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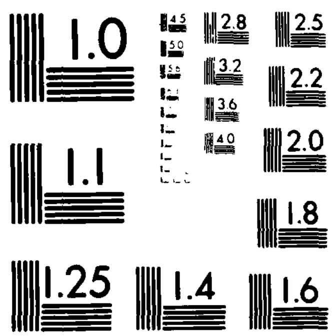

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AIR FORCE INTEGRATED READINESS MEASUREMENT SYSTEM (AFIRMS)

Weapon System Management Information System (WSMIS) Interface Study

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1. GENERAL

pose of the Interface Specification. The interface specification for Force Integrated Readiness Measurement System (AFIRMS), (Contract No. 33-C-0022), and the Weapon System Management Information System (WSMIS) sen to fulfill the following objectives:

To determine the feasibility of an interface between AFIRMS and WSMIS,

To determine the sources of WSMIS data required for AFIRMS needs,

To preliminarily define and design an interface gateway between AFIRMS and WSMIS.

s interface specification also contains information and methodologies to accommodate some of the current fundamental differences in the data the two systems. Finally, the focus is on possible interfaces through FIRMS would acquire information from WSMIS. Other interfaces whereby eceives AFIRMS output or through which the two systems exchange tion may be possible.

IRMS Synopsis. This section provides a brief introduction to the Air ntegrated Readiness Measurement System (AFIRMS). A more complete tion is provided in the AFIRMS Functional Description.

Key AFIRMS Concepts. AFIRMS is an automated, tasking based, decision system designed for the operations community. As such, it evaluates d force capability to perform tasked missions based on the availability ific resources. During the Learning Prototype Phase (LPP) of the , the following areas were examined:

Aircraft,
Aircrews,
Munitions, and
POL.

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.

1.2.2 AFIRMS Functions. Four basic 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 (e.g., sorties) 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 levels. Aggregation refers to the creation of a composite understanding of capability for several units.

1.3 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 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 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.

.4 WSMIS Synopsis. This section provides a brief introduction to the Weapon ·stem Management Information System (WSMIS).

.4.1 WSMIS Functions. WSMIS is intended to be a management information ·stem of the logistics community which provides a measure of readiness and ıstainability for weapon systems and key resource groups throughout the Air ›rce. The resources currently identified for inclusion are:

a) reparable spares
b) engines

c) consumables

- POL
- munitions
- TRAP

d) support equipment

e) nonreparable spares

In addition, WSMIS will perform 'get-well" analysis to resolve logistics limitations as identified through the readiness and sustainability outputs.

Three separate but interfacing modules comprise the WSMIS architecture as depicted in Figure 1-1.

1) Readiness Assessment Module (RAM) - Measures wartime readiness of weapon systems and resources required to launch the first sortie.

2) Sustainablity Assessment Module (SAM) - Calculates individual and integrated capability of weapon systems and key resources based on a WMP-5 or user-entered scenario.

3) Get-Well Assessment Module (GWAM) - Identifies critical limiting factors as collected by RAM and SAM, isolate causes, evaluate near- and long-term "get-well" plans, and monitor the progress of "get-well" solutions.

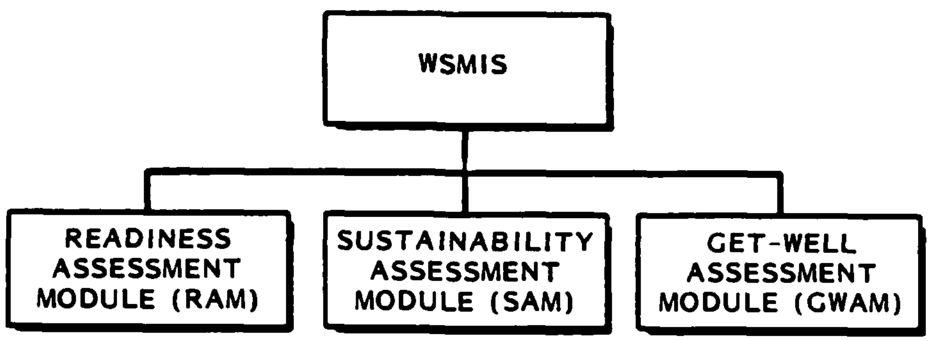

Figure 1-1. WSMIS Functional Overview

SECTION 2. WSMIS OVERVIEW

The following is a more detailed description of WSMIS intended to identify the current status of the system and to introduce areas addressed later in this study.

2.1 Status. Currently, the three modules are in various stages of development and do not interface with one another.

The RAM portion of WSMIS is under development in Reading, Mass., where a prototype version has been collecting data (for more than a year) from two Air Force inventory systems, AVISURS (G033B) and MICAP (D165A). The information is available interactively to System Program Managers (SPMs), System Control Officers (SCOs), Item Managers (IMs), and MAJCOMs via an unclassified network.

Transfer of the prototype system to a production system running on an AMDAHL computer at Tinker AFB is scheduled to be completed by the end of calendar year 1985.

Theatre and unit level sustainability assessments are being generated by SAM once per week based solely on spares data. The spares information is regularly collected at HQ AFLC through the Combat Supply Management System (CSMS). Processing occurs at HQ AFLC on the WWMCCS computer system with outputs made available via the classified WWMCCS Intercomputer Network (WIN).

Prior to the development of an interface between CSMS and WSMIS, the accuracy of CSMS data was questionable, and the information was hardly acceptable for use in spares sustainability assessments. Since WSMIS began relying on CSMS for spares data, widespread efforts have improved the accuracy of and confidence in CSMS. However, recent studies of the CSMS database reveal that the problem has not been completely resolved.

As stated earlier, GWAM performs get-well assessments by examining the problem parts identified through RAM and SAM. GWAM is currently in the early stages of development. Since the output produced (immediate, short-term, and long-term "get-well" plans) does not fit into the scope of AFIRMS, further discussion will involve WSMIS-RAM and WSMIS-SAM only.

Expansion of all three WSMIS modules to include engines, consumables, support equipment, and non-reparable spares is scheduled to occur in sequence during the next two years. Specifically, engines are scheduled for inclusion by November 1985, providing the first integrated assessments from WSMIS. Consumables (POL, TRAP, and Munitions) will be added by February 1986. Assessments will also be expanded to include all major commands. Additional Air Force data systems are being studied for possible interface to WSMIS as sources of data for the various resource categories.

