Requirements Modeling and Management of Naval Aviation Training

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ABSTRACT

Historically, the assignment of training resources (instructors, aircraft, simulators, flight hours, etc.) to those units responsible for training Navy and Marine Corps aviators was based more on tradition than on quantitative, requirements-based analysis. This often led to a mismatch between the individual unit's annual training requirement and the resources that were at its disposal, resulting in under production or wasted resources. In the Fall of 1999, this process began to change. Under the direction of the then Commander, Naval Air Forces Pacific (CNAP) and the Navy's Director of Naval Aviation Manpower and Training (OPNAV N789), the Navy embarked on the development and deployment of a methodology that established quantifiable links between Fleet Replacement Squadron student training requirements and the resources required to train them. Developed using COTS software, the Production Planning Factor (PPF) tool enables Navy and Marine Corps aviation training units to not only identify their training resource requirements but also determine training capacity based on the resources actually available. This tool has formed a critical node in the development of integrated production plans across the various phases of the training process and directly contributed to an average 14 percent reduction in the time-to-train pilots since its inception. In addition, the number of pilots trained has increased from 91.3 percent of the "Fleet Requirement" in FY99 to 100.6 percent of the number of pilots required in FY03. This paper addresses the methodology employed in the development of the Production Planning Factor model as well as the linkage between the results of the tool and the training improvements noted above. Practical implications and concerns with the current tool's use and plans for future enhancements are also presented.

ABOUT THE AUTHOR

Glenn Pittman is a 1973 graduate from Pennsylvania State University with a BA in International Relations. Following commissioning as an Ensign through the NROTC program he reported to flight training in Pensacola, FL earning his coveted "Wings of Gold" in March 1975. His initial assignment was flying the H-3 Sea King and subsequently transitioning to the S-3 Viking. During his Fleet tours he served in various operations and maintenance positions while deploying aboard aircraft carriers to the Atlantic Ocean, Mediterranean Sea, Indian Ocean and Arabian Gulf. He also served as a flight instructor in both the Training Command and at the Fleet Replacement Squadron accumulating over 4,500 flight hours and 450 carrier landings in various aircraft. In addition to serving as Commanding Officer of an advanced strike training squadron, he also served as the Assistant Chief of Staff for Training and Operations (N3) for the Chief of Naval Air Training and as "Air Boss" on board the U. S. S. Nimitz (CVN-68). An additional staff assignment was as the manpower and personnel analyst in the Assessment Division on the staff of the Chief of Naval Operations. A graduate of both the Naval Postgraduate School and the Naval War College, he holds masters degrees in both Financial Management and Strategic and International Studies and held subspecialty qualifications in Financial Management and Operations Analysis. Since retiring from the Navy in June 1998, he has been working as a program manager on Department of Defense, U.S. Marine Corps, Air Force and Navy manpower, readiness and training efforts for CACI, Inc. of Arlington, Virginia. In this capacity he has been instrumental in the development of resource requirements modeling processes within the Naval Aviation training process. He is currently a Director in CACI's Manpower, Readiness and Training Division.

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INTRODUCTION

In the years directly after the Cold War, the Navy reduced its aviation force structure by approximately 37.5%, dropping the number of operational squadrons from 227 to 144 and reducing the number of aviation officer billets by 3,000. In consonance with this force structure reduction, annual pilot and Naval Flight Officer training rates and initial officer accession requirements were reduced below the steady-state numbers required to sustain the existing force levels. This was done in an effort to offset the surplus aviation endstrength resulting from the force structure reductions. This under-accession and under-training condition emanated from a decision by Navy manpower planners to retain rather than separate excess fleet aviators. These excess aviators were then used to fill the gaps generated by the under-production of initial assignment aviators in the fleet. As these excess aviators aged out of the fleet, Navy pilot and NFO accessions and initial training requirements were ramped up placing increased stress on a training process that was not equipped materially or culturally to adequately handle the increase.

