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STANDARD MISSILE LOGISTICS: BLUEWATER AND LITTORAL WARFARE READINESS

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ABSTRACT

Standard Missile is the premier air defense missile system employed aboard U.S. and allied naval ships around the world. Logistics, repair planning, and budgeting for such a large scale weapon system requires both deterministic and stochastic projections of thousands of manufacturing, repair, and transportation parameters. The sheer magnitude of this task overwhelms any single analyst or group of analysts. The Standard Missile Workload Simulation Model, written in Arena, assists defense and industrial planners in predicting facility and manufacturing utilization, costs, material shortages and surpluses, and fleet asset readiness.

1 INTRODUCTION

Arguably Naval logistics fleet support provides an essential foundation for theater battle strategy. It could well be that World War II was won by the allies because of their military-industrial logistics network rather than their superior warfare strategy. Use of simulation to bind fleet doctrine and strategy to the national industrial base provides tools to evaluate the effects of changes in the logistical infrastructure. These changes can effect both economic costs and asset readiness. The ability to predict and analyze the future status of weapon system supply lines with “what if” capability, can provide military planners and strategists with much needed possible and probable ramification information.

2 MODEL OVERVIEW

Standard Missile Simulation Modeling is performed by the Port Hueneme Division, Naval Surface Weapons Center, under charter from the Naval Sea Systems Command. The current model is in its third generation. The first generation model was developed in the late 1970’s and early 1980’s on a Digital PDP 11. This model was strictly analytical. It required a third party specialist to enter the data and multiple programmers for model maintenance. It was inventory driven and assumed that all missiles would be processed. It included no considerations for variation in fleet activity. It was run twice a year under highly controlled conditions.

A VAX based simulation model was developed in the late 1980s which included deterministic and stochastic simulation of various shore activities but still relied on inventory driven logic. The output of this model included analysis of ten model runs with stochastic model components being seeded with 10 different random number streams to evaluate the potential variation of output. This resulted in a significant step forward in the modeling process, but required the education of end users who were not comfortable with statistical nomenclature and results that were expressed in ranges. This model was written in the SIMSCRIPT language and included spreadsheet data entry and automatic report generation. This made it possible for a single person to input data and analyze outputs without extensive computer training other than basic operating system (VMS) commands. The fleet portion of this model was open looped with no capacity or scheduling constraints.

The introduction of 386 level computers allowed the second generation model to be converted to an OS2 Desktop computer in 1992. This allowed the average personnel computer user to run the simulation model. The model was inventory driven with no major enhancements over the VAX version.

The third and current generation of the Workload Simulation Model incorporates both stochastic and deterministic simulation components to forecast, from planned ship schedules, ten years of program activity. This activity includes: intermediate level maintenance and missile recertification testing at Naval Weapon Station Intermediate Level Maintenance Facilities (ILMFs); introduction of new production rounds into the fleet through contractor operated All Up Round Facilities (AURFs); testing and recertification of designated fleet returned rounds at the AURFs; repairs; scheduled component upgrades at the contractor; and government operated Depot Level Maintenance Facilities (DLMFs). (See Figure 1.)

SIMULATION MODEL FLOW DIAGRAM

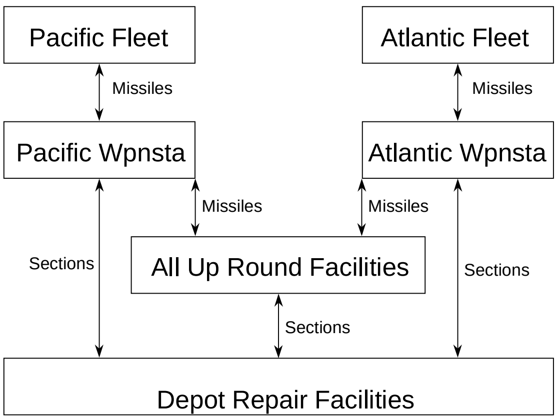

Figure 1: The Model Encompasses the Entire Stockpile to Target Sequence

Within performance tolerance bands, the model projects missed loadouts by ship name, hull number, missile type, and event date. Multiple ship missions based on threat scenario may be evaluated.

Fleet schedules are derived directly from the Navy’s on-line Fleet Modernization Program and Maintenance Information System (FMPMIS) Database. Missiles and missile sections are tracked by system assigned serial numbers. Ships are tracked by hull number and missile load throughout the model run. The model projects and tracks missiles throughout their life cycle in a closed loop. Display capability allows the viewing of this data in graphical or detailed text format.

