Selection and Evaluation of AIDS for Aircraft Nonavionics Subsystems

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This paper presents the results of a study that included a survey of industry on the status of Aircraft Integrated Data System (AIDS) components required to monitor certain nonavionic subsystems and in-house review of maintenance, monitoring, and AIDS component requirements. To evaluate the various AIDS configurations resulting from the industry survey and in-house studies, a deterministic computer model was developed that provided cost effectiveness data in the terms of maintenance cost effect and aircraft operational availability effect. The study showed that AIDS can be cost effective and increase aircraft operational availability if a given combination of cost/maintenance improvement values can be achieved. It also showed that once AIDS is shown cost effective for one subsystem, the cost of adding other subsystems is outweighed by the cost/operational benefits achieved. Further study is required to prove the true practicability of mechanical subsystem trend analysis.

Introduction

IN recognition of the increased activity in the field of AIDS and of certain military requirements, McDonnell Aircraft Company (MCAIR) established a company funded AIDS study. The most significant AIDS activities/requirements that prompted this study were 1) requirements for increased aircraft availability and probability of mission success; 2) requirements for the reduction in aircraft maintenance time; 3) release by the USAF of AF Regulation 375-11, "Installation of Aircraft Integrated Data Systems (AIDS) in Current and Future Aircraft"; 4) continuous development, test, and evaluation of various AIDS configurations by both the airlines and the military;[1] and 5) improvement of AIDS components both in capability and weight. It has thus become apparent that AIDS, in some form, is to be a way of life for the aircraft industry.

This study indicated that there are really two time-dependent answers to the AIDS problem: a near-term solution, early to mid-1970's, for operational capability; and a far-term solution, beyond the mid-1970's, for operational capability. It is to the near-term AIDS problem that this paper is addressed. Further, this paper is limited to nonavionics in a fighter aircraft operational environment.

Approach

The goal of the near-term portion of this study was to define a typical military aircraft nonavionics AIDS and to determine, quantitatively, the operational and economic effect on the over-all weapon system. The approach used to achieve this goal consisted of the following basic steps: 1) in-house studies to define a preliminary baseline AIDS for an industry survey and to identify AIDS problem areas; 2) a survey of industry to determine the AIDS capability in existence; 3) in-house review of USN/USAF maintenance experience on the F-4 aircraft to determine maintenance factors; and 4) development of an evaluation technique that would provide quantitative evaluation of AIDS and would include the capability for parametric analysis of the various input/output data.

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Industry Survey

The examination of industry capability included the determination of technical feasibility, physical characteristics, availability, and cost of AIDS as proposed by the selected vendors. To provide the vendors with a common set of ground rules from which to propose, a "Preliminary Baseline AIDS" was defined, airborne subsystems were described, and specific problem areas were identified for vendor comment.

The definition of the preliminary baseline AIDS included the following requirements: 1) continuous parameter monitoring; 2) comparison of monitored values with established limits (see Fig. 1), a) identification of parameters that have failed and fault isolation and identification of the Line Replaceable Unit (LRU) or flight line replaceable component, and b) identification of parameters that exceed predetermined intermediate values for trend analysis failure prediction; 3) consideration of selective data recording; 4) self-test capability; and 5) failure of AIDS not to affect operation of monitored airborne subsystem.

The preliminary baseline configuration was further described as shown in Fig. 2.

In the selection of nonavionic subsystems that were to be specified as applicable, a review of the total direct maintenance manhour requirements was made. Table 1 indicates the percentage applicable to each major category. It was apparent that the concentration of effort to identify the candidate nonavionic subsystems should be in the airframe, utilities, and propulsion areas.

A detailed analysis of USN data and USAF 66-1 taped data and reports was made, and the results of this review (see Fig. 3) indicated that five subsystems should be considered as candidates for AIDS.

The requirements for monitoring these subsystems were included in the data provided to the vendors. A brief subsystem description was provided, and the vendors were to identify parameters and sensors.

In addition to recommending an AIDS configuration, the vendors were requested to provide comments on the following AIDS related problems: 1) multiplexing vs individual sensor wiring; 2) the effect of ground processing of failure data on aircraft turnaround; 3) recommended military organizational structure required to process and distribute the recorded data; and 4) techniques proposed to select parameters to be monitored.