By the start of FY98, the Naval Aviation training pipeline was in extremis. Naval Aviation had not produced the steady-state fleet requirement for pilots and NFOs for several years and the time-to-train had increased significantly. The time required to train a Navy strike pilot had reached 48 months in relation to a syllabus that should have taken approximately 30 months. The overloaded training system had students stashed in "pools" throughout the entire process from initial accession to completion of their Fleet Replacement Squadron (FRS) training and assignment to their first operational squadron.

The backlogs in the training process were also impacting the fleet and personnel policies. At the operational squadrons, the excessive time required to train new replacement pilots and Naval Flight Officers resulted in a requirement to extend the time for those aviators on their initial sea tours as well as generating gapped billets across almost all Naval Aviation communities because the required replacements were still in the training pipeline. The excessive time required for training coupled with the extension of first sea tour lengths also impacted the ability of many aviators to make desired and essential follow-on tour assignments further impacting normal career flow points.

In an effort to correct this situation, the Navy began a series of initiatives to improve aviation production. This paper focuses on one of those initiatives, the development and introduction of Production Planning Factors (PPFs) which established a standardized, quantitative, requirements-based methodology for determining FRS training resource requirements and provide a realistic training capacity analysis tool.

BACKGROUND

Production Planning Factors (PPFs) had been utilized by the Chief of Naval Air Training (CNATRA) to determine their requirement for training aircraft, instructors, simulators and flight hours for over 25 years. Over the years the use of PPFs had evolved into a set of algorithms that looked at CNATRA training requirements across a multi-year timeline including the various interfaces and sequences between individual phases of undergraduate flight training. The use of the model as well as the embedded algorithms, standard variable definitions and a set of standardized values to be used for formal resource planning were codified in a Chief of Naval Operations instruction. This set of formulas and procedures has evolved into the current CNATRA Resource Planning System (RPS).

In the Fall of 1998 the Navy was faced with a burgeoning FRS training requirement, excess student inventories and excessive time-to-train. In an attempt to bring the same type of quantitative rigor into the resource requirements determination process for the post-CNATRA pilot and NFO training process, the Commander, Naval Air Forces, Pacific (CNAP) initiated a program to develop a similar PPF model for use by the FRS. Using the established CNATRA PPF methodology as a baseline, FRS PPF development was commenced using an FRS cross-functional working group. In addition to representatives from selected

Navy and Marine Corps FRS units, this working group included membership from each of the stake holders in the process: the Bureau of Naval Personnel, the OPNAV resource sponsor, CNATRA representatives, and representatives from both Type Commander staffs. Through a series of working-group meetings and various FRS surveys, the key variables and algorithms that captured the essential requirements and inherent differences associated with FRS production efforts were identified and formulated. Key differences between the standard CNATRA variable set and those adopted for use by the FRS were driven by the different maintenance philosophies (full contact maintenance Vs. Navy maintenance) associated with CNATRA units and the FRS and the resulting higher number of enlisted personnel assigned to the FRS when compared to CNATRA undergraduate training squadrons. A chart displaying the key, standardized variables for both CNATRA and FRS PPF is provided in Figure 1.

CNATRA / FRS PPF Assumptions

PPF Key Variable Value	CNATRA	FRS
Training-Days/Yr	237 Days	228 Days
Aircraft Workday	10 Hrs/Day	12 Hrs/Day
Instructor Workday	8 Hrs/Day	8 Hrs/Day
Instructor Availability	80 Pct	66 Pct
Validated Overhead Billets	3 Billets (Min)	6 Billets (Min)

Figure 1. PPF Standardized Variables

Initial development of a functional FRS PPF Model was commenced using the commercial off the shelf software (COTS) *Microsoft*® *Excel*©. Although the PPF model could have been developed using other applications or even developed as a web-based or web-enabled database application, Excel was chosen due to its universal availability throughout the various FRS units and associated training production management staffs. Excel also enjoyed general familiarity within the FRS units since it was already in wide use for tracking maintenance and training data. The Excel-based PPF model consisted of several imbedded worksheets that facilitated data entry and provided the means to automate the computations necessary to calculate the unit's annual resource requirements.