3 MODEL DEVELOPMENT AND OPERATION

The development of the Standard Missile Workload Simulation Model required the efforts of individuals that had industrial, military logistic system, simulation and computer programming experience. The final development team included individuals who had backgrounds in all of these areas. This prevented the typical “what does this do or mean” questions when simulation newcomers deal with complex military industrial systems. The appropriate staffing prevented the long learning curve that is sometimes associated with acquainting military planners with civilian simulation concepts, computer programming, and manufacturing floor procedures.

The advent of high speed Pentium desktop computers, the porting of powerful simulation software (Arena) to the 32 bit Window NT environment, and the use of user-friendly interfaces such as Microsoft Visual Basic 4.0 and its accompanying VBXs and OCXs (Visual Basic add-ins) allowed the development of the most recent version of the Standard Missile Workload Simulation Model. The reusable nature of the model allows military and budgetary planners to evaluate existing and proposed logistic performance of Standard Missile assets and facilities given various threat scenarios. The flexible nature of the model has allowed its rapid evolution and successful use in an era of high uncertainty with limited funding and manpower.

The Standard Missile Workload Simulation Model was designed to project Intermediate Level Maintenance Facility, Depot Level Maintenance Facility, and All-Up-Round Facility workloads for missiles and sections. The output of the model is used to derive intermediate and depot level workload requirements for spare sections, spare and repair parts, test equipment and facility budgeting. The model can provide “what if” scenarios depending on input parameter changes. With moderate data input modifications, a model run can begin within minutes of run request, and can be completed within an hour.

A distinctive feature of the workload simulation model is its use of current operational data to set the model in its initial state without the necessity for a warm-up period. The front end of the workload simulation model has a Visual Basic (Version 4) menu system. This menu system interfaces with the various input sources and calls the appropriate program or programs which “intelligently” extract, develop, and reformat information in a form that can be read by the Arena system environment. In the near future, the input portions of the front end may be ported to an HyperText Markup Language (HTML) or a Java (J++) environment.

The Fleet Modernization Program and Maintenance Information System database contains the maintenance schedule for all ships in the U.S. Fleet for the next ten years. This database is downloaded in an Excel format by file transfer protocol (ftp). The front end takes this format and using “intelligence” decides how this schedule will be executed in terms of major and minor missile onloads and offloads. This is accomplished by hull number with the knowledge of ship class, future missile load, home port, and home yard information. (See Figure 2.)

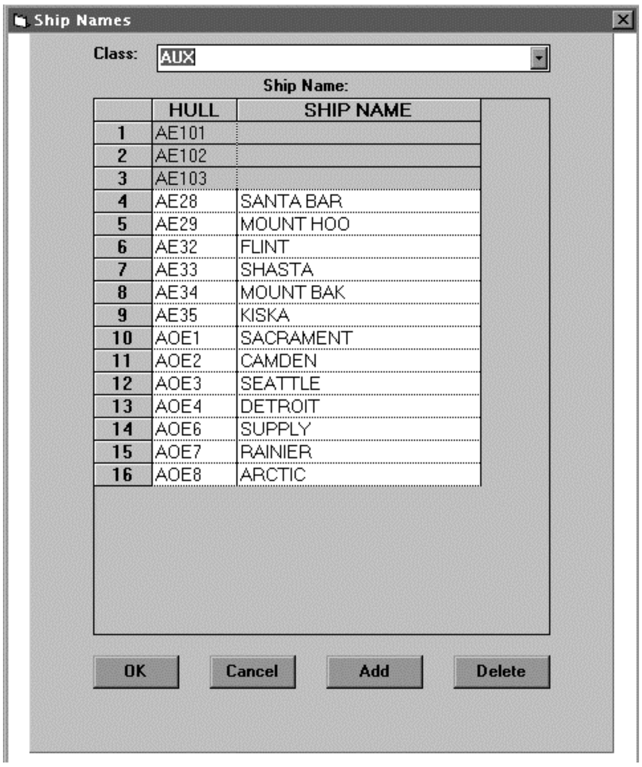

Figure 2: Simulation Is Based on Actual Ships in the Fleet

Missile load and missile offload information can vary for the same ship class due to differences in mission. Development of missile load and missile offload predictions still requires the intervention of a human analyst. International influences and fleet doctrine are much too complicated and dynamic to be machine generated at the present time.

Inconsequential maintenance operations (in relation to missile onloads and offloads) are automatically stripped from the FMPMIS schedule. Remaining maintenance activities are transformed to equivalent missile loadouts and offloads. The generated schedule is then output in Excel format for operator review. It is also output in a form that is read directly into the Arena environment to allow the model to determine which ships are loaded with what types of missiles upon model initiation. Future model ship loadout and offload event generation is not relegated to a random number deviate generator, but to actual ship schedules by hull number. Schedules are deviated using distribution parameters gleaned from fleet history data. Should end users want to play "what-if" with the schedule, all they need to do is supply the schedule to be examined in FMPMIS Excel format and the front end will do the rest. It is not necessary for anyone to examine the front end outputted Excel formatted data. The outputted Excel formatted data is strictly available for verification and validation purposes. This is all done automatically without assistance from the user.