A complete pricing breakdown (nine parts) was requested, including design and development, test items, and a testing

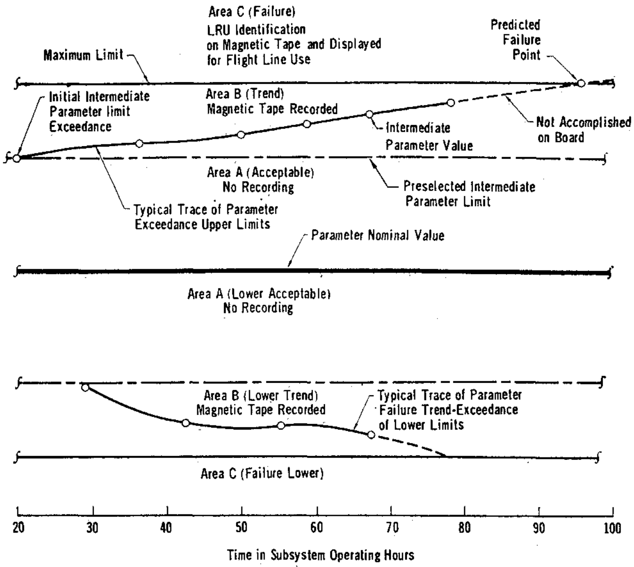

Fig. 1 Parameter evaluation.

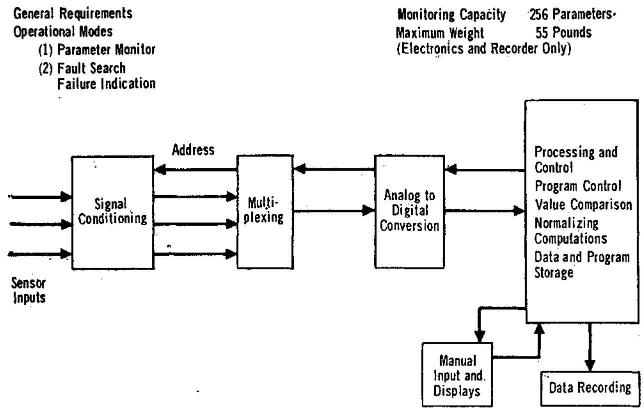

Fig. 2 Preliminary baseline configuration.

program, supporting engineering, handbook preparation, etc. Finally, the vendors were advised that the requirements were to be considered as a baseline guide and that innovations or deviations would not be considered nonresponsive, but in fact, new and original schemes would be welcomed.

Vendor Recommendation Evaluation

The survey indicated that an adequate hardware capability existed to provide an AIDS using conventional electronics weighing 55 lb exclusive of the interconnecting sensor wiring and the additional needed sensors. Several AIDS components are in existence and MIL qualified. The remaining items peculiar to AIDS will not require any design techniques that advance the state-of-the-art or require the development of special components.

In addition, the survey indicated the possible availability of a light-weight configuration weighing 38.5 lb. This configuration, relying on third generation electronics, will require further development.

In-House Studies

In order to more conclusively define the final baseline configuration it was necessary to augment the survey data with in-house studies. The areas requiring additional attention were 1) parameter selection, 2) sensor and wire bundle weight, 3) military ground based data handling requirements, and 4) onboard computer requirements.

Parameter selection

The importance of optimum parameter selection and its attendant effects of AIDS operational requirements and physical configuration warranted further in-house effort. Basically, the selection of parameters requires an understanding of the total system concept to ensure proper identification of subsystem testing requirements. Test requirements (parameters) determined on this basis suggest the need for a new engineering "-ility" which could be called "Fault Isolubility." This new discipline would consider the interrelated requirements as effected by parameter selection on airborne subsystem functional design/operational requirements, support analysis/concept requirements, and maintenance and spares requirements/concepts. Tools used by this discipline to determine parameter needs would include such procedures as simulation models and failure mode and effects analysis.

Specifically such basic considerations would include the possible use of existing parameters/sensors that are available to provide information displays to the aircrew, to the impact of parameter selection on the AIDS onboard computer in its possible need for requiring flight mode identification normalization computations, or the need for special fault isolation routines.

The in-house studies of the survey subsystem description provided the following Table 2 recommendations. Thus, it appears that the quantity of parameters required for monitoring airborne subsystems of the configuration considered in this study can be reduced to approximately 130.

Table 1 Direct maintenance manhours

Airframe	32.0%	Avionics	26.67%
Utilities	16.8%	Ordnance	4.5%
Propulsion	18.5%	Miscellaneous	1.5%

Sensor and wire bundle weight

With the establishment of the quantity and type of parameters to be measured, further analysis is now possible to determine the need for additional sensors, types of sensors needed, sensor weight and, finally, the total sensor/wire bundle weight. The various studies[2] have indicated that wire bundle weight represents 44–51% of the total AIDS weight depending on the application of remote signal handling units and multiplexing.

