Assessing Logistics Cost Using the FMS Decision Support and Budgeting Model

By

Steven House
Information Spectrum, Inc.

Introduction

Recent decline in the Department of Defense (DoD) budget due to changes in the world political environment have decreased the resources available to national defense. During the 1990s, there has been continued pressure from Congress to reduce defense spending without compromising readiness of naval aviation. This has caused the Navy to seek ways to reduce the logistics infrastructure thus freeing up scarce resources for fleet modernization. One initiative naval aviation logistics managers adopted was expanded use of readiness based sparing (RBS) as a method for reducing shipboard spares allowances.

Background

The concept of RBS to develop consumer allowances in the Navy is not new. It evolved because previously used allowance computational models were equipment oriented and did not relate dollars spent to weapon system readiness. Naval aviation first used RBS during the early 1980s for development of the packup kits for the SH-60B LAMPS Program and by NAVAIR to budget interim support spares requirements for new systems. Early in 1993, NAVICP, Philadelphia (formerly known as ASO) in conjunction with the fleet commander, tested the RBS concept with the deployment of the USS America (CV-66). Post-cruise analysis of the RBS exercise concluded that the RBS Aviation Consolidated Allowance List (AVCAL) supported America's airwing with no loss in readiness. In addition, the RBS AVCAL was approximately $33 million less than the traditional demand based AVCAL. This was accomplished by increasing the range of less expensive weapons replaceable units (WRAs) by 24 percent while decreasing depth of high cost WRAs by only .01percent (Source: 1995 article in the *Supply Corps Newsletter* written by the Deputy Branch Head for IMA/Site Support, Mr. Jim Stabalito). Since this initial RBS test, all afloat aviation allowances have been computed under RBS with an average net savings of approximately $32 million per aircraft carrier. Implementation of RBS at shore stations is now continuing with equally favorable results.

Because of the increased cost of today's weapon systems, many potential international customers are seeking ways to reduce their initial and life cycle support costs so that they can afford to buy the right mix of weapon systems. In arriving at these decisions, they seek data to assess whether reducing initial logistics support will adversely affect weapon system readiness. The more sophisticated customers use their own life cycle cost models to do the analysis. However, less sophisticated FMS customers rely on the U.S. government and the individual services to provide the data and recommend a cost effective support strategy. In either case, it is incumbent on the Navy FMS community to adopt an RBS approach which will meet the readiness and cost objectives set by the potential FMS customers. The Navy - developed Aviation Retail Requirements Oriented to Weapon Replaceable Assemblies (ARROWS) model is the RBS tool currently being used by the Navy to provide the best mix of spares which will support weapon system cost and/or readiness objectives. It was used by NAVICP, Philadelphia to realize the AVCAL cost reductions discussed earlier and to identify future benefits through continuing implementation of RBS for Naval air stations and Marine Corps support packages. It therefore follows that by adopting RBS analyses using this model, the Navy can demonstrate to the potential FMS customer that it is adopting cost saving techniques which will reduce life cycle cost while still maintaining performance and readiness of each weapon system.

In 1995, NAVAIR wanted to develop a decision support and budgeting (DSBM) model for the FMS assistant program manager for logistics (APML) to use for quick preparation of price and availability estimates during in-country briefings and to support site surveys after an FMS case was signed. This model needed to be portable so that it could operate on laptop computers, be user friendly and capable of assessing multiple "what if" scenarios which can assess the support cost of alternative support strategies. Since a stand alone ARROWS model is difficult to use and requires extensive training before the user can become proficient in its use, a more user friendly approach had to be developed. The approach was to developed a powerful tool which provides integrated logistics support managers with the capability to use, adjust and assess an already established baseline database (developed specifically for each individual FMS case) to assess cost implications of alternative operational and maintenance repair concepts. A series of "front end" menu screens and programs were developed to assist the user in reviewing the aircraft configuration, making changes to the maintenance repair concept, defining the operational and support characteristics of each unique FMS case and automating all the inputs to the ARROWS model. The DSBM model then fed data to ARROWS for computation of all desired alternatives, displayed run results and provided detailed outputs which can be used to assess the cost implications of each alternative. Figure 1 provides an overview of the objective and purpose of the model.