Some data is manually input using an Excel-like VBX. This input data does not reside on easily downloadable databases. Where the likelihood of user input error is present in using previously entered data, pick lists are provided so that consistency in data entry is maintained. Changing certain data, such as simulation start year, causes reformatting of Arena input data to reflect the new year. The front end maintains all data for past years. Users are allowed to initialize the beginning state to reflect past years. This is an important feature in model verification and validation.

The conceptual operation of the model takes ship information from the FMPMIS file and loads the simulation model with ship missile data in relationship to location, time and type. Missiles offloaded from ships are moved to Not Ready for Issue (NRFI) magazines at the scheduled maintenance facility. Ninety days before a ship is scheduled to arrive for loadout, and at scheduled intervals afterwards, the NRFI magazines are searched for the required missiles types. If the required missile types are found, they are sent to Missile Sentencing Inspection (MSI) to determine if they need to be recertified on the round level missile test set or if they can be sent directly to the Ready For Issue (RFI) magazine. Missiles are tested to see if they may be recertified as RFI. If missiles fail the recertification, the failed sections are removed from the missile and sent to a repair facility. RFI sections of the same type as the failed sections are taken from the facilities spare section inventory and built back into the failed missiles. These missiles are then retested. The cycle continues until the missiles are recertified and sent to the RFI magazine. Failed sections set to the repair depot are repaired and returned to the facility's RFI spare section inventory. If twenty days before the ship is to arrive, not all of the missiles to recertify for that ship have been located, other facilities are searched for the proper missile types. If the proper missiles are found they are shipped to the facility needing the missiles. If, at the time the ship is to be loaded, missiles are still not found, suitable substitute missiles are loaded if they are available. When the ship is loaded and sent back to sea, it fires its projected firing schedule removing fired missiles from its shipboard magazine before it offloads missiles on its next scheduled maintenance. Missiles may be processed at the facility where they are offloaded or may be shipped to other facilities for processing. All Up Round (AUR) missiles and failed components under warranty are sent back to their manufacturer for processing and recertification. Missiles scheduled for reconfiguration are taken immediately from ship offloads or RFI magazines to processing facilities where they are reconfigured and returned. The simulation is run for a 10-year period. As the simulation runs, scheduling bottleneck, and fiscal information is recorded.

Numeric data generated by the model is written to files at appropriate times during the model run. The Visual Basic back end then reformats this information at the end of a model run into data recognizable by the appropriate graph or report generator VBX or OCX. Upper management likes to see animation in summary reviews, but when the rubber meets the road, good tabular and graphical data is the basis for sound decision making. Graphs and printouts of activity loading, ship onloads and offloads, and asset readiness may be accessed through menu selections, option boxes, and list boxes. (See Figure 3.)

