis" below). (AFR 178-1)
Cost-Effective Alternative (1)	-	That alternative, which, when compared to all alternatives: a. Maximizes benefits and outputs when costs for each alternative are equal; or, b. Minimizes costs when benefits and outputs are equal for each alternative. (AFR 178-1)
Cost-Effective Alternative (2)	-	The alternative that provides the greatest benefit for the least cost. (AFP 178-8)
Cost-Effectiveness Alternative	-	(See Cost-Benefit Analysis (2) Above)
Cost Elements	-	The segments of total cost that are to be given separate treatment in the analysis. (AFP 178-8)
Cost Estimating Relationship (CER)	-	Numerical expression of the link between a characteristic, a resource, or an activity and a particular cost related to it. The expression may be a simple average, percentage, or complex equation that relates cost to physical and performance characteristics. (AFP 178-8)

Cost, Opportunity	-	The benefits that could have been obtained by some other use of resources. (AFP 178-8)
Criteria	-	The standards against which evaluations are performed. Measures used should relate to the purpose sought. (AFP 178-8)
Depreciation	-	An operating cost and a corresponding reduction in the value of an asset estimated to have accrued during an accounting period due to age, wear, or the effects of natural elements such as decay or corrosion. (AFP 178-8)
Decision	-	In an estimate of the situation, a clear and concise statement of the line of action intended to be followed by the commander as the one most favorable to the successful accomplishment of his mission. (JCS Pub 1)
Deployment	-	In a strategic sense, the relocation of forces to desired areas of operation. (JCS Pub 1)
Discount Factor	-	The multiplier for any specific discount rate that translates expected cost or benefits in any specific future year into its present value. (AFP 178-8)
Discount Rate (1)	-	The interest rate used in calculating the present value of expected yearly costs and benefits. Represents the price of money needed to adjust for the time value. (AFP 178-8)
Discount Rate (2)	-	That rate which is used to transform future costs or benefits into a value of present worth (see "Present Value" below). It is a way to compare total costs of alternatives that have different expenditure patterns over time, recognizing the time value of money. (AFR 178-1)
Discounting (1)	-	The procedure of using the discount rate to determine present value costs and benefits. (Cost and benefit streams are multiplied by their corresponding discount factors to yield discounted (present value) costs and benefits.) (AFR 178-1)
Discounting (2)	-	A computational technique using an interest rate to calculate present value of future benefits and costs. Used in evaluating alternative investment proposals that can be valued in money. (AFP 178-8)

Economic Analysis (1)	-	A systematic approach to the problem of choosing how to employ scarce resources and an investigation of the full implications of achieving a given objective. (AFP 178-8)
Economic Analysis (2)	-	A systematic approach to the problem of choosing how to use scarce resources, and an investigation of the full implications of achieving a given objective in the most efficient and effective manner. (AFR 178-1)
Economic Life	-	The period of time over which the benefits to be gained from a project may reasonably be expected to accrue to the DoD. (AFR 178-1)
Effectiveness (1)	-	A means of performance or output received from an alternative. A primary expression of benefits. (AFR 178-1)
Effectiveness (2)	-	Ability of a project to meet objectives. (AFP 178-8)
Efficiency (1)	-	Measure of input versus output. (AFP 178-8)
Efficiency (2)	-	The amount of output per unit of input. The quality whereby one alternative uses less input per unit of output than another alternative. (AFR 178-1)
Employment	-	The tactical usage of aircraft in a desired area of operation. (AFM 11-1)
Expected Annual Cost	-	The expected annual dollar value (in constant dollars) of resources, goods, and services required to establish and carry out a program or project. (AFR 178-1)
Feasibility Study	-	A study of the applicablity or practicability of a proposed action or plan. For example, the feasibility of converting a cash-based accounting system to an accrual accounting system. (AFP 178-8)
Historical Cost	-	The cost of any objective, based on actual dollar (or equivalent) outlay, ascertained after the fact. (AFR 178-1)
Input	-	Resources used to obtain output. (AFP 178-8)
Investment	-	Resources spent for capital assets. Usually, one-time or nonrecurring cost. (AFP 178-8)

Investment Cost	-	A sum of money spent to acquire a future capability. An investment is an acquisition made with the expectation of realizing benefits beyond 1 year. This includes acquisitions that are financed in more than 1 year. (AFR 178-1)
Least Cost Alternative	-	The alternative producing, the same or greater output than any other alternative at the least cost. (AFP 178-8)
Life-Cycle Cost	-	The total cost of an item or system over its full life. It includes the cost of development, procurement, ownership (operation, maintenance, support, etc.), and where applicable, disposal. (AFR 178-1)
Life-Cycle Cost Estimates	-	All anticipated costs directly and indirectly related to an alternative during all stages; preoperational, operational, and terminal. (AFP 178-8)
Mean, Arithmetic	-	The sum of all the values of a set of observations divided by the number of observations. Also known as an average. (AFP 178-8)
Median	-	The central value of a set of observations that have been arranged in order of magnitude. It is that value which divides the set so that an equal number of items are on either side of it. (AFP 178-8)
Military Capability	-	The ability to achieve a specified wartime objective (win a war or battle, destroy a target set). It includes four major components: force structure, modernization, readiness, and sustainability. (JCS Pub 1)

a) Force Structure - Numbers, size, and composition of the units that comprise our Defense forces, e.g., divisions, ships, airwings.

b) Modernization - Technical sophistication of forces, units, weapon systems, and equipments.

c) Readiness - The ability of forces, units, weapon systems, or equipments to deliver the outputs for which they were designed (includes the ability to deploy and employ without unacceptable delays).

d) Sustainability - The "staying power" of our forces, units, weapon systems, and equipments, often measured in number of days. (Note: This is the part 2. definition of sustainability, which is published alphabetically.)

Mission	-	The task together with its purpose, thereby clearly indicating the action to be taken and the reason therefore. The dispatching of one or more aircraft to accomplish one particular task. (JCS Pub 1)
Mode	-	The observations that occur most frequently in a set of observations. It is a measure of central tendency in a frequency distribution. (AFP 178-8)
Model	-	A representation of the relationships that define a system or situation under study. Its purpose is to predict what will happen when a system becomes operational in performance and input. A model, with its analytical discipline features, may be a set of mathematical equations, a computer program, or any other type of representation ranging from verbal statements to physical objects. Models permit the manipulation of variables to determine how a process, subject, or concept would behave in different situations. (AFP 178-8)
Objectives	-	Statements of what we are trying to accomplish. In analysis, objectives are stated in a way that does not prevent alternative approaches. Sometimes referred to as interim goals. (AFP 178-8)
Output (1)	-	Program results such as goods produced and services performed expressed in quantities that can be related to specific inputs, organizational missions, and functions. Outputs provide a basis for evaluating the productivity and efficiency of an organization or activity. (AFP 178-8)
Output (2)	-	Goods and services produced or capable of being produced. (AFR 178-1)
Payback Period	-	The time it takes to recover an investment outlay. Also referred to as payoff period or cash recovery period. (AFP 178-8)
Performance Measurement	-	Comparing the amount of work accomplished with an establised standard. (AFP 178-8)
Physical Life	-	The estimated number of years that a machine, piece of equipment, or building can be physically used by the DoD in accomplishing the function for which it was procured or constructed. An ititial estimate of physical life may require adjustment, if significant alterations or conversions are subsequently proposed or effected. (AFR 178-1)

Planning Programming, Budgeting Systems (PPBS)	-	An effort to tie forward planning to budgeting by programming. Key elements are program budgeting and program analysis. (AFP 178-8)
Present Value	-	The sum of each year's expected yearly cost multiplied by its discount factor over all years of the planning period. (AFR 178-1)
Program Evaluation	-	Analysis of ongoing actions to determine how well the stated objectives are being accomplished. Program evaluation studies entail a comparison of actual performance with the intended accomplishments. (AFR 178-1)
Real Property	-	Land and rights therein, utility generation plants and distribution systems, buildings, structures, and improvements thereto. (AFR 178-1)
Recurring Costs	-	Expenses for personnel, materiel consumed in use, operating overhead support services, and other items incurred on an annual basis. (AFR 178-1)
Residual Value	-	The expected future value of an asset at any point in time before the end of its economic life. (AFR 178-1)
Resources	-	Assets available and anticipated for operations. Includes people, equipment, facilities, and other things used to plan, implement, and evaluate programs. (AFP 178-8)
Risk	-	The probability that some assumption or estimate is wrong. (AFR 178-1)
Sensitivity Analysis	-	Examination of the effects obtained by changing the direction and magnitude of assumptions embodied in analyses. Does the change in assumptions increase benefits? By how much? Does it decrease benefits? By how much? The relative sensitivity of assumptions shows the effort required to isolate and define their elements of uncertainty. (AFP 178-8)
Shortfall	-	The absence of forces, equipment, personnel, materiel, or capability -- identified as a plan requirement -- that would adversely affect the command's ability to accomplish its mission. (JDA JDS Procedures Manual 1 Jan 82)
Sortie (air)	-	An operational flight by one aircraft. (JCS Pub 1)
Standard	-	A criterion for evaluating performance and results. (AFP 178-8)

Sunk Cost	-	The sum of past expenditures or irrevocably committed funds related to the project. Such costs are generally not relevant to decision-making as they reflect previous rather than present choices. (AFR 178-1)
Tasking	-	(NATO) The process of translating the allocation into orders, and passing these orders to the units involved. Each order normally contains sufficient detailed instructions to enable the executing agency to accomplish the mission successfully. (JCS Pub 1)
Technological Life (1)	-	Estimated number of years before the existing or proposed equipment or facilities become obsolete due to technological changes. (AFP 178-8)
Technological Life (2)	-	The estimated number of years before technology will make the existing or proposed equipment or facilities obsolete. (AFR 178-1)
Terminal Value	-	The expected value of assets at the end of their economic life. (AFR 178-1)
Uncertainty	-	Lack of knowledge about outcomes in a decision such that it is not possible to assign probabilities in advance. (AFP 178-8)
Uniform Annual Cost	-	The average cost per year for those years in which benefits accrue. It is obtained by dividing the total present value cost (for the full life cycle) by the sum of the present value factors of the years in which benefits accrue (economic life). (AFR 178-1)
Variable	-	An element subject to change. (AFP 178-8)

SECTION 2. INTRODUCTION TO AFIRMS

This section provides a brief introduction to the Air Force Integrated Readiness Measurement System (AFIRMS). A more complete description is provided in the AFIRMS Functional Description.

2.1 AFIRMS Synopsis.

2.1.1 Key AFIRMS Concepts. AFIRMS is an automated, tasking based, capability assessment system. As such, AFIRMS evaluates unit and force capability to perform tasked missions based on the availability of specific resources.

a. The conceptual requirements for AFIRMS are two-fold:

(1) Assessment of combat capability against specific tasking. The user can assess unit/force combat capability against any planned or ad hoc tasking, e.g., War Mobilization Plan (WMP), Operation Plan (OPlan), Fragmentary Order, Air Tasking Order (ATO), Contingency Plan, etc.

(2) Assessment of combat capability based on budget appropriations. AFIRMS provides a tool for computing long-term readiness and sustainability trends, spanning two to six fiscal years. This tool permits comparison of readiness and sustainability by fiscal year and can therefore highlight the impact of appropriation changes. Thus, changes in funding are related to changes in force readiness and sustainability. Also, senior Air Force decision makers are supported during budget deliberations and Air Force budget allocations.

b. AFIRMS implementation has two key concepts:

(1) Integrated approach to tasking based capability assessments. AFIRMS has two integrative dimensions. First, all applicable resources and their usage interactions are considered. For example, in sortie capability assessment, AFIRMS evaluates capability in terms of all four essential resource types (aircrew, aircraft, munitions, fuel), their interdependencies, and their generative components (such as spares for aircraft, training qualifications for aircrew, load crews for munitions, and hot pits for fuel). Second, other automated systems (such as the Combat Supplies Management System (CSMS), Combat Fuels Management System (CFMS), Weapon System Management Information System (WSMIS), etc.) outputs are integrated into capability assessment calculations through system interfaces between those systems and AFIRMS.

(2) Data Quality Assurance. Capability assessment is no better than the data upon which it is based. Therefore, AFIRMS emphasizes a user orientation toward quality assurance of source data. Unit and other data input level users are provided effective tools to accomplish their daily activities and therefore develop a vested interest in AFIRMS data currency and validity. Capability assessment data can then be extracted for use by higher or parallel users with maximum confidence in its validity.

2.1.2 AFIRMS Functions. Four basic AFIRMS functions combine to assess readiness capability:

a. Translate Tasking. As a tasking based capability assessment system, tasking must be converted into a standard format recognized by AFIRMS. Tasking is defined in AFIRMS to the unit level and may consist of actual, hypothetical, standard, or contingency tasking. Any of these taskings can be defined within specified WMP or OPlan constraints, at the option of the user. Likewise, the tasking may be defined by the user for present, historic or future requirements.

b. Define Resources. The resource definition function of AFIRMS ensures that information about inventory status is available and accurate. Wherever possible, this data is obtained by interface with other functional systems. As with tasking, resource information can be defined for actual, hypothetical, or contingency situations, either present, historic, or future.

c. Determine Ability to Perform. Determining the force's ability to perform is the essential function of AFIRMS. The tasking and resource data are processed to determine how much of the specified tasking can be accomplished with the resources available. Ability to perform is evaluated in terms of the task metric (sorties,etc.) and the cost metric (dollars) to provide readiness/sustainability and dollars to readiness assessments.

d. Aggregate, Analyze and Present Data. Aggregation, analysis and presentation ensure the proper grouping and display of data to provide useful information at the unit, major command and HQ USAF. Aggregation refers to the creation of a composite understanding of capability for several units.

2.2 AFIRMS Documentation. A set of nine types of documents describes AFIRMS. A list of these AFIRMS documents is provided below along with a short description of the particular aspects of AFIRMS which are addressed by each document.

a. Functional Description (FD). The FD provides the description of AFIRMS concepts in user terms. It is the baseline document which ties the AFIRMS documents together.

b. Economic Analysis (EA). The EA states AFIRMS estimated costs. It explains the cost factors of AFIRMS implementation alternatives and states the recommended alternative.

c. Evolutionary Implementation Plan (EIP). The EIP details the current plan for AFIRMS implementation. It describes the time sequence of the implementation by functional blocks, organizations and work phases (analysis, development, installation, etc.).

d. System Specification. The AFIRMS System Specification adds the design requirements to the functional concepts in the FD. It divides the system into subsystems (HQ USAF, HQ USAFE (MAJCOM), and Wing (unit)) and assigns functions required within each subsystem. The system specification details the overall architecture, intersite interface gateways, processing logic flows and the communications network specifications.

e. Subsystem Specifications. There are three AFIRMS subsystem specifications: HQ USAF, HQ USAFE (MAJCOM/numbered Air Force), and the Wing (unit/squadron). Subsystem specifications detail the specific design and/or performance requirements of the system at that level. Design details cover the architecture, required functions, the functional users, intrasite interface gateways, and applicable processing logic flows.

f. Database Specifications. There are three AFIRMS database specifications: HQ USAF, HQ USAFE (MAJCOM/numbered Air Force), and Wing (unit/squadron). These specifications describe the database architecture, size and content, as well as logical data relationships for the functions performed at each of the AFIRMS levels.

g. Data Requirements Document (DRD). The DRD identifies, categorizes, and groups the generic types of data used in AFIRMS. It also defines each type of AFIRMS data element (attribute class).

h. Product Descriptions (PDs). The PDs visually portray the products which implement the AFIRMS functions as input and output tools.

i. Transform and Model Descriptions. The Transform and Model Descriptions Document defines how AFIRMS calculates the output data from the input data. Specific algorithmic calculations are provided. Logical groups of algorithms forming AFIRMS models and transforms are described.

SECTION 3. ASSUMPTIONS

3.1 Introduction. This section identifies, and where appropriate, assesses the assumptions underlying the Economic Analysis. As used throughout this document, the word assumption" means a judgement concerning unknown factors and the future mode in analyzing alternative courses of action (AFP 178-8). Each assumption represents a statement by system builders of what they consider most likely to occur based on observed facts, trends, and plans. The assumptions limit the range of the alternatives by covering factors implied by the objectives or by specifying requirements at a greater level of detail than the objectives. Some will affect the development of alternatives and others will influence the cost/benefit analysis.

3.2 Enumeration of Assumptions. This section lists the underlying assumptions regarding: Information Requirements, Time, Environment, Hardware, Software, and Communications Technology, Security, and Economics.

3.2.1 Information Requirements. The information requirements for AFIRMS continue to evolve. AFIRMS is not a closed-end system with static requirements. The emergence of new automation systems, and changes in readiness and budgetary demands of the Air Force, influence the development of AFIRMS.

3.2.2 Time.

a. Economic Life: AFIRMS is an evolutionary system. The current planning effort for AFIRMS alternatives can reasonably be expected to accrue benefits up to ten years following initial operational implementation. Ten years is the required standard economic life of electronic systems in AFR 173-13.

b. Physical Life: The period until the equipment, specifically hardware, ceases to be functional for AFIRMS. However, AFIRMS is more than equipment. It also contains software and procedures that are likely to be enhanced and carried over to new equipment. This factor may be preempted by technological life.

c. Mission Life: The mission life of AFIRMS appears to be indefinite.

d. Technological Hardware Life: The period before new technology makes AFIRMS obsolete. This, like physical life, may not be clearly expressible as a single number. That is, partial (or continuous) replacement of AFIRMS components, may lead to such evolution of the whole that in time all original components will have been replaced.

3.2.3 Environment. Assumptions in this section address the kind of world in which the system will exist and the influences of that world on the system:

a. It is assumed that AFIRMS will be used only by the Air Force units identified in this document.

b. Information may be required from EIFEL, a NATO system, or other Allied systems. (Refer to Section 3.2.5 Security.)

c. The level of computer literacy of system users and managers requires high system reliability and ease of use.

d. The amount and type of training required depends upon two factors: the assumed knowledge of Air Force personnel who use, operate or maintain the system and, the design and documentation of the system.

e. Regardless of the communications throughput required between sites, conserving the use of communications is a design goal for several reasons:

(1) Line charges are relatively high, even on common user networks.

(2) Less reliance on communications means less risk of system nonavailability.

(3) Obtaining greater bandwidth requires considerable effort and lead time.

(4) To minimize response time degradation.

(5) To maximize data integrity (protect data from modification or loss).

(6) To minimize risk of compromising classified data.

f. On-base communications rely on base telephone lines or expeditionary lines for data communications to AFIRMS terminals. AFIRMS uses common user local area network projects, where appropriate, on a cost/benefit basis.

g. Computing power and storage is available for AFIRMS from other systems, e.g., WWMCCS Information System (WIS) or Phase IV. Availability is determined by the respective program managers on a case-by-case basis.

h. Data communications encryption is a flat fee when the Defense Data Network (DDN) is implemented.

i. Air Force Size and Complexity:

(1) Peacetime: The general structure of the Air Force in terms of size, complexity, command structure, and mission are assumed unchanging in peacetime. Some restructuring and changes in weapon systems can be expected. Deployed units have the capability to report (at a minimum) to the AFIRMS system.

(2) Crisis: AFIRMS is responsive to changes in the command structure during crises. A range of changes are predictable, such as war mobilization restructuring, contingency organizations, contingency bases, etc.

j. UNITREP data continues to be required by the Joint Chiefs of Staff (JCS).

k. AFIRMS is designed to minimize the difficulty in interfacing to other automated information systems. Initially, all worst case AFIRMS interfaces with external automated systems are air-gap. During later phases of the interface effort, the systems that are most beneficial to AFIRMS for early hardwired interface capabilities are 1 through 6. Project AFIRMS Block 1 interfaces are WWMCCS and AUTODIN.

Other programs under development or completed include but are not limited to:

(1) Air Force Operations Resource Management System (AFORMS)

(2) Weapon System Management Information System (WSMIS)

(3) EIFEL (NATO Command and Control System)

(4) European Distribution System (EDS) (USAFE only)

(5) Joint Operation Planning and Execution System (JOPES)

(6) World Wide Military Command and Control System (WWMCCS)

(7) Combat Ammunition System (CAS)

(8) Combat Fuels Management System (CFMS)

(9) Combat Supplies Management System (CSMS)

(10) Weapon System Assessment Model (WSAM)

(11) Mini-Dyna-METRIC Model

(12) Logistics Capability Measurement System (LCMS)

(13) Contingency Operations/Mobility Planning and Execution System (COMPES)

(14) Local Area Network (LAN)

(15) AUTODIN

(16) Defense Data Network (DDN).

l. Existing Unit Automation. PACAF, SAC, and MAC plans for the installation of ADPS at Wing level preempt the need for the acquisition of substantial additional AFIRMS computers. (The actual number and type of existing and planned ADPSs will be fully defined in the Analysis Phase of the initial implementation Block for each of these segments.)

m. Equipment Physical Surroundings. Two levels of restrictions apply based on the necessity to deploy the equipment. Reliablity and availability of AFIRMS are high, but the AFIRMS equipment is not enhanced for survivability. It is used, as is, under crisis conditions.