Figure 1 - Model Overview

¥ Easy to use budgetary life cycle cost (LCC) Tool

¥ Trades off costs and readiness

¥ Focuses on major logistics cost drivers

¥ Uses 3M historical data tailored to each FMS case

¥ Documents:

- Cost of alternative operational and support strategies
- Critical WRAs/SRAs and high cost drivers
- Spares and repair of reimbursables cost to meet readiness and cost targets
- CLSSA budgetary forecast

¥ Portable, user friendly and provides quick response to customer s inquires with minimum training

It was determined that the Navy's aviation 3M database contained the component failure and support information to the level of detail needed to characterize each weapon system. Figure 2 depicts the process of selecting and extracting the data from the aviation 3M database for an in-service Marine helicopter such as the AH-1W aircraft program. Figure 3 provides the data inputs to the model - all of which are derived from aviation 3M data.

Figure 2 - Database Analysis Procedure

¥ Extra 3M data using Navy system

  ¥ Select aircraft lot, squadrons and time period that best reflects FMS usage rages

  ¥ Collect data by part number

    ¥ O-Level remove and replace actions for each maintenance significant WRA

    ¥ I-Level repair and BCM actions for WRAs and SRA

    ¥ Maintenance significant piece parts

¥ Focus on what s breaking in the fleet (USMC)

¥ Validates actual repair success and turnaround time (TAT)

  ¥ Change turn around time in dataset

Figure 3 - Primary Imputs to the Weapon System Configuration File

¥ Part number
¥ WUC
¥ Nomenclature
¥ Indenture (WRA, SRA, Sub-SRA, Etc.,)
¥ Mean flight hour between supply demand (MFHBD)
¥ I-Level BCM rate
¥ I-Level & depot turnaround time (TAT)
¥ I-Level repair rate (percent)

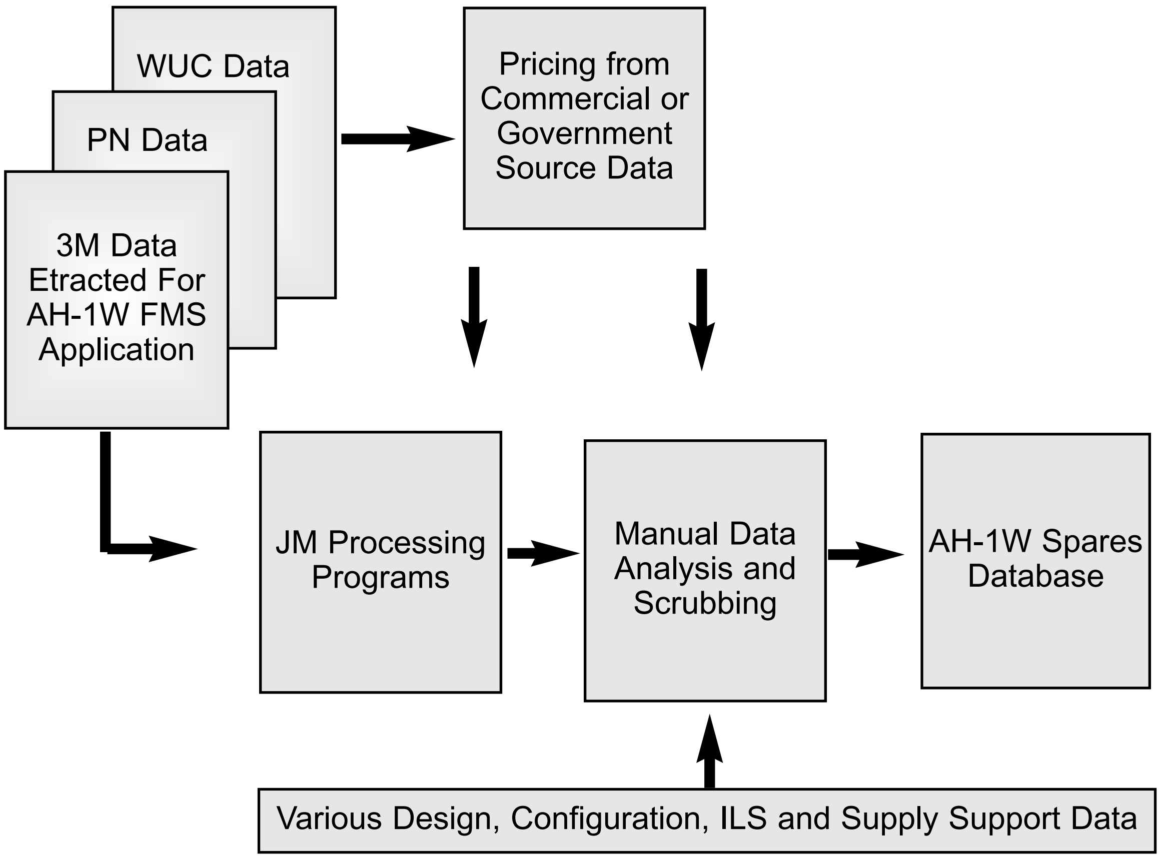
While the aviation 3M data accuracy has improved significantly in recent years, it still requires “cleaning up” before it can be used by the DSBM. Equally important, configuration anomalies must be addressed to ensure the configuration input into the model reflects the configuration desired by the FMS customer. Preparing the baseline database using historical data generated by the fleet is the initial step to this process. Follow-on analyses using this database are then conducted to validate the configuration, repair concept, demand rates and cost assumptions used in the database. This detailed process ensures that inputs to the DSBM are representative and can be used to provide an accurate assessment of the maintenance and spares resources required support each FMS case in an operational environment. Although this initial process is somewhat tedious and requires some manual interventions, it has been extensively automated to reduce the cost and the time associated with developing future databases. However, once the database is initialized, the APML can use it multiple times to investigate issues unique to each customer. Although periodic refreshment of the data is required, the cost of updating the data is minimal. Figure 4 provides anticipated questions that might be asked by managers when asked to fund creation of the RBS database. Answers to those questions are also provided.