Following preliminary development with assistance from the FRS PPF working group, a phased implementation program for FRS PPFs and the Excel–based model commenced at the beginning of FY99 with full implementation achieved across all Navy and most USMC FRS units by the start of FY00. The resulting FRS PPF algorithms and process requirements were then codified in the new OPNAV Instruction 3500.31 Series. This instruction remains in effect and governs the preparation, submittal, and endorsement requirements for the FRS PPF work-ups as well as detailed explanations of the algorithms and calculations.

The Navy requires each FRS unit to submit PPF-generated resource requirements annually as part of the formal integrated production planning process. Due to the long lead time and length of most of the training tracks, the planning process spans not only the current government fiscal year but also reaches out to the next three years. This long range planning cycle enables the aviation training production managers responsible for the process to identify early potential resource capacity and training integration issues and take corrective actions to mitigate the impacts. It also allows adequate accession planning so that the correct number of students is entered into naval aviation in order to meet the out-year requirements. For these annual PPF submissions, FRS units are required to use the standardized values displayed in Figure 1 for those variables. This levels the playing field and generates a more consistent resource requirement picture.

PRODUCTION PLANNING FACTOR METHODOLOGY

Why Use PPFs?

The FRS PPF model was developed to meet four key objectives:

- Provide a standardized methodology for calculating FRS resource requirements
- Utilize and adapt a historically accepted methodology
- Provide a ready audit trail for model results
- Provide a quantitative "what-if" and training capacity analysis capability

The FRS Production Planning Factors Model was developed to provide a standardized, quantitative, and direct link between the squadron's annual training requirement and the resources needed to complete or accomplish that requirement. The primary key to the PPF model's historical acceptance in the budgetary arena is in its use of a set of standardized equations and variables across all FRS units. Specific values for planned annual training days, instructor availability, as well as instructor and aircraft planned hours per day are applied consistently across all units. This eliminates many of the previous points of contention when addressing the calculations of required training resources from various FRS units. This becomes especially apparent when comparing resource requirements between similar FRS units with similar training requirements which previously may have had significantly different identified resource requirements. Use of the PPF algorithms and standard variables ensure that similar FRS units doing the same job with all other things being equal will have the same resource requirements. This "repeatability" is essential to winning the war for allocation of scarce budget resources.

A follow-on objective that flows from the use of standardized algorithms and variables is the requirement to provide a ready audit trail of the resource requirement calculations and the various inputs that generated them. In the PPF model, this is achieved through use of CNO approved syllabus values and CNO annual student training requirements when determining the resource requirements. Although some modification may be required to the above to account for unique situations, by determining resources based on a published set of prescribed syllabus requirements and then applying these against the set of standardized variables and algorithms, it is much easier to appraise the results and determine critical relationships. It also becomes much easier to communicate the requirement when it is based on readily available data rather than multiple conflicting assumptions.

In addition to providing the standardized set of algorithms and a ready audit trail, the PPF model needs to facilitate the individual FRS' ability to conduct comprehensive Analysis of Alternatives (AoA) or "what-if" analysis to evaluate available options for meeting training requirements in times of insufficient resource allocations or analyzing available excess capacity when available resources exceed those required. The ability to translate available resources to a training capacity is critical in order to coordinate training flows based on a units wherewithal to produce its stated training requirement. By modifying the input variables associated with the PPF model, a unit can evaluate potential corrective or alternative actions and the "pain" associated with those alternatives. It is important for Navy decision makers to be able to make informed assessments and weigh the alternatives available to them. The PPF provides a quantitative analysis vehicle for that assessment.

FRS PPF Model: A High Level View

The goals of the FRS PPF model are to provide visibility into the necessary training resources to produce the pilots and NFOs required by the fleet and provide a quantitative analysis of the available capacity based on currently assigned or planned resources. The knowledge of available training capacity within the individual FRS units is a key element in providing the ability to effectively coordinate and integrate the entire naval aviation training process. It is also important to note that although the primary driver for the development of the FRS PPF methodology was shortfalls in initial pilot and NFO training production, the PPF requirements model is intended to capture the resource requirements associated with completion of all required training syllabi in the applicable FRS. This includes not only initial training, but refresher training, enlisted aircrew training, and other syllabi as required. Figure 3 provides a high level overview of the FRS PPF model including inputs and outputs.