Sensor selection requires the consideration of many characteristics, but several take on increased significance when

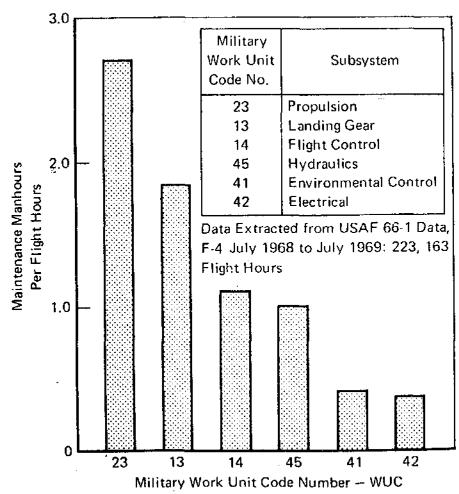

Fig. 3 Subsystem maintenance requirements.

AIDS applications are considered. These are repeatability, response time, resolution, range, error, and damping.

These characteristics will have an impact on the success of the trend analysis portion of the total AIDS program particularly on the computer processor and its ability to identify a true intermediate limit change or maximum tolerance exceedance. This problem could be further compounded by the time required for a changed signal value to settle as a function of the computer operational time in evaluating a signal and falsely shifting intermediate limits or switching into LRU failure identification logic routines. The in-house study results are shown in Table 3. The wire bundle weight was estimated based on the following considerations. Three remote multiplexing units are required; thus a coaxial interconnecting cable is required from each remote unit to the signal processor/computer at 30 ft each, for a total weight of 2.33 lb. The sensor to multiplexer interconnecting wire average length is assumed to be 8 ft. The total number of wires required for the 124 sensors, considering 2-, 3-, and 4-wire shielded and unshielded inputs is estimated at 384 weighing a total of 9.78 lb.

Military ground based data handling requirements

This deals with the military problems of data use and equipment and trained personnel required to process the trend analysis data recorded by each aircraft during each flight. The importance of the proper use and expeditious handling of these data cannot be overemphasized because this is one of the main advantages that the military gains by using AIDS.

The solution to this problem of ground data processing is many faceted, involving the processing of data received from many geographical locations and the dissemination of various types of data to many users on a varying time scale, including real time to monthly data outputs. The solution requires the consideration of the development of software programs to provide reporting flexibility and the interface problem of data transmission equipment and data processing equipment. Although the C-5A MADAR ground processing segment and the military data handling study document were reviewed, the equivalent TAC situation had not been established, and it was obvious that any useful solution to this problem must be considered a separate study involving the various using military commands.

Computer study

As there appeared to be some uncertainty concerning computer implementation and the resulting capacity requirements, it was decided to make an in-house study of the computer requirements, considering specific computer operations that were not necessarily defined in detail in the information contained in the survey.

To establish a baseline for the study, the following conditions were assumed. 1) 130 parameters to be monitored and compared. 2) Three flight modes to be identified. 3) In addition to usual tolerances associated with a nominal value, intermediate values will be established for each parameter for trend analysis purposes. The first comparison will be made to these values. 4) 25 parameters will require a change in intermediate (trend) values and maximum (failure) tolerances depending on the aircraft operating mode. 5) If an established intermediate value is exceeded for a specific number of cycles, but the maximum tolerance is not exceeded, the original intermediate value is replaced by the new value, and all future comparisons are made with this new intermediate value until it is exceeded, and then the replacement cycle is repeated. The original intermediate tolerance is stored in the computer. 6) 25 parameters require computations. 7) A manual input is required prior to each flight consisting of aircraft identification, engine identification, and date. 8) All maximum tolerance exceedances will be recorded on magnetic tape and printed out on paper tape and will include the following: parameter number, parameter measured value, LRU identification, flight mode identification, elapsed time of flight, and aircraft tail number. The preceding data will also be recorded on magnetic tape for each Δ intermediate tolerance exceedance and maximum tolerance failure.

Table 2 Parameter monitoring recommendation

Propulsion (2 engines)	48	Electrical (2 generators)	15
Hydraulic (2 primary) (1 utility)	12	Flight control and landing gear actuation	31
Environmental	18	Total	124

Figure 4 is a Computer Data Flow Diagram that defines the various operations the computer must perform. These operations are broken into three categories: AIDS initiate, AIDS setup, and parameter evaluation, and are described as follows.

The data flow starts with the manual insertion of the header data, the reestablishment of all intermediate tolerances to basic conditions, and an AIDS self-check is made.

Following this initiation step, the repetitious cycle of data flow starts with a series of set-up operations. These operations include checking external inputs to determine if an established flight mode exists and, upon identification of an established mode, the corresponding intermediate and failure limits are selected.