Figure 4 - Typical Results Using the DSBM

- ¥ Question - What benefits can I realize by implementing a readiness based sparing (RBS) strategy over conventional sparing approach to achieve a 60 percent FMS target?
  - ¥ Current Answer - Don t Know!
  - ¥ FMS model analysis - spares cost is $15.7M vs $10.8M (20 percent less), range increased by 21 percent, depth increased by 16 percent
- ¥ Question - What additional spares investment is needed to increase FMS rate from 60 percent to 75 percent?
  - ¥ Current Answer Don t Know!
  - ¥ FMS model analysis - increase spares cost from $15.7M to 17.3M (10 percent increase)
- ¥ Question - What is the life cycle cost implications of adopting an O-D vs the Navy O-I-D maintenance concept?
  - ¥ Current Answer Don t Know!
  - ¥ FMS model analysis O-D is 25 percent more expensive than O-I-D

Besides the aviation 3M data, latest pricing information must be added to the model. That can come from existing government databases or from commercial databases which contain parts supply support and procurement information. Figure 5 depicts a diagram of the entire process of building the database for a typical weapon system (AH-1W).

Figure 5 - Database Development Process For a Typical Weapon System



Once the Navy baseline database is built, the APML, through menu-driven user friendly screens, can use the model to conduct numerous analyses pertaining to each specific FMS application. This process begins with defining the operational scenario for each operating site, the repair and support characteristics of the system (i.e intermediate and depot repair capability and repair turnaround times), readiness goals and objectives and the sparing strategy to be implemented (RBS versus demand based sparing). Key elements of this decision support analysis include:

- Number of operating aircraft at each site
- Programmed flying hour utilization rate
- Repair capability for each WRA/SRA
- I-level and D-level turn-around time
- Sparing and readiness objectives option
    - Weapon system full mission capability (FMC) objectives
    - Demand based sparing using fixed protection level

An overview of the model structure is provided in Figure 6.