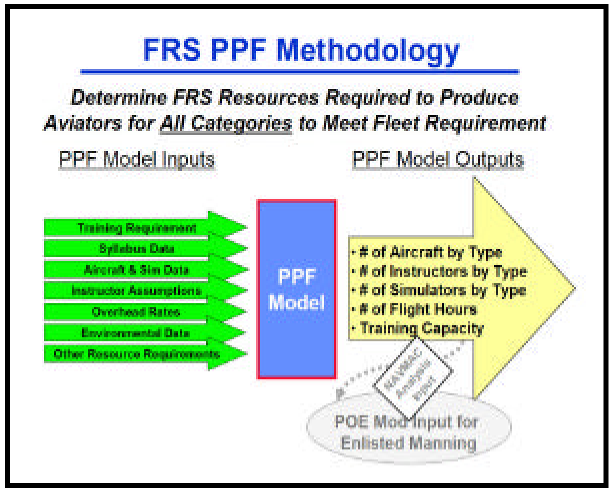

Figure 2. FRS PPF Model Overview

PPF Model Inputs

Required inputs into the Excel-based PPF model can be grouped into seven general classes:

- Annual Student Training Requirements
- Individual Syllabus Requirements
- Aircraft and Simulator Data
- Instructor Data and Assumptions
- Estimated Flight and Simulator Overhead Requirements
- Environmental Data
- Other Non-Syllabus Driven Requirements

This set of input variables represents and defines the squadron training requirement and operating environment. While some of the variables use pre-defined values that are required to be used by all the FRS units for resource requirement submissions such as planned annual training days, instructor work-day, etc., others such as student training throughput, syllabus requirements, weather factors, aircraft availability, etc. are squadron specific and depend directly on the individual squadron mission and location. All variables can be modified as desired when conducting in-house analysis of options or evaluating impacts of changing resource levels on the ability to enhance or modify capacity and requirements.

Annual Student Training Requirements

The first set of variables required is the annual FRS training requirements by the individual syllabus. This involves capturing not only the current year's requirement but also the following year's requirement. This enables the model to adjust the estimated workload required in the desired year for anticipated changes in student loading being driven by any change in the following year's throughput requirements. If annual training requirements are increasing from one year to the next, the actual workload required in any given year will be greater than what would be required if the training requirement remained steady from year to year. Conversely, this "equivalent" workload would decrease in a given year if the subsequent annual student throughput declined. The model captures this variation and adjusts the annual work-load requirements for these changes.

Individual Syllabus Requirements

Once you know how many students are required to be trained through the available syllabi, the next set of variables necessary to accurately reflect the required resources is the definition of what each of the syllabi needs in terms of those resources. Syllabus entries are on a per student basis and include the planned syllabus length, estimated attrition, and specific training event data and should be based on the Navy approved syllabus. This later data is usually entered by aircraft and/or simulator type and focuses on the number of events, flight or simulator hours, instructor hours, and any direct support requirements. Entries are also required to define the academic and flight support as well as any other training.

Another key component in defining specific syllabus requirements is to define the level of system support required from each of the required aircraft and simulator resources. This is accomplished in the Excel-based PPF model by defining the number of events in the syllabus that require either a full mission capable (FMC) or partial mission capable (MC) training resource. By defining a general system requirement for the individual events and then combining this with the estimated time that the available aircraft and simulator resources will meet these system requirements, it is possible to calculate a percentage of the time that a given resource should be available to support one of the syllabus events. This estimated percentage is defined as the estimated Ready for Training (RFT) rate. RFT is used to calculate how many total aircraft and/or simulators are required to meet the desired student syllabus throughput as well as a minimum number of average RFT assets needed to be available on a continuous basis.

In cases where two or more students share the same training resource at the same time, allowances need to be made in the syllabus data in order to ensure that the resource requirement is not over estimated. An example of this potential problem would be when an Enlisted Aircrew Instructor is filling a defined aircraft crew position requirement during a pilot aircraft flight syllabus training sortie while filling an instructor requirement for a student enlisted aircrewman being trained on the same flight. In this case, failure to adjust the Enlisted Aircrew Instructor hours required on one or both syllabi to account for this sharing of his time would result in the generation of a requirement for two enlisted instructor bodies for this event instead of the one that is actually required. It is easy to see that in the above scenario, there is also potential to double-count the aircraft, flight hour, and instructor pilot requirement since all of these resources are being shared by both the student pilot and student aircrewman.