(1) Space.

(a) Site Locations. Systems are installed at various Air Force installations worldwide. The central site location space ranges from a maximum of 20 square feet for the smallest configurations, to a maximum of 200 square feet for the largest configuration.

(b) Flooring. Equipment does not require raised flooring. The flooring may be carpeted. There are no special static control facilities.

(c) Ceiling Height. The distance from the floor surface to the unobstructed ceiling is at least 8 feet.

(d) Access Route. Equipment is installed in buildings with typical access being a normal office doorway. Some facilities are established computer facilities with double door access.

(2) Electrical Power. All equipment is capable of operating within the requirements of MIL-E-4158 and is further defined by the following:

(a) Voltage regulation steady state: +10% to -15%

(b) Voltage disturbances: 30% for less than 0.5 seconds

Momentary undervoltage: -100% acceptable to 20 milliseconds

Transient overvoltage: 200% for less than 0.2 milliseconds

Surges: IAW IEEE 587-1980

(c) Voltage harmonic distortion: +3% -5% (with linear load)

(d) Frequency variation: 50/60Hz plus or minus 1Hz

(e) Frequency variation rate of change: 1Hz/sec. (slew rate)

(f) Power factor: 0.8

(g) 220/240 Volts: +or-10%, single phase, 2 wire.

(h) 105/110 Volts: +or-10%, single phase, 2 wire (Japan).

Deployable equipment operates using an Air Force 25KVA generator.

(3) Air Conditioning. The ambient temperature is maintained between 60 and 90 degrees F with a relative humidity of between 20 and 90 percent. No special dust, static electricity control, or chilled water facilities is available.

(4) Remote locations. Remote equipment is installed in various office environments. Terminals, office printers, and modems fit on normal table tops or desk surfaces.

(5) TEMPEST Requirement. All equipment, connectors, and cabling that convey classified information meets the limits specified in NACSIM 5100A. All equipment is on the Preferred Products List (PPL) or approved by AFCSC/EPV San Antonio, TX 78243.

3.2.4 Hardware, Software, and Communications Technology.

a. Hardware:

(1) The general architecture and the software and hardware have a modular design. Relevant changes in hardware technology during the economic life enable AFIRMS to provide enhanced processing capabilities.

(2) No changes in hardware contribute to limiting the life of the system since the functions of the system can be transferred to new hardware when maintenance and operating costs require updating.

b. Software:

(1) AFIRMS is designed to isolate the impact of the introduction of new hardware and software during its life. That is, flexibility, portability, and top-down structured modular design are key guides.

(2) Having the AFIRMS functions available leads to new perceptions and to requests for further improvements. This, in turn, leads to maintenance activities as identified in the cost factors. It is assumed, however, that a complete system rewriting occurs only:

(a) As a gradual evolution within proposed hardware and support software.

(b) As required by entirely new hardware system design and software concepts.

(3) Ada* is the preferred programming language. Its life expectancy exceeds the economic life of AFIRMS. Other Air Force and DoD standard languages are used, where Ada is not available or is wholly inappropriate for segments of the software.

(4) Support Software: AFIRMS is not made obsolete by the development of a new operating system, database management system (DBMS), or other support software. In particular, the development of fast, large volume, full capability relational databases is anticipated. This contributes to a need to isolate implementation details in AFIRMS. Isolation is accomplished by modular design and layered protocols for communications and for systems software calls.

c. Communications: The eventual operational DDN facilitates secure and low-cost communications in later AFIRMS implementation blocks.

3.2.5 Security.

a. Maximum security level is Top Secret. AFIRMS encryption equipment is required on DDN to carry Top Secret data.

b. Sufficient cryptographic devices are supplied for AFIRMS communications needs.

c. Interface to NATO Secret and other allied classified information are initially air-gap.

d. The Air Staff and all MAJCOM headquarters operate in the System High security mode at a level of Top Secret. The majority of Wings operate in the controlled mode with user and information at security levels of Unclassified through Secret.

3.2.6 Economics.

a. General inflation and specific deflation.

(1) The opportunity cost of money is assumed using the 10% discount factor from AFR 178-1 for computing the present value of the alternatives.

(2) Procurement costs for major system components (such as CPU, RAM, hard disk) have declined steadily over the past decade. This downward trend continues. Therefore, future costs for equivalent computing capabilities are lower during successive years of AFIRMS implementation than at the start. However, since the evolving system requirements demand increasing computing capability, no cost deflation or inflation factor is used in this analysis.

*Ada is a registered trademark of the U.S. Government (Ada Joint Program Office).

(3) Costs of software development increase manpower costs each year at the general inflation rate. However, improved software development methods increase productivity to keep software cost rates constant.

b. Software residual value. Technological advances and innovations in computer programming languages and techniques may possibly render the applications software code obsolete by the end of AFIRMS' economic life. Nevertheless, the analysis, principles, and concepts forming the foundation for this code retain some economic value. No software residual values can be estimated with enough accuracy to be useful to the comparison of alternatives.

3.2.7 System Variables. Other system variables which have been shaped the definition of the alternatives are described in Appendix A, System Variables.

SECTION 4. ALTERNATIVES

4.1 Overview. This section describes the range of alternatives available to meet the Air Force's total requirements for a system to measure readiness. The alternatives that fulfilled the objectives of AFIRMS were considered viable, but not all the viable alternatives were considered feasible. Appendix C discusses the infeasible alternatives. The UNITREP system, as a baseline, and two feasible alternatives are described in this and succeeding sections. Differences in the costs and benefits of all the alternatives are analyzed in Section 5.

The alternatives provide answers to two major requirements of the Air Force: operational requirements and integration with other systems. The operational requirements include the requirement for unit deployment and for operating in a crisis. AFIRMS must be integrated with existing hardware and automated information systems (AISs) in the MAJCOMs and with new AISs, as they are implemented.

To account for major differences in the MAJCOMs' units according to their requirements, the MAJCOMs' units are considered as falling into one of four categories: deployable units with unit automation, deployable units without unit automation, non-deployable units with unit automation, and non-deployable units without unit automation. Units with unit automation are those with significant, on-line, automated support for functions throughout the Wing, beyond the base-level computer systems. Each of the four types of units includes both Continental United States (CONUS) and overseas-based units.

4.2 Feasibility Screening. Feasibility was evaluated from two perspectives, technical and operational. Technical feasibility pertains to equipment, software, communications technology, and ergonomics. Operational feasibility pertains to the ability of a system to be integrated into the operational environment of the Air Force. Criteria for both technical and operational feasibility are listed in Appendix B. In general, the following requirements were considered in feasibility screening:

a. Technical feasibility. Hardware, software, and communications should be advanced and fully tested. The system should not require research and development. The software development and system integration effort should also not require revolutionary methods that might expose the program to high development risk.

b. Operational feasibility. The system should not adversely affect the ability of the Air Force or any Air Force organization to perform its mission.

Several alternatives which met the objectives of AFIRMS have been eliminated from full analysis of costs and benefits because they failed to meet the feasibility criteria. These alternatives and the reasons for their elimination are listed in Appendix C.

4.3 Alternative #1 - Current UNITREP Overview. This section describes the reporting process through the UNITREP system. Even though the current UNITREP system does not meet the capability objectives of AFIRMS, it has been included for cost comparison purposes in order to provide a frame of reference against which the relative value and cost of the recommended alternative can be judged.

Air Force units report their combat readiness (C-ratings) through the UNITREP system. (Detailed reporting requirements can be found in AFR 55-15 dated 22 November 1982). C-ratings are assigned to show a unit's overall combat readiness and the availability of selected unit combat essential materiel and personnel resources. Measured area C-ratings provide visibility of resource status to advise the National Command Authorities (NCA) on current force readiness. Only organic resources under the operational control (OPCON) of the reporting unit or its parent unit are measured for unit readiness reporting.

Unit C-ratings are based on the unit's wartime mission as identified in the unit's Designed Operational Capability (DOC) statement. Wartime resources or missions to be measured in the UNITREP C-ratings are primarily based on those planned capabilities extracted from volumes 3 and 5 of the USAF War Mobilization Plan. Equipment to process UNITREP at the Wing generally consists of one keypunch machine and one computer terminal. Three man-hours per day are required for UNITREP processing including data collection, data entry (punching of IBM cards), quality assurance (QA), etc. Processing at the Wing involves keypunching approximately five to ten cards, followed by a manual check to ensure accuracy. For Wings that have WWMCCS interconnectivity, the punched card data is then loaded onto the system, processed into report form, and transmitted (for example, via the WWMCCS intercomputer network) to the MAJCOM. For those Wings that do not have WWMCCS interconnectivity, the cards are transported to the Communications Center where an 80 column listing of the cards is printed, and a check is made to ensure they have been punched correctly. The data is then transmitted

to the MAJCOM via either AUTODIN or through the National Automatic Communications System (NACE). Transmission through NACE involves transferring the punched card data to tape (standard card to tape process). The tape is then loaded into NACE and the data is put in a holding file. This holding file is then used to automatically (transparent processing) generate the report. UNITREP data for flying units is processed and transmitted daily, except Saturday. This data reaches the MAJCOMs within 24 hours, and is therefore, fairly current.

MAJCOM level UNITREP processing requires three people working eight hours per day. UNITREP data received from the Wing is once again reviewed for accuracy. Wing data is aggregated into one report, which is then sent to the Air Staff. Although Wing data has been aggregated, the report is still by Wing. (At the same time that UNITREP data is transmitted to the Air Staff, it is also transmitted to the JCS for further processing.)

Air Staff level UNITREP processing requires four people working eight hours per day. Air Staff processes UNITREP data once daily. The Air Staff UNITREP database consists of 164,000 records (K-cards). 1307 records were updated during 14 March 1985 processing. Daily Air Staff processing usually takes one and a half hours on the Honeywell 6000.

Processing of UNITREP data at the Wing is performed by personnel at the E-3 to E-4 level. At the MAJCOM, data support personnel are generally at the E-6 level and at the Air Staff, computer system support is provided by senior enlisted personnel. Actual UNITREP analysis is performed at the Major and Lt. Col. levels.

4.4 Alternative #2 - Single Microcomputer at Each Wing.

4.4.1 Features.

a. Minimal AFIRMS hardware at each Wing. Variety of central computers at MAJCOM headquarters. Minicomputer at HQ USAF.

b. Availability of AFIRMS for Wing deployment, not individual Squadron deployment.

c. Phased development and implementation, uniform for all MAJCOMs.

d. Leased, dedicated, inter-site communications until common user packet switch communications become available.

e. UNITREP data incorporated and reported.

This alternative would provide AFIRMS services to all levels of the Air Force structure with minimal intrusion of hardware into the wings. HQ USAF and MAJCOM headquarters would process AFIRMS on AFIRMS or existing computers. The Wings would have one classified microcomputer to input resource data, process AFIRMS, and produce capability assessments for the Wing staff. Although all Wings and MAJCOMs would have the same AFIRMS architecture, AFIRMS wing number and type of interfaces (and subsequent data accuracy) would be different between MAJCOMs as a result of differences in levels of existing automation. Units with less existing automation would perform a large amount of manual input of the resource information required by AFIRMS. The AFIRMS equipment would be deployable for Wings that must deploy, but AFIRMS capability would be limited by the ability of other Wing systems to deploy. Many Wings would have to revert to manual input of resource data during deployments. Because there is a single AFIRMS computer at each Wing, deploying squadrons would not have automated AFIRMS support during their separation from the Wing. Non-deployable Wings would have a commercial off-the-shelf computer.

Each MAJCOM's system would be implemented as a separate but centrally managed effort. The initial development would provide the full capability described for this alternative. When new functional area information systems are installed, AFIRMS interfaces with new systems can be developed and installed, as required.

As a part of the integration in each MAJCOM and Wing, Alternatives #2 and #3 can replace the calculating and reporting functions of UNITREP to provide UNITREP data at the wings. UNITREP reports would still be finalized with commanders' judgment and transmitted from the Wings. The AFIRMS support would replace the manual computation and provide for entry of UNITREP data as a matter of routine within normal AFIRMS functions.

4.4.2 Architecture. The general architecture of the whole system is hierarchical. Equipment at the Air Staff would be dedicated to AFIRMS and would interface to the Air Force World Wide Military Command and Control System (WWMCCS) Information System

(AFWIS) and other systems. Communications with MAJCOM headquarters would use the DDN in a secure mode as soon as it is available. See Section 3 for assumptions concerning AFWIS and DDN.

Computers at MAJCOM headquarters would be dedicated AFIRMS minicomputers and interfaced to other systems. Several commands, including the Strategic Air Command (SAC), would implement AFIRMS on the WWMCCS mainframe at MAJCOM headquarters. All MAJCOM headquarters would have both hardwired and remote intelligent terminals connected to the central processor.

MAJCOMs with capacity on existing classified computer equipment, or the ability to upgrade existing classified computers, would add the required capacity for processing AFIRMS. Some of the workstations installed at HQ USAF and MAJCOM headquarters would be color display intelligent workstations.

The wing microcomputers would be color display intelligent workstations with a high capacity hard disk. Each wing/base microcomputer would have its own communications link to the MAJCOM headquarters. The communications link must be separate from unclassified base data communications, because the AFIRMS computer would operate in the System High secure mode for classified data to the Secret level.

4.4.3 Software. Information generally flows from the lower command levels upward. Some information would pass from one MAJCOM to another for assessing capability with resource and unit support from the supporting MAJCOMs.

Resource data or other information required from the Phase IV computer which supports the wing would be transferred at programmed time intervals.

4.5 Alternative #3 - Hybrid Architecture.

4.5.1 Features.

a. Numerous types of central processors for Wings. Variety of central computers at MAJCOM headquarters. Minicomputer at HQ USAF.

b. Automated AFIRMS support available for separately deploying Squadrons.

c. Phased MAJCOM development and implementation.

d. Intelligent workstations capable of temporary autonomous operation at all levels.

e. Leased, dedicated, inter-site communications until common user packet switch communications become available.

f. UNITREP data incorporated and reported.

The main feature that distinguishes this alternative from the others is the fact that the system implementation accommodates each MAJCOM's compatibility, operational, and deployment requirements.

The MAJCOMs with predominantly deployable units would have deployable computer, communications, and cryptographic equipment at the Wing and squadron level. The system would be designed with transportability, ease of installation, robust operation, limited redundancy, and backup and recovery procedures. The software system would be integrated into the existing functional area systems to give feedback to users without undue data entry redundancy. UNITREP functions would be included in the AFIRMS system by the system's producing UNITREP outputs from AFIRMS data and from UNITREP-unique data. (See UNITREP comments in paragraph 4.4.1.)

MAJCOMs with predominantly non-deployable units would have commercial off-the-shelf computers and intelligent terminals at those Wings that do not deploy.

SAC, MAC, and PACAF would not require a large amount of additional computer and communications equipment, since a significant level of unit automation would exist by the time AFIRMS is implemented. (See Assumptions.)

Implementation for each MAJCOM would be developed as a separate but centrally managed effort. Additionally, blocks of capability would be developed and installed in increments over the life of the system within each MAJCOM. The initial block of capability in each MAJCOM would not be the full capability described for this alternative.

4.5.2 Architecture. The overall hierarchical composition of the system is the same as Alternative #2. Equipment at the Air Staff would be dedicated to AFIRMS and interfaced with AFWIS and other systems. Communications with MAJCOM headquarters would use the DDN in a secure mode. See Section 2 for assumptions concerning AFWIS and DDN.

Computers at MAJCOM headquarters would largely be dedicated AFIRMS minicomputers and interfaced to other systems. Several commands, including SAC, would implement AFIRMS on the WWMCCS mainframe at the headquarters. All MAJCOM headquarters would have both local hardwired terminals and remote terminals.

At sites where an AFIRMS central processor is installed, the communications would be configured in a modified star. As the system grows and matures, the hub could have more than one processor. The configuration at the hub would differ, depending on the requirement for deplovment and processing capacity. Non-deploying units without existing unit automation would have a single minicomputer at the center; deploying units without unit automation would have a group of microcomputers at the hub to provide adequate processing power and redundancy. Units with existing unit automation would add the processing and storage capacity required for running AFIRMS software.

4.5.3 Software.

The data exchange protocol between MAJCOM headquarters and the Air Staff would be the same for all MAJCOMs, despite the hardware and communications differences. Each MAJCOM would report the same kind of readiness assessment and resource information, as appropriate to the mission of the MAJCOM.

The general system architecture to be used for each site is based upon a centralized database and a set of functional area databases. The centralized database would be accessed via a central node module (CNM). Each CNM will service one or more functional areas (FAs), and would share the centralized database with any other CNM comprising the central node. Each CNM would have a full duplex high bandwidth communications path to each on-line storage device that has any part of the centralized database resident upon it. Each CNM would have one or more high bandwidth full duplex communications paths to one or more other CNMs comprising the central node. If only two CNMs comprise a central node, communications paths between the two would be provided. Each CNM would have one private on-line storage device which contains the system software for that CNM and would be used for system storage space only.

A communications path would be provided for normal communications with a higher/lower level site. In addition to this normal channel which would be shared between all CNMs, each CNM would have an alternate temporary path to the higher level site. This alternate path must be variable in nature, and the software must be capable of communicating using a variety of protocols and speeds. A communications path would be provided for normal communications between an FA workstation and a CNM. In addition to this normal channel, each FA would have an alternate temporary path of communications (e.g., a dial-up phone line). Each CNM would have the required receiving equipment to accept the alternate path transmission. It would be possible for the FA to use the alternate transmission path to link directly to a CNM at a higher/(lower) level site.

Each CNM would have a copy of the DBMS being used for the subsystem. The processing of the updates or retrievals from the centralized database would be distributed between the CNMs. Each CNM would be responsible for updating the databases of the FAs attached to it as required. It would also be responsible for transmitting the data updates made by one or more of its attached FAs to all other CNMs to allow them to update their FA's databases as required. Each FA would be an intelligent device, capable of multiprogramming, containing its own resident database and copies of required software. The data resident on the FA database would consist of update/read and/or read-only data elements. The specific data and support software to be resident would be determined by the data needed for a functional area's normal uses. When an update is made on the FA, it sends the update transaction to the CNM to allow update of the centralized database and for synchronization of the databases of other FAs. The FA DBMS must have a host language interface.

No ad hoc queries will occur between sites. The CNM at each site will normally provide periodic updates of predefined data to the higher level command. Special updates of these predefined data can be requested in addition to the periodic updates. Ad hoc queries within a specific site are provided to select users in a read only mode within AFIRMS.

The CNM is also capable of responding to a request from a higher level outside of the normal update cycle. These will normally be processed at a low priority level. However, there is a method to increase the service priority from the site at which the operation will occur.

SECTION 5. COSTS AND BENEFITS

5.1 General Process. This section describes the costs and benefits used in the analysis of the economic life of AFIRMS alternatives. After an overview of the generic cost and benefit factors is stated, present value summaries of the alternatives are given, and highlights of the most significant costs and benefits for each alternative are discussed. The section concludes with a comparison of the costs and benefits that are detailed for each alternative in Appendix D.

The costing of each alternative takes into account the evolutionary implementation strategy and MAJCOM differences. The costing assumes that the LPP software and documentation (specifications) exist at the beginning of development. It is also assumed that LPP hardware at HQ USAF and HQ USAFE will be used for their initial operational implementation. Sensitivity analysis discussed in Section 6 outlines some of the implications of this assumption, if it proves incorrect.

The recurring costs for software are assumed to remain higher, relative to the initial development costs, than historic data indicates for automated information systems. The reason for the high software maintenance factor is the evolutionary nature of the requirements and the intention of AFIRMS to accommodate evolving requirements.

5.2 Explanation of Cost Factors and Benefits. Cost factors are separated into recurring or non-recurring costs. Non-recurring costs consist of development, acquisition, and installation costs. Recurring costs are operations and maintenance (O&M) expenses for personnel, hardware, software, supplies, and utilities. This separation of costs into recurring and non-recurring provides a distinction between operating costs and development/acquisition costs.

The major benefits are decomposed according to utility, manageability, and timely implementation, in order to reflect the objectives against which they measure performance. Utility applies to the information output and system utility. Manageability is a combination of low technical and management risk. Timely implementation emphasizes the importance of obtaining some program results as soon as possible, but not at the cost of long-range Air Force and AFIRMS goals. See Appendix D for a complete description of each factor.