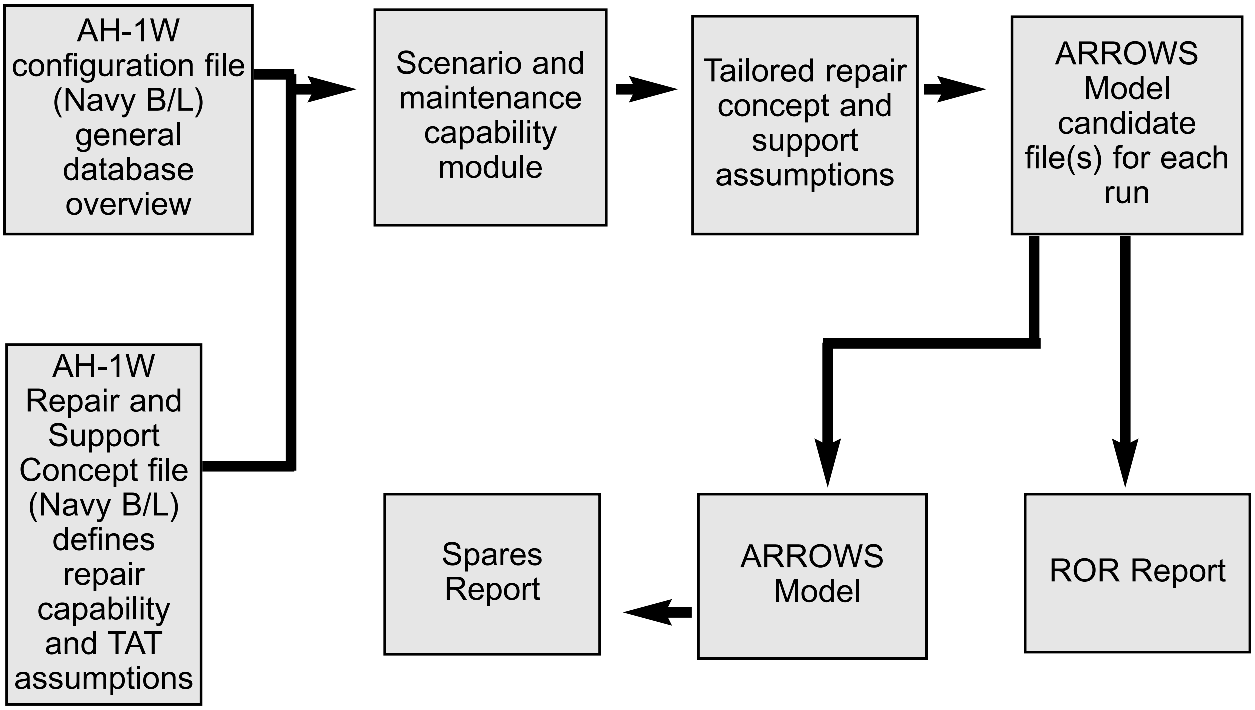


Figure 6 - Decision Support Model Structure

The model provides the APML the capability to analyze four simultaneous runs, and compare the effects of various operational and maintenance strategies on spares requirements. For example, the APML may test a strategy that assumes no (or limited) I-level maintenance capability, and compute the additional funding needed for the extended spares pipeline. Also, an APML can use the DSBM to assess additional I-level repair capability and/or changes to I-level turn around time to take advantage of a particular regional repair capability existing within the proximity of potential FMS customers. For example, consider a situation where the current baseline Navy I-level repair concept for an electrical engine starter can be changed to reflect increased repair capability. In this example, only 40 percent of all I-level induction are repaired at the I-Level because I-level shops cannot rewind and balance the rotor. Under this scenario, as many as 60 percent of the starters are sent back to the depot for rotor rewind and balance. Assuming that starter rewind and balance capability already exists in country (i.e. no additional depot level support equipment or training would be needed), the APML adjusts the starter repair rate to 90 percent and assigns an I-level TAT of 30 days. By adjusting the model inputs and running the model, an assessment of both the spares cost and the repair of repairables (ROR) cost can quickly be computed. Figure 7A and Figure 7B provides the results of two identical runs which were conducted to assess increased I-level repair capability for 18 items in the database. It is clear that by increasing the intermediate level repair capability of the starter to 90 percent only seven spares are needed instead of 14. In addition, as shown in Figure 7B, the number of depot repair actions is reduced from 13 to 2 actions per year under the scenario examined. Because the additional repairs would be done in-country, the FMS customer reliance on overseas ROR would be reduced and they would achieve additional self sufficiency, a primary goal of most international customer.