2.2 Information Flow. WSMIS-RAM inputs are collected from existing Air Force data systems (see Section 2.3) and stored in classified and unclassified data bases. The information is used to obtain resource status, readiness assessments, and short-term projections of problem parts. The output is interactively available to MAJCOMs, SPMs, SCOs, and IMs throughout the Air Force via computer workstations. The resource status generated through WSMIS-RAM will serve as input to WSMIS-SAM while identified problem parts are to be fed to WSMIS-GWAM.

Resource inventory data for WSMIS-SAM are also gathered through interfaces with other unit and MAJCOM level data systems. The information flows via networks (e.g., WIN and AUTODIN) or through air-gap (tape) interface to HQ AFLC where the actual processing for sustainability assessments occurs. In future implementations, data and processing will be downloaded to the ALCs to alleviate the burden on the AFLC WWMCCS computer.

WSMIS-SAM outputs are available weekly through the WIN at the MAJCOM level and can be accessed via the WMMCCS terminal. Output is concurrently transmitted to the Air Staff. Base Level output is automated where access to the WIN exists; otherwise, hardcopy output may be obtained through the MAJCOM.

2.3 Inputs. WSMIS acquires the majority of its information from existing Air Force data systems. Other inputs are generated through worksheet procedures with pertinent information extracted and manually entered into the system.

WSMIS-RAM receives aircraft status information through AVISURS on a monthly basis. At best, the data is one month old when received, but efforts are underway to gather the data from alternate sources. For instance, an interface between WSMIS-RAM and the Maintenance Management Information and Control System (MMICS, G073C) would permit daily update of the information. MICAP provides spares information to WSMIS-RAM on a weekly basis.

CSMS transmits spares data on a weekly basis to WSMIS-SAM, where it is required, as input for capability assessment. Other inputs, such as sorties demanded and attrition rates, are manually derived from an OPLAN/Parameter Worksheet. Ad-hoc scenarios can be prepared through the worksheet, but the complexity and lengthiness of the procedure limits its usability. An automated procedure, which is currently under development and is referred to as No Plan/Sensitivity Analysis, should facilitate easier input of alternative tasking scenarios.

The inclusion of additional resource areas into WSMIS requires interfaces with other information systems. Engine data can be collected through the current MICAP interface, but new interfaces must be developed for POL, munitions, and other consumables. Current plans call for the acquisition of POL data from the Combat Fuels Management System (CFMS, D225) and munitions data through the Combat Ammunition System (CAS, D078).

2.4 Outputs. The following sections provide a brief overview of the output generated by WSMIS-SAM. Due to demands on computer resources imposed by the Dyna-METRIC model, WSMIS limits the resulting reports to nine "snapshot" days of the 30-day scenario. Although the Dyna-METRIC model calculates results for all 30 days, the data for only nine days is output by WSMIS. These nine days are not necessarily consecutive. The capability output is calculated and presented based on "on-hand" stock and on "authorized" stock.

2.4.1 OPlan Data. The WSMIS output which summarizes the scenario used for a run of the model is provided in the OPlan Data Report. It provides the following data at both the unit (squadron) and theatre levels:

		Day	Rate
1)	Sortie Rate	1-7 8-30	3.00 1.00
2)	Sortie Duration	1-30	2.00
3)	Maximum Sorties	1-30	3.50
4)	Combat Attrition	1-30	0.00

Since scenario information is an input to WSMIS (through OPlan/Parameter Worksheets) the information is available for more than the nine day restriction of other outputs.

2.4.2 FMC Sortie Quantity Data. The FMC Sortie Quantity Data Report displays the number of FMC sorties flown versus the number of FMC sorties demanded for each of nine days of the 30-day scenario. The theatre level report includes a summary for all bases in the scenario along with totals for each individual base. A unit (squadron) level report is also available.

2.4.3 Cumulative FMC Sortie Quantity Data. The Cumulative FMC Sortie Quantity Data Report is very similar to the previous report except that its sortie totals are displayed cumulatively, i.e., sorties shown for day 7 are the total sorties for days 1 through 7. This report is generated at both the theatre and unit levels, and it displays data for 9 days of the 30-day scenario.

2.4.4 Aircraft NMCS Quantity Data. The Aircraft NMCS Quantity Data Report presents the daily number of aircraft grounded due to parts failure and the daily percentage of aircraft that are grounded. The output is available for 9 days of the 30-day scenario at both the theatre and unit levels.

2.4.5 Average Sorties per Aircraft per Day. The Average Sorties per Aircraft per Day Report reflects the average number of sorties flown per aircraft and the maximum sorties allowed for that aircraft type on each of 9 days of the 30-day scenario.

2.4.6 Problem Item List. In the Problem Item List up to 20 parts are displayed that caused enough aircraft to be grounded resulting in the sorties demanded being greater than the sorties actually flown. In contrast to most of the other reports, these data are available for just two days of the 30-day scenario.

SECTION 3. THE Dyna-METRIC MODEL

Because the core of WSMIS-SAM spares sustainability assessment is the Dyna-METRIC Model developed by the Rand Corporation, it is important that some of its capabilities and assumptions be presented.

3.1 Capabilities.

The four key capabilities of Dyna-METRIC are:

- Forecasting component pipelines.
- Estimating aircraft availability and sorties.
- Identifying problem parts.
- Suggesting cost-effective stock purchases.

The full model consists of approximately 17,000 lines of FORTRAN code and must be run on a large computer. Even where large computers are accessible, the memory requirements of Dyna-METRIC often force computer runs to off-hours.

3.2 Assumptions.

OPERATIONAL ASSUMPTIONS:

- Demand sorties, not actually flown sorties, determine the consumption of spare parts. In other words, aircraft down for spare parts continue to consume spare parts.
- The fully mission capable (FMC) figures do not mean all mission capable aircraft. The model assumes that any aircraft with a hold in it (lack of one or more parts) is grounded. Partially mission capable (PMC) aircraft are not considered.

REPAIR ASSUMPTIONS:

- There are ample repair facilities to perform all repair operations. The model assumes that for each broken part, there is a maintenance technician available to begin repairs on that item.
- The repair processes and the demand processes are independent. The repair shops operate strictly on a first-in-first-out basis without regard to the balance of stock in the supply warehouse or the grounded aircraft on the flightline.