The parameter comparison operation cycle now starts with the first determination being the need for normalizing the parameter, followed by comparison with intermediate and failure and LRU identification logic routines. Intermediate exceedances are recorded on the magnetic tape, failures are recorded on magnetic tape (trend analysis use) and printed in English language on paper tape (flight line use).

The computer evaluation indicated that it was capable of performing all of the arithmetic operations required and that its speed of operation was more than adequate. However, there were two deficiencies as follows.

1) Memory: this computer has a 4096, 18 bit word memory. A memory greater than 4096 words is required because of the storage requirements for literal data, LRU fault isolation routines, and mode dependent intermediate and failure value storage. To make this computer adequate for the five subsystem monitoring requirement, it will be necessary to add memory, available in units of 4096 words, which will increase the computer weight by 2.5 lb.

2) Elapsed time: an internal clock is not included for determining elapsed time.

Baseline AIDS

In establishing a final Baseline AIDS configuration, three basic AIDS survey requirements had the greatest impact: 1) weight limitation, 2) immediate identification of a failed LRU or flight line replaceable component, and 3) accumulation of trend analysis data.

The in-house studies validated the following: 1) The reduction in number of parameters from 256 to 124 required to monitor the hypothetical subsystems to meet the study

Table 3 Added wire bundle/sensor weight

Number of parameters monitored	124
Number of existing sensors in aircraft	51
Number of sensors added	73
Weight of added sensors	16.06 lb
Wire bundle weight	12.7 lb
Total weight	28.76 lb