Aircraft and Simulator Availability Data

The aircraft and simulator availability data entered into the model are a combination of historical maintenance availability data and general assumption for average aircraft work-hours per day, turn-around and servicing requirements and scheduled maintenance requirements. Data is entered for each defined aircraft or simulator classification. Most units use the standard classifications by Type/Model/Series (e.g., F/A-18C, F/A-18D, 2F192). However, if another classification is more appropriate to the mission, the user may choose any aircraft classification that is desired (single-seat events vs. two-seat events, etc.). The combination of these entries and the syllabus data provided above are used by the model to generate the required aircraft and simulator resources.

Instructor Data and Assumptions

Data for instructors is entered by type. The model supports differentiating between Instructor Pilot, Instructor NFO, and Enlisted Aircrew Instructor requirements. However, similar to aircraft, the unit can use these classifications as pseudonyms for any relevant instructor type. For most cases, general instructor data entry for the model variables is based on values already defined as given or fixed. While it is desirable to change some of these values when conducting off-line analysis, the requirement to provide a standardized set of instructor working conditions mandates that, at least for formal annual resource submissions, the standard values for availability and work-hour per day are used for the data inputs (See Figure 1). However, additional squadron specific data is required to better define the total instructor requirement. This additional data includes the average tour length for instructors in the command, the estimated time required to become qualified to instruct the required syllabi and complete the Instructor Under Training (IUT) program, etc. These entries are then combined with the other syllabus data and variables to calculate the overall instructor requirement for the unit.

Flight and Simulator Overhead Requirements

Execution of a training syllabus requires more than just the flight and simulator hours defined in the particular syllabus. Weather, student performance, or mechanical problems may result in a training event being incomplete and require it to be flown a second or third time. Aircraft maintenance to correct a mechanical malfunction or failure may require the completion of one or more functional check flights before the aircraft can be returned to a RFT status. There may be a requirement to ferry aircraft and/or students to a different location for participation in a training detachment. Instructors need to be trained and re-certified in order to teach the required syllabi. All of the above are examples of overhead flight hour requirements that will need to be addressed from an aircraft, flight hour, and instructor resource requirements perspective. Similar considerations are also present when addressing requirements for simulators and simulator support hours.

In the FRS PPF Model, these overhead requirements are usually addressed as an estimated percentage of total syllabus hours. The source of this data is usually from historical records but may be adjusted for anticipated changes. However, for the annual FRS PPF submissions described earlier, the use of Navy approved values for the relevant overhead classifications are mandated. If these "approved rates differ significantly from the FRS unit's estimates, this difference should be noted in the subsequent submittal for approval. Applying the overhead percentages in addition to the syllabus flight, simulator and instructor hour requirements generates a total work-load requirement, which can then be translated into a total aircraft, simulator and instructor resource requirement to complete this work-load.

Environmental Variables

Weather continues to play a large role in the ability to complete required training. With the addition of the necessity to train students with Night Vision Devices (NVD) across virtually every Navy and USMC FRS, the impact of daylight and night illumination levels on the ability to complete syllabus events has increased significantly over the last decade. The net result of these environmental factors is to reduce the number of training days or training hours available to the unit to complete the required training mission. Reducing the time available to complete the mission results in an increase in the number of resources required to do the tasks. The model adjusts for these differences and allows the resource requirement for doing the same task to be different for a USMC squadron located in San Diego, CA and a Navy squadron located in Norfolk, VA.

Other Resource Requirements

In addition to completing its training mission, FRS units are often tasked to provide other support functions that require resources to be available. With the trend to consolidate FRS training into a single squadron for each type of aircraft over the past several years, most FRS units now act as not only the Navy's model manager for their particular aircraft but also provide many of the Navy training team functions associated with their aircraft's particular operational missions. Several rotary FRS units provide scheduled Search and Rescue (SAR) or passenger logistics support as part of their regular duties in addition to training students. Depending on the level of the tasking, this category of data could produce a significant requirement for resources above and beyond those needed for the training mission accomplishment.