PIPELINE ASSUMPTIONS:

- The depot is an infinite source of stock. There are no out-of-stock conditions at the depot.
- The transportation pipelines are continuous.
- All parts can be cannibalized completely and indiscriminately. The model assumes that any part can be pulled from one broken aircraft to fix another. There is no accessibility problem, nor is there any requirement to maintain a broken spare part on an aircraft to fulfill, for example, weight and balance criteria. Cannibalization of parts is complete in that no attempts to cannibalize are unsuccessful nor does cannibalization pull maintenance resources away from the repair of other broken spare parts. It is instantaneous in that the model automatically concentrates the holes in the fewest number of aircraft. This last assumption is important because it can materially affect the outcome of a model run. It is also an assumption for which there is no satisfactory work-around.

SECTION 4. INTERFACE ALTERNATIVES

Presented below are three possible interfaces between AFIRMS and WSMIS. The first two are discussed in less detail, but it is not intended to dismiss them entirely. The third includes an in-depth explanation since it is the preferred interface.

Hardware considerations are not addressed in this study since the AFIRMS hardware architecture has not been fully determined at this time. WSMIS operates on Honeywell computers and uses existing Air Force and DoD networks for communications. AFIRMS proposes to use existing hardware wherever possible, and the method of communicating between AFIRMS and WSMIS at individual sites can be determined only after the hardware has been identified.

4.1 Graphic Output Display. The output reports produced by WSMIS are in tabular format with no current graphic capability. It is possible that AFIRMS could fill this gap by receiving the WSMIS output and displaying it on medium to high resolution graphic output devices.

Many of the screens required for such an interface already exist. For example, AFIRMS can display readiness and sustainability graphs for various resources, and the WSMIS-SAM output of spares assessment would fit easily into this screen display. The same should hold true for the other resource groups as they are implemented within WSMIS.

4.2 AFIRMS/WSMIS-RAM. Section 2.3 presents the data systems with which WSMIS currently interfaces and some of the others that are being examined for potential interface. AFIRMS also expects to gather information from existing data systems, but if that same data is available through WSMIS-RAM then an interface to one system is preferable to multiple interfaces to numerous systems.

The apparent benefits of such a plan include:

a) The restraints imposed by hardware and software incompatibilities are reduced since the design and implementation of many interfaces is eliminated.

b) It alleviates the burden that another interface would place on the various data systems (e.g., CSMS would accommodate WSMIS rather than both AFIRMS and WSMIS).

However, there exist three shortcomings that serve to discourage an AFIRMS/WSMIS-RAM interface as the sole means of gathering resource data for AFIRMS.

a) WSMIS does not currently address all resources included in AFIRMS.

b) The timeliness of the WSMIS data cannot accommodate the wing's need for current data.

c) The location of the data complicates the interface and results in redundant transfer of information.

WSMIS currently performs assessments based soley on aircraft spares as the resource input. The incorporation of engines, consumables, etc. is planned for the future. However, WSMIS has no intention of ever including Aircrew information while AFIRMS regards this as a major resource group. AFIRMS cannot rely on WSMIS for Aircrew information and must, therefore, continue to collect it directly or via an interface with another system (e.g., AFORMS).

AFIRMS also stresses the importance of timely and accurate data. Timeliness is particularly important at the wing level where fluctuations in resource quantities and changes in status are of more immediate interest. At the MAJCOM level and, to an even greater extent, at the Air Staff level, such fluctuations are less visible and resource data appears more static. Still, assessments based on timely wing level data lend more credibility to capability measurements at all three levels of command. Currently, the resource data used by WSMIS-RAM is not timely enough for use by AFIRMS. The aircraft status collected through AVISURS is updated every thirty days and the MICAP supply information is updated weekly. The timeliness of both sets of data must improve before AFIRMS relies on WSMIS-RAM for input data.

The third problem concerns the location of data stored by WSMIS-RAM. Information is, or is intended to be, gathered from Air Force-standard data systems and aggregated at the ALCs and HQ AFLC. For AFIRMS to utilize the resource data available in WSMIS-RAM, the information must be disseminated back to the wing level. Alternatively, AFIRMS at the wing level could independently collect resource data via interfaces with other data systems, thereby avoiding this problem. At the same time, AFIRMS could acquire WSMIS-RAM resource data at the MAJCOM level; however, the data is now readily available through the "roll-up" mechanism of wing level AFIRMS systems.

The timeliness of data within WSMIS-RAM is expected to improve in the future as its interface methods are enhanced and also because many of the systems with which it interfaces are expected to improve their own timeliness. Nevertheless, the problem of funneling data back down to the wing will still exist. AFIRMS resource data will be more timely if acquired via direct interfaces with existing information systems.

4.3 AFIRMS/WSMIS-SAM. Another potential point of interface between AFIRMS and WSMIS exists with the AFIRMS Sortie Generation Model (SGM) and WSMIS-SAM by incorporating WSMIS aircraft spares sustainability assessment into the SGM. If AFIRMS can rely on the WSMIS-SAM spares output, it would alleviate the need to implement a new method of spares assessment to satisfy that requirement. Furthermore, since the Dyna-METRIC model is accepted as an accurate means of measuring spares capability, AFIRMS integrated capability assessment could obtain a higher degree of accuracy and credibility.

A typical scenario might include the WSMIS-SAM spares (aircraft) sustainability assessments being received and examined by AFIRMS to determine what set of SGM inputs would produce such a result. To simplify such a procedure some of the inputs could be derived from WSMIS-SAM since they correspond directly to SGM inputs. Other inputs might be given default values. The remainder must fall within a specified range of realistic values.

An issue that must be resolved is the source of the tasking that is used to calculate the capability assessments. Ideally, the tasking would be originated by AFIRMS users and be transmitted as input to WSMIS-SAM with the resulting assessments transmitted back to AFIRMS as shown in Figure 4-1. In order to accomplish this, the AFIRMS tasking data must first be aggregated by wing to a total sortie amount for each day. Currently, the Dyna-METRIC model does not accommodate specific mission types, but, rather, assumes tasking to be a total number of sorties demanded per day.