5.3 Overview of Major Cost Factors for Each Alternative

5.3.1 Alternative #1 - UNITREP. All costs for UNITREP are in the recurring category; no non-recurring costs exist because the UNITREP system is currently operational. The predominant item (over three-fourths) of the life cycle cost is manpower. The system requires extensive manpower support for the review of data. While Wings devote several hours of one person's time daily, the MAJCOM headquarters and the Air Staff have full-time officers and enlisted personnel to accumulate and evaluate input data and reports.

5.3.2 Alternative #2 - Single Microcomputer at each Wing. The analysis, design, and programming effort requires over 45% of the total life cycle system cost. This effort predominates because of the large amount of data systems integration at the Wing level. This is one of the problems that AFIRMS addresses, namely, integrating the myriad of system configurations at every wing/base. Personnel costs are 29.5% of the life cycle cost. This figure is high because the maintenance effort for software written for AFIRMS is computed into the figure for personnel. In turn, the cumulative software maintenance is high because the software maintenance effort for each year is 30% of the level of effort for originating the software for each MAJCOM headquarters and each Wing headquarters. This alternative does not require personnel to be dedicated to support AFIRMS at the Wings.

The implementation schedule of this alternative affects its recurring costs. Since the implementation occurs earlier than for Alternative #3 in most MAJCOMs, the system is operational longer and the recurring costs are proportionately higher. For example, the cumulative costs for communications links are greater for this alternative than for Alternative #3, despite the fact that the annual line usage for units of the same size is the same for both alternatives.

The major costs of UNITREP disappear in each MAJCOM when this alternative and Alternative #3 initially implement AFIRMS in all Wings of each MAJCOM. The additional costs for continuing to operate UNITREP until each alternative is implemented are shown as the UNITREP Operation line item in the cost summaries below. Based on the same annual costs as Alternative #1, the UNITREP costs for Alternative #2 are the sum of annual costs until AFIRMS' initial implementation in each segment is completed.

5.3.3 Alternative #3 - Hybrid Architecture. Personnel costs are the highest cost item, at 27% of life cycle costs. Analysis, design, and programming at 24%, and hardware and software maintenance at 23% are not much lower than personnel costs. The personnel costs are high not only because of the higher maintenance costs for the greater amount of initial software, but also because one enlisted person per Wing is dedicated to AFIRMS support. Hardware and packaged software maintenance plays a larger role than in Alternative #2, because of the large equipment acquisition. The hardware and packaged software acquisition costs for this alternative are almost 7 times the acquisition costs for Alternative #2. This results in maintenance costs for hardware and packaged software being 6.4 times the same cost item for Alternative #2.

The UNITREP costs are larger then those for Alternative #2 because AFIRMS is initially implemented later for this alternative. This longer schedule results in more annual UNITREP operation costs.

5.4. Cost Summaries

The following totals for each alternative are described in detail in Appendix D:

Alternative	#1 UNITREP	#2 SINGLE MICROCOMPUTER AT EACH WING	#3 HYBRID ARCHITECTURE
PROCUREMENT	$0	$6,358,966	$43,018,297
O&M/ANALY, DESIGN & PROG.	0	45,684,571	57,133,054
O&M/INSTALLATION	0	3,409,754	13,228,659
O&M/HDWE & SOFTWE MAINT	4,296,000	8,575,788	54,488,414
O&M/SUPPLIES	776,000	1,101,364	3,024,446
O&M/COMM LINKS	5,712,586	5,173,185	4,323,236
AIR FORCE MANPOWER			
OFFICERS	2,080,036	3,433,565	2,993,839
ENLISTED	35,281,134	25,999,748	62,372,628
LIFE-CYCLE TOTALS	$48,144,586	$99,736,942	$240,580,109
UNITREP OPERATION	-	$22,716,089	$27,438,968
GRAND TOTALS	$48,144,586	$122,453,031	$268,019,077

TOTAL PRESENT VALUE COST SUMMARY

The detailed annual costs used to arrive at the life-cycle totals above help derive the total present values. The following figures are based on the 10% annual discount factors given in AFP 178-8:

Alternative #1	$29,580,034
Alternative #2	$62,274,199
Alternative #3	$141,297,626

5.5 Overview of Major Benefits for Each Alternative. This sub-section highlights the special strengths and weaknesses of the alternatives that are explained in detail in Appendix D.

Alternative #1 - UNITREP

This alternative scores 28.0 out of 100 in the evaluation of benefits in Appendix D. This alternative scored favorably under management and timely schedule, since this system is already operational. There is no development or implementation to fund and manage. All command levels understand the system outputs and how to use the system to answer questions the system can address. Finally, UNITREP uses standard Air Force and WWMCCS hardware and communications. The major disadvantage of the system is that it does not meet the major requirements of AFIRMS: namely, a tasking-based readiness assessment, and timely and accurate data at the main operating base and during deployments.

Alternative #2 - Single, Classified Microcomputer at Wings

This alternative scores 42.0 for benefits in Appendix D. There are several distinct benefits to this alternative. It improves greatly on the readiness measurement metric over UNITREP; it improves the integration of other automated information systems (AISs); initial worldwide implementation can occur within several years after start-up; it

would be deployable for the Wing headquarters and evolutionary development would allow some further integration with other AISs at all command levels. The major drawback of this alternative is that it does not meet the squadron deployment requirements of the Tactical Air Forces. Most of the benefits apply only to the peacetime situation for non-deployed units and for Wings that deploy as a single unit with the headquarters, e.g., one-squadron groups/wings in AFRES/ANG.

Alternative #3 - Hybrid Architecture

This alternative scores 92.8 for benefits in Appendix D. This alternative has all the advantages of Alternative #2, plus greater improvement in a number of areas. This alternative gives even greater improvement than Alternative #2 to units that do not already have significant unit automation. AFIRMS would put terminals directly in the hands of users who currently use paper input and outputs. The timeliness and resultant accuracy of data input would be a vast improvement over current procedures. And for those units that have a deployment mission, equipment and software would be provided for use in the deployed environment, thus improving the timeliness and accuracy of information. For units with unit automation, this alternative would give a better degree of integration with other AISs than Alternative #2, since equipment would be acquired and analysis would be performed to supplement existing systems, where necessary, and ensure a more coherent implementation approach than Alternative #2. Additionally, this alternative makes maximum use of existing unit automation. The major disadvantages of this alternative are the length of time for final implementation and the larger incremental risks that are incurred during implementation. The schedule for implementation stretches out further than Alternative #2, because there is more equipment to acquire and install, and more systems integration and training to accomplish. This larger effort also carries larger scheduling and project management uncertainties.

5.6 Comparison of Costs and Benefits. The evaluation of benefits is largely subjective. This sub-section highlights the quantitative and qualitative points of analysis. The costs used in the discussion are the total present values, displayed in paragraph 5.4.

The UNITREP alternative cannot be considered a viable candidate, because of the timeliness and lack of tasking basis problems, which are sited throughout AFIRMS documents. UNITREP also does not meet the Congressional mandate for projecting readiness and linking dollars to readiness. But, as the only current readiness reporting system and the system required by the JCS, UNITREP is a viable system for comparison.

Alternative #2, Single Microcomputer at each Wing, is a strong candidate because it provides the integrated readiness measurement capability and other related peacetime benefits to the Air Force. These results would be accomplished more quickly and at less expense than Alternative #3. However, minimal deployable capability and less integration are provided than for Alternative #3.

Alternative #3, Hybrid Architecture, satisfies a very high percentage of the overall goals of AFIRMS. The major strength of this alternative is the extent of integration and credibility of information that is gained for each MAJCOM's deployment mission and current automation environment. Alternative #3, the Hybrid Architecture, offers outstanding support to units without unit automation and to deployable units.

SECTION 6. SENSITIVITY ANALYSIS

6.1 Key Life-Cycle Cost Factors. This section investigates the effect that changes in key variables may have on the selection of an alternative. The sensitivity analysis was first directed toward key variables which deal with the scope, system boundaries, and environment of AFIRMS, since these areas were expected to have the highest uncertainty and to have a large potential effect on system life-cycle cost. These variables are:

- Type and quantity of existing ADP in each MAJCOM.
- Required deployable hardware for TAC, USAFE, and PACAF units.
- Costs of military and contractor manpower per year.

Next, sensitivity analysis was performed on the number of required workstations and terminals, since this factor was expected to have a major effect on final costs and benefits. Finally, consideration was given to variables dealing with the functions and resources that the alternatives include:

- System Economic Life
- Software Integration Effort at each Wing
- Estimate of lines of code
- Implementation Schedule, i.e. Start year and length of implementation blocks

6.2 Analyzing Cost Sensitivity. Sensitivity to differences in unit costs was analyzed by changing the variables higher and lower to see how the final system alternative costs are altered. The variation of the factors was selected according to a range of reasonable expectation, based on the analysts' knowledge of systems development and operation and the Learning Prototype experience. For cost sensitivity analysis, the life cycle costs are used for comparison since UNITREP costs are independent of AFIRMS sensitivity parameters. This is because UNITREP benefits are largely a "by product" of normal AFIRMS functionality and therefore ultimately contribute to reducing UNITREP costs rather than increasing AFIRMS costs.

The variables that were found to be the most sensitive were personnel, existing automation, implementation schedule, and software development (in order of significance).

Variation in number of personnel has a marked effect on system life-cycle cost. The personnel numbers reflect the effort dedicated to data input and processing, not data use. Therefore, the personnel numbers used for UNITREP do not include substantial effort required of some personnel who spend a large amount of their daily effort analyzing UNITREP outputs. Sensitivity analysis of personnel shows that Alternative #2 could reasonably become cheaper than Alternative #1. If daily processing support of Alternative #1, UNITREP, doubles to three-quarters of a man-day at each Wing for enlisted personnel, and each MAJCOM headquarters devotes 1 officer and 5 enlisted personnel versus 3 enlisted personnel, the projected life-cycle cost of Alternative #1 increases 77% to over $85 million. This figure is about 14% less than the life-cycle cost of Alternative #2. If, on the other hand, support of Alternative #2 requires one enlisted person full-time at each Wing versus no additional personnel projected, the life-cycle cost increases 43% to over $143 million, versus the calculated $99.7 million. If no enlisted personnel were required at each Wing for Alternative #3 instead of the one projected, the life-cycle costs would drop 13% to $208 million.

Variations in the implementation schedule were tested by reducing and increasing both the starting year and the length of the initial implementation for each MAJCOM and HQ USAF. This test does not apply to Alternative #1, which requires no implementation. The implementation schedule for Alternative #2 in Sections 4 and 5 is actually a 20% compression of the schedule for Alternative #3. If Alternative #3 is compressed similarly, life-cycle costs would increase by 9.4% to $263 million, but the total present value would increase by 14% to $161 million. Not factored into this compression are the added costs and management problem of performing analysis, design, and installation on a tighter schedule, when there is little "slack" to begin with. Both compression and expansion of the implementation schedules by 20% for Alternatives #2 and #3 produce approximately a 9% change in the life cycle costs and about 14% difference in the total present values.

Varying the MAJCOMs assumed to have unit automation has a significant impact on the recommended alternative, Hybrid Architecture. If PACAF, MAC, and SAC did not have unit automation and required the same hardware as the other MAJCOMs in Alternative #3, the alternative would cost $269 million over its life, or 12% more than the projected $240 million. If HQ USAF, AFLC, AAC, TAC, AFRES, and ANG use existing automation, like PACAF, MAC, and SAC, Alternative #3 becomes $112 million, which is 53% cheaper. Alternative #3 would then resemble Alternative #2 in cost, since the

amount of equipment for Alternative #3 would have been reduced to little more than Alternative #2. Alternative #3 also remains higher because of the larger amount of software required for the more complex Wing distributed architecture.

The software sensitivity test was performed by varying the estimate of the number of lines of software that would be developed as "core" software and as MAJCOM unique software. Raising the software estimate for Alternative #2 by 20% raises the life-cycle cost of the alternative 15.4% to $115 million. Lowering the software estimate for Alternative #3 by 20% brings Alternative #3 down 6.7% to $224 million. A sensitive software variable is the ratio of Wing software effort to MAJCOM software effort. If the ratio of 7.5% for Alternative #3 is reduced to the 5% used for Alternative #2, the life-cycle costs of Alternatives #3 drop 6% to $226 million.

6.3 Analysis Summary. The sensitivity analysis does not alter the recommendation of Alternative #3, but it gives insight into the cost risk of four major factors: personnel, software size estimates, the assumed requirement for AFIRMS dedicated equipment, and the implementation schedule.

It is likely that more personnel provide UNITREP support than is discussed in this document. Therefore, Alternative #1 may not be as favorable, based solely on cost, as it appears in this Analysis. If the personnel and software estimates for Alternative #2 and #3 are inaccurate, both estimates would err in the same direction. Alternative #3 would remain more expensive but still more beneficial than Alternative #2. Likewise, if compression or expansion of the implementation schedules occurs, it will tend to effect Alternatives #2 and #3 in approximately the same proportion. Another factor that would impact cost is the requirement for installation of more AFIRMS' dedicated hardware at Wing level in PACAF, MAC, and SAC. If this requirement is found to exist, there is more than a cost impact. The level of benefit assumed in this study for both Alternatives #2 and #3 in all areas of information output is based on the assumption that these MAJCOMs can mainly use existing automation for AFIRMS. If this is not the case, then the cost/benefit of the two alternatives, as documented here, are high.

SECTION 7. CONCLUSIONS

7.1 Summary. There must be an AFIRMS or a system that accomplishes the same objectives specified by the AFIRMS Functional Area Requirement document. A Congressional mandate requires the readiness capabilities that will be provided by AFIRMS. And pressures of the user community and of emerging Air Force regulations on standards for systems integration require the kind of technical solution that will be provided by AFIRMS.

The choice of what AFIRMS will be, according to this analysis, is between two alternatives with many similarities. They both must be adapted to the automation environment of each MAJCOM, the deployment mission, and to the myriad of Air Force standard and command-unique automated information systems (AISs). The alternatives must also use common communications facilities, wherever possible, because of the economy and built-in reliability associated with large redundant-link networks. Therefore, the major points of the decision between Alternatives #2, Single Microcomputer at each Wing, and Alternative #3, Hybrid Architecture, are: implementation schedule requirements, desired end benefits, and affordability. Alternative #3 is the contractor recommendation, because it gains the required level of integration with other AISs and provides maximum support for deployed units. Although Alternative #2 is less expensive, it does not provide sufficient integration and deployability for a capability assessment system in the Air Force.

APPENDIX A. DESCRIPTION OF SYSTEM VARIABLES

A.1 Air Force-Constrained Variables.

a. System Scope Variables

(1) Organizational Extent - 267 sites will be involved, including HQ USAF, 9 MAJCOMs and Specified Commands, 19 Numbered Air Force (NAF)/AF Component Commands, and 229 wings/bases. The maximum number involved with AFIRMS will be the Air Force in its entirety.

(2) Implementation Schedule - Period of time and total effort to implement AFIRMS in each MAJCOM. This is measured by man-years and the period of time to customize and install hardware and software in each participating MAJCOM, and across all MAJCOMs.

(3) Systems Interfacing - AFIRMS will interface with a number of existing Air Force information management systems. Interface requirements for each MAJCOM will be evaluated during the analysis phase of implementation. Results and requirements for system interfacing will then be detailed in the system and subsystem specifications for that implementation block.

(4) Data Security - Specific users at each site will have unrestricted access to certain kinds of data at other levels. Other users will be restricted to certain data by requiring the organization that "owns" the data to approve access. Other users will be restricted to certain data at their site only.

b. User Benefit Variables

(1) Quantity and Period of Standard Reports - The standard reports required at each level will be established during the analysis phase of implementation.

(2) Flexibility of Outputs - A variety of methods for displaying system outputs were evaluated during the LPP. Output displays will be developed to enhance user acquisition of specific information. Output formats will vary based upon the needs and sophistication of AFIRMS models implemented.

(3) Flexibility and Level of Model Details - Models will be developed with standard Air Force-wide parameters for each type of wing. Users at all levels will be able to place new values into the models. Parameters in the models will be sufficiently detailed to allow the models to be customized to each individual wing without rewriting the model software. (Control of model parameters has not been constrained by the Air Force. See the last variable under Section B.2, Model Parameter Controls.)

(4) On-line Historical and Projection Data (HQ USAF and MAJCOM) - Readiness data available at HQ USAF and MAJCOM levels include current data, historical data, and projection data. Data retention requirements are defined in the specifications for each level of AFIRMS implementation. Wing level requirements, since it has not been stipulated by the Air Force, is covered under the variables bounded by system requirements.

(5) Frequency of Data Updates - The update requirement for each data element will be established based on the criticality of the data to the users.

(6) Ability to Query Simulated Situations - A "what-if" capability; the users at each level will be able to run models designed specifically for that level and subordinate levels. The users will be able to change the data values for subordinate units for running the models. Users will be able to simulate changes in assets and query the changed readiness conditions.

(7) Ad Hoc Database Queries - At all levels, each user will be able to query the database according to their authorization to access the required information.

c. Design Variables

(1) Model Sophistication - AFIRMS will use models that produce results which are validated by the users. Models are designed around user requirements versus modeling technique requirements. These models will evolve as the users and the requirements on them change. Models will be designed to facilitate development and implementation of "better" models.

(2) Security Needs - The system will carry data at classification levels of Unclassified through Top Secret. In order to handle the multiple levels of classified information, appropriate security measures are required: personnel access, computer hardware and software controls, administrative procedures, physical access, and communications security. Measures will be instituted, when appropriate, to obtain an acceptable level of risk.

A.2 Variables Bounded by System Requirements.

a. System Scope Variables

(1) Lease versus Buy - The type and amount of equipment that will be leased or purchased by the Air Force.

Range: Lease versus buy all commercial type ADP and communications equipment.

Measure: Cost, quantity, and type of hardware leased and/or purchased for each year of economic life.

(2) Contractor versus In-House Development of the Preferred Alternative - The amount and type of work that will be performed by contractor personnel or by Air Force personnel.

Range: All software analysis development, maintenance, and software and hardware installations in the field done by contractor personnel versus entire project planned, programmed, installed, and maintained by Air Force personnel.

Measure: Man-years and cost of effort by contractor and/or by Air Force for each year. All considerations of life-cycle costing will be considered in yearly cost estimates.

b. User Benefit Variables

(1) Breadth of Accountable Resource Areas - Those resources which contribute less directly to accomplishing the flying mission may not be included in the initial AFIRMS system. For example, bench stock levels at depot maintenance activities may be too distant a relationship to be included. As resource areas are added, more input data, more complex processing and more output displays are required.

Range: Only the wing elements of the aircraft sortie, i.e., aircraft, aircrews, munitions, fuel and supply, versus all major wing and base functional areas and the hierarchy of support for those functions.

Measure: The resources and the command levels where AFIRMS will account for those resources.

(2) On-line Historical and Projection Data (Wing) - Data retained on-line for selected users.

Range: Six months past and projection of monthly data versus five years past and seven years projection of daily data.

Measure: Number of years and periodicity of historical and projection readiness and resource data.

(3) Human Factors Engineering - Degree to which design, hardware, and software are applied to align functions and characteristics of the automated portion of the system with human needs. There are two major aspects of this variable: design of the human task sequence and design of the man-machine interfaces. Task design covers the logical sequence of activities for the operator. Man-machine interface includes such elements as perception and use of color, types of keyboard, voice, or other input devices, layouts of Cathode Ray Tube (CRT) displays, and use of voice output.

Range: Simple keyboard and monochrome CRT interface (off-the-shelf items) versus sophisticated, elaborately designed hardware and software interfaces, i.e., MIL Specification.

Measure: Degree of ease or difficulty for users to learn and use the system.

(4) Amount of User Training Required - Classroom or terminal training required for operators, staff managers, and commanders are estimated to be:

Range: Maximum time for each: one week - terminal operators; one week - staff managers; two days - commanders. Minimum time for each: two days, two days, and one hour, respectively.

Measure: Amount of time for each of three levels.

(5) Availability - Time the sytem has functionality available to any user at each site. All terminals, communications, and computers are included for each site.

Range: All terminals, communications and computers are available 95% of the time based on reliability factors of MTTR - 4 hours and MTBF - 2,000 hours; versus 99.95% availability for MTTR - 30 minutes and MTBF - 50,000 hours reliability factors.

Measure: Percent of time some defined functions are available to users at each site; mean time to repair, mean time between failure.

(6) System Response Time - Time that an operator must wait for a response to the completed transaction entry. Time includes complete processing of the transaction and sending a response that informs the operator that the transaction has been completed and accepted, or has been rejected. The type of processing performed and completeness of the response are part of the human engineering variable. A message to the operator to "wait" is not the kind of response that is counted as response to the transaction.

Range: Twenty minutes for response to a complex query (not including model execution) is an allowable extreme, whereas, data entry transaction response time could be on the order of two seconds.

Measure: Time in minutes and seconds between the operator's last action to indicate user completion of a transaction, and the first indication to the operator that the transaction is accepted and completed, or rejected by the system.