In addition to the above, it is also generally accepted that not all instructor bodies are created equal. While it may be realistic to assume that a full-time instructor can be counted on to provide eight hours per day of instructional duties, it is not considered likely that a commanding officer, executive officer, squadron department head or other key FRS staff positions will have the time available to provide this same eight hours per day for instructional duties. Data to allow for computation of the additional manpower or other resources needed as a result of these non-syllabus driven requirements and reduced availability also must be accommodated.

FRS PPF Model Algorithms

The FRS PPF model uses a series of algorithms that converts the user inputs for training requirements, syllabus requirements, and other assumptions and tasking to a number of resources necessary to complete the training mission. The algorithms calculate the total work-load required and the available work-load for each individual resource. The total workload required is then divided by the available workload to arrive at the number of the specific resource required to accomplish the task. This is illustrated in the following equations:

$$R_{required} = \frac{RH_{required}}{RH_{available}}$$

$$\text{Where: } R_{required} = \text{Resources Required}$$

$$RH_{required} = \text{Hours Required by Resource}$$

$$RH_{available} = \text{Hours Available per Resource}$$

This process is repeated on a syllabus by syllabus basis (including any overhead or other tasking requirements) for each resource and then summed by resource. The result is the total number of resources required for each type of resource to complete the training mission as defined by the variables and previously entered assumptions.