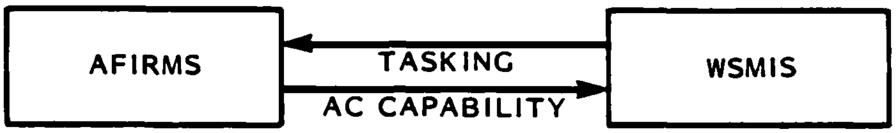

Figure 4-1. AFIRMS/WSMIS-SAM Interface

Currently, it is not feasible for WSMIS-SAM to accept tasking from AFIRMS since the procedure for establishing a WSMIS-SAM tasking scenario is lengthy and cumbersome. Furthermore, the entire WSMIS-SAM execution takes nearly a full day, and storage requirements are enormous. The notion of requesting another execution against a new tasking scenario is not realistic at this time. However, ad-hoc scenarios are a feature that WSMIS plans to support in the future. At that time the transmission of an AFIRMS tasking scenario should be further investigated.

Alternatively, AFIRMS must accept the scenario against which WSMIS-SAM performs its weekly calculations of sustainability. In this case it is necessary to utilize the AFIRMS Translate Tasking process to break an aggregated set of tasking into specific mission types with priorities. This step is essential since capability assessments cannot be performed in AFIRMS against aggregate WMP-5-like tasking. More information on Translate Tasking can be found in the AFIRMS Functional Description and AFIRMS Transforms and Models Document.

SECTION 5. INTERFACE DESIGN

5.1 Specific WSMIS Outputs. The following sections identify particular WSMIS-SAM outputs that are required for the interface between WSMIS-SAM and the AFIRMS SGM suggested in Section 4.3 above.

Two sets of assessments are provided in many of the WSMIS-SAM outputs. The first is based on "On-hand" stock and the second on "Authorized" stock. AFIRMS would be interested in the WSMIS assessments based on On-hand stock rather than those based on Authorized stock since such a view better represents the operations community. However, authorized stock assessments may be used in "what-if" scenarios.

5.1.1 OPlan Data. The information contained in the OPlan Data report is of interest to AFIRMS because it presents the inputs that generate the aircraft capability output. More importantly, the information contained in the OPLAN Data report is required if the second tasking alternative discussed previously is implemented (i.e., tasking data is extracted from WSMIS). If AFIRMS tasking is used as input to WSMIS-SAM these requirements are eliminated.

Of particular interest are the sortie rates, durations, and attrition rates which appear in the WSMIS WMP-5 format. Currently, the attrition rate is an input from the OPlan/Parameter Worksheet, and regardless of the value on the worksheet WSMIS defaults to a value of 0%. AFIRMS should accept the value nonetheless since WSMIS may lift this restriction in the future.

Some of the values available through the OPLAN Data report and their AFIRMS equivalents are presented below.

	OPlan Data	AFIRMS Equivalent
1)	Sortie Rate	Aircraft Turns per Day
2)	Sortie Duration	Sortie Duration
3)	Attrition	Combat Attrition

A user of the AFIRMS system would select the WSMIS scenario by name to have the data transferred to the AFIRMS database. This information must be processed to ensure that data exists for each day of the scenario for each unit. For example, if a unit begins on day 8 of a scenario, rate values of zero would be inserted into the AFIRMS database for days 1 through 7. Finally, tasking data must be aggregated by wing versus the WSMIS organization by squadron since the AFIRMS SGM begins its assessments at the wing level.

Tasking would have to be derived from the Sortie Rate through the Translate Tasking function of AFIRMS referenced earlier. The data in the AFIRMS database would be assigned a descriptive task identification label to designate WSMIS as the source of the scenario.

When WSMIS implements its No-Plan/Sensitivity Analysis, or ad-hoc scenario feature, AFIRMS can transmit its own tasking to WSMIS against which assessments are performed. Information from the OPlan Data report would no longer be necessary.

5.1.2 FMC Sortie Quantity Data and Cumulative FMC Sortie Quantity Data. The FMC Sortie Quantity Data and its cumulative totals comprise the information in which AFIRMS would be most interested in obtaining for incorporation of spares into its capability assessment. The FMC Sortie Quantity Data is equivalent to Individual Resource Capability: Aircraft in the AFIRMS environment.

From the WSMIS output AFIRMS must derive the SGM rates (i.e., repair rate and break rate) that would produce such an Individual Aircraft Capability result. Using both the FMC Sortie Quantity Data and the Cumulative Data, the values for the missing 21 days of the scenario must be interpolated. With the full scenario output and, perhaps, the attrition rate provided via OPlan Data, realistic AFIRMS SGM rates could be derived and input to produce such an output.

This procedure must be implemented if AFIRMS is to maintain its current what-if analysis. Such a procedure has been worked through manually with the SGM as it current exists. A mathematical approach to deriving realistic SGM inputs can be found in Appendix A. This approach is intended to demonstrate the feasibility of deriving SGM rates based on WSMIS output. A more preferable solution may exist.

5.2 Interface Design Specification.

5.2.1 Feasibility of an AFIRMS/WSMIS-SAM Interface. At this time the most feasible interface between AFIRMS and WSMIS-SAM is uni-directional, from WSMIS to AFIRMS. The interface could be in the form of a hardwire physical connection or airgap, e.g., tape. For an IOC interface, the idea of a once-a-week tape interface from WSMIS-SAM at HQ AFLC to AFIRMS is acceptable. This is primarily due to the current shortfall of WSMIS executing against only standard WMP-5 tasking on a pre-defined basis.

Initially, any ad-hoc tasking desired by AFIRMS users must be within the realm of total WMP-5 tasking. Later, when ad-hoc tasking functionality is introduced into WSMIS, the interface will evolve to accommodate it.

In the short-term, the idea of an interface between AFIRMS and WSMIS-SAM does not seem very appealing due to the lack of an integrated look at resource capability and the inflexibility of the tasking available as input to SAM. However, in the long-run there exists a great opportunity to interface to a production system that already computes a logistics view of aircraft capability. The minor problems that inevitably arise with any fledgling data processing system are due to be ironed out soon. Therefore, a planned phased implementation of an AFIRMS/WSMIS-SAM interface is a more effective methodology. This plan would design and implement an interface against current assumptions. The design of the interface will acknowledge the scheduled improvements and modifications, both long-and short-term, to be implemented in SAM.

5.2.2 **AFIRMS/WSMIS-SAM Interface Description.** WSMIS-SAM consists of five integrated subsystems:

DATA PREPROCESSOR SUBSYSTEM - Provides automated interfaces to the CSMS, D024/D042, D029, and D104 data systems; uses data tapes generated periodically at the Headquarters of the MAJCOMs and AFLC, and the ALCs by these systems as input; and validates, edits, and reformats the tapes for input to the data storage subsystem.