Figure 7A - Spares Levels For Alternative Repair Capability

PART NUMBER	WUC	NOMENCLATURE	UNIT COST $	SPARES REQUIREMENTS: WITHOUT I-LEVEL REPAIR		SPARES REQUIREMENTS: WITH FULL I-LEVEL REPAIR	
				# OF SPARES	SPARES COST	# OF SPARES	SPARES COST
5002T83P02	2246100	Pump Rotary	7,310	6	$43,860	3	$ 21,930
6000T12P22	2246200	Fuel Control, Main, T	30,790	12	369,480	4	123,160
28B135163A	4221900	Generator, Alternator	3,910	10	39,100	5	19,550
20069010	29E2G10	Starter, Engine, Electric	5,640	14	78,960	7	39,480
4004T63G08	2246300	Actuator Assembly	2,170	6	3,020	3	6,510
6008T32G03	2246400	Valve, Pilot	2,170	9	19,530	4	8,680
4005T01P03	2246500	Purifier Assembly, C	2,770	7	19,390	3	8,310
4067T04G02	2246B00	Valve, Linear, Direct	1,830	10	18,300	4	7,320
4000T98P02	2247100	Pump, Rotary	3,320	5	16,600	2	6,640
U5203174	2247200	Cooler, Oil	4,360	2	8k720	1	4,360
37D400347P101	2249100	Vibrator, Ignition C	2,780	10	27,800	4	11,120
3014T56P01	224A100	Valve, Solenoid	1,700	10	17,000	5	8,500
1423480102	56X1200	Gyroscope, Displacement	32,870	17	558,790	6	197,220
S25KAW3	51R1500	Indicator, Air Speed	1,430	5	7,150	3	4,290
MS280751	51R1A00	Indicator, Vertical	3,000	4	12,000	2	6,000
A1620	51R1C00	Indicator, Turn And	1,830	4	7,320	4	7,320
32520101101	51X1600	Altimeter, Pressure	3,680	7	25,760	4	14,720
400240	51X1Z00	Clock, Panel	760	13	9,880	7	5,320

Figure 7B - Depot Repair Actions For Alternative Repair Capability

PART Number	WUC	NOMENCLATURE	UNIT COST ($)	DEPOT REPAIR ACTIONS PER YEAR	
				WITHOUT I-LEVEL REPAIR	WITH I-LEVEL REPAIR
5002T83P02	2246100	Pump Rotary	7,310	5	0
6000T12P22	2246200	Fuel Control, Main, T	30,790	15	2
28B135163A	4221900	Generator, Alternator	3,910	8	1
20069010	29E2G10	Starter, Engine, Electric	5,640	13	2
4004T63G08	2246300	Actuator Assembly	2,170	4	0
6008T32G03	2246400	Valve, Pilot	2,170	7	1
4005T01P03	2246500	Purifier Assembly, C	2,770	4	0
4067T04G02	2246B00	Valve, Linear, Direct	1,830	8	1
4000T98P02	2247100	Pump, Rotary	3,320	3	0
U5203174	2247200	Cooler, Oil	4,360	1	0
37D400347P101	2249100	Vibrator, Ignition C	2,780	8	1
3014T56P01	224A100	Valve, Solenoid	1,700	7	1
1423480102	56X1200	Gyroscope, Displacement	32,870	24	2
S25KAW3	51R1500	Indicator, Air Speed	1,430	3	0
MS280751	51R1A00	Indicator, Vertical	3,000	2	0
A1620	51R1C00	Indicator, Turn And	1,830	0	0
32520101101	51X1600	Altimeter, Pressure	3,680	4	1
400240	51X1Z00	Clock, Panel	760	10	2
TOTAL				126	14

Figure 8 provides the cost impact of adopting the following three different maintenance strategies:

- No WRA repair capability at the I-level, i.e. WRAs are removed at the organizational level and sent to depot for repair (None),
- Using the current Navy baseline maintenance concept (Navy B/L),
- Increasing I-level repair capability by repairing all SRAs (Full SRA).

Also provided, is the spares cost of the Navy baseline repair concept under reduced I-level and depot level repair turn around time. These type of sensitivities can allow ILS managers to quickly assess the benefits of reducing or increasing I-Level repair response by reducing administrative processing times, achieving faster repair times, reducing awaiting parts time, implementing a faster transportation system and relying on regional repair in-country. Clearly, for this example, providing additional support equipment, automatic test equipment, test program sets and manpower to repair SRAs may not be cost effective in view of the small (but measurable) cost saving in spares dollars as compared to the Navy baseline repair concept. Figure 8 data was based on the SH-2F aircraft. The benefits from increasing I-level SRA repair may increase significantly for fighter/attack aircraft that rely on a more expansive avionics suite and I-level repair capability to sustain it.