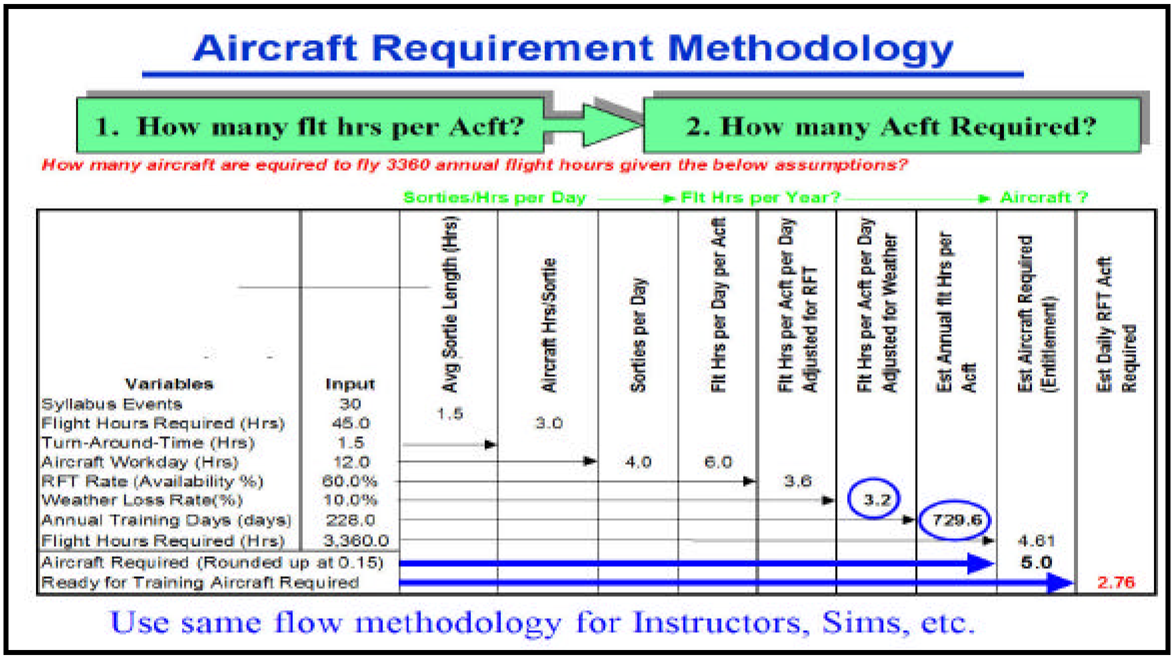

Figure 3. Sample PPF Aircraft Requirement and Rounding

An important feature of the FRS PPF model is the business rule on when resource requirements are rounded up or down to the next whole value. In the current model, resource requirements for aircraft, simulators and instructors are displayed at the whole integer value. Rounding for instructors, aircraft and simulator resource requirements occurs at 0.15. For example, if the result of the above calculations was a total requirement for 15.23 aircraft of a particular type/model/series to complete the training and other requirements, this total would be rounded to 16.0 aircraft for total resources required since the total would round up to the next higher whole aircraft at 15.15. This rounding methodology is consistent with the same methodology applied in the original CNATRA PPF algorithms and introduces a conservative approach to calculating resource requirements. The lower threshold for rounding usually generates a limited extra surge capacity that facilitates the units in their ability to respond to unforeseen conditions or short term barriers that cause the training environment to differ substantially from that defined by the normal variable inputs and assumptions. Rounding occurs only at the high level rollup and not at the individual syllabus level. This prevents a condition where the presence of multiple syllabi, all rounding up a requirement, would have the potential to artificially inflate the resource requirement for a particular resource.

An example of this procedure would be calculating the number of aircraft required to complete a given flight hour requirement. Figure 3 displays a example of the flow of calculations that are utilized in the model to determine the number of aircraft required given notional variables and annual workload. In the example, using the standard assumptions for work-day, etc., and an estimated RFT rate of 60%, the PPF algorithms generate an estimated 729.6 flight hours available per year per aircraft. If the total annual flight hour requirement was for 3,360 flight hours then the required number of aircraft to complete this tasking would be calculated at 4.61 aircraft (3,360 hours /

729.6 hours per aircraft). At the high-level resource requirement summary this total would round to 5.0 aircraft as a result of the rounding business rule. The same methodology is applied to instructor and simulator requirements using the applicable variables associated with those specific resources.

Based on the inputs supplied by the FRS unit and the algorithms contained in the model, the model calculates the number of resources required to complete the mission.

FRS PPF Requirements Model Outputs

The outputs from the PPF Model can be classified into two broad categories:

- Individual Resource Requirements
- Training Capacity

<u>Individual Resource Requirements</u>

Individual resource requirements for aircraft, simulators, flight hours, simulator hours, and instructors are calculated on a syllabus by syllabus basis. Each syllabus resource requirement is computed to include applicable allowances for student attrition as well as the defined overhead and support requirements. As discussed above, these totals are then summarized to the squadron level to determine a total resource requirement needed to complete the entire mission. Figure 4 displays a sample PPF Resource Summary Sheet for a notional F/A-18 FRS squadron from the Excel-based model.

STRIKE FRS
Production Planning Factors Worksheet
Resource Requirement Summary
FY06 ANNUAL

ANNUAL RESOURCE REQUIREMENTS

Manpower Requirements			Updated:	24 May 04
	Pilot	NFO / WSO	Enlisted	Total
Instructors Required	37	16	10	63
IUTs Required (Steady State)	6	2	0	8
Total Instructors Required (Training Mission)	43	16	10	71
Additional Manpower Requirements	Pilot	NFO / WSO	Enlisted	Total
(From Additional IP Requirements Worksheet)	9	6	0	15
Total PPF Manpower Required	52	24	10	86
Aircraft, Flight Hour and Simulator Requirements				
Aircraft Required	Aircraft 1	Aircraft 2		Total
A-Status Required - Planning Factors	7	23		30
A-Status Required - WSPD	10	34		44
Average Daily RFT Aircraft Required	4.0	13.7		17.7
Flight Hours Required	Aircraft 1	Aircraft 2		Total
Syllabus / Support Flight Hours Required	3,404.0	11,488.2		14,892.2
Overhead / Attrition Flight Hours Required	1,140.0	3,829.2		4,969.2
Total Flight Hours Required	4,544.0	15,317.4		19,861.4
Simulators Required	Sim 1	Sim 2		Total
Total Simulator Hours Required	3,045.3	2,991.4		6,036.7
Total Simulators Required	2.0	2.0		4.0

* IUT requirement listed represents number of "steady state" IUTs required to support listed IP / NFO IE requirement
** Instructors, aircraft, and simulators are rounded up to next whole number at 0.15

FRS PPF Version 7.08 (06/03)

Figure 4. Sample FRS Resource Summary

The resources listed above are a summation of the various individual syllabus resource requirements. The manpower requirement is displayed as the number of instructors needed by type (pilot, NFO, and Enlisted Aircrew) as well as the requirement for these types derived from the additional, non-syllabus driven mission requirements. As mentioned previously, the instructor requirement number represents a rounded requirement that is raised to the next higher number at 0.15.