MODEL PARAMETER SUBSYSTEM - Provides the means by which OPlan and other parameter data are communicated, input, and maintained in the data storage subsystem for use as criteria for execution of the model subsystem.

MODEL SUBSYSTEM - Consists of a program to collect the model input into a format required by the model, and the Dyna-METRIC software itself.

OUTPUT SUBSYSTEM - Provides the SAM system users with the capability to generate SAM outputs locally through use of a desk-top computer.

INPUT SUBSYSTEM - Input data for SAM consists of magnetic tapes containing CSMS data from the MAJCOMs. These tapes are transmitted to HQ AFLC via AUTODIN. Parametric data (OPlans, D029, D104) available from HQ AFLC and the ALCs.

Figure 5-1 depicts a simplistic view of an AFIRMS information flow utilizing an interface with WSMIS. Typically, an AFIRMS user enters the desired tasking, whether it is standard or ad-hoc, at a workstation that has access to AFIRMS. This tasking is passed through an interface module that sends the data needed as input to WSMIS-SAM. This interface module may also aggregate AFIRMS tasking to a "unit-level only" orientation from the "mission type within unit" approach currently used by AFIRMS. AFIRMS will interface to WSMIS-SAM in the "automated scenario build" module, which is part of the No-plan/Sensitivity Approach due to be available in WSMIS-SAM in IOC by January 1986. Basically, the No-Plan approach allows the user to enter or change scenario data for an "unplanned" war in an on-line, interactive mode. The January 1986 software release is to be implemented for the Tactical Air Command and will allow tasking modifications at the theatre level only. The Sensitivity input parameters that may be altered will consist of the maximum turn rate, the sortie rate, and the attrition rate and may be modified by unit- or theatre- level.

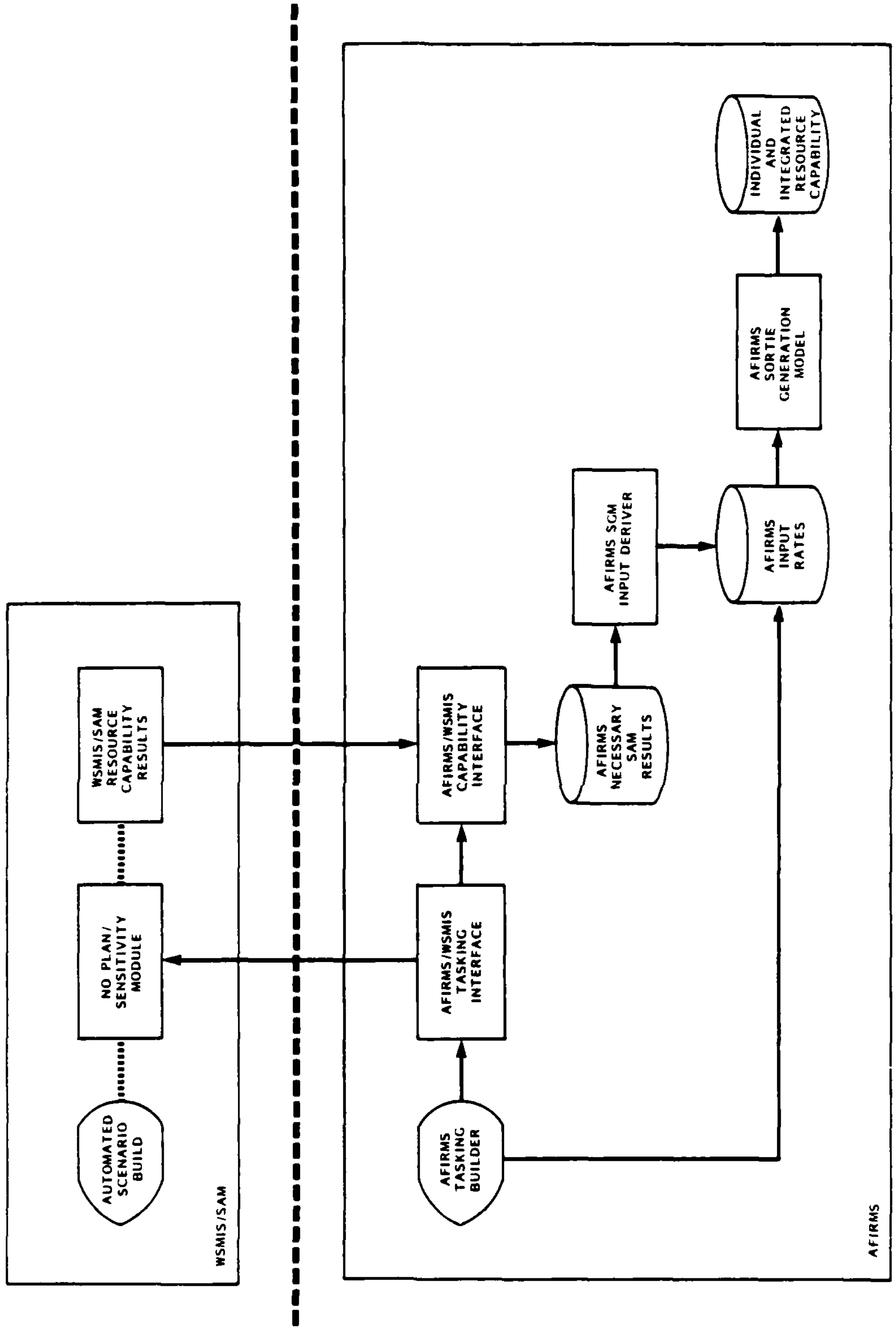

Figure 5-1. AFIRMS/WSMIS-SAM Interface Information Flow

Currently, the No-Plan approach is available as a manual process in what is termed the Model Parameter Subsystem where OPlan/Parameter worksheets are filled out by the user and entered into the system at HQ AFLC. It tends to be a somewhat cumbersome process with the results not as timely as might be desired. The new software automates this process and should make it easier to implement an automated interface that utilizes AFIRMS user inputs.

The AFIRMS tasking inputs in Figure 5-1, which tend to emphasize an operations look versus a strictly logisitics viewpoint, are also stored within AFIRMS for later use. Most of these inputs are not currently utilized by WSMIS-SAM but may be in the future with the addition of the additional resource groups due in February 1986.