(7) Transportability - All equipment, regardless of size or operating environment requirements, would be transportable. This variable deals with the relative ease of disassembling, moving, and re-establishing any of the AFIRMS equipment either from one base to another, or from one location on a base to another. Deployable equipment will be more transportable than non-deployable equipment. Non-deployable means the equipment is not meant to deploy with the combat unit, but is transportable nevertheless.

Range: The equipment for flying squadrons could require weeks to relocate and could involve a number of prime movers versus several days or hours and a limited number of personnel. Wing equipment could require 2 months versus several days.

Measure: Man-hours of effort to disassemble, load, unload, and reassemble; amount of materials consumed in dissassembly, packing, and reassembly of equipment and communications.

(8) Environmental Durability - Extremes of humidity, temperature, dirt, physical handling, and electromagnetic radiation the equipment can endure while in operation and in transit. This includes handling and use by the operator. Reference to military standards will be required. The equipment must meet environmental conditions stated in the assumptions.

Range: The equipment could be largely commercial office equipment; some would be industrial grade. At the other extreme, all of the equipment that might have to be moved for use in a crisis situation must be extremely rugged.

Measure: Operating and storage temperature and humidity ranges, operating and storage shock durability, radiation and protection, and amount of pressure allowed on such areas as the keyboard, CRT screen, cabinets, cables, and connectors.

(9) Maintenance and Recovery - This variable consists of several factors: The degree to which the system helps users anticipate equipment or communication outages and degradation, and retains functionality during periods when parts of the system are degraded and aids in re-establishment of full functionality after all equipment and facilities have been physically restored.

Range: At one extreme, extensive manual recovery would be required when the equipment gave users and maintenance personnel little warning of mounting problems. Maintenance personnel would have to rely on external test equipment and diagnostic checklists to determine the fault. Many users would receive erroneous outputs during this time. Restoration of databases would require manual intervention. At the other extreme, equipment would warn users and maintenance personnel of predictable faults and would give most users some functionality during periods of degradation. All functions performed would be valid. Recovery would be aided by internal equipment diagnostics and automated communications and database recovery routines.

Measure: Amount of time and man-hours of effort for recovery for various types of physical fault. Amount of user time lost during degradation.

c. Design Variables

(1) Database Distribution - Amount of data stored within smart terminals located close to functional area of primary user and in mini-computers and mainframes located in central areas that are removed from functional areas.

Related to this variable is the volume of communications between computers and between terminals and their supporting computer. Another subordinate variable is the amount of redundant storage of data.

Range: All resource and readiness data could be stored on the central minicomputer and mainframe. The base-level mainframe and minicomputer would not store any redundant data files. At the other extreme the intelligent terminals would store a large volume of the data entered and retrieved by users of the terminal. There would also be a great amount of redundant storage to allow for stand-alone processing and to aid in restoration of functions after a degradation or loss of service.

Measure: Average number of bytes of data stored on each type of terminal and computer and percentage of redundancy in data stored in comparison with other terminals and computers. The amount of time required to transmit data, the number of data transactions, and how that affects user response time.

(2) Sharing Hardware and Facilities - AFIRMS outputs can be processed and communicated to the user by any of a wide variety of intermediate computer and data communications hardware and facilities. Not all configurations will make the required performance possible, but within a range of performance parameters, there will be latitude in using Phase IV and WIS or specified equipment that is unique to AFIRMS.

Range: Phase IV computers can be used to store the large majority of AFIRMS data and the DDN can be used for some processing and all data communications. On the other hand, all new computer and peripheral equipment could be purchased to support AFIRMS.

Measure: Response time, amount of storage, processing time for AFIRMS required data, priority of access to computer system resources.

(3) Sharing of Information with other Software Systems - The use of existing information sources versus maintaining unique, independent AFIRMS software. Information sharing from/with other systems provides lattitude and constraints on systems architecture and communications architecture.

Range: AFIRMS maintains all information independently, replicating required information versus information is fully integrated over all systems.

(4) Centralization of Computing Capability - The processing of AFIRMS data can be accomplished by locating computers at squadron level up through the Air Staff level. On the other hand, processing could be highly centralized at regional, MAJCOM or higher levels.

Range: Decentralized with computers at every squadron versus highly centralized with computers only at MAJCOMs.

Measure: Distribution of processing power and independence of computer functions.

(5) Maintenance Effort and Spare Parts Required - The hardware and software can be specified, designed and tested so as to require minimal or substantial maintenance and operation effort and supplies. Although maintenance has a direct relationship to availability, it is also possible that the system could have high availability at a very high or a very low cost in operations and preventive and corrective maintenance.

Range: High availability could be provided by high redundancy of components which require frequent replacement. On the other hand, a highly available system could be produced with highly reliable, stringently tested equipment that requires little preventive maintenance and that is simple to operate.

Measure: Hours of operator and maintenance personnel time per hour of system operation, plus costs of spare parts.

(6) Model Parameter Controls - This variable applies to the control of parameters (not data about resource levels) used by the software to determine capability. At periodic intervals, Air Force, MAJCOM and wing parameters for the models would be adjusted to reflect new standards, levels of performance and new constraints. This function of managing standards and default values for all models and algorithms that produce readiness measurements is necessary to maintain credibility of the outputs at an individual command and across commands.

Range: Centralized Air Force control and semi-annual update of all parameters vs. totally decentralized to the Wing level with updating as necessary.

Measure: Levels of command, types or groups of parameters and periodicity of updates.

APPENDIX B. TECHNICAL AND OPERATIONAL FEASIBILITY ISSUES

a. Technical Feasibility Issues

(1) Hardware

(a) General

1 Operating environmental considerations (power, heat, humidity, etc.)

2 Size

3 Weight

4 Tolerance to physical shock during handling and transportation

5 Controlling electromagnetic or acoustic emanations (i.e. TEMPEST)

(b) Central processor

1 Processing speed

2 Primary storage capacity

(c) Storage (Non-primary) capacity and access time

1 On-line auxiliary

2 Off-line auxiliary

(d) Other peripherals - physical

1 Display devices

2 Hardcopy devices

3 Data entry devices

(e) Telecommunications equipment

1 Communications processor speed

2 Classification level

3 Data link throughput

(f) Interfaces

1 Speed

2 Compatibility

3 Security

(2) Software

(a) Operating system features, size, speed

(b) Functional packages

(c) Applications software

(d) Interfaces

(3) Configuration

(a) Reliability

(b) Component matching

(c) Breadth of connectivity

(d) Restart capability

(e) Backup capability

b. Operational Feasibility Issues

(1) Procedural factors

(a) Data control and update procedures

(b) Manual backup procedures

(c) Manual restart procedures

(d) Security procedures

(e) Scheduling of ADP, communications, and personnel resources

(f) Maintenance and support requirements

(g) Ease of use and requirement for training

(2) Global factors

(a) System expandability for mobilization

(b) Deployability

(c) Vulnerability

(d) Manning requirements (e.g., civilian vs. military) for operations and hardware and software maintenance

(e) Degraded mode operation (e.g., with electronic data links inoperative)

(f) Survivability

(g) Communications

APPENDIX C. INFEASIBLE ALTERNATIVES.

a. Entirely stand-alone AFIRMS data entry, processing, and communications. This alternative would consist of processors at the wing, MAJCOM, and HQ USAF levels that were distinct from all other systems. Likewise, communications and data entry would be distinct from, and redundant with, other systems.

This alternative is operationally infeasible because of the redundancy of equipment and manual procedures, and because of the excessive manpower requirements for training personnel in data entry, computer and communications operations, and maintenance. This alternative would also present numerous problems in interfacing with other automated data systems.

b. Computer Assisted Force Management System (CAFMS). This involves sharing the use of CAFMS or other local microprocessor systems at the wing level. This alternative would add one terminal to the wing processor and provide for data entry and retrieval using the single terminal.

This alternative is technically and operationally infeasible since local storage is not powerful enough to handle the required level of AFIRMS processing in addition to the CAFMS or similar system processing. Obtaining outputs on only one terminal is far below the required level of monitoring daily readiness and resource status. Additionally, CAFMS will not be used by USAFE; EIFEL follow-on is planned to provide an approximate equivalent capability. However, EIFEL is a NATO system, and data interchange restrictions make this system unsuitable due to policy reasons.

c. Extending the AFIRMS LPP hardware into operational status. This alternative entails the sole-source acquisition of hundreds of commercial minicomputers and peripherals. This alternative is operationally infeasible for two major reasons. The equipment does not meet deployability requirements, nor would such a large sole-source acquisition be justifiable.

d. Multiple Wing intelligent terminals remoted from MAJCOM central host processor. This alternative is operationally infeasible because of the heavy dependence of Wing operations on the communications link to the MAJCOM. The cost of the links would be extremely high, because high bandwidth would be required. More importantly, the reliability of communications is a problem during peacetime, that would become interolerable during crisis.

APPENDIX D. DETAILED DESCRIPTION OF COSTS AND BENEFITS

D.1 Organization. This appendix describes all cost factors, prices, and benefits in detail. The basis for all costs by MAJCOM are costs for each remote terminal site, Wing/Numbered Air Force/Air Division Headquarters and MAJCOM headquarters. These costs are aggregated according to the organization of each MAJCOM and according to the implementation schedule for each alternative. The benefits are described in general and in detail for each alternative. This appendix includes the benefit evaluation scores for each alternatives, which are used in the final cost/benefit analysis.

D.2 Description of Cost Model. The AFIRMS cost model consists of four elements (each described in a paragraph below): cost estimating models for software and communications, a list of item costs by type of Air Force organization, eight categories of costs for each MAJCOM's organization types, and the annual MAJCOM and summed costs.

a. The software cost estimating model is based on the Constructive Cost Model (COCOMO). The communications recurring costs are based on the DDN Cost Allocation Model document dated September 1984. The dollar costs of communications and the level of manpower effort for software are then listed as part of the costs for each type of unit.

b. For each type of Air Force organization, the costs for individual pieces of equipment and work components are itemized. Except for the software and communications costs, the itemized costs depend largely on the costs of individual equipment and task effort costs obtained from commercial vendors and the Air Force, respectively, as described in detail in this Appendix. Each alternative requires a different number of types of organizations. Alternative #1 uses generic Wings and MAJCOMs (see page D-8). Alternative #2 uses deployable and non-deployable Wings as well as MAJCOM headquarters requiring AFIRMS minicomputers and MAJCOM headquarters that use WWMCCS computers (see pages D-14 through D-17). Alternative #3 differentiates among eight types of organizations. These types include deployable and non-deployable Wings with a headquarters and a number of deployable and non-deployable remote terminals. Alternative #3 contains another differentiation among organizations by specifying "large" Wings as having ten remote terminals and "small" Wings as having five remote terminals. The deployable and non-deployable Wing headquarters are of two types: with unit automation and without unit automation. Finally, there are the same two types of MAJCOM headquarters that are used for Alternative #2 (see pages D-24 through D-31).

c. The itemized costs are aggregated into three categories of non-recurring and five categories of recurring costs for each specific MAJCOM. These MAJCOM costs are formed by multiplying the number of organizations of each type in the MAJCOM by the appropriate organization costs.

d. For each year, for each MAJCOM, initial and recurring categories of costs distribute over the economic life of AFIRMS based on implementation schedule. The annual costs for all MAJCOMs are then summed for each year for each of the eight categories. The annual system costs of the eight categories are summed over the 10-year economic life to yield the life-cycle totals shown in Section 5. The present value of each alternative shown in Section 5 is the sum of the present values for each year, computed using the discount factors from AFP 178-8.

D.3 Cost Categories.

D.3.1 Non-recurring. All costs under this general category are attributed to the first two implementation blocks of each segment, as defined in the EIP.

a. Acquisition. This includes the cost for acquiring computer and communications hardware, and packaged software. The total communications equipment cost includes an additional 43% of the purchase cost for initial spares (as recommended by the 485th Engineering Installation Group (EIG)). System software and DBMS will support proposed NBS standards.

b. Initial Analysis, Design, and Programming. In addition to analysis, design, and programming costs, this category includes planning, engineering, and design for security. The level of effort for this cost factor is derived using the Constructive Cost Model (COCOMO). The input data for calculations is a consensus of program size and project characteristics by the senior software engineers for the AFIRMS LPP. The software development effort for each Wing is a proportionate amount based on the size of the MAJCOM headquarters.

   Applications will be written in Ada or other Air Force standard programming languages. Contractor costs are assumed for all costs in this category. All expansion beyond Block 2 is costed as recurring Operations and Maintenance (O&M) cost. All analysis and design for deployable Wings is costed at 25% more than non-deployable Wings to account for the effort to make the system flexible enough to interface with the deployed location's communications, existing functional area AISs, and hardware.

c. Hardware Installation. This category includes all hardware-related costs from time of receipt from the manufacturer until the hardware is assembled, connected, and tested on site.

d. Communications Installation. This category includes all engineering, site survey, and installation work and all materials for the installation of classified and unclassified communications. A cost of $30 per hour for Air Force Communications personnel and appropriate costs for materials are used. (Obtained from the 485th EIG.)

e. Site Preparation. Building modification, air conditioning (where required), and installation of power, both unclassified and secure.

D.3.2 Recurring for each Segment. The following costs are expressed in constant dollars without inflation.

a. Hardware and Software Operations and Maintenance. Each segment's hardware O&M costs are calculated as a percentage of the computer and communications hardware purchase cost for each year of operation. Since hardware purchases include upgrades to existing ADP, in some cases, the associated maintenance costs are applied to AFIRMS. Percentages of 15% and 25% are used for maintenance spares for non-deployable and deployable equipment, respectively. (Provided by AF/XOOIM.) For communications equipment, the maintenance rate is applied to the cost of basic hardware, not to the total cost with spares. A software maintenance annual rate of 15% is applied to the basic cost of purchased system software. Applications software maintenance costs are applied to the Air Force personnel figure.

b. Supplies. Supplies consist of paper, printer ribbons, floppy diskettes, magnetic tape, and other expendables. Usage is based on rates experienced during the AFIRMS LPP and on estimates of data volume and back-up requirements in the AFIRMS Database Specifications. Unit costs were obtained from Paragram, a commercial ADP supplies distributor.

c. Communications Link(s). Leased line and other annual usage and maintenance. DDN costs are based on the Defense Communications Agency DDN Cost Allocation Model document dated September 1984.

d. Manpower. Air Force manpower positions are attributed for full-time work on AFIRMS. Some of the enlisted personnel calculated as part of MAJCOM personnel are for software maintenance of the MAJCOM-unique software and some are for Wing-unique software. The level of effort for software maintenance is 30% of the initial development effort. This rate applies to the core, support software and to the MAJCOM- and Wing-unique software. Maintenance and enhancements of the core software will be performed by the Data Systems Design Office; the billets for these personnel have been added into HQ USAF. The exact number of software personnel is discussed for each alternative, below. The annual cost for each enlisted billet is $28,000; $52,000 for each officer billet. (Provided by AF/XOOIM.)

D.4 Air Force Organization

The number of units to receive AFIRMS in each MAJCOM are assumed to consist of four basic types. A "Large Wing" is assumed to have a headquarters and ten remote terminal sites. A "Small Wing" is assumed to have a headquarters and five remote terminal sites. All NAFs and ADs are assumed to require the same equipment as the generic Wing headquarters. All MAJCOM headquarters are assumed to require the same equipment, maintenance, etc. HQ USAF is assumed to be the size of two generic MAJCOM headquarters.

The following organization is used for all alternatives.

Major Command	Type of Unit	Quantity	
HQ USAF	MAJCOM HQ	2	(includes DSDO software maintenance)
USAFE	MAJCOM HQ	1	
	NAF/AD	2	
	Small Wing	0	
	Large Wing	14	
AFLC	MAJCOM HQ	1	
	ALC	6	
PACAF	MAJCOM HQ	1	
	NAF/AD	2	
	Small Wing	2	
	Large Wing	5	
AAC	MAJCOM HQ	1	
	NAF/AD	0	
	Small Wing	0	
	Large Wing	2	
TAC	MAJCOM HQ	1	
	NAF/AD	2	
	Small Wing	0	
	Large Wing	21	
MAC	MAJCOM HQ	1	
	NAF/AD	2	
	Small Wing	0	
	Large Wing	20	
AFRES	MAJCOM HQ	1	
	NAF	3	
	Small Wing	35	
	Large Wing	0	
ANG	MAJCOM HQ	1	
	NAF	0	
	Small Wing	92	
	Large Wing	0	
SAC	MAJCOM HQ	1	
	NAF/AD	2	
	Small Wing	0	
	Large Wing	38	

For Alternative #3, two other distinctions are made about MAJCOM units. All TAC, USAFE, AFRES and ANG wings are considered deployable; and PACAF, MAC, and SAC are considered having unit automation.

D.5. Detailed Explanation of Major Benefits.

D.5.1 Utility.

a. Information Output

(1) Integrated. AFIRMS outputs should be a cohesive picture of unit/force combat capability. This means that AFIRMS' perspective of the status of resources and of the contribution of the resources to readiness and sustainability should be consistent with other AISs and with the assessment of the functional area resource managers. The information that is displayed to the user, on paper or CRT, must be complete and self-explanatory to answer the user's requirement. All users whose resource data inputs are required for measuring capability should receive feedback to know the effect of their input. This benefit factor also relates to the depth and breadth of the resource information that can be aggregated and measured against any level of tasking. Some users require more detail in the resource and capability areas they monitor or the tasking parameters they must be able to vary. Information linking dollars to readiness and projecting capability should be available in the system. The security classification of information at each command level is an important part of the completeness of the information. MAJCOM HQs and HQ USAF must have information up to a classification of Top Secret; Wings must have information up to Secret.

(2) Timely. The user knows that the recency of the information allows confidence in making a decision based on that information. Timeliness is affected by speed of data input, data transfer between sites, processing of database queries, processing of models, and transfer from other AISs. The requirement for timeliness changes under crisis conditions, when there is the possibility for dramatic change in status from minute to minute. The system can answer the greater demand for timeliness in crisis situations.

(3) Credible. The user believes the system output. Credibility is generally established over a period of time and can be based on first-hand use and verification, trusted evidence, or knowledge and intellectual verification of the technical description of the components of the system.

b. System Utility. Two general equipment requirements apply to all alternatives: all equipment to process classified must meet TEMPEST requirements, and there must be sufficient storage capacity for the AFIRMS current and "what-if" database.

(1) Reliability, Availability, Maintainability. The system is working when the user needs it and keeps working as long as needed. When the system is not working 100%, it works in a degraded mode and/or it is fully operational in a short time. The use of Air Force-supplied, common-user communications links will provide some redundancy for high availability and limited survivability. The distributed database concept will also contribute autonomy of system components for higher availability than a single centralized database concept. Total system availability should be at least 90%, and the availability of any single site should be 95% based on degraded mode operation. This benefit also includes system availability to appropriate users.

This benefit factor is heavily weighted toward availability of equipment and communications for deployed units. Deployable equipment must be able to operate under the conditions listed in the Assumptions section. Deployable equipment and software must also be configurable to operate with or without another Air Force unit at a Main Operating Base (MOB), Collocated Operating Base (COB), or bare base.

Maintainability relates to the man-hours of preventive and corrective maintenance required per hour of operation.

(2) Easy to use. The system requires little training, because operations are self-explanatory, easily understood processes, oriented towards language (prompts) the user can understand. As users become familiar with operating the system, they are able to get the information they need faster than a novice can. In other words, the system allows for growth of the users' knowledge and allows "shortcuts."

(3) Growth. The hardware and software are well-suited to the evolutionary nature of AFIRMS. As more features and components can be added, incremental changes in the system can produce incremental benefits. This characteristic implies a requirement for modular equipment, that is easily expandable. Major redesign or acquisition should not be required for steadily increasing capability. Components should, therefore, facilitate conversion to Local Area Network (LAN) architecture by conforming to International Standards Organization/Open Systems Interconnection (ISO/OSI) communications protocol standards. Finally, interfaces to other systems should be planned during initial analysis and design to facilitate implementation when those systems and AFIRMS are ready to interface.

D.5.2 Manageable.

a. Incremental. The complexity of implementing, changing or expanding the system is such that program management does not have to assume a large risk at one time. Instead, a succession of small commitments of funding and resources is undertaken that allows managers the flexibility to redirect the program based on the progress of each step.

b. Sharing. This benefit factor means using or acquiring facilities and equipment in common with other users or systems. Use of the Defense Data Network (DDN) common user communications network is an example where commonality is both more manageable and more affordable than leasing dedicated lines of equivalent throughput. Interfaces with other systems also contribute to sharing information and facilities. For example, an air gap interface to North Atlantic Treaty Organization (NATO) data is a very desirable feature. Taking maximum advantage of existing computer equipment is another example where sharing is an advantage over AFIRMS' being a totally separate system.