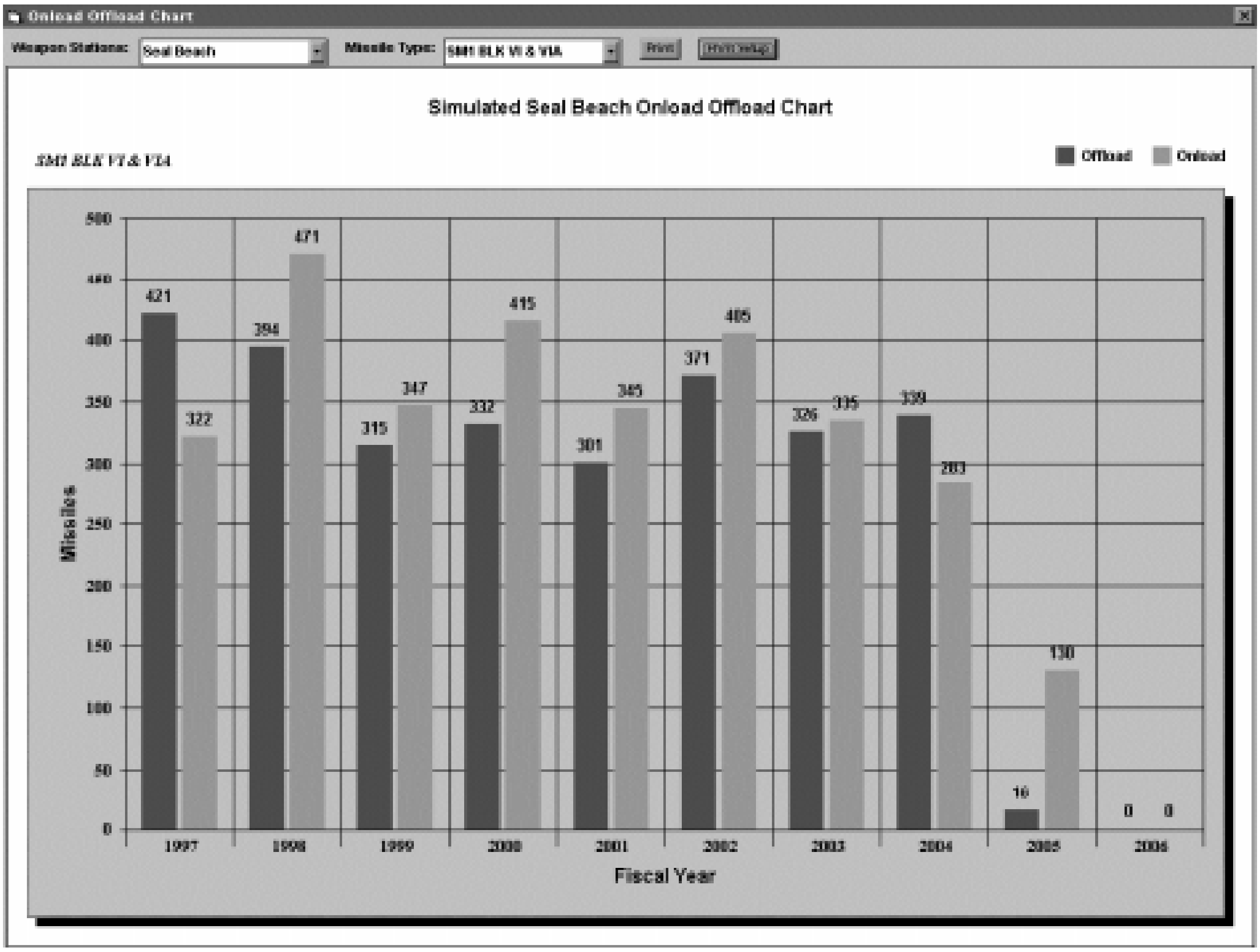

Figure 3: Data Is Presented Graphically to Facilitate Analysis

4 MODEL FUTURE

The workload model will likely evolve as situations rapidly change. Modular design and developer gymnastics will challenge the traditional military software configuration and change control processes. It also provides challenging "opportunities" for developers and planners to provide community wide change control and data consistency.

The ultimate model data input goal is to have all data automatically inputted and manipulated by the model front end. Real time tracking of missile and section inventory information will be loaded into the model as the initial condition or modeling state. Screen display of initial conditions will not only be beneficial to the long-term simulation modeling community but also the immediate military and logistic planners. Selection of a future date or time will provide a model projection of conditions using the same display with the inclusion of certainty information. Activity based reports or graphs will be available for any user selected time frame. Logistic gaming features will allow for the inclusion of human decision at any moment in the projection with the outcomes displayed and evaluated by the system. Economical, logistical, and strategic interactions will be evaluated and displayed. In the same manner as concurrent engineering involves all portions of the design and operations community, the model will combine the involvement of military, logistic, and funding decisions, and require the coordinated input of diverse communities.

The model output display will ultimately have a "real time" output representation. At the push of a button all input data will be manipulated and loaded into the simulation model which will run automatically. Output parameters will be displayed graphically. This will include the existing status and simulated projected status of logistic facility loading, logistic facility capability, projected ship loadouts, projected ship offloads, and projected missed loadouts. Most of the features of the concurrent output representation now exist.

5 CONCLUSION

Simulation modeling in the Standard Missile community has been validated as a valuable tool in large scale weapon system logistical planning. Direct access of the model by planners without intermediate intervention by simulation professionals increases the value of the model as a planning and forecasting tool. Using current data to load the initial model state makes the model valuable in forecasting the consequences of proposed schedules on existing and proposed facilities. The showcasing of simulation use in this fashion, will open up simulation opportunities previously not considered as simulation options.

AUTHOR BIOGRAPHIES

STEPHEN A. FISHER is an Industrial Specialist for the Naval Surface Warfare Center, Port Hueneme Division. In this capacity, he is responsible for the development, planning, and implementation of large-scale military weapons system logistic simulation models for the Naval Sea Systems Command. He has held this position for the past twelve years. Before coming to the Naval Surface Warfare Center, he had extensive manufacturing experience in the commercial arena. He holds B.S. and M.S. degrees in science and business.

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