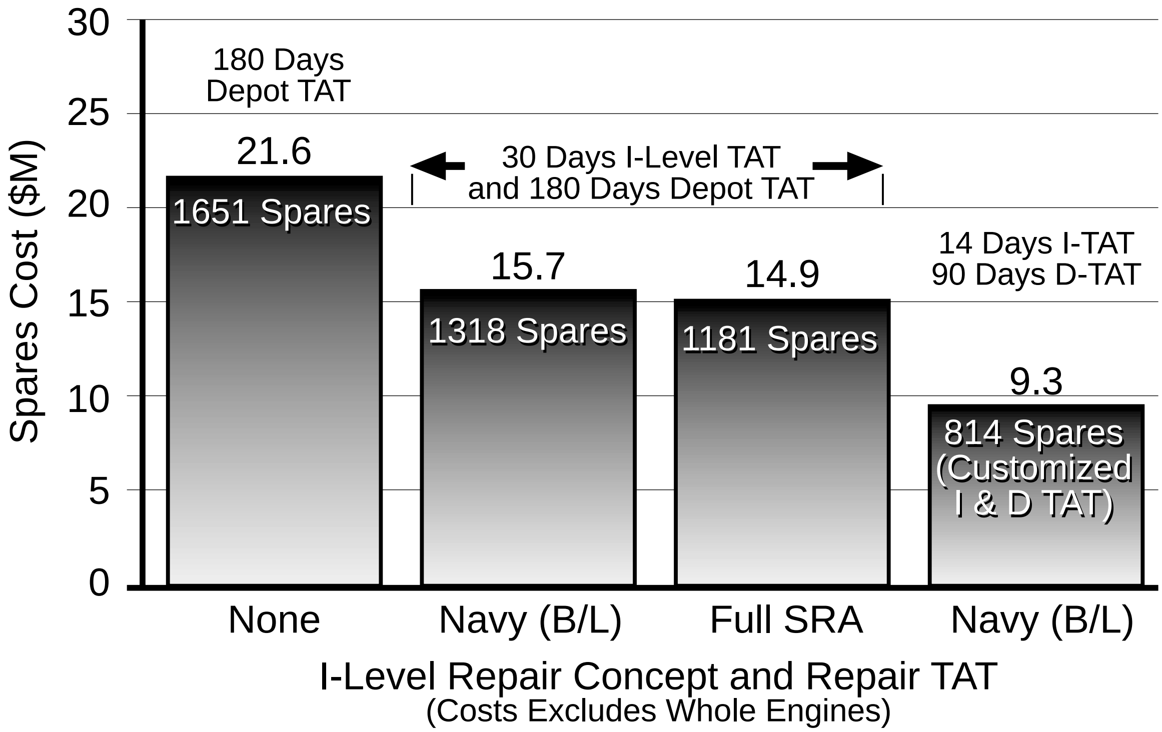


Figure 8 - Spares Cost To Achieve Constant Readiness For Various Repair Options

ARROWS can also compute spares using the conventional demand based sparing approach (where each item is spared to a constant protection level) and forecast weapon system readiness for that mix of spares. This capability is valuable when FMS customers are unfamiliar with the RBS technique and want the APML to provide results based on the traditional methodology so as to better understand and appreciate the advantages of RBS optimization. Figures 9, shows the benefits of implementing RBS procedures in lieu of using demand based sparing approach. This figure clearly shows that to achieve 60 percent FMC rate using more depth. The RBS optimization is achieved by making cost trade-offs (i.e. buy fewer of the more expensive WRAs) without compromising the desired goal of 60 percent readiness.

As discussed earlier, reducing turn-around time by increasing FMS customer self sufficiency or relying on expedited transportation can achieve a significant reduction in pipeline spares cost. This savings can be used to offset the one time cost of buying increased support equipment and training or the added transportation cost. Figure 10 provides sample data with varying turn-around times. This chart provides the user and the FMS customer with a better appreciation of reducing the repair pipeline associated with in-country repair and the time it takes to repair the item overseas or in the U.S.