D.5.3. Timely Schedule. AFIRMS responds to a Congressional mandate to link dollars to readiness and to project readiness. Therefore, the AFIRMS program should accomplish its goals as soon as possible. Likewise, long-range Air Force and AFIRMS goals must not be sacrificed in gaining results too hastily.

D.6 Explanation of Cost Data. The costs for each alternative start with the itemized costs of equipment and facilities for remote terminals, Wing/NAF/AD Headquarters and MAJCOM Headquarters. The implementation schedule for the alternative is stated. Finally, all costs are aggregated by cost category for each MAJCOM.

D.7 Detailed Costs - Alternative #1 - UNITREP.

D.7.1 Non-recurring. There are no non-recurring costs for UNITREP, since the system is operational.

D.7.2 Recurring for Each Segment.

a. Hardware Operations and Maintenance. Equipment located at the Wing level generally consists of one keypunch machine and a maximum of one computer terminal. Daily Air Staff processing usually takes 1 1/2 hours on the Honeywell 6000. (Most of the manual and automated work estimates were provided by AF/XOOIM.)

b. Communications Link(s). Reports are transmitted to the MAJCOM either by AUTODIN or NACE (National Automatic Communications System). Processing and transmission of UNITREP data occurs 6 days a week (for flying units). DDN costs, mentioned above, are used. Each Wing transmits an average of 7.5 80-character cards daily; MAJCOM headquarters transmit all Wing data plus an estimated average 15 cards.

c. Manpower. The most significant manpower costs of UNITREP are in the user community and are not estimated here. Wing commanders, their staffs, and MAJCOM headquarters and Air Staff personnel use UNITREP and other systems to assess readiness in the way that AFIRMS proposes. The current methods are extremely labor-intensive, but diffused among many functional areas and command levels. The UNITREP costs that could be obtained with some accuracy, described below, were those directly involved in providing the UNITREP reports.

At wing level, UNITREP processing manpower usage consists of three man-hours per day. This includes data collection and entry (punching of IBM cards), quality assurance (QA), etc. Most UNITREP work is performed by personnel at the E-3 and E-4 level.

At the MAJCOM, UNITREP processing manpower usage is three people, eight hours per day. UNITREP data received from the wing is again reviewed. Data support personnel are generally at the E-6 level.

At the Air Staff, UNITREP processing manpower usage is four people, eight hours per day. Computer system support is provided by senior enlisted personnel; actual UNITREP analysis is performed at the Captain and Major level.

AFIRMS ECONOMIC ANALYSIS

AFIRMS Alternative Number 1

WING/NAF/AD HEADQUARTERS

Hardwe & Softwe O&M		$1,200.00	Keypunch or terminal lease/maint.
Supplies/Yr.		$100.00	Paper and cards
Comm Link(s)/Yr.		$2,205.76	DDN
Personnel			
Officers	0	$0.00	
Enlisted	0.375	$10,500.00	Data Entry

MAJCOM HEADQUARTERS

Hardwe & Softwe O&M		$12,000.00	WWMCCS H6000 processing
Supplies/Yr.		$4,800.00	Share of system supplies
Comm Link(s)/Yr.		$2,202.83	DDN
Personnel			
Officer	0	$0.00	Dedicated positions
Enlisted	3	$84,000.00	Data review, prep, retrieval

AFIRMS Economic Analysis — ALTERNATIVE 1 - UNITREP Total Costs by MAJCOM — 30-May-85

	USAFE	HQ USAF	AFLC	PACAF	AAC
NON-RECURRING COSTS:					
Acquisition	$0	$0	$0	$0	$0
Analy, Des & Prog	$0	$0	$0	$0	$0
Site Prep & Install	$0	$0	$0	$0	$0
RECURRING COSTS:					
Hdwe & Sftwe O&M	$312,000	$240,000	$192,000	$228,000	$144,000
Supplies	$64,000	$96,000	$54,000	$57,000	$50,000
Comm Link	$374,949	$44,057	$154,374	$220,546	$66,143
Officers	0 $0	4 $2,080,036	0 $0	0 $0	0 $0
Enlisted	9 $2,520,081	6 $1,680,054	5 $1,470,045	6 $1,470,045	4 $1,050,036
TOTAL COSTS	$3,270,949	$4,140,057	$1,870,374	$2,290,546	$1,310,143

	TAC	MAC	AFRES	NGB	SAC
NON-RECURRING COSTS:					
Acquisition	$0	$0	$0	$0	$0
Analy, Des & Prog	$0	$0	$0	$0	$0
Site Prep & Install	$0	$0	$0	$0	$0
RECURRING COSTS:					
Hdwe & Sftwe O&M	$396,000	$384,000	$574,000	$1,224,000	$600,000
Supplies	$71,000	$70,000	$86,000	$140,000	$88,000
Comm Link	$529,352	$507,295	$860,216	$2,051,324	$904,331
Officers	0 $0	0 $0	0 $0	0 $0	0 $0
Enlisted	12 $3,255,108	11 $3,150,099	17 $4,830,153	38 $10,500,342	18 $5,040,162
TOTAL COSTS	$4,251,352	$4,111,295	$6,352,216	$13,915,324	$6,632,331

D.8 Detailed Benefits - Alternative #1.

D.8.1 Utility.

a. Information Output

(1) Integrated. UNITREP reports are most useful as a combat capability indicator, not to assess the combat capability of a unit to perform a specific tasking. The Designed Operational Capability (DOC) is the tasking against which the UNITREP measures resources. Additionally, the print output formats are restricted to several standard displays.

(2) Timely. The AUTODIN transmission of data and the considerable manual effort required to prepare, transmit, and aggregate the reports cause the data to be weeks old by the time it is available to Air Staff personnel.

(3) Credible. Because the standards for UNITREP criteria are well-established, the resource ratings are credible. However, the commander's estimate, which is subjective, and the lack of timeliness detract from credibility.

b. System Utility

(1) Reliability, Availability, and Maintainability. Since the system is not timely, many workarounds can be used to ensure the reports reach higher headquarters.

(2) Easy to use. The system is difficult to use. Data entry by keypunch uses 80-column formats that are described in a large users manual, and the standard printed outputs are produced by ADP personnel, not by users. (Production by ADP personnel also detracts, in a sense, from credibility.)

(3) Growth. There is potential for the system to expand, by interfacing the system to more resource systems and expanding the number or types of tasking against which the resources are measured.

D.8.2 Manageable.

a. Incremental. Since UNITREP is implemented, this benefit factor is at a maximum.

b. Sharing. UNITREP uses Air Force standard computers and communications, but does not exchange data with any other AIS.

D.8.3 Timely Schedule. Since UNITREP is implemented, this benefit factor is at a maximum.

D.9 Detailed Costs - Alternative #2 - Single microcomputer at each Wing.

D.9.1 Non-recurring.

a. Acquisition. At HQ USAF and MAJCOM headquarters, a TEMPEST minicomputer, intelligent workstations, communications and cryptographic equipment would be acquired. The minicomputer costs are based on current costs for commercial equipment of the size of the DEC Microvax II with approximately 1 gigabyte of disk storage and 32 ports. Some MAJCOM HQ's will upgrade current WWMCCS equipment, instead of acquiring a new, separate minicomputer. The upgrade will consist of CPU, internal memory, communications channel, and disk memory. The CPU upgrade would consist of additional cache memory, an additional processor, and/or an entirely new CPU module. Internal memory upgrade would add RAM and/or disk cache memory. A communications channel upgrade would increase throughput significantly to accommodate communications with the wings by adding a channel or upgrading existing channel speed. The workstation costs are based on Zenith Z-150 TEMPEST microcomputers with floppy disks and 320KB of RAM.

Acquisition of wing equipment would consist of one TEMPEST microcomputer and printer, an uninterruptible power supply (for deployable units), communications modem, and cryptographic device. Each Wing will require one cryptographic device at the Wing and one for the MAJCOM headquarters. One crypto fixed plant adapter is required at each wing, but only one is required at MAJCOM headquarters for every two wings. Microcomputers for deployable units would have extra comm ports for different types of communications interfaces. Power conditioning for non-deployable units would be a regulator, whereas deployable units would have an uninterruptible power supply.

Approximately $500 of packaged software would be necessary for DBMS and graphics support for each Wing. The minicomputer software would average $6,000 per MAJCOM headquarters plus $500 per intelligent workstation, totalling $10,000 for the headquarters.

b. Initial Analysis, Design, and Programming. All analysis, hardware and software design, and programming will be a centrally managed and coordinated effort. Each MAJCOM's mission requirements and automation environment will be accommodated, but control will be maintained over the diversity of MAJCOM sub-systems. The ratio of Wing software development to MAJCOM headquarters development is 5%, based on software sizing estimates.

The principal vehicle for implementing AFIRMS software will be the establishment and maintenance of interface standards and a core of portable, AFIRMS support software. The interface standards will define the interface between AFIRMS and Air Force standard systems, between MAJCOM AFIRMS and MAJCOM-unique systems. The interface standards will deal with both communications and software interfaces, with limited options for both. The AFIRMS core, support software will contain the standard interface software, application graphics software that is common to all organizations, and application support software that is required for all MAJCOM-unique applications. This software is estimated at 140 thousand lines of delivered source instructions requiring 515 man-months. The applications support core software will have general graphic and tabular routines that interface with the DBMS, so that knowledgeable users can make changes to screens without

programmer effort. The applications core software for the microcomputer workstations would include the capability for deploying Wings to take enough data and programs to act as a stand-alone wing or to "plug into" another AFIRMS wing.

For HQ USAF development, the core, support software would be developed concurrently with expansion of LPP software on LPP hardware. Core software for Wings requires conversion of VAX and Chromatics software to run on a single ZENITH Z-150 with a DBMS. Dumb terminal software will stagnate and be replaced when intelligent workstations are widely installed with the core software, so that one type of terminal software will be standard. MAJCOM HQs, as a whole, will differ from HQ USAFE and HQ USAF. At HQ USAFE and HQ USAF, LPP VAX software would be used as much as possible, then the AFIRMS core software would be converted from ORACLE, that was used in the LPP, to a different DBMS. Other MAJCOM HQs will convert core software to suit acquired minicomputer or existing classified computer. The software development for all MAJCOM headquarters is estimated at 60 thousand lines of delivered source instructions requiring 212 man-months.

c. Hardware Installation. HQ USAF and MAJCOM HQs will have substantial installation of minicomputer and peripheral equipment. Wing equipment installation of the microcomputer will consist mainly of testing, since there is so little equipment.

d. Communications Installation. One man-month of Air Force communications personnel effort includes engineering and installation of the single computer link to the MAJCOM headquarters.

e. Site Preparation. Minicomputer secure space and power and secure terminal areas will require considerable planning and effort before installing equipment at HQ USAF and MAJCOM HQ sites, regardless of computer configuration. Wing secure communications will require the efforts of a three-man team for about a week.

D.9.2 Recurring for each Segment. All recurring costs are allocated annually according to the implementation schedule, below.

a. Hardware and Software Operations and Maintenance. The maintenance rates described under Cost Categories, paragraph D.3., above, are applied to all purchased hardware and packaged software. Maintenance of the software developed for AFIRMS is discussed under Manpower, below.

b. Supplies. Diskettes, disk cartridges, and paper are estimated at $500 per year for Wings and $400 per month for MAJCOM headquarters.

c. Communications Link(s). The DDN costing method, described above, was used. The data transmissions from Wings were assumed to be 2500 characters, three times daily. MAJCOM transmissions were assumed to include all Wing transmissions plus 400 characters for each of 500 additional transmissions to the Air Staff daily.

d. Manpower. All MAJCOM headquarters receive 1 enlisted person for AFIRMS administrative support; MAJCOMs with a dedicated AFIRMS minicomputer also receive an officer for project coordination. Each MAJCOM headquarters receives additional enlisted personnel for software maintenance. The DSDO receives 12 enlisted personnel for software maintenance.

Implementation Schedule - Alternative #2

The following schedule is a compression of the schedule in the Evolutionary Implementation Plan. This schedule is used because the equipment and software development efforts are much less than is anticipated in the EIP. The acquisition, development, and maintenance costs depend on this implementation schedule. Year 1 is the start of development after the LPP.

Major Command	Year of Installation Start	Length of Installation (in months)
HQ USAF	1	50.4
USAFE	1	52.8
AFLC	2.2	45.6
PACAF	3	40.8
AAC	4.6	38.4
TAC	3	38.4
MAC	6	84
AFRES	2	36
ANG	2	36
SAC	4.6	62.4

AFIRMS Economic Analysis — AFIRMS Alternative Number 2

Non-deployable units
WING/NAF/AD HEADQUARTERS

Computer Equipment Acquisition			
$4,270.00	1	$4,270.00	TEMPEST ZENITH Z150 w/Hard disk
$1,900.00	1	$1,900.00	TEMPEST Printer
$350.00	1	$350.00	Voltage Regulators
Computer Equipt TOTAL		$6,520.00	
Communications equipt acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$850.00	2	$1,700.00	2400 bps sync modem
Comm equipt TOTAL		$10,750.00	
Comm spares		$4,622.50	
Comm TOTAL		$15,372.50	
Packaged software acquisition		$500.00	
Analysis, Design and Programming			
$8,000.00	10	$80,000.00	Initial Man-mo of effort
Hardware installation			
$2,333.33	0.125	$291.67	Install Effort
			Install Materials
Hdwe install TOTAL		$291.67	
Communications installation			
$4,800.00	1	$4,800.00	Secure and unclass Comm
		$4,000.00	Materials
Comm Install TOTAL		$8,800.00	
Site Prep			
$2,333.00	0.5	$1,166.50	Minor Construc Effort
		$2,000.00	Materials
Site Prep TOTAL		$3,166.50	
Hardwe & Softwe O&M		$2,665.50	
Supplies/Yr.		$500.00	
Comm Link(s)/Yr.		$2,289.07	DDN to MAJCOM HQ
Personnel			
Officers	0	$0.00	Dedicated positions
Enlisted	0	$0.00	
Softwe Enl	0.25	$6,978.27	MAJCOM software maint. personnel

AFIRMS Economic Analysis — AFIRMS Alternative Number 2

Deployable Units
WING/NAF/AD HEADQUARTERS

Computer Equipment Acquisition			
$4,270.00	1	$4,270.00	TEMPEST ZENITH Z150 w/Hard disk
$1,900.00	1	$1,900.00	TEMPEST Printer
$850.00	1	$850.00	Uninterrupt. Power Supply
Computer Equipt TOTAL		$7,020.00	
Communications equipt acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$850.00	2	$1,700.00	2400 bps sync modem
Comm equipt TOTAL		$10,750.00	
Comm spares		$4,622.50	
Comm TOTAL		$15,372.50	
Packaged software acquisition		$500.00	
Analysis, Design and Programming			
$8,000.00	13	$104,000.00	Initial Man-mo of effort
Hardware installation			
$2,333.33	0.125	$291.67	Install Effort
			Install Materials
Hdwe install TOTAL		$291.67	
Communications installation			
$4,800.00	1	$4,800.00	Secure and unclass Comm
		$4,000.00	Materials
Comm Install TOTAL		$8,800.00	
Site Prep			
$2,333.00	0.5	$1,166.50	Minor Construc Effort
		$2,000.00	Materials
Site Prep TOTAL		$3,166.50	
Hardwe & Softwe O&M		$4,517.50	
Supplies/Yr.		$500.00	
Comm Link(s)/Yr.		$2,289.07	DDN to MAJCOM HQ
Personnel			
Officers	0	$0.00	Dedicated positions
Enlisted	0	$0.00	
Softwe Enl	0.31	$8,722.83	MAJCOM software maint. personnel

AFIRMS Economic Analysis — AFIRMS Alternative Number 2

MAJCOM HEADQUARTERS WITH DEDICATED MINICOMPUTER

Computer equipment acquisition			
$150,000.00	1	$150,000.00	Minicomputer: 4 mips 5 meg RAM, 1000 meg disk, multiple comm ports
$2,899.00	8	$23,192.00	TEMPEST ZENITH Z150
$1,900.00	2	$3,800.00	TEMPEST Printer
$2,600.00	2	$5,200.00	TEMPEST color dot matrx prtr
Computer Equipt TOTAL		$182,192.00	
Communications equipment acquisition			
$3,400.00	1	$3,400.00	Crypto equipt.
$1,500.00	1	$1,500.00	Fixed plant adapter
$2,000.00	1	$2,000.00	9600 bps sync modem
Comm equipt TOTAL		$6,900.00	
Comm spares		$2,967.00	
Comm TOTAL		$9,867.00	
Packaged software acquisition		$10,000.00	
Analysis, Design and Programming			
$8,000.00	212	$1,696,000.00	Initial Man-mo of effort
$8,000.00 HQ USAF	515	$4,120,000.00	
Hardware installation			
$2,333.33	3	$7,000.00	Install Effort
		$20,000.00	Install Materials
Hdwe install TOTAL		$27,000.00	
Communications Installation			
$4,800.00	1.5	$7,200.00	Secure and unclass Comm
		$2,000.00	Materials
Comm Install TOTAL		$9,200.00	
Site Prep			
$2,333.00	1.5	$3,499.50	Minor Construc Effort
		$2,000.00	Materials
Site Prep TOTAL		$5,499.50	
Hardwe & Softwe O&M		$29,863.80	
Supplies/Yr.		$4,800.00	
Comm Link(s)/Yr.		$23,887.20	
Personnel			
Officer	1	$52,000.00	Dedicated positions
Enlisted	1	$28,000.00	
Softwe Enl.	5	$139,565.36	

SOFTECH

AFIRMS Economic Analysis — AFIRMS Alternative Number 2

MAJCOM HEADQUARTERS WITH WWMCCS COMPUTER ENHANCEMENT

Computer equipment acquisition			
$100,000.00	1	$100,000.00	WWMCCS Enhancements
$2,899.00	8	$23,192.00	TEMPEST ZENITH Z150
$1,900.00	2	$3,800.00	TEMPEST Printer
$2,600.00	2	$5,200.00	TEMPEST color dot matrx prtr
Computer Equipt TOTAL		$132,192.00	
Communications equipment acquisition			
$3,400.00	1	$3,400.00	Crypto equipt.
$1,500.00	1	$1,500.00	Fixed plant adapter
$2,000.00	1	$2,000.00	9600 bps sync modem
Comm equipt TOTAL		$6,900.00	
Comm spares		$2,967.00	
Comm TOTAL		$9,867.00	
Packaged software acquisition		$10,000.00	
Analysis, Design and Programming			
$8,000.00	212	$1,696,000.00	Initial Man-mo of effort
Hardware installation			
$2,333.33	3	$7,000.00	Install Effort
		$20,000.00	Install Materials
Hdwe Install TOTAL		$27,000.00	
Communications Installation			
$4,800.00	1.5	$7,200.00	Secure and unclass Comm
		$2,000.00	Materials
Comm Install TOTAL		$9,200.00	
Site Prep			
$2,333.00	1.5	$3,499.50	Minor Construc Effort
		$2,000.00	Materials
Site Prep TOTAL		$5,499.50	
Hardwe & Softwe O&M		$36,273.00	
Supplies/Yr.		$4,800.00	
Comm Link(s)/Yr.		$23,887.20	
Personnel			
Officer	0	$0.00	Dedicated positions
Enlisted	1	$28,000.00	
Softwe Enl.	5	$139,565.36	

AFIRMS Economic Analysis — ALTERNATIVE 2 - SINGLE MICROCOMPUTER AT EACH WING — Total Costs by MAJCOM — 30-May-85

	USAFE		HQ USAF		AFLC		PACAF		AAC	
NON-RECURRING COSTS:										
Acquisition		$493,379		$404,118		$308,679		$315,489		$237,599
Analy, Des & Prog		$3,312,000		$7,512,000		$2,176,000		$2,584,000		$1,856,000
Site Prep & Install		$237,830		$83,399		$115,249		$152,023		$66,216
RECURRING COSTS:										
Hdwe & Sftwe O&M		$765,146		$470,710		$317,377		$458,742		$169,375
Supplies		$99,491		$75,657		$53,984		$58,262		$27,913
Comm Link		$470,346		$376,508		$260,381		$278,710		$136,989
Officers	1	$404,190	4	$1,639,271	1	$359,902	0	$0	1	$250,255
Enlisted	10	$2,176,445	23	$5,075,520	7	$1,356,577	8	$1,356,577	6	$808,533
TOTAL COSTS		$7,958,737		$15,636,964		$4,948,091		$5,250,520		$3,552,842

	TAC		MAC		AFRES		NGB		SAC	
NON-RECURRING COSTS:										
Acquisition		$571,269		$387,856		$894,819		$1,882,899		$862,859
Analy, Des & Prog		$4,040,000		$2,468,571		$5,576,000		$11,264,000		$4,896,000
Site Prep & Install		$323,637		$222,414		$507,510		$1,169,451		$532,026
RECURRING COSTS:										
Hdwe & Sftwe O&M		$870,006		$169,489		$1,469,796		$3,341,054		$544,093
Supplies		$103,913		$28,214		$178,500		$381,000		$94,431
Comm Link		$487,916		$132,584		$831,540		$1,758,614		$439,598
Officers	0	$0	0	$0	1	$390,008	1	$390,008	0	$0
Enlisted	13	$2,320,589	8	$550,024	17	$3,570,136	34	$7,140,272	15	$1,599,296
TOTAL COSTS		$8,717,241		$3,959,129		$13,418,164		$27,327,017		$8,968,238

D.10 Detailed Benefits - Alternative #2.