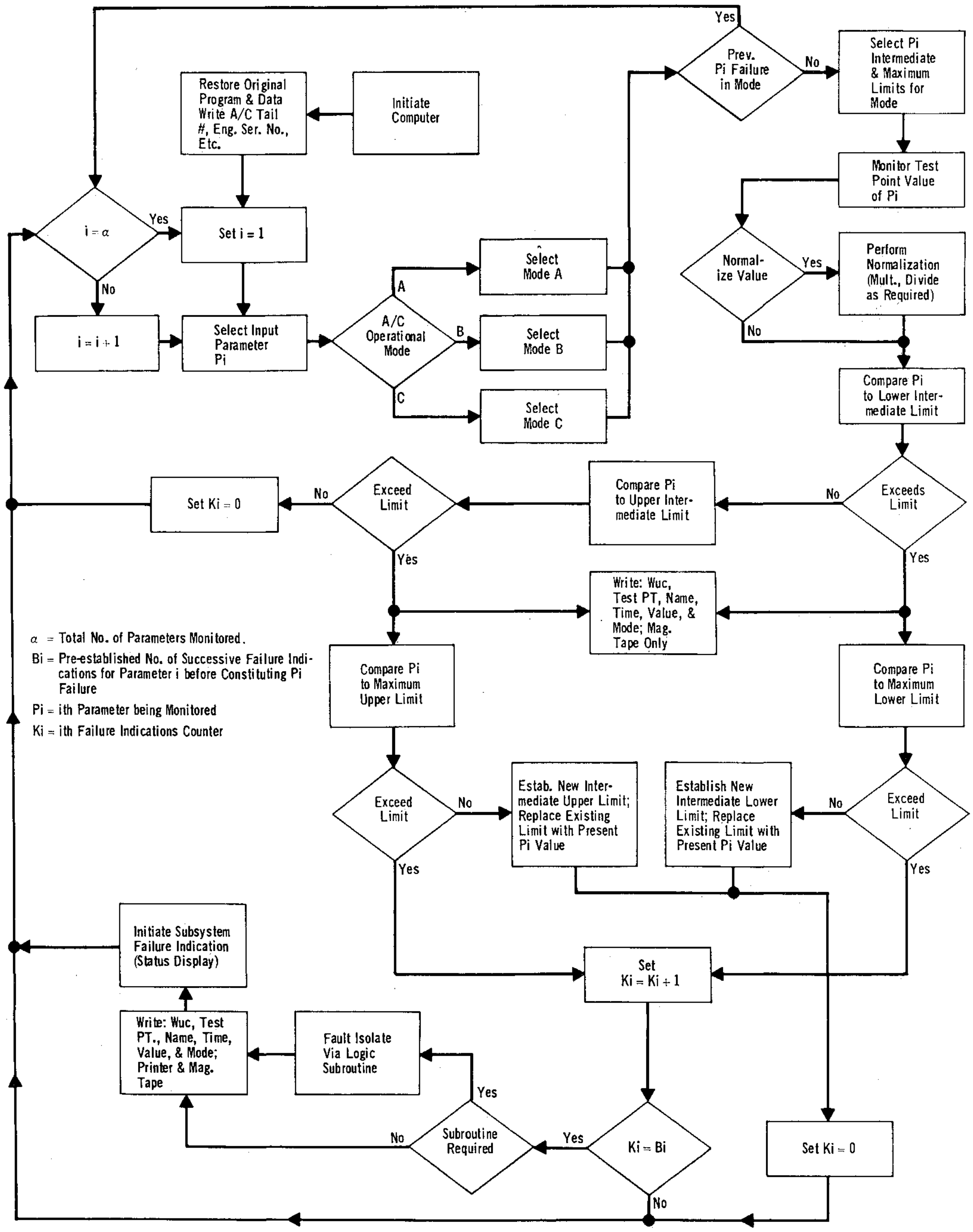

Fig. 4 Computer data flow diagram AIDS.

requirements with the attendant weight reduction in added sensors and wire bundle weight. 2) The fact that, by the proper selection and mechanization of AIDS components, there was no weight advantage to be gained by processing of recorded data off the aircraft to identify LRU or flight line replaceable components; thus, this did not receive further consideration. The deletion of this approach also eliminated the possibility of an operational penalty that depended on the immediate availability of ground base flight line data processing equipment. 3) In conjunction with study 2, the onboard computer requirements, although greater than anticipated could be met within the weight limitation assumed. 4) Based on 2 and 3, the requirement for providing flight line maintenance data can be accomplished within the weight limitation by the use of an available paper tape printer.

In selecting a configuration for evaluation, the possibilities must include consideration of two approaches. The first approach, using known design techniques and available components, will be identified as the conventional approach, as described in Fig. 5. The second approach, relying heavily on large-scale integrated metal oxide semiconducter (LSI-MOS) techniques now under development, will be identified as the light-weight approach. This approach also considers lighter weight intersensor wiring techniques and is described in Fig. 6.

AIDS Evaluation

Because a subsystem of this type does not add directly to aircraft performance, i.e., speed, range, time to climb, etc., some real measurable benefit must be achieved before AIDS can be included in the aircraft. Therefore, some evaluation technique must be found that will provide a procedure to convincingly measure such benefits. These benefits can be expected to appear as economic and increased operational reliability as affected by logistic and operational inputs. This evaluation technique should provide logistic outputs defining the onboard support required and the maintenance level allocations for the items not requiring onboard support. These logistic outputs should include a consideration of the various support configuration costs as a function of dollar

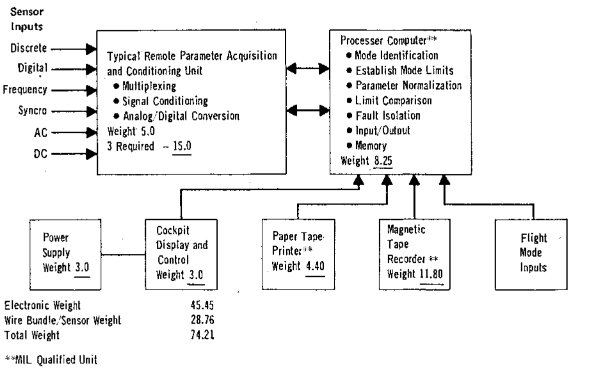

Fig. 5 Recommended baseline configuration—conventional approach (5 subsystems monitored; 130 parameters) early 1970 operational capability.

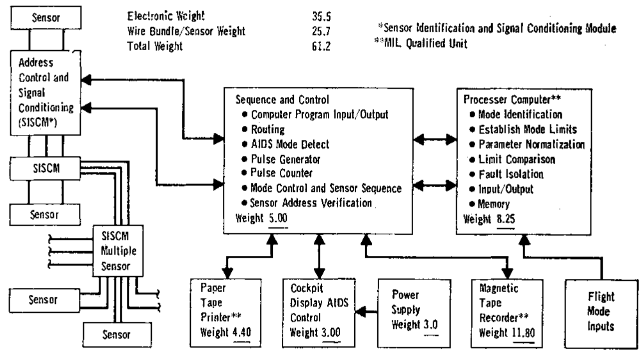

Fig. 6 Recommended baseline configuration—lightweight approach (5 subsystems monitored; 130 parameters) early 1970 operational capability.

benefits. The evaluation should be based on the mission completion requirements as specified for the weapon system.

A review was made of available models including the modified SAMSOM II as used in the IBM report,[3] Garrett's deterministic approach,[4] and the Douglas simulation model.[5] It was determined that none of these provided all of the outputs desired, although the Douglas model, which is based on mission completion requirements as a function of avionic LRU onboard maintenance requirements, approached the desired outputs.