After WSMIS computes spares capability and makes it available for use by AFIRMS, AFIRMS retrieves the WSMIS-SAM output by interfacing to the post-processor file generated by the post-processor located within the SAM output subsystem. The interface will extract what it needs from this file and store it within AFIRMS. Specifically, what is extracted from the post-processor file is the data used to generate the FMC Sortie Report and the Cumulative FMC Sortie Report. FMC Sortie Demand Quantity and FMC Sortie On-Hand Quantity by day is available from this file. A difficulty exists here in that only data from nine different days is available on the reports.

Further investigation is necessary to determine whether results of the whole 30 day scenario are available in the post-processor file. If they are not available, then data used to generate the Cumulative FMC Sortie Report must be used to interpolate the remaining days' data. The format of the data should be identical in either case. However, the actual number of computer program modules will vary as will the type of processing that need take place, e.g., interpolation.

The WSMIS output is input to the AFIRMS Sortie Generation Model (SGM) Input Deriver, a function of which is described in Appendix A. Essentially, this module derives aircraft maintenance attrition rates (break rates) and repair rates. Currently available as input to the D029 Pre-processor is a data item called Base Repair Rate. It is believed that this rate may not include certain intangibles such as maintenance crew experience levels and time to remove and replace a broken part from the aircraft. Therefore, it is currently assumed that the break rates and repair rates are not used as input to WSMIS-SAM but are used within AFIRMS and, therefore, must be statistically estimated. Another reason for deriving these rates is that currently within AFIRMS repair rates can vary by unit. If it is determined that the needed information, e.g., crew experience, removal and replacement times, and variation by unit, is present in WSMIS-SAM Base Repair Rates then that information will be utilized because it follows that, on average, the sum of all the repair rates of all the broken parts on an aircraft should be relatively equal to the man-hours necessary to fix that aircraft.

In the interim, it will be assumed that maintenance attrition rates and aircraft repair rates must be calculated given WSMIS-SAM outputs. Once these rates are estimated by the Deriver module, they are input, along with various other parameters and resource groups, into the AFIRMS SGM, and individual and integrated resource capability assessment are obtained as output. Since WSMIS-SAM does not currently compute an integrated assessment, nor does it plan on ever integrating aircrews and support personnel, AFIRMS must perform this function. When SAM does begin computing an integrated assessment using multiple resource areas, AFIRMS should be prepared to substitute WSMIS-SAM's results for its own pending Air Force approval. This should also be contingent upon WSMIS' integrated assessment being calculated based on an interrelationship among resources as advocated within AFIRMS.

5.2.3 AFIRMS/WSMIS-SAM Interface Data Specification. Initially, The AFIRMS/WSMIS-SAM interface will be uni-directional, from WSMIS to AFIRMS. It will contain only Spares capability data for nine different days of the typical 30 day WMP-5 scenario for each flying unit (squadron) within a MAJCOM. The data will be obtained from the Post-Processor file in the following format for each flying unit:

Unit Name	8 ASCII characters
Day	2 digit integer
FMC On-hand Sorties	6 digit float pt w/2 decimal places
Cumulative FMC On-hand Sorties	6 digit float pt w/2 decimal places

If it has been determined by the interface program that the input tasking is needed as well, because it is not more readily available elsewhere to AFIRMS, then the following data will also need to be obtained:

Sorties Demanded	6 digit float pt w/2 decimal places
Sortie Rate	4 digit float pt w/2 decimal places
Sortie Duration	4 digit float pt w/2 decimal places
Attrition Rate	4 digit float pt w/2 decimal places

Attrition rate is the equivalent of combat attrition rate and is set to 0.00% in WSMIS-SAM. The interface will be built to accommodate this parameter in the event its value ever changes.

It is recognized that WSMIS-SAM also outputs sustainability assessments by theatre (including reports by base) but, in keeping with AFIRMS charter to measure capability by unit, WSMIS sortie capability will be retrieved and stored by squadron. If a wing assessment is desired then squadrons belonging to the same wing will have their tasking and capability assessments combined after it is retrieved from WSMIS.

Since only nine days of capability are currently assumed to be available from WSMIS, they must be input to an interpolation module in order to derive the remaining 21 days. An aggregation of squadron data into wing data must occur first, provided a wing assessment is desired. However, when WSMIS begins to output all 30 days of the WMP-5 scenario or if all 30 days' data are available in the post-processor file, the interpolation module may be discarded. After interpolation, each wing's capability is processed against the tasking according to a procedure like that outlined in Appendix A. This determines, within appropriate bounds, the values of AFIRMS input parameters, i.e., break and repair rates, that would produce the same capability assessment as that produced by WSMIS-SAM.

For the near-term, the tasking is known in advance because it is standard WMP-5 and, therefore, is not necessarily processed each time an interface occurs. However, whenever the WMP-5 tasking does change, currently on an annual basis, AFIRMS tasking must also change. This may be done any of three ways: manually, through a hardwire interface, or via a tape interface. The most straight-forward method is for the interface program to compare dates to see if the date WSMIS-SAM tasking was last updated is greater than the date on which WSMIS-SAM tasking was last copied to AFIRMS. If it is, it is then copied to AFIRMS again. Otherwise, if the tasking has not changed there is no need to recopy it. It should be noted that these steps may not be necessary if the interactive No-Plan/Sensitivity process of WSMIS-SAM is available for most MAJCOMs at the time of the interface implementation. If the interactive module is available at that time and is capable of handling unit-level as well as theatre-level tasking then most, if not all, AFIRMS ad-hoc tasking could be passed to WSMIS-SAM through it.

<u>5.2.4 Interim Interface Data Specifications</u>. As WSMIS-SAM adjusts to new requirements and as new functions are added to meet those requirements, the impact must be minimal to the existing AFIRMS/WSMIS-SAM interface. The design of the interface must also be able to accommodate changes and additions to the WSMIS-SAM program. Current short-term enhancements to WSMIS-SAM include the capability of users to view the entire 30 day output and the automation of the task-entering process that enables users to enter ad-hoc tasking on a timely basis. Integration of engines as part of the aircraft capability assessment is also due to be completed by November 1985.

The expansion of the output to 30 days will not cause any direct changes to the interface. If data for 30 days is determined to be currently available in the post-processor file then 30 days will be extracted during the initial interface. If 30 days' data is not available then it must be planned to accept only data for 9 days until the enhancement becomes available. The ability to accommodate 30 days versus 9 days will only be an adjustment in the amount of data involved in the interface. However, the need for interpolation on 9 days to obtain results for 30 days will be obsolete with the enhancement. The assumption is that the inclusion of 30 days' results, if available, in the initial interface would entail less work in the long-run and should be implemented if possible. However, with either implementation the interface data specification will be unchanged. Until more information is obtained it is assumed that only 9 days are available and that interpolation must take place.