D.10.1 Utility.

a. Information Output

(1) Integrated. Since the system would take in resource data primarily from other systems, the system would be able to give Wing commanders and their staffs integrated readiness measurements based on the resource status data that is already input and used by personnel in the Wing. Units without existing unit automation would be more limited in the extent of resource data used by AFIRMS' models, since input would largely be manual. Units with existing unit automation would have more extensive resource data available from other systems, giving a broader range of more timely resource data for more timely and complete readiness measures. The MAJCOM headquarters would have less detailed outputs available from wings without existing unit automation. The Air Staff would have as complete a picture of readiness and dollars to readiness as would be required in peacetime. When units smaller than Wings are deployed, their data would be transmitted by message or telephone and input manually.

(2) Timely. At Wings without existing unit automation, manual data input would slow down system throughput and there would be high demand for printed outputs. Data flow from Wings to MAJCOM headquarters would be as timely as necessary when squadrons are not deployed; likewise for data transfers between MAJCOM headquarters and the Air Staff.

(3) Credible. Wing resource status data from AFIRMS would not be highly credible on a minute-to-minute basis, due to the slow manual input and lack of user feedback. But because several updates would occur daily, the readiness projections on a daily basis would provide highly credible trend information to the Wing commander and his staff.

b. System Utility

(1) Reliabilty, Availability, and Maintainability. A single microcomputer and its interface to other AISs would present few maintenance problems, and be available for deployment and reinstallation with relative ease. Automated AFIRMS support would not be available for squadrons that deploy separately from their Wing headquarters.

(2) Easy to use. The AFIRMS computer system would be easy for experienced and untrained personnel to use, because of the simple interface with the user and effective use of color graphics. Interfaces with other AISs would require some manual and semi-automated procedures that would require trained personnel to perform.

(3) Growth. The single microcomputer at the Wings could itself be expanded by adding external hard disks for the database and additional ports for hardware interfaces. Additionally, more processors could be added to give a distributed microcomputer configuration, as is proposed for alternative #3. Expansion of the MAJCOM headquarters' dedicated minicomputers would be easy technically, if space and other facilities permitted. Expansion of the MAJCOMs using WWMCCS equipment is not predictable. The DBMSs on dedicated AFIRMS equipment will allow for easy growth of the database and, eventually, flexible queries by users.

D.10.2 Manageable.

a. Incremental. This alternative is very favorable in this benefit area. The hardware acquisition and installation would be a very small effort. However, at each Wing with existing automation, the integration effort would require considerable analysis and engineering to determine appropriate interfaces with other AISs.

b. Sharing. This alternative takes advantage of other systems and facilities at sites that already have considerable automation. Common-user communications are also employed wherever possible.

D.10.3 Timely Schedule. With just one microcomputer to install at each Wing, implementation would take about 4 man-months. This would include analysis and design of communications and software interfaces and any special software for the particular base. The initial implementation could be even faster, if a minimal number of standard interfaces were designed as a single effort and installed for every Wing in a MAJCOM. After the initial standard installation, each Wing's software could be upgraded to accommodate individual base differences.

D.11 Detailed Costs - Alternative #3 - Hybrid Architecture.

D.11.1 Non-recurring.

a. Acquisition. HQ USAF and MAJCOM HQs hardware acquisition would be the same as Alternative #2. Wing hardware acquisition would differ according to the deployment mission, automation environment, and size. Large Wings have 10 remote terminals and small wings have 5 remote terminals. Units with existing unit automation would acquire 1 TEMPEST microcomputer and communications modems, and cryptographic equipment. Microcomputers for deployable units would have extra comm ports for different types of communications interfaces. Power conditioning for non-deployable units would be a regulator, whereas deployable would have an uninterruptible power supply.

Units without existing unit automation would have different equipment, depending on whether the unit is non-deployable or deployable. Non-deployable units would acquire a TEMPEST central minicomputer with 3 local intelligent workstations with floppy disk storage and 10 remote microcomputer workstations, each with its own hard disk for database storage. Packaged software for DBMS and graphics support would average $500 per workstation throughout the configuration. The minicomputer would be a multi-user "super" microcomputer or physically small minicomputer of about 1 million instructions per second (MIPS) processing power, 300 megabytes of disk storage and a magnetic tape unit. Communications and cryptographic equipment would be the same type as the units with unit automation. Three of the 10 workstations would be unclassified, requiring encryption equipment that uses the National Bureau of Standards Data Encryption Standard (DES) algorithm. For costing purposes, all encryption devices are $3400, the price of a KG-84 encryption device. $3000 crypto safes would be required at about half the remote terminal sites, because secure facilities would not already exist for the crypto equipment (Crypto safe price was obtained from Mosler). Power conditioning would be provided by a power regulator, (priced from Sun Research, Inc. New Durham, NH).

Deployable unit configuration would be similar to the non-deployable configuration with several exceptions. A TEMPEST central multi-microcomputer cluster would be in place of the central minicomputer. Power conditioning would be provided by an uninterruptible power supply, which is priced from Sun Research, Inc.

b. Initial Analysis, Design, and Programming. HQ USAF and MAJCOM HQs would be the same effort as in Aiternative #2. The core software for this alternative is 200 thousand lines of delivered source instructions or 704 man-months. This effort is larger than alternative #2 because of the complexity of the Wing distributed database software. The analysis and design effort for each Wing would also be 50% higher for this alternative than for #2. The ratio of Wing software development to MAJCOM headquarters development is 7.5%. Whereas alternative #2 requires a number of interfaces with other systems mainly at the MAJCOM HQ, this alternative requires additional analysis and software at the Wings for the integration of the workstations with on-base systems. For units with unit automation, full integration of AFIRMS with the other AISs would require more analysis and design than the effort for alternative #2. Each remote terminal site also requires another 2% additional effort to the amount of Wing headquarters software effort.

Non-deployable Wings with unit automation would require software for the single, central microcomputer, and software for the remote, semi-autonomous microcomputers. Deployable units with unit automation would require software for remote microcomputers to deploy and act as a mini-wing central without remotes.

Units without unit automation fall into the same two categories. Non-deployable units would require software for the central minicomputer and DBMS and the same remote software as for units with unit automation, above. Deployable units would require software for the central microcomputer cluster and DBMS and the same remote software as for units with unit automation, above.

c. Hardware Installation. Remote sites would require one-half a man-week; Wing headquarters would require one man-month for the non-deployable minicomputers and two man-weeks for the deployable central microcomputer cluster. MAJCOM installation would require one and one-half man-months for the larger computer or WWMCCS upgrade.

d. Communications Installation. Engineering and installation of the remote sites would require 2 man-weeks; one and a half man-months for the Wing headquarters and the MAJCOM headquarters.

e. Site Preparation. Wing terminal areas would require secure cabling and other security measures, in some cases. Wing headquarters would require power lines and some wall and door carpentry.

D.11.2 Recurring for each Segment. All recurring costs are allocated annually according to the implementation schedule below.

a. Hardware and Software Operations & Maintenance. The maintenance rates described under General Cost Factors, above, are applied to all purchased hardware and packaged software.

b. Supplies. Remote terminal sites would use only $20 a month or $240 per year; Wing headquarters would use $1000 per year with AFIRMS equipment and $500 per year on shared equipment. MAJCOM headquarters would use supplies at the same $400 monthly rate as Alternative #2.

c. Communications Link(s). The DDN costing method, described above, was used. The data transmissions from Wings were assumed to be 2500 characters, three times daily, based on the data transmission estimates performed in the LPP. MAJCOM transmissions were assumed to include all Wing transmissions plus 400 characters for each of 500 additional transmissions to the Air Staff daily.

d. Manpower. All Wing headquarters without unit automation have one enlisted person dedicated for AFIRMS administration. All MAJCOM headquarters have one officer and one enlisted person dedicated to AFIRMS administration. For MAJCOM headquarters with a dedicated minicomputer, two additional enlisted personnel are assigned for hardware operations and database administration. Each MAJCOM headquarters receives additional enlisted personnel for maintenance of MAJCOM-unique and Wing-unique software. The DSDO receives 16 enlisted personnel for core software maintenance.

Implementation Schedule - Alternative #3

Since recurring costs are time-dependent, the implementation schedules of the alternative are accounted for. Year 1 is the start of expenditure of funds for software development. The length of installation is the length of the first two blocks planned in the Evolutionary Implementation Plan. This installation length spreads the initial development and installation costs over an appropriate period.

Major Command	Year of Installation Start	Length of Installation (in months)
HQ USAF	1	66
USAFE	1	63
AFLC	2.75	57
PACAF	3.75	51
AAC	5.75	48
TAC	3.75	48
MAC	7.5	105
AFRES	2.5	45
ANG	2.5	45
SAC	5.75	78

Economic Analysis AFIRMS Alternative Number 3

Non-deployable units
REMOTE TERMINAL

Unit Cost	Qty	Line item	Equipment Description
Computer equipment acquisition			
$2,899.00	1	$2,899.00	TEMPEST ZENITH Z150
$1,900.00	1	$1,900.00	TEMPEST Printer
$430.00	1	$430.00	500 Watt Voltage Regulator
Computer Equipt TOTAL		$5,229.00	
Communications equipment acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$850.00	2	$1,700.00	2400 bps sync modem
$3,000.00	0.5	$1,500.00	Crypto Safe
Comm equipt TOTAL		$12,250.00	
Comm spares		$5,267.50	
Comm TOTAL		$17,517.50	
Packaged software acquisition		$500.00	
Analysis, Design and Programming			
$8,000.00	0.2985	$2,388.00	Initial Man-mo. of effort
Hardware installation			
$2,333.33	0.125	$291.67	Install Effort
		$1,000.00	Install Materials
Hdwe install TOTAL		$1,291.67	
Communications Installation			
$4,800.00	0.500	$2,400.00	Secure and unclass Comm
		$2,000.00	Materials
Comm Install TOTAL		$4,400.00	
Site Prep			
$2,333.33	0.250	$583.33	Minor Construc Effort
		$1,000.00	Materials
Site Prep TOTAL		$1,583.33	
Hardwe & Softwe O&M		$2,696.85	
Supplies/Yr.		$240.00	
Comm Link(s)/Yr		$0.00	

Non-deployable units
WING/NAF/AD HEADQUARTERS WITHOUT UNIT AUTOMATED DATA PROCESSING

Computer Equipment Acquisition			
$60,000.00	1	$60,000.00	Minicomputer
$2,899.00	3	$8,697.00	TEMPEST ZENITH Z150
$1,900.00	2	$3,800.00	TEMPEST Printer
$430.00	3	$1,290.00	500 Watt Voltage Regulators
Computer Equipt TOTAL		$73,787.00	
Communications equipt acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$850.00	2	$1,700.00	2400 bps sync modem
Comm equipt TOTAL		$10,750.00	
Comm spares		$4,622.50	
Comm TOTAL		$15,372.50	
Packaged software acquisition		$1,500.00	
Analysis, Design and Programming			
$8,000.00	14.925	$119,400.00	Initial Man-mo of effort
Hardware installation			
$2,333.33	1.000	$2,333.33	Install Effort
		$4,000.00	Install Materials
Hdwe install TOTAL		$6,333.33	
Communications installation			
$4,800.00	1.5	$7,200.00	Secure and unclass Comm
		$6,000.00	Materials
Comm Install TOTAL		$13,200.00	
Site Prep			
$2,333.00	1.5	$3,499.50	Minor Construc Effort
		$6,000.00	Materials
Site Prep TOTAL		$9,499.50	
Hardwe & Softwe O&M		$12,905.55	
Supplies/Yr.		$1,000.00	
Comm Link(s)/Yr.		$2,289.07	DDN
Personnel			
Officers	0	$0.00	Dedicated positions
Enlisted	1	$28,000.00	
Softwe Enl	0.35	$9,839.36	MAJCOM software maint. personnel

Economic Analysis AFIRMS Alternative Number 3

Non-deployable units
WING/NAF/AD HEADQUARTERS WITH UNIT AUTOMATED DATA PROCESSING
Computer Equipment Acquisition

$4,270.00	1	$4,270.00	TEMPEST ZENITH Z150 w/Hard disk
$1,900.00	1	$1,900.00	TEMPEST Printer
$430.00	1	$430.00	500 Watt Voltage Regulators
Computer Equipt TOTAL		$6,600.00	
Communications equipt acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$2,000.00	2	$4,000.00	9600 bps sync modem
Comm equipt TOTAL		$13,050.00	
Comm spares		$5,611.50	
Comm TOTAL		$18,661.50	
Packaged software acquisition		$1,000.00	
Analysis, Design and Programming			
$8,000.00	15	$120,000.00	Initial Man-mo of effort
Hardware installation			
$2,333.33	0.125	$291.67	Install Effort
		$1,000.00	Install Materials
Hdwe install TOTAL		$1,291.67	
Communications installation			
$4,800.00	1	$4,800.00	Secure and unclass Comm
		$4,000.00	Materials
Comm Install TOTAL		$8,800.00	
Site Prep			
$2,333.00	0.5	$1,166.50	Minor Construc Effort
		$2,000.00	Materials
Site Prep TOTAL		$3,166.50	
Hardwe & Softwe O&M		$3,097.50	
Supplies/Yr.		$500.00	
Comm Link(s)/Yr.		$2,289.07	DDN
Personnel			
Officers	0	$0.00	Dedicated positions
Enlisted	0	$0.00	
Softwe Enl	0.35	$0.00	MAJCOM software maint. personnel

Economic Analysis AFIRMS Alternative Number 3

Deployable Units
REMOTE TERMINAL

Unit Cost	Qty	Line item	Equipment Description
Computer equipment acquisition			
$4,270.00	1	$4,270.00	TEMPEST ZENITH Z150 w/Hard Disk
$1,900.00	1	$1,900.00	TEMPEST Printer
$995.00	1	$995.00	600 Watt Unint. Pwr Supply
Computer Equipt TOTAL		$7,165.00	
Communications equipment acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$850.00	2	$1,700.00	2400 bps sync modem
$3,000.00	0.5	$1,500.00	Crypto Safe
Comm equipt TOTAL		$12,250.00	
Comm spares		$5,267.50	
Comm TOTAL		$17,517.50	
Packaged software acquisition		$500.00	
Analysis, Design and Programming			
$8,000.00	0.373125	$2,985.00	Initial Man-mo. of effort
Hardware installation			
$2,333.33	0.125	$291.67	Install Effort
		$1,000.00	Install Materials
Hdwe install TOTAL		$1,291.67	
Communications Installation			
$4,800.00	0.500	$2,400.00	Secure and unclass Comm
		$2,000.00	Materials
Comm Install TOTAL		$4,400.00	
Site Prep			
$2,333.33	0.250	$583.33	Minor Construc Effort
		$1,000.00	Materials
Site Prep TOTAL		$1,583.33	
Hardwe & Softwe O&M		$4,928.75	
Supplies/Yr.		$240.00	
Comm Link(s)/Yr		$0.00	

Economic Analysis AFIRMS Alternative Number 3

Deployable Units
WING/NAF/AD HEADQUARTERS WITHOUT UNIT AUTOMATED DATA PROCESSING

Computer Equipment Acquisition			
$4,270.00	6	$25,620.00	TEMPEST ZENITH Z150 w/Hard disk
$5,000.00	5	$25,000.00	External TEMPEST 40 MB Hard Disk
$1,900.00	2	$3,800.00	TEMPEST Printer
$995.00	6	$5,970.00	600 Watt Unint. Pwr Supply
Computer Equipt TOTAL		$60,390.00	
Communications equipt acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$850.00	2	$1,700.00	2400 bps sync modem
Comm equipt TOTAL		$10,750.00	
Comm spares		$4,622.50	
Comm TOTAL		$15,372.50	
Packaged software acquisition		$6,000.00	
Analysis, Design and Programming			
$8,000.00	18.65625	$149,250.00	Initial Man-mo of effort
Hardware installation			
$2,333.33	0.500	$1,166.67	Install Effort
		$4,000.00	Install Materials
Hdwe install TOTAL		$5,166.67	
Communications installation			
$4,800.00	1.5	$7,200.00	Secure and unclass Comm
		$6,000.00	Materials
Comm Install TOTAL		$13,200.00	
Site Prep			
$2,333.00	1.5	$3,499.50	Minor Construc Effort
		$6,000.00	Materials
Site Prep TOTAL		$9,499.50	
Hardwe & Softwe O&M		$18,685.00	
Supplies/Yr.		$1,000.00	
Comm Link(s)/Yr.		$2,289.07	DDN
Personnel			
Officers	0	$0.00	Dedicated positions
Enlisted	1	$28,000.00	
Softwe Enl	0.44	$12,299.20	MAJCOM software maint. personnel

Economic Analysis AFIRMS Alternative Number 3

Deployable Units
WING/NAF/AD HEADQUARTERS WITH UNIT AUTOMATED DATA PROCESSING
Computer Equipment Acquisition

$4,270.00	1	$4,270.00	TEMPEST ZENITH Z150 w/Hard disk
$1,900.00	1	$1,900.00	TEMPEST Printer
$995.00	1	$995.00	600 Watt Unint. Pwr Supply
Computer Equipt TOTAL		$7,165.00	
Communications equipt acquisition			
$3,400.00	2	$6,800.00	Crypto equipt.
$1,500.00	1.5	$2,250.00	Fixed plant adapter
$2,000.00	2	$4,000.00	9600 bps sync modem
Comm equipt TOTAL		$13,050.00	
Comm spares		$5,611.50	
Comm TOTAL		$18,661.50	
Packaged software acquisition		$1,000.00	
Analysis, Design and Programming			
$8,000.00	20	$160,000.00	Initial Man-mo of effort
Hardware installation			
$2,333.33	0.125	$291.67	Install Effort
		$1,000.00	Install Materials
Hdwe install TOTAL		$1,291.67	
Communications installation			
$4,800.00	1	$4,800.00	Secure and unclass Comm
		$4,000.00	Materials
Comm Install TOTAL		$8,800.00	
Site Prep			
$2,333.00	0.5	$1,166.50	Minor Construc Effort
		$2,000.00	Materials
Site Prep TOTAL		$3,166.50	
Hardwe & Softwe O&M		$5,203.75	
Supplies/Yr.		$500.00	
Comm Link(s)/Yr.		$2,289.07	DDN
Personnel			
Officers	0	$0.00	Dedicated positions
Enlisted	0	$0.00	
Softwe Enl	0.44	$0.00	MAJCOM software maint. personnel

Economic Analysis — AFIRMS Alternative Number 3

MAJCOM HEADQUARTERS WITH DEDICATED MINICOMPUTER

Computer equipment acquisition			Minicomputer: 4 mips
$150,000.00	1	$150,000.00	5 meg RAM, 1000 meg disk, multiple comm ports
$2,899.00	8	$23,192.00	TEMPEST ZENITH Z150
$1,900.00	4	$7,600.00	TEMPEST Printer
Computer Equipt TOTAL		$180,792.00	
Communications equipment acquisition			
$3,400.00	1	$3,400.00	Crypto equipt.
$1,500.00	1	$1,500.00	Fixed plant adapter
$2,000.00	1	$2,000.00	9600 bps sync modem
Comm equipt TOTAL		$6,900.00	
Comm spares		$2,967.00	
Comm TOTAL		$9,867.00	
Packaged software acquisition		$10,000.00	
Analysis, Design and Programming			
$8,000.00	199	$1,592,000.00	Initial Man-mo of effort
$8,000.00 HQ USAF	704	$5,632,000.00	Initial Man-mo of effort
Hardware shipping and installation			
	0	$0.00	Shipping
$2,333.33	3	$7,000.00	Install Effort
		$20,000.00	Install Materials
Hdwe ship & install TOTAL		$27,000.00	
Communications Installation			
$4,800.00	1.5	$7,200.00	Secure and unclass Comm
		$2,000.00	Materials
Comm Install TOTAL		$9,200.00	
Site Prep			
$2,333.00	1.5	$3,499.50	Minor Construc Effort
		$2,000.00	Materials
Site Prep TOTAL		$5,499.50	
Hardwe & Softwe O&M		$29,653.80	
Supplies/Yr.		$4,800.00	
Comm Link(s)/Yr.		$23,887.20	
Personnel			
Officer	1	$52,000.00	Dedicated positions
Enlisted	3	$84,000.00	Operations and Admin
Softwe Enl.	4.69	$131,191.44	Software Maint.