In considering the task of developing a comprehensive simulation model that included the evaluation techniques discussed above, it was decided that the complexity and usefulness could not be justified. A better and more adaptable approach would be a deterministic cost effectiveness model for AIDS that would be used in conjunction with a simulation model of the Douglas type. This model considers the total cost picture starting with design and development through squadron ownership costs during the complete life cycle of the aircraft. The evaluation provides a measure of the operational reliability that includes probability of increased aircraft availability and increased successful mission completion. The following sections describe these considerations as used in the model developed during this study.

Cost Considerations

Cost data included as inputs to the model have been broken down into the following elements: 1) aircraft operation data cost—including operational and maintenance costs; 2) AIDS nonrecurring costs—including all of design, development, flight test, special tools, AGE, etc. (completely amortized during the first year of squadron activation); 3) AIDS recurring cost—including basic subsystem cost, installation, weight penalty, etc.; and 4) ownership cost—including such considerations as ground data processing, subsystem maintenance, etc.

Operational Reliability

Operational reliability, as used in this model, is the probability that at a given time a given aircraft will be able to perform a successful mission. The particular form of effectiveness measure chosen is the relative change in operational reliability as measured against a baseline support configuration as effected by AIDS. This effectiveness factor, which considers a constant aircraft baseline configuration, permits comparison of the effects of AIDS configuration variation.

The calculation of operational reliability is explicitly or implicitly based on the following basic conditions. 1) A failure in any component of a system being monitored by the AIDS is a failure of the entire aircraft in regard to availability for a mission. 2) An aircraft is considered to be failed if a) it contains a failure (known or unknown), or b) it does not contain a failure but it is judged to contain a failure. 3) Aircraft operational reliability is considered degraded if a) a failure exists, b) a failure will occur during flight, or c) an aircraft is down for scheduled or unscheduled maintenance. 4) The AIDS has the following effect(s) on the operational reliability. It a) has no effect on the probability a failure will occur, b) will, with trend predictions, reduce the probability of a failure in flight, c) will reduce the probability that a given aircraft is down for maintenance

Table 4 Tabulation of cost savings

Model economic outputs	Total life cycle savings Condition A	Total life cycle savings Condition B	Total life cycle savings Condition C	Savings per aircraft per year Condition A	Savings per aircraft per year Condition B	Savings per aircraft per year Condition C
Reduction in false removals	$ 3,949,680.00	$ 5,221,680.00	$ 13,592,880.00	$ 411.42	$ 543.98	$ 1,415.92
Reduction in periodics (phased)	23,737,536.00	25,729,536.00	34,681,536.00	2,477.66	2,680.16	3,612.66
Reduction in overhauls (engine only)	14,260,800.00	14,260,800.00	14,260,800.00	1,485.50	1,485.50	1,485.50
Reduction in secondary failures	22,069,440.00	23,475,840.00	47,706,240.00	2,298.50	2,445.40	4,969.40
Reduction in aborts	9,343,296.00	22,317,696.00	82,682,496.00	973.26	2,324.76	8,612.76
Reduction in AGE	1,015,440.00	1,335,440.00	2,335,440.00	...	...	...
Reduction in unscheduled maintenance	6,576,000.00	8,053,728.00	17,322,440.00	685.46	838.93	1,304.43
Total	$80,952,192.00	$100,394,720.00	$212,579,920.00	$8,331.80	$10,318.73	$21,400.67

	Condition A	Condition B	Condition C
Total cost of owning and operating the AIDS	$72,630,536.00	$87,892,736.00	$104,273,536.00
$\frac{\text{Savings}}{\text{Cost}} =$	1.11	1.14	2.04

[i.e., will reduce the number of false removals and allow extension of periodic (scheduled) maintenance], and d) reduces aborts.

Probability considerations

In order to implement calculation of a usable value for the AIDS effect on operational reliability, it was necessary to define a set of probabilities. These probability relationships, in order to be usable in the required early program phases, were derived assuming that the variables involved were essentially statistically independent.

Cost Effectiveness Model Outputs

Outputs from this model show the effects of AIDS in the areas of economic impact and aircraft operational reliability. The economic impact is reported in the terms of cost savings/losses on a year-by-year basis throughout the life cycle of the aircraft. The model provides a cost breakdown on various maintenance activities and ownership costs.

Aircraft operational reliability is expressed in terms of increased aircraft availability resulting from the inclusion of AIDS combined with improved probability of successful mission completion. This operation reliability effect only considers the airborne subsystems under consideration for AIDS and is presented as an old $\bar{R}_0$ and new $\bar{R}_n$.