The automation of user-generated tasking in WSMIS-SAM, called No-Plan/Sensitivity, will allow users to substitute ad-hoc tasking as input to the SAM instead of the standard WMP-5. Currently, this procedure is done manually. When this automation becomes available it is planned to interface directly with the module that processes the user's tasking input. Initially, the specification of the data involved in this interface is assumed to be as follows:

Base Identification Code	4 ASCII characters
Day	2 digit integer
Sorties Demanded	6 digit float pt w/2 decimal places

When tasking is able to be modified by unit the interface must change to accommodate the following data:

Unit Name	8 ASCII characters
Day	2 digit integer
Sorties Demanded	6 digit float pt w/2 decimal places

The Sensitivity parameters passed to WSMIS-SAM from AFIRMS will have the following format:

Sortie Rate	4 digit float pt w/2 decimal places
Sortie Duration	4 digit float pt w/2 decimal places
Attrition Rate	4 digit float pt w/2 decimal places

The format of the Sensitivity parameters will remain static whether associated with theatre or unit.

Since AFIRMS' tasking is broken out by Mission Type per unit, there may exist the necessity to aggregate AFIRMS tasking by unit before passing it to WSMIS-SAM. However, since the No-Plan/Sensitivity is not yet implemented, it is not certain whether there will be a need for this "aggregation" of tasking before AFIRMS sends it to WSMIS. If aggregation must occur, the AFIRMS user will enter his tasking on a priority mission type basis. This priority will be utilized by AFIRMS when the integration of aircraft capability assessments with the other primary resource areas within AFIRMS is desired. The most apparent effect is on munitions because different mission types utilize different SCLs. However, fuel is a resource that may also be affected. Preliminary thoughts have already begun in this area but more work is still required.

Until an interface between AFIRMS and the No-Plan/Sensitivity module of WSMIS-SAM is possible, ad-hoc tasking must be handled internally by AFIRMS. Otherwise, the time-consuming manual process that is currently available in WSMIS-SAM must be used.

Engines are due to be integrated with spares for sortie capability assessments in November 1985. In WSMIS, engines will be treated as another spare part and, therefore, will not effect the interface between AFIRMS and WSMIS-SAM.

5.2.5 Integration with Other Resource Areas. Three primary resource areas are to be added to the WSMIS-SAM sortie capability assessment in February 1986: munitions, TRAP, and POL. The resulting assessment is said to be integrated but is actually based on the amount of sorties that can be flown against the original tasking as constrained by the limiting resource. This assessment assumes for each resource that tasking was met on the previous day and that the resources needed to attain that tasking were, in fact, expended. A truly integrated assessment depletes resources based on sorties actually flown versus how many were tasked.

Nevertheless, when these resource areas are included in the WSMIS-SAM, the default output results of the model will be these "integrated" assessments. If the individual resources are desired to be reviewed, a special request must be made before the weekly SAM run is executed. Therefore, before an interface data specification is designed, a decision should be made regarding the extent to which AFIRMS should or needs to interface to WSMIS-SAM to obtain assessment using resources other than spares. Below are the data items that are assumed to be necessary and available in an AFIRMS/WSMIS-SAM interface to these resource areas:

- Resource Name
- Day
- Sorties Capable

The formats of these data items are as yet unknown and are due to be available when these resource capability assessments are delivered in February 1986.

Provided the WSMIS-SAM individual sortie capability assessments of the major resource areas are validated as the most accurate and most current, then they can be utilized by AFIRMS as input to a model that combines them with other major resource areas, e.g., personnel, and derives an integrated sortie capability from them. This interface would occur within WSMIS-SAM at the MAPS, TAPS, and PAPS modules of WSMIS-SAM due to be developed and delivered by February 1986.

SECTION 6. CONCLUSION

The interface between AFIRMS and WSMIS-SAM is currently feasible at the MAJCOM and Air Staff levels, but before it can reach its full potential a few of the WSMIS-SAM proposed enhancements must be implemented. Each of the enhancements mentioned below is scheduled for implementation during the next two years (calendar years 1986 and 1987).

- The WSMIS-SAM No-Plan/Sensitivity feature is key for the full implementation discussed in Section 5. Without it, AFIRMS must either accept WSMIS-SAM input scenarios or rely on the cumbersome OPlan/Parameter Worksheet approach. With it, the tasking scenario in AFIRMS may be preprocessed and transmitted to WSMIS-SAM.

- An enhancement to selectively execute the Dyna-METRIC Model based on MRA rather than PAA is another option that would usually be exercised by AFIRMS. The use of MRA produces a better representation of the operational view of aircraft readiness and sustainability.

- Integration of Dyna-METRIC 4.4 is expected to lift some of the restrictions imposed on WSMIS-SAM by the current 3.04 version. For example, WSMIS expects to be able to extend the time frame of assessments beyond the current 30-day limit; an option that AFIRMS would certainly utilize. Secondly, the new version of the Dyna-METRIC model lifts the assumption of 100% cannibalization of aircraft.

- The proposed off-loading of WSMIS-SAM processing and storage requirements from the WWMCCS computer at HQ AFLC to the computers at the ALCs should serve two purposes. First, the heavy demands imposed on one computer by the No-Plan/Sensitivity approach will be alleviated. The response to user needs, including those of AFIRMS, should improve. Second, with the added storage capacity, WSMIS-SAM could increase the number of days for which capability assessments are saved beyond the current 9-day limitation.

- The incorporation of new resource groups, e.g., POL and munitions, to WSMIS-SAM adds to the capability output that AFIRMS may potentially acquire through the interface. Until those resource assessments meet with Air Force approval and until the integrated capability assessment addresses the inter-relationship among resources, it is recommended that AFIRMS exercise the option to receive only the Dyna-METRIC output on aircraft spares and engines.

Due to the evolutionary nature of both AFIRMS and WSMIS and the fact that many areas of the two systems are not fully defined, it is difficult to provide more detail on an interface than has been given in this study. For instance, both programs focused initial efforts on the Tactical Air Force and have only recently expanded to other MAJCOMs. Therefore, an AFIRMS/WSMIS interface specification must also be evolutionary in order to accommodate changes within either system.