Economic Analysis AFIRMS Alternative Number 3

MAJCOM HEADQUARTERS WITH WWMCCS COMPUTER ENHANCEMENT

Computer equipment acquisition				
$100,000.00		1	$100,000.00	WWMCCS Enhancements
$2,899.00		8	$23,192.00	TEMPEST ZENITH Z150
$1,900.00		4	$7,600.00	TEMPEST Printer
Computer Equipt TOTAL			$130,792.00	
Communications equipment acquisition				
$3,400.00		1	$3,400.00	Crypto equipt.
$1,500.00		1	$1,500.00	Fixed plant adapter
$2,000.00		1	$2,000.00	9600 bps sync modem
Comm equipt TOTAL			$6,900.00	
Comm spares			$2,967.00	
Comm TOTAL			$9,867.00	
Packaged software acquisition			$10,000.00	
Analysis, Design and Programming				
$8,000.00		199	$1,592,000.00	Initial Man-mo of effort
$8,000.00	HQ USAF	704	$5,632,000.00	
Hardware shipping and installation				
		0	$0.00	Shipping
$2,333.33		3	$7,000.00	Install Effort
			$20,000.00	Install Materials
Hdwe ship & install TOTAL			$27,000.00	
Communications Installation				
$4,800.00		1.5	$7,200.00	Secure and unclass Comm
			$2,000.00	Materials
Comm Install TOTAL			$9,200.00	
Site Prep				
$2,333.00		1.5	$3,499.50	Minor Construc Effort
			$2,000.00	Materials
Site Prep TOTAL			$5,499.50	
Hardwe & Softwe O&M			$35,923.00	
Supplies/Yr.			$4,800.00	
Comm Link(s)/Yr.			$23,887.20	
Personnel				
Officer		1	$52,000.00	Dedicated positions
Enlisted		1	$28,000.00	
Softwe Enl.		4.685408	$131,191.44	Software Maint.

AFIRMS Economic Analysis — ALTERNATIVE 3 - HYBRID ARCHITECTURE — Total Costs by MAJCOM — 30-May-85

	USAFE	HQ USAF	AFLC	PACAF	AAC
NON-RECURRING COSTS:					
Acquisition	$5,052,203	$401,318	$744,616	$339,238	$846,908
Analy, Des & Prog	$4,338,200	$8,816,000	$2,308,400	$2,952,000	$1,878,560
Site Prep & Install	$1,508,392	$83,399	$215,897	$161,023	$245,265
RECURRING COSTS:					
Hdwe & Sftwe O&M	$7,278,441	$436,334	$628,432	$404,272	$355,556
Supplies	$393,164	$70,629	$63,379	$47,868	$37,700
Comm Link	$437,339	$351,483	$220,780	$228,987	$92,512
Officers	1 $375,826	2 $765,159	1 $305,164	1 $267,653	1 $169,004
Enlisted	30 $6,071,135	31 $6,386,239	15 $2,464,832	11 $2,464,832	10 $910,038
TOTAL COSTS	$25,454,466	$17,310,306	$6,951,398	$5,986,328	$4,535,502

	TAC	MAC	AFRES	NGB	SAC
NON-RECURRING COSTS:					
Acquisition	$7,337,316	$287,118	$7,741,263	$19,306,759	$961,560
Analy, Des & Prog	$5,591,900	$1,692,800	$7,696,325	$16,696,100	$5,162,769
Site Prep & Install	$2,212,705	$108,020	$2,377,239	$5,951,887	$364,834
RECURRING COSTS:					
Hdwe & Sftwe O&M	$7,818,072	$74,334	$10,513,015	$26,638,795	$341,161
Supplies	$410,550	$11,286	$562,507	$1,374,427	$52,938
Comm Link	$401,813	$53,033	$735,451	$1,555,396	$246,442
Officers	1 $273,006	0 $37,143	1 $344,940	1 $344,940	1 $111,003
Enlisted	40 $5,880,232	6 $300,014	62 $11,515,909	140 $26,003,666	17 $1,255,208
TOTAL COSTS	$29,925,356	$2,563,734	$41,486,199	$97,870,964	$8,495,857

D.12 Detailed Benefits - Alternative #3.

D.12.1 Utility.

a. Information Output

(1) Integrated. This alternative is outstanding in the degree of integration with other AISs and the completeness of information presented, whether the unit is at its CONUS/main base or deployed. At the Wings, all functional users with resources reportable to AFIRMS would know what data is being used and what resource shortfalls are critical to the Wing's taskings. This feedback would supplement the data input and reporting functions of the other AISs. At the MAJCOM headquarters and the Air Staff, integration with other AISs would provide those levels with a coherent picture of overall current readiness, readiness trends, and detailed resource readiness status. At wings without unit automation, all users would have feedback from their data input, whether it was through AFIRMS or another AIS. At Wings that already have unit automation, every functional area would have feedback, whether through the existing AIS or through an AFIRMS module that supplements the existing AIS.

(2) Timely. Data at the wing will be much more timely since resource data from other AISs would be used to update the AFIRMS database as often as the wing requires. For functional areas that do not have an existing AIS, AFIRMS would be able to take timely manual input of required resource status data. The Wing staff would be able to receive near real-time updates on their tasking readiness during a crisis. The MAJCOM headquarters could make accurate Wing readiness projections in crisis planning and would receive timely updates of critical Wing shortfalls during crisis execution. HQ USAF will have the data from MAJCOM in a much shorter timeframe than is possible under current systems.

(3) Credible. The data at all command levels will have high credibility, because the wing data and data transfer will be timely and accurate, even under deployment conditions.

b. System Utility - All TEMPEST requirements will be met and adequate database storage will be provided on all processors.

(1) Reliability, Availability, and Maintainability. At MAJCOM headquarters and Wings where AFIRMS equipment is installed, system availability will be high. Where existing unit automation is used for AFIRMS, measures will be taken to improve availability and maintainability where possible. AFIRMS microcomputer workstations and use of the distributed database concept provide semi-autonomous operation of each AFIRMS workstation. Use of common-user communications, wherever possible, and degraded mode operation will back-up the normal mode of operation. For example, for deployable wings without unit automation, the multiple microcomputer cluster at the hub of the AFIRMS network provides inherent redundancy and makes parts stockage less of a problem than for a single large computer. The deployability of the equipment will make AFIRMS available to deployed squadrons and Wings.

(2) Easy to use. Both the AFIRMS system itself and the interfaces to other AISs will be easy to use and manage, because they will be well-designed by concentrating design effort on integration of the systems into a set of systems that are as coherent as possible. Integration of deployed units with the systems in the receiving command will be accomplished during initial system design, making the use of AFIRMS during deployments almost as easy as operation at the main base.

(3) Growth. Growth would not be limited, even where minimal AFIRMS computers and communications equipment would be installed. Wings and MAJCOM headquarters that would not initially need an AFIRMS main processor, workstations, or communications equipment could always add the capability incrementally by the addition of microcomputer workstations or microcomputers for processors. Microcomputers could be added to extend the system to other resource areas, and each microcomputer can be expanded to a limited extent.

D.12.2 Manageable.

a. Incremental. The evolutionary development approach (described in detail in the AFIRMS Evolutionary Implementation Plan document) would commit program funds and resources in small enough pieces to permit Air Staff and MAJCOM redirection without significant loss of resources or program momentum.

b. Sharing. The use of existing equipment, communications and AISs would be a primary goal, and any necessary computer acquisitions would rely primarily on Air Force standard computers.

D.12.3 Timely Schedule. Again, the evolutionary approach brings an initial benefit to each MAJCOM after minimal necessary analysis of requirements. Then succeeding analysis and design adds further essential functions.

D.13 Relative Weights of the Benefits. Each of the benefit factors described in paragraph D.4. becomes an evaluation criterion by assigning a relative weight of importance against all other benefits and disregarding cost. (The relative weight adds up to ten to be useful in the comparison of alternatives in the remainder of this section.) As can be seen in the Table below, the basic division is between utility, manageability, and timely schedule. Each of these is further subdivided, and the rationale for the weight assignments follows. Utility is given three times the weight of manageability and timely schedule because utility means meeting the objectives of the system. Manageability deserves such weight because the chosen alternative must be implemented and kept under control to continue reaping benefits.

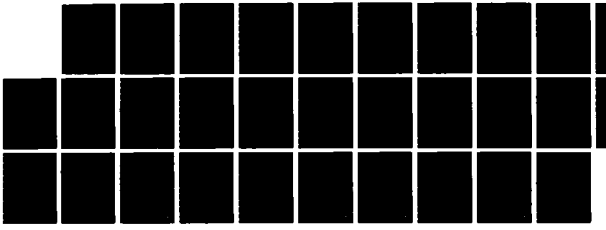
Timeliness of the implementation schedule is separated from the other categories to be made explicit. A program that gets results in a timely manner and continues to improve will keep the interest of users and decision makers. On the other hand, a program that stagnates or is too long in development, can fall behind changing requirements.

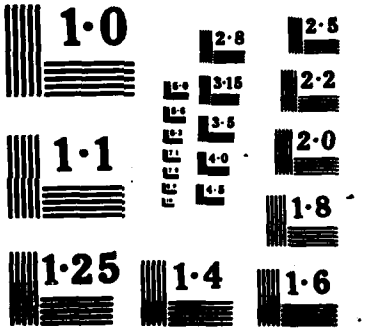
EVALUATION CRITERIA

	Relative Weights
75% UTILITY	
Information Output	
Integrated	1.2
Timely	.8
Credible	2.0
System	
RAM	1.7
Easy to Use	.8
Growth	1.0
15% MANAGEABILITY	
Incremental	1.0
Sharing	.5
10% TIMELY SCHEDULE	1.0
	10.0

AD-A170 510 AIR FORCE INTEGRATED READINESS MEASUREMENT SYSTEM 2/2
(AFIRMS) ECONOMIC ANALYSIS(U) SOFTECH INC ALEXANDRIA VA
31 MAY 85 F49642-83-C-0022

UNCLASSIFIED F/G 5/2 NL

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Within the category of utility, the information output shows a slight edge in importance, again, because the system objective is to provide information. However, system utility has a very key role since any system of information is worthless if users cannot access the information. Conversely, a system that provides even mediocre quality information could be very valuable if it has high availability during crisis.

Of the three characteristics of the information output, credibility rates highest because the user requires information for decisions. The information may not be the whole picture or be up to the minute, but it must be accurate. Finally, having an integrated picture is considered slightly more important than having less complete information more quickly.

Reliability, Availability, and Maintainability is the most important aspect of system utility. The system must work under all circumstances to provide vital information on the readiness of forces to accomplish wartime tasking. The ability of the system to accommodate gradual evolution is necessary because future requirements must be satisfied without having to start over or to make major changes in the system. Ease of use is important for the system to be a daily, living tool for decision makers and the people who execute the decisions. The division of manageability shows the incremental approach to be of prime importance. An incremental approach allows for both ease of management, each step being a smaller risk than the whole, and for the impact on the users who will see gradual, steady improvement to meet their needs. The "common sense" characteristic of sharing hardware and software are important in both the initial justification, acquisition, and development stages of a system, and in the operations and maintenance stages. Using standard hardware is one common approach to attaining this benefit.

D.14 Assignment of Scores to the Alternatives. For each evaluation criterion, a score is assigned based on analysis of the benefits described above. The total score gives a measure of how each alternative meets the current AFIRMS requirements.

ASSIGNMENT OF BENEFIT SCORES TO THE ALTERNATIVES

	UTILITY INFO OUTPUT INTEGRATED	TIMELY	CREDIBLE	SYSTEM R.A.M.	EASY TO USE	GROWTH	MANAGE-ABILITY INCREMENTAL	SHARING	TIMELY SCHEDULE	TOTAL SCORE
	12 %	8 %	20 %	17 %	8 %	10 %	10 %	5 %	10 %	100 %
#1 UNITREP	0	0	1	1	1	3	10	1	10	28
#2 SINGLE MICROMPUTER AT EACH WING	3	2	2	3	4	5	9	5	8	42
#3 HYBRID ARCHITECTURE	10	10	10	9	20	9	8	9	8	92.8

AFIRMS Economic Analysis

ANNEX 5

HQ USAF SEGMENT ECONOMIC ANALYSIS

Preliminary

SOFTECH

AFIRMS Economic Analysis
ANNEX 5
HQ USAF SEGMENT ECONOMIC ANALYSIS

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SECTION 1. OVERVIEW

1.1 Purpose. This Annex to the AFIRMS Economic Analysis outlines the objectives, requirements, and options for implementing Block 1 of the HQ USAF segment of AFIRMS as defined in the AFIRMS Evolutionary Implementation Plan. The expected costs and benefits for options to accomplish the objectives, and key analysis factors which support the contractor-recommended option, are also presented in this draft. This Annex is more detailed than the task description and costing in the AFIRMS Economic Analysis. As one of the evolutionary documents of AFIRMS, this document will be updated and refined in conjunction with the Evolutionary Implementation Plan, Annex 5, HQ USAF Segment Plan.

1.2 Block 1 Objectives.

a. Refine the content, layout, and operator interface of AFIRMS displays for operational use by the Air Staff.

b. Improve the accuracy/realism of the Sortie Generation Model (SGM) to provide useful capability assessments of USAFE fighter/reconnaissance wings to the Air Staff.

c. Provide data exchange with USAFE and the Air Force Logistics Command (AFLC).

d. Provide all system documentation in accordance with DoD Standard 7935.1-S and AFR 205-16.

e. Provide training for operators and staff officers.

1.3 Assumptions. The assumptions stated in Section 3 of the AFIRMS Economic Analysis are applicable to the HQ USAF Block 1. Additionally, the implementation will be accomplished according to the phases described in the EIP, Annex 5.

1.4 Contractor-Recommended Option. The AFIRMS LPP system at HQ USAF serves the Basic AFIRMS Functions (refer to the Functional Description for a detailed discussion of these functions), but enhancements are required in order for AFIRMS to be a viable operational system for the Air Staff. These enhancements could be implemented at three levels. At the highest level of capability, the Air Staff would be able to access the system directly and easily. However, the software development effort to accomplish this level would be costly and lengthy. At the lowest essential capability level, the Readiness Assessment Group could provide a variety of AFIRMS products to Air Staff offices. The mid-level capability would provide some AFIRMS functions directly to the Contingency Support Staff (CSS) and Logistics Readiness Center. Not all the required functions would be implemented.

The contractor recommends that the mid-level capability be implemented to give the CSS and other Air Staff offices direct use of AFIRMS. The software development effort would not be as timely as would be the case with the minimum essential level, but routine staff use of the system would provide long-range benefits in subsequent implementation blocks.

SECTION 2. SYSTEM REQUIREMENTS

2.1 Requirements Based on LPP Products.

a. Assessment of Capability Against Fighter/Recce Tasking. This information is the basic requirement AFIRMS must satisfy.

b. Assessing Dollars to Readiness. This information is another significant requirement for AFIRMS at MAJCOM headquarters and at the Air Staff.

c. Status Information. The status of bases/units, the inventory, and condition of resources provides the raw data for AFIRMS capability assessments. This information is required by headquarter staffs at all levels. Frequent use of this AFIRMS information will increase the accuracy of the resource data, thereby increasing staff confidence in AFIRMS data. This, in turn, will help increase the credibility and usefulness of AFIRMS capability assessments.

2.2 Operational Requirements. Operational requirements are grouped into four general categories:

a. User-interface. These requirements involve the interaction of the system and the operator, and the appearance and usefulness of the output displays.

b. SGM. These requirements relate to the method of data input, the model's internal algorithm, and the available output data.

c. MAJCOM interface. HQ USAF Interface with the MAJCOMs will involve AFLC and USAFE.

d. Hardware. Hardware requirements involve upgrading LPP equipment and acquiring new equipment.

2.2.1 Screens for Implementation. The screens to be implemented are listed in the AFIRMS Product Descriptions, 31 May 1985.

2.2.2 Expansion and Refinement of AFIRMS Displays.

a. Include unit and resource status data for all MAJCOMs at HQ USAF. Data requirements are subject to revision by analysis of readiness metrics for each MAJCOM.

b. The SGM must be enhanced to incorporate the following:

(1) Properly account for individual resource capability;

(2) Properly account for munitions required and decremented for standard conventional loads (SCLs) below first priority;

(3) Produce the data to portray force readiness based on redistribution of resources in excess of the tasking for any units.

c. User Interface/Display Revisions.

(1) Additional data support for the Contingency Support Staff.

(2) Change certain screen columns and data codes to be more useful.

(3) Additional map displays with more parameter flexibility.

(4) More summaries on tabular screens.

(5) Management briefing versions of tabular displays, i.e., exception data which can be selected by the user, vice the LPP product which produces full status reports.

(6) HELP screens for all menus, parameter screens and displays.

(7) Queuing of screen requests to save waiting time.

(8) Stored display screens that can be quickly recalled without recalculation.

(9) Date/time "stamping" of data to indicate its age.

(10) Command language for faster retrievals by experienced operators.

(11) Automatic reporting of data values that have crossed a critical threshold.

(12) Improved editing on tabular screens.

(13) Make parameter screens "smarter" about contents of the database values for selection by the operator.

(14) Additional sorting criteria for tabular screens.

2.2.3 Establish Interface for Communications to USAFE and AFLC.

2.2.4 Hardware Requirements.

a. New TEMPEST graphics printer: paper and transparency, lower maintenance cost, transparency print should take 1.5 minutes or less.

b. Two TEMPEST medium speed character printers: at least 200 characters per second, dot matrix format will be required in AF/XOOIM and in the LRC for quick review of tabular data prior to running a model.

c. In addition to the two monochrome terminals currently located at AF/XOOIM, four more TEMPEST monochrome terminals are required at the HQ USAF site by the end of Block 1 (CSS floor, LRC, PRC, and XOX).

d. The minicomputer must be upgraded to accommodate the data for MAJCOMs in addition to USAFE, and for expansion/modification of the SGM.

SECTION 3. BLOCK IMPLEMENTATION OPTIONS

3.1 Overview. Each option includes the four categories of requirements described in Section 2. The first two options would be implemented as improvements over the software used at HQ USAF for the LPP. The other option involves conversion of the color graphics software from the LPP color graphics terminal to the Air Force standard microcomputer. All options satisfy training and hardware requirements to the same degree; that is, all options include user documentation, training and acquisition of a better TEMPEST color graphics printer and two TEMPEST 200 character per minute printers.

The differences between the options can best be summarized as variations in the level of capability of the system by the end of Block 1. Option 1 attains the highest level of capability in all four categories; mid-level capability is attained by Option 2; and, Option 3 is the lowest essential capability level. Table 3-1 summarizes the differences between the Options.

Table 3-1

SUMMARY OF OPTIONS

	1 - High	2 - Mid	3 - Low
1. User Interface/Display Revisions			
CSS Functions	yes	yes	no
Briefing Version of Tables	yes	no	no
Display Columns and Codes	yes	no	yes
More Summaries on Tables	yes	no	no
HELP Screens	elaborate	cryptic	no
Stored Screens	yes	yes	no
Date/Time Stamping	yes	yes	no
Command Language	yes	no	no
Threshold Reporting	yes	no	no
Improved Editing	yes	no	minimal
Parameter Selections	yes	yes	minimal
Direct Queries to USAFE	yes	no	no
2. SGM Revisions			
Individual Resource Capability	yes	yes	yes
Munitions and SCL priority	yes	yes	no
Redistribution of Resources	yes	no	no

Table 3-1

SUMMARY OF OPTIONS (Continued)

	1 - High	2-Mid	3-Low
3. MAJCOM Interface			
USAFE Communications	1200 baud dedicated	1200 baud dedicated	AUTODIN
AFLC Communications	AUTODIN	AUTODIN	tape
4. Hardware			
Additional Monochrome terminals	4 DST-102	2 DST-102	no
Color graphics printer	yes	yes	yes
Two 200 cpm printers	yes	yes	yes

3.2 Option 1 - Highest Level Capability. This option would provide a larger number of Air Staff personnel with useful AFIRMS display products than would the other options. Personnel and logistics staff officers in the CSS would be able to directly access status screens. HELP screens would be available at all times to assist the operator with procedures and screen assumptions. Exception status would automatically be reported to user terminals that required specific notification. Editing of tabular screens would be improved to be easier and faster by implementing a full screen editor instead of the current line editor. The parameter choices would be more generalized and suited to a variety of needs. The SGM and the screen displays themselves would also be improved. More terminals would be located in functional areas, and several terminals would be able to make direct queries to the USAFE database at HQ USAFE, Ramstein Air Base.