Cost Effectiveness Model Applications

Having established baseline configurations and determined the basic model considerations, the next step was to explore the capability and versatility of the model. The model will: 1) provide a comparison of AIDS supported subsystems as a function of conventional AGE support; 2) compare the effect of varying the number of subsystems supported by AIDS; 3) compare AIDS having the same capability but different physical characteristics and costs; 4) provide the capability to determine the effect of varying operational and maintenance inputs to pinpoint the degree of improvement or lack of improvement; and 5) provide an operational reliability value change for all conditions listed.

Subsystem variation

The first application of the model will be made per the following conditions, which demonstrate its capabilities for applications 1 and 2.

Condition A is the feasibility of adding AIDS to the aircraft considering only one mechanical subsystem (engine) that has a high MMH/FH maintenance requirement and is considered mission critical.

Condition B is AIDS still cost effective if a candidate subsystem (environmental control) with very low MMH/FH is added to the capability of the AIDS established in Condition A?

Condition C is the increase in cost effectiveness by adding three more subsystems (electrical, hydraulic, and flight control and landing gear actuation) to the capabilities of the AIDS established in Condition B.

Economic impact

Figure 7 represents the economic results of the cost effectiveness study of the three conditions. The aircraft

Table 5 Cost and saving differential

Condition comparison	Cost increase	Savings increase
A–B	15,262,200.00	19,442,528.00
A–C	31,643,000.00	131,627,728.00
B–C	16,380,800.00	112,185,200.00

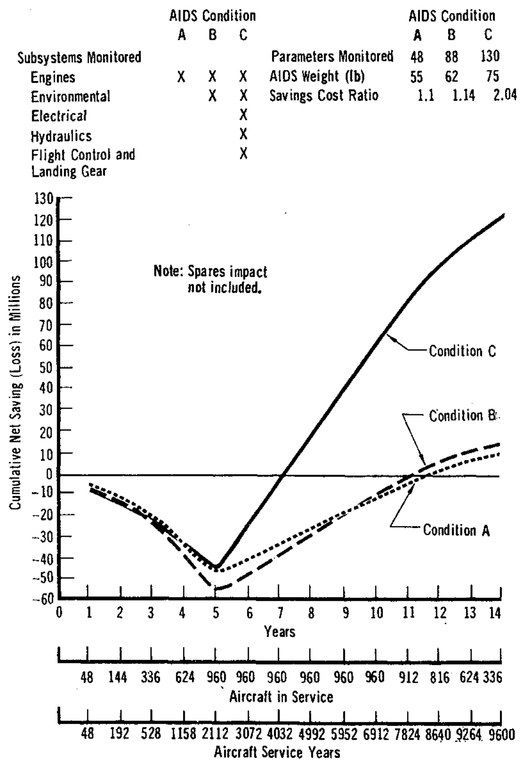

Fig. 7 Cumulative cost study model results—AIDS (conventional).

configuration is the same as defined in the vendor survey. The AIDS configuration and cost information is based on the vendor response as modified by in-house studies. Maintenance inputs were based on past maintenance experience for a like aircraft. For purposes of this cost study, the maintenance inputs were based on F-4 experience because of the extremely large data sample readily available. For the new aircraft subsystems, a certain improvement factor can be applied to past data, which will result in cost model data inputs that, assuming the past experience data sample is large, will provide inputs based on some semblance of fact. The new subsystem improvement factor was reflected in the use of such values as MTBF, etc., as established for the new systems.

The model considers a 10-yr life cycle but assumes a gradual aircraft buildup, and thus a gradual reduction. Operational data considered 960 aircraft flying 22 missions per month at 1 hr 30 min per mission. The number of missions per month was reduced, rather than the number of aircraft available, to take into account that a certain number of squadron aircraft are not available for missions.

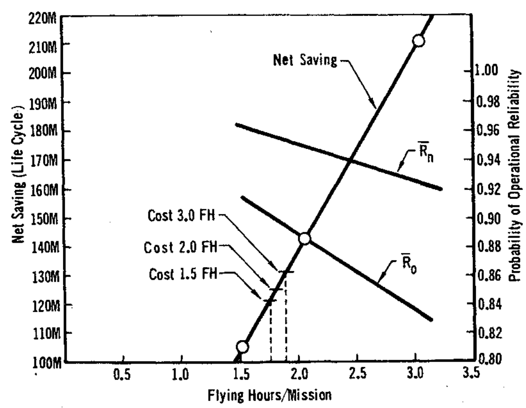

Fig. 8 Life cycle net savings as a function of flying hours.

Table 6 Operational reliability

	Condition		
	A	B	C
$\bar{R}_0$	0.912433	0.912433	0.912433
$\bar{R}_n$	0.917652	0.920959	0.959790
$\bar{R}$	0.57%	0.93%	5.19%

$\bar{R}_0$ = operational reliability with no AIDS.
$\bar{R}_n$ = operational reliability with AIDS.
$\bar{R}$ = % improvement in operational reliability.