Spares Method	% FMC	Cost ($M)	Range	Depth
Demand Based	60%	19.8	417	1140
RBS	60%	15.7	507	1318

Figure 9 - Overall Spares Statistics For Demand Based Sparing Versus RBS

In summary, the NAVAIR decision and support budgeting model can provide the benefits described below:

- Quick-look capability to forecast spares requirements using optimization techniques,
- Easy to use tool for logisticians to assess alternative maintenance strategy,
- Trade off readiness versus cost at the system/sub-system level,
- Scenario driven- e.g. flying hours, sites, turnaround time,
- Embedded computational model is same model used by U.S. Navy for domestic requirements,
- Ongoing Navy upgrades to provide a more Windows-like environment.

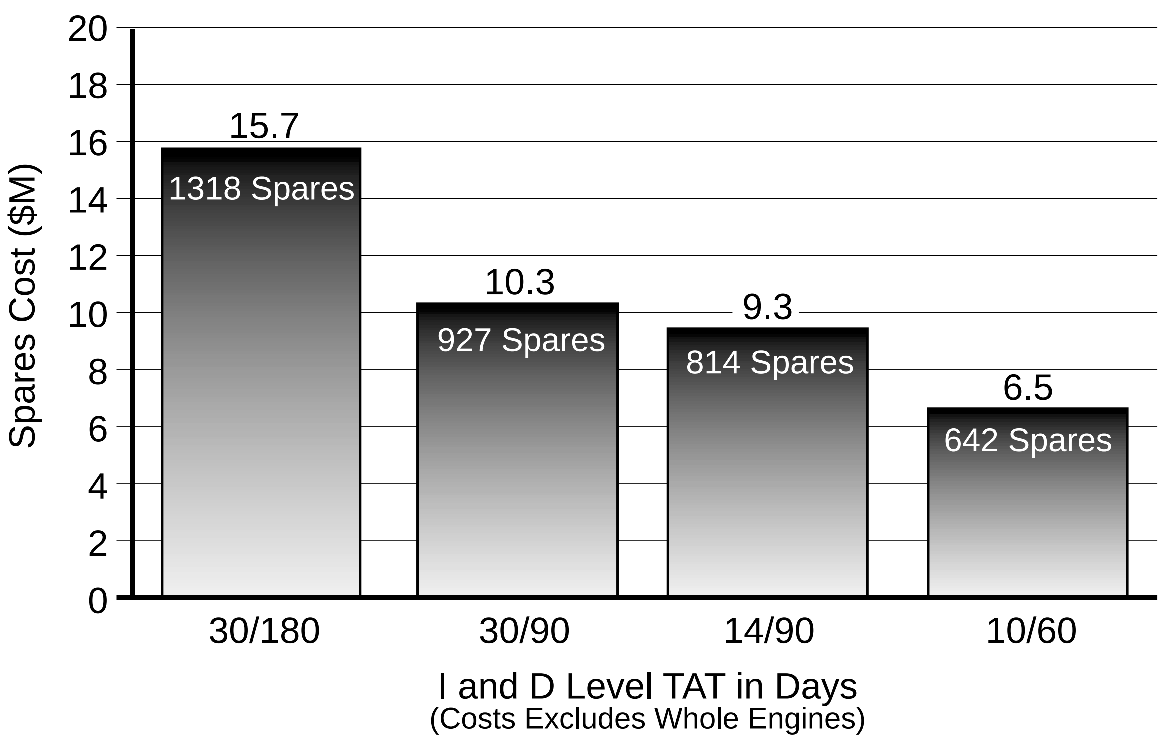


Figure 10 - Sensitivity To Repair TAT

About the Author

Steve House is currently the Director International Programs, Planning and Logistics for Information Spectrum, Inc. which is the prime support contractor for the Naval Air Systems Command FMS Logistics Directorate. He is a retired Navy Supply Corps Captain with extensive acquisition logistics and FMS experience while in the Navy. He also has lived and worked overseas a total of thirteen years, including business and financial manager of the Navy's commercial component repair program in the Western Pacific and Commanding Officer of the Navy's largest overseas supply depot in Subic Bay, Philippines.