The hardware architecture would include the central minicomputer used during the LPP. All color graphics and monochrome terminals would be cabled directly to the central minicomputer.

The communications interface with USAFE would be via secure, dedicated link at 1200 baud, allowing timely USAFE status updates.

3.3 Option 2 - Mid-level Capability.

AFIRMS products would be developed for this option to be more useful and easier to use than the LPP system. Additional terminals would give logistics personnel and the CSS direct access to AFIRMS.

The architecture would be identical to Option 1, using the same means and speed of data communications with USAFE. Support of the CSS, however, would be more limited than with the first option.

3.4 Option 3 - Lowest Essential Capability.

AFIRMS would be available to the Air Staff and the CSS through data support provided by the Readiness Assessment Group. The system would be slightly improved over the LPP system regarding hardware and the SGM.

SECTION 4. COSTS AND BENEFITS

4.1 Cost Factors of Options.

4.1.1 Option 1 - Highest Capability.

a. Analysis/Requirements Definition Phase. Documentation of the requirements and system design would be a major effort for this option because of the quantity of requirements.

b. Development Phase. All aspects of development would be a large effort because of the volume of requirements.

c. Installation Phase. Hardware and software acquisition and installation would be extensive and would continue through most of the block period.

d. Operations Phase. This option would require considerably more software and slightly more hardware maintenance than the other two options.

4.1.2 Option 2 - Mid-Level Capability.

a. Analysis/Requirements Definition Phase. Minor improvements in all four categories of the requirements would not be pursued, thereby simplifying specification, design, and documentation.

b. Development Phase.

c. Installation Phase. Acquisition and installation would require less effort than for Option 1 because fewer terminals would be installed.

d. Operations Phase.

4.1.3 Option 3 - Lowest Essential Capability

a. Analysis/Requirements Definition Phase. Only the correction of major software and hardware problems from the LPP system would be designed and documented.

b. Development Phase.

c. Installation Phase.

d. Operations Phase.

4.2 Benefits of Options.

4.2.1 Option 1 - Highest Level Capability.

a. Utility. Although a complete resource status and capability picture would not be available, the timeliness of the resource data would be very useful and credible for the Air Staff. The system would require the least training of all options because of the additional system operator and display features. The maintenance of software for this option would require a greater effort than would be the case for the other options. The hardware and software would have limited growth potential since the hardware is close to throughput capacity and the LPP software was not modularly designed for extension of operational functions.

b. Manageability. Accomplishment of the software development effort would present a large task management problem.

c. Timely Implementation. The software development could not realistically be accomplished by the end of Fiscal Year 1986. Hardware installation could begin early in 1986 for all the options.

4.2.2 Option 2 - Mid-level Capability.

a. Utility. The data would be as complete and timely as the first option, but the system would be more difficult to use. Less software to develop for this option would mean less to maintain. Hardware and software growth limitations are the same as Option 1.

b. Manageability. The level of software development would require a special effort in carefully managing the project.

c. Timely Implementation. The software development could be completed late in the third quarter in Fiscal Year 1986.

4.2.3 Option 3 - Lowest Essential Capability.

a. Utility. The data would not be as timely as the other two options and could not be used by the CSS. However, the data would be very useful and credible for normal Air Staff requirements. This option would be the easiest to maintain. This option would allow minor growth to the level of functions in Option 1.

b. Manageability. This option would not be difficult to accomplish.

c. Timely Implementation. The software development could be accomplished early in calendar year 1986.

4.3 Description of Detailed Costs. Non-recurring costs include the computer equipment unit prices which are based on the Datasec DST-100 monochrome TEMPEST terminal and the WIS standard IBM 5182 Color Printer. The site preparation unit cost of $2,333.00 is the average monthly cost for enlisted personnel who would install secure communications and power. Approximately three and one-half days per task, per terminal was required during the LPP. The material costs are an approximation for conduit, cable, filters, and connectors for each terminal.

The software development costs are based on an average annual cost for analysts, software engineers and programmers in commercial industry. The level of effort estimate was derived using the Constructive Cost Model (COCOMO). The input data for calculation is a consensus of estimates of program size and project characteristics by several senior software engineers who have extensive experience with all of AFIRMS LPP software.

Recurring costs include the communications costs which are the only significant operating cost differences between the options.

The estimate of supplies is based on paper and printer supplies. Communications costs for the first two options are based on the costs incurred during the LPP. Maintenance costs of 18% per year for all AFIRMS hardware at HQ USAF are standard in the computer industry. The purchase price of all the hardware at the HQ USAF site is approximately $250,000. The software maintenance cost is based on two people being assigned to corrective maintenance and minor modifications after installation of the software.

The options are costed in Tables 4-1 through 4-3 of this Annex.

Table 4-1

HQ USAF OPTION NUMBER 1

ECONOMIC ANALYSIS - HQ USAF Block 1

20 Mar 85

Unit Cost	Qty	Line item	Equipment Description
Computer equipment			
$3,495.00	4	$13,980.00	TEMPEST Monochrome Terminal
$3,174.00	2	$6,348.00	WIS Color TEMPEST Alphanumeric Printer
Computer Equipt TOTAL		$20,328.00	
Site Prep			
$2,333.00	0.500	$1,166.50	Secure Comm
$2,333.00	0.500	$1,166.50	Secure areas & Power
$416.75	4.000	$1,667.00	Materials
Site Prep TOTAL		$9,087.75	
Non-recurring Equipment Total		$29,415.75	
Analysis and Software Development			
$8,333.33	1310 man-mo.	$10,916,666.67	
Annual Operating Costs			
Supplies		$1,000.00	
Communications		$12,000.00	
Software Maint.		$200,000.00	
	Annual Total	$213,000.00	

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Table 4-2

HQ USAF OPTION NUMBER 2

ECONOMIC ANALYSIS - HQ USAF Block 1

20 Mar 85

Unit Cost	Qty	Line item	Equipment Description
Computer equipment			
$3,495.00	2	$6,990.00	TEMPEST Monochrome Terminal
$3,174.00	2	$6,348.00	WIS Color TEMPEST Alphanumeric Printer
Computer Equipt TOTAL		$13,338.00	
Site Prep			
$2,333.00	0.250	$583.25	Secure Comm
$2,333.00	0.250	$583.25	Secure areas & Power
$416.75	2.000	$833.50	Materials
Site Prep TOTAL		$7,085.25	
Non-recurring Equipment Total		$20,423.25	
Analysis and Software Development			
$8,333.33	315 man-mo	$2,625,000.00	
Annual Operating Costs			
Supplies		$1,000.00	
Communications		$12,000.00	
Software Maint.		$200,000.00	
Annual Total		$213,000.00	

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Table 4-3

HQ USAF OPTION NUMBER 3

ECONOMIC ANALYSIS - HQ USAF Block 1

20 Mar 85

Unit Cost	Qty	Line item	Equipment Description
Computer equipment			
$3,495.00	0	$0.00	TEMPEST Monochrome Terminal
$3,174.00	2	$6,348.00	WIS Color TEMPEST Alphanumeric Printer
Computer Equipt TOTAL		$6,348.00	
Site Prep			
$2,333.00	0.000	$0.00	Secure Comm
$2,333.00	0.000	$0.00	Secure areas & Power
$416.75	0.000	$0.00	Materials
Site Prep TOTAL		$0.00	
Non-recurring Equipment Total		$6,348.00	
Analysis and Software Development			
$8,333.33	58 man-mo.	$483,333.33	
Annual Operating Costs			
Supplies		$1,000.00	
Communications		$0.00	
Software Maintenance		$200,000.00	
	Annual Total	$201,000.00	

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Section 5

COMPARISON OF OPTIONS

The procedure for comparing the options is located in Section 5 and Appendix D of the AFIRMS Economic Analysis. The numeric scores in Table 5-1 are based on the benefits described in Section 4 of this annex.

Table 5-1

ASSIGNMENT OF SCORES TO THE OPTIONS

		EVALUATION CRITERIA UTILITY Information Complete	Timely	Credible	sSystem sRAM	Easy	Growth	sMANAGE- sABILITY sIncr.	Shar.	TIMELY IMPLEMEN-TATION	SATISFIES REQMTS (100 max.)	Cost Score / Total Score
	Relative Weights	1.2	.8	2	1.7	.8	1	1	.5	1		
Highest Capability		7	6	6	6	8	5	4	1	5	56.3	7
												63.3
Mid-Level Capability		6	6	6	6	7	5	5	1	7	57.3	8
												65.3
Lowest Essential Capability		6	2	6	6	6	5	6	1	8	55.3	10
												65.3

AFIRMS Economic Analysis

ANNEX 10

USAFE SEGMENT ECONOMIC ANALYSIS

Preliminary

SOFTECH

AFIRMS Economic Analysis
ANNEX 10
USAFE SEGMENT ECONOMIC ANALYSIS

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SECTION 1. OVERVIEW

1.1 Purpose. This Annex to the AFIRMS Economic Analysis outlines the objectives, requirements, and options for implementing Block 1 of the HQ USAFE AFIRMS and eighteen fighter/reconnaissance wings. The expected costs and benefits for options to accomplish the objectives, and key analysis factors which support the recommended option are also presented in this draft. This Annex is more detailed than the task description and costing in the Economic Analysis. This document will be updated and refined in conjunction with the Evolutionary Implementation Plan, Annex 10, USAFE Segment Plan.

1.2 Block 1 Objectives.

a. Provide major AFIRMS functions for HQ USAFE and all fighter and reconnaissance wings.

b. Refine the content and layout of AFIRMS output displays for use by the HQ USAFE staff.

c. Convert and revise color graphics software to operate on the Air Force standard microcomputer.

d. Provide all system documentation in accordance with DoD Standard 7935.1-S and AFR 205-16.

e. Provide training for operators and staff officers.

1.3 Assumptions. The assumptions stated in Section 3 of the AFIRMS Economic Analysis are applicable to the HQ USAFE Block 1 implementation. Additionally, the block will be implemented according to the phases described in the EIP, Annex 10.

1.4 Contractor-Recommended Option. Option #3, an unclassified network of microcomputers at the 14 fighter and reconnaissance wings, is the recommended option.

SECTION 2. SYSTEM REQUIREMENTS

2.1 Operational Requirements. The requirements are grouped into four general categories:

a. User-interface. The user-interface requirements involve the interaction of the system and the operator, and the appearance and usefulness of the output displays.

b. Sortie Generation Model (SGM). These requirements relate to the method of data input, the model's internal algorithm and the available output data.

c. HQ USAF Interface. HQ USAF must have a data communications link with HQ USAFE.

d. Hardware. Hardware requirements involve upgrading LPP equipment and acquiring new equipment. Conversion of the color graphics terminal software from the LPP equipment is required to accommodate the use of Air Force standard microcomputers at all USAFE Wing sites.

2.1.1 LPP Screens for Implementation. The screens to be implemented are listed in the AFIRMS Product Descriptions, 31 May 1985.

2.1.2 Expansion and Refinement of AFIRMS Displays.

a. Incorporate SGM, display screen and any other core system improvements developed at HQ USAF into all appropriate USAFE products.

b. Provide functions and displays for the Operations Support Center (OSC) at HQ USAFE, Ramstein AB.

2.1.3 Hardware Requirements.

a. New TEMPEST graphics printer: paper and transparency, lower maintenance cost.

b. TEMPEST medium speed character printer.

c. Mini-computer upgrade: main memory, mass storage.

d. TEMPEST commercial color graphics workstations to replace the LPP color graphics workstations at HQ USAFE.

2.2 Fighter and Reconnaissance Wing Capability.

a. The major functions of the color graphics terminal used during the LPP must be converted to the Air Force standard microcomputer. Additional functions will be required for use of the microcomputers as stand-alone processors. If the microcomputers are interconnected, the software must provide operating procedures for on-base communications outage periods.

b. The database will be both redundant and distributed for system survivability and to permit degraded operations in the event of a catastrophic failure of the system. Distributed means that the squadrons will maintain their aircrew data locally, Job Control will have the aircraft data, etc. Redundant means that the data would also be maintained on at least one other workstation than the primary data site.

   Additionally, the flying squadrons with deployment missions will need a PC sized DBMS or a File Management System to permit independent operations as a mini-wing at a deployed location. The squadron system should also be compatible with other wing sites as they may be tasked to deploy to another wing's location and operate as a part of that wing.

c. The deployed squadron will have no means of data communications with its home wing.

d. Modular software that will later allow for transmitting data to both HQ USAFE and adjacent wing workstations should be designed into the workstation software.

SECTION 3. OPTIONS

3.1 Overview. Each of the options include the four categories of requirements described in Section 2. The HQ USAFE options will be implemented as improvements over the minicomputer system used for the LPP. All wing options involve new hardware and implementation of functions that were tested during the LPP. However, the conversion to Air Force standard microcomputers requires substantial software development. All options satisfy training and hardware requirements to the same degree; that is, all options include user documentation, training, and acquisition of a better TEMPEST color graphics printer and two TEMPEST 200 character per minute printers.

The differences between the options can best be summarized as variations in the level of software modularity and microcomputer connectivity. Option 1 would provide unconnected microcomputers with well designed modular software to accommodate networking in Block 2 implementation. Option 2 would provide stand-alone microcomputers. This software may have to be substantially redesigned later to accommodate communications with other on-base microcomputers. Option 3 would provide connected microcomputers with a distributed redundant database. Table 3-1 summarizes the differences between the options.

3.2 Option 1 - Classified, Separate Microcomputers with Modular Design. The microcomputers at various locations around the wing would be able to input their status. Data would be exchanged periodically to update the Wing Operations Center (WOC) microcomputer and vice versa. Data exchange would be accomplished by couriers carrying floppy disks. Some of the microcomputers would process classified data.

This option would satisfy the Basic AFIRMS Functions for peacetime. It would provide the Wing staff and HQ USAFE with periodic snapshots of status and would provide all the capability assessments available. However, it lacks the timeliness required for tracking flying operations at the wing or for exercise or crisis modes. The modular design would have payoff when networking capability is available, avoiding a large redesign effort. The Z-150s for HQ USAFE would be programmed as terminals to the central minicomputer.

Table 3-1

SUMMARY OF OPTIONS

	1 Separate Microcomputers with Modular Design	2 Separate Microcomputer	3 Communicating Microcomputers
1. User Interface			
Display revision OSC needs	yes	no	yes
2. HQ USAF Interface			
Accommodate speed selected by HQ USAF	yes	yes	yes
3. Hardware			
Additional terminals in the OSC	4 Z-150's	no	2 Z-150's
Color graphics printer	yes	yes	yes
Two 200 cpm printers at HQ USAFE	yes	yes	yes
Wing processor configuration	Separate micro's Floppy disk transfer (some classified)	Separate micro's Floppy disk transfer (some classified)	Connected Micro's (Unclassified)
Communications from Wing to HQ USAFE	AUTODIN	AUTODIN	1200 Baud Dedicated

3.3 Option 2 - Classified, Separate Microcomputers. The major difference between this option and the first option is that the software would not be specifically designed to accommodate interactive communications with other microcomputers. However, with this less expensive design, there is the possibility that commercial software products would later be available to obviate the need for especially modular design.

3.4 Option 3 - Unclassified Microcomputer Network. All microcomputers would communicate with each other through a central message server. The database would be both redundant and distributed for system survivability and to permit degraded operations in the event of a catastrophic failure of the system. Distributed means that the squadrons would maintain their aircrew data locally, Job Control would have the aircraft data, etc. The schedule and tasking data would reside at the WOC. Redundant means that the WOC would also maintain a database that duplicates the squadron, maintenance, munitions, and fuels data in the central database and would be periodically updated from the individual databases (different periods for different data). The WOC's scheduling data would be duplicated at all local sites and the tasking data (and perhaps the squadron's aircraft data) would reside at the squadrons. If the WOC, a local site or communications failed, the wing could continue to operate.

Additionally, the flying squadrons with deployment missions would need a PC sized DBMS or a File Management System to permit independent operations as a mini-wing at a deployed location. The squadron system should also be compatible with other wing sites as they may be tasked to deploy to another wing's location and operate as a part of that wing. These deploying squadrons would take their aircraft and aircrew databases with them and upload the tasking, munitions, and fuels databases at their deployed locations. Also, they would need the ability to perform the translate tasking, capability assessment and scheduling functions at their deployed locations. In addition, if the squadron deploys to a base already possessing a wing (with an AFIRMS), it would join that wing's system and become a local site of the inplace system.

The deployed squadron would not communicate with its home wing, but instead with the controlling MAJCOM site as if it were a wing. The MAJCOM site could relay the squadron status information to the home wing's MAJCOM who can then relay it to the home wing, i.e., TFS to MAJCOM A to MAJCOM B to TFW.)

The Z-150's for HQ USAFE would be programmed as terminals to the central minicomputer.

SECTION 4. COSTS AND BENEFITS

4.1 Cost Factors of Options.

4.1.1 Option 1 - Classified, Separate Microcomputers with Modular Design.

a. Analysis/Requirements Definition Phase. Documentation of the requirements and system design would be a major effort for this option because of the quantity of requirements. A significant portion of the effort would be directed toward conversion of the color graphics software to accommodate interactive file updates and retrievals for interconnected Air Force standard microcomputers. The specification of the displays, software, and procedures would require thorough analysis. The LPP color graphics terminal was a powerful microcomputer with a more sophisticated operating system and library of utilities than the Air Force standard Z-150 microcomputer. The lower resolution of the Z-150 would necessitate adjustment of a number of the display screens, also.

b. Development Phase. All aspects of development would be a large effort because of the volume of requirements.

c. Installation Phase. Hardware and software acquisition and installation would be extensive and would continue through most of the block period.

d. Operations Phase.

4.1.2 Option 2 - Classified, Separate Microcomputers.

a. Analysis Phase. Although communication among the microcomputers would not have to be defined, the differences from the LPP color graphics terminal would require much the same analysis as mentioned for Option 1.

b. Development Phase. The design and conversion of software from the LPP equipment would be a sizable effort due to the many differences in the display and processing characteristics. A truly modular design would require almost as much total development effort as Option 3.

c. Installation Phase. Installation of the stand-alone hardware would present little problem in site preparation. Only software installation would be a task, because of the number and geographical distance of the equipment.

d. Operations Phase.

4.1.3 Option 3 - Unclassified Microcomputer Network.

a. Analysis Phase. This effort would be as large an effort as for Option 1.

b. Development Phase. The final design of the networking and communications software would be additional for this option over Option 1. This option would also involve hardware interfacing.

c. Installation Phase. Site preparation and communications installation would be more extensive for this option transfers Option 1.

d. Operations Phase.

4.2 Benefits of Options.

4.2.1 Option 1 - Classified, Separate Microcomputers with Modular Design.

a. Utility. All the options would provide for squadrons to deploy with their own database. The system meets the basic requirements to support capability assessments.

b. Manageability. This option has a long-term advantage in being able to accommodate networking. This option could easily evolve to a network of classified microcomputers.

c. Timely Implementation. This is not an advantage of any of the options. Analysis and development would require at least two years.

4.2.2 Option 2 - Classified, Separate Microcomputers.

a. Utility. Same as Option 1.

b. Manageability. This option is the smallest effort, but could have long-range impacts on total system costs for USAFE.

c. Timely Implementation. See Option 1.

4.2.3 Option 3 - Unclassified Microcomputer Network.

a. Utility. This option would be very timely, aiding users in their daily tasks and encouraging accurate data input.

b. Manageability. This option has the additional effort of communications installation at all wings. It would allow the easiest upgrade to a classifed network. However, the software technology is currently at the front of technology and, therefore, highly uncertain.

c. Timely Implementation.

4.3 Summary of Costs. Initial analysis indicates the following costs:

	Option 1	Option 2	Option 3
Non-recurring			
Equipment	$500 K	$500 K	$950 K
Installation	0	0	50
Analysis & Software	16,000	12,500	18,000
Recurring (Annual)			
Communications	0	0	173
Hardware and Software Maintenance	275	275	340

SECTION 5. COMPARISON OF OPTIONS

The procedure for comparing the options are located in Section 5 and Appendix D of the AFIRMS Economic Analysis. The numeric scores in Table 5-1 are based on the benefits described in Section 4 of this annex.

Table 5-1

EVALUATION OF WING OPTIONS FOR USAFE BLOCK I

	EVALUATION CRITERIA UTILITY Information Complete	Timely	Credible	System RAM	Easy	Growth	MANAGE-ABILITY Incr	Shar	TIMELY IMPLEMEN-TATION	SATISFIES REQMTS (100 max.)
Relative Weights	1.2	.8	2	1.7	8	1	1	5	1	
Separate, classified Z-150's with modular design	5	1	4	9	8	5	7	3	3	51
Separate, classified Z-150's	5	1	4	9	8	3	8	3	3	52
Unclassified micro network	8	6	8	5	7	7	6	3	2	61

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