The curve for Condition C (Fig. 7) shows that it takes over 7 yr before the AIDS becomes cost effective. A more meaningful assessment should consider the term aircraft service years. The term aircraft service years is defined as the number of aircraft in service at a given time, multiplied by the number of years in service. In this sense, the AIDS becomes cost effective when only 42.5% of the total aircraft service years have been spent. A breakdown of the dollars savings is tabulated in Table 4.

Some of the maintenance/operational inputs used were phased inspection time, diagnostic times "on" and "off" the aircraft, secondary failure rates, aborts, etc.

It is apparent that the AIDS is cost effective for any of the conditions investigated. It is interesting to note that if the cost estimates were increased by 33% and the savings were reduced by 33%, the Condition C AIDS would still be cost effective.

The cost study also indicated that a cost savings can be achieved by merely monitoring the engine and, further, that to add either one or four subsystems represents a benefit increase in greater proportion than the AIDS cost growth for adding these subsystems. These figures are summarized in Table 5.

Operational reliability factor ($\bar{R}$)

The operational reliability results for the conditions investigated are given in Table 6.

AIDS configuration comparison—common capability

In this application (3), the cost model will be applied to the situation that compares two different AIDS configurations with the same monitoring and recording capability.

To illustrate this application, a comparison was made between the two baseline configurations, Fig. 5—conventional approach, and Fig. 6—light-weight approach. These two configurations are designed to monitor the same airborne subsystems and provide the same informational outputs, and thus have a common capability. The difference shows up in weight and assumed increased cost, with the LSI-MOS approach being lighter but more expensive on a per unit basis. Because the cost model includes a penalty measured in dollars and cents for adding weight to the aircraft, the total cost figure plus the savings/cost ratio should provide the information needed to determine the optimum AIDS. A comparison of these results is given in Table 7. The operational reliability remains at 5.19% as both AIDS have the same capability.

The results of this comparison indicate that, although the light-weight approach has a weight advantage, its higher unit cost offsets its weight advantage; thus, for the conditions considered, the conventional approach must be considered optimum.

Table 7 Cost effectiveness configuration comparison—common capability

	Conventional approach (Cond. C)	Light-weight approach
Weight	75.0 lb	62.0 lb
Unit cost	$60,000.00	$80,000.00
Saving/cost ratio	2.14	1.76

Input variation—mission length

Application 4 indicates that input variations can be made. This application shows the effect of varying the operational input of flying hours per aircraft per month.

Figure 8 shows the cost model results achieved by varying the flying hours per mission. The configuration used in this comparison was the higher cost, light-weight configuration. From this chart, the following various facts are evident. 1) The net savings increase varies directly as the flying hours/mission increase. 2) The operational reliability $\bar{R}_n$ and $\bar{R}_0$ decrease as can be expected with $\bar{R}_0$ decreasing faster than $\bar{R}_n$. This indicates that the more the aircraft is flown, the greater the effect AIDS has on the over-all monitored subsystem operational reliability. 3) This AIDS (lightweight configuration) has to be flown 1.7 hr before the net savings equal the AIDS cost.

Conclusions and Recommendations

This study has shown that a cost effective AIDS subsystem can be obtained for nonavionic fighter aircraft subsystems in the early 1970 time period. Components either exist or new components needed will not require the development of new techniques or circuit elements.

The study has also provided a cost effectiveness model that permits a detailed evaluation of the various operational/logistic effects of adding an AIDS subsystem. Further, this model is structured to provide a cost effectiveness comparison based on established maintenance/cost values and thus will provide a quick evaluation of any proposed configuration against a standard AIDS. This of course leads to the possibility that under certain conditions, AIDS may not be cost effective.

Continued effort is being directed to refining the maintenance inputs and to increasing its scope in the logistics area, i.e., spares savings considerations and data reduction requirements.

As is the case with many studies, they often generate as many related, but new, questions as they answer. This study was no exception, and the following problems are recommended for further study. 1) The feasibility of applying trend analysis techniques to mechanical subsystems. There is no conclusive evidence, except for the jet engine, that parameter failure signatures can be established in the Δ increments required to provide trend analysis data. 2) Assuming that trend analysis is practical, the problem of efficient usage and dissemination of the taped data should be studied. There are indications that data of this type could provide an input to such military reports as Air Force Recoverable Assembly Management Systems (AFRAMS) and could possibly provide data for the Integrated Logistics/Management Information System (IL/MIS) used during the Weapon System Acquisition Phase.

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