APPENDIX A. DUPLICATION OF WSMIS RESULTS IN AFIRMS

WSMIS results can be duplicated in AFIRMS by finding a set of inputs to AFIRMS that yields the WSMIS results. If the WSMIS result is the daily change in the number of mission-capable aircraft, for example, the inputs in question might include the sorties per day, flight hours per sortie, combat attrition rate, equipment failure attrition rate, and repair times. The input set selected from the infinite number of possible sets is the set with the maximum likelihood. This is the set of inputs with equal z values that yield the observed results, where a z value is the deviation of a number from the mean of its distribution in standard deviations. Symbolically,

$$\frac{\hat{i} - \bar{i}}{s_i} = \frac{\hat{j} - \bar{j}}{s_j} \qquad \text{for all } i, j,$$

where

$\hat{i}$ = estimated value of input i,

$\bar{i}$ = mean value of input i, and

s_i = standard deviation of input i.

In general, a three-step procedure is followed to make the estimates:

(1) A set of critical WSMIS results is identified, where a critical set is one that determines one, and only one, possible value of z.

(2) The critical set is substituted in the equation or equations used in AFIRMS.

(3) z is found by calculation or by successive substitution of positive or negative values of z into the AFIRMS equation until a value is found that yields the observed result.

An example may be based on the WSMIS outputs in Table 1. The critical input data are the sorties flown on days 7 and 20. The number of available aircraft on each of these two days is given by the sorties flown divided by the sorties per day per aircraft. This is true because there was a shortfall of sorties on days 7 and 20, which was not the case for the other first 20 days cited. Thus,

$$u = \frac{71}{s} - \frac{23}{s}$$

where

u = decrease in available aircraft from day 7 to day 20,

s = the number of sorties flown in one day by one aircraft in WSMIS.

The value of u may be used in an equation that gives the result of flying 24 sorties per day for 13 days in AFIRMS:

$$13 [24 (\bar{a} + z s_a) - \bar{r} - z s_a] = u$$

where

$\bar{a}$ = mean attrition per sortie, AFIRMS, which equals the mean equipment failure attrition per sortie when the combat attrition is zero,

z = unknown value to be determined,

s_a = standard deviation of a, AFIRMS,

$\bar{r}$ = mean daily aircraft repair rate, AFIRMS, and

s_r = standard deviation of r, AFIRMS.

TABLE 1

WSMIS OUTPUT, EXAMPLE 1

DAY	SORTIES DEMANDED	SORTIES FLOWN	CUMULATIVE SORTIES
1	72	72	72
3	72	72	216
5	72	72	360
7	72	71	502
8	24	24	526
10	24	24	574
15	24	24	694
20	24	23	812
30	24	20	1032

To date, the preceding standard deviations have been zero in AFIRMS. This eliminates the terms with z, in which case the difference between a and r is determined but not the individual values. The most probable individual values may be estimated either directly or through estimation of the most probable real life standard deviation values. Estimates of both mean values and standard deviations may be based on the Maintenance Data Collection (D026) of the Air Force Logistics Command.

The form of the AFIRMS equation is determined by the WSMIS outputs. For example, Table 2 shows outputs that are identical to those given previously except that the assigned sorties remained at 72 throughout the 30-day period. In this case, all available aircraft are flown to the limit every day, and the number of aircraft available at the end of a day is given by a recursive equation:

$$A_{d+1} = A_d b + r$$

where

b = daily aircraft survival probability,

$A_{d=1}$ = aircraft at the end of day d+1,

A_d = aircraft at the end of day d.

In this case, z is estimated from

$$u = A_7 - A_{20}$$

$$= A_7 - (A_7 x^{13} + \sum_{k=0}^{12} y x^k)$$

where

$$x = \bar{b} = z s_b,$$

$$y = \bar{r} + z s_r,$$

and the expression for A_{20} is derived by expanding the recursive relationship thirteen times:

$$A_8 = A_7 x + y$$

$$A_9 = A_8 x + y = A_7 x^2 + x y + y$$

$$A_{10} = A_9 x + y = A_7 x^3 + x^2 y + x y + y$$

$$\vdots$$

$$A_{20} = A_{19} x + y$$

This expression is polynomial in z, so successive approximations are used to solve for z. Trial values of z are substituted in the equation until a value is found that makes the equation balance. This point of balance yields the maximum likelihood values of the two unknown variables.

TABLE 2

WSMIS OUTPUT, EXAMPLE 2

DAY	SORTIES DEMANDED	SORTIES FLOWN	CUMULATIVE SORTIES
1	72	72	72
3	72	72	216
5	72	72	360
7	72	71	502
8	72	69	571
10	72	63	703
15	72	54	998
20	72	51	1020
30	72	45	1490

APPENDIX B. GLOSSARY

AFB - Air Force Base

AFIRMS - Air Force Integrated Readiness Measurement System

AFLC - Air Force Logistics Command

AFORMS - Air Force Operations Resource Management System

ALC - Air Logistics Center

AUTODIN - Automatic Digital Network

AVISURS - Aerospace Vehicle Inventory, Status, and Utilization Reporting System

CAS - Combat Ammunition System

CFMS - Combat Fuels Management System

CSMS - Combat Supplies Management System

DoD - Department of Defense

FMC - Fully Mission Capable

GWAM - Get-Well Assessment Module

HQ AFLC - Headquarters, Air Force Logistics Command

HQ USAF - Headquarters, United States Air Force

IM - Item Manager

IOC - Initial Operational Capability

LPP - Learning Prototype Phase

MAC - Military Airlift Command

MAJCOM - Major Command

MICAP - Mission Capability

MMICS - Maintenance Management Information and Control System

MRA - Mission Ready Available

NMCS - Not mission Capable Supply

OPlan - Operating Plan

POL	- Petroleum, Oils, and Lubricants
RAM	- Readiness Assessment Module
SAC	- Stategic Air Command
SAM	- Sustainability Assessment Module
SCO	- System Control Officer
SGM	- Sortie Generation Model
SPM	- System Program Manager
TRAP	- Tanks, Racks, Adapters, and Pylons
WIN	- WWMCCS Intercomputer Network
WMP	- War Mobilization Plan WMP-5 refers to Volume 5 of the War Mobilization Plan
WSMIS	- Weapon System Management Information System
WWMCCS	- World-Wide Military Command and Control System

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