Aircraft requirements are displayed by the classification entered by the FRS. The total aircraft requirement is further differentiated by displaying the number of aircraft needed based on the model calculated annual availability and flight hours per aircraft as well as the number of aircraft needed if the average annual flight hours per aircraft are maintained at the user entered utilization rate. This rate is normally set to the Navy's planned average utilization rate for the aircraft based on the Weapon System Planning Document (WSPD). The user may enter any value desired for the "WSPD Rate" and therefore calculate the aircraft requirement based on any given average annual flight hour rate per aircraft.

The annual flight hour requirement by aircraft classification is also calculated as well as a total flight hour requirement. This is further subdivided into the syllabus flight hours and the hours associated with the overhead and programmed student attrition rate.

Simulator requirements are also presented by user-defined type. Total simulator hours needed are displayed by type as well as the rounded number of simulators considered necessary to complete the syllabus and overhead requirements.

It is significant to note at this point, that the current PPF resource model <u>does not</u> provide an estimated requirement for manpower not already captured as part of the instructor cadre or "Additional Manpower" algorithms. Enlisted personnel for other duties such as aircraft maintenance, squadron administration, or other non-training related duties and requirements for additional officers, particularly in the maintenance department (Assistant Maintenance Officer, Material Control Officer, etc.) are not normally included in the model resource requirements calculations. Requirements for these additional personnel are handled through the normal Navy manpower analysis process. However, the PPF generated requirements for aircraft and flight hours, which form the basis for the required aircraft maintenance effort, form a key input to this process. The Naval Manpower Analysis Center (NAVMAC) receives these inputs via the Navy's established Planned Operational Environment (POE) modification process. FRS units submit these requests through their normal chain-of-command to OPNAV N780/N782B when their training requirement, and therefore resource requirement, changes significantly. After approval, the POE-mod is forwarded to NAVMAC for analysis. Following their review and validation of the POE-mod inputs, NAVMAC will modify the squadron manning document to reflect <u>all</u> manpower requirements for the squadron.

Once the resource requirements are determined, the next step is to calculate the annual training capacity based on the actual or planned resources that will be available.

<u>Training Capacity Analysis</u>

The analysis of available training capacity is critical to the effective management of the end-to-end training process. Too many students in the pipeline results in excess dead-time and extended time-to-train as students compete for too few resources. Conversely, too few students result in missed class seats, idle resources, and missed training opportunity. Both situations eventually will manifest themselves in the gapped operational billets or extended sea-tour requirements discussed earlier.

The current PPF model uses user inputs for anticipated numbers of available resources and the generated resource requirement numbers to calculate an estimated capacity by syllabus. This is a weighted-capacity calculation. To calculate estimated capacity, the model distributes the available resources across the various syllabi and the "Additional Requirements" proportional to their portion of the total requirement for that resource. This results in an expected number of students that can be trained through each syllabus.

Figure 5 is an excerpt from a notional FRS PPF model capacity output worksheet. The upper portion of the sheet provides data entry for the available instructor, aircraft, simulator, and flight hour resources using the same classifications as elsewhere in the model. Once the resources are entered, macros within the PPF model calculate the available capacity and display the annual student training requirement, adjusted annual work-load requirement, and a calculated capacity. This capacity is the limiting (lowest) value as defined by the individual resources associated with that syllabus. The annual capacity output is also color-coded to reflect the capacity as a percentage of the annual requirement. If calculated capacity is at or above the requirement, it is not color-coded. Capacity calculated within 10% of the requirement is coded as **YELLOW**. Estimated available capacity below 90% of requirement is coded as **RED** and indicates a significant potential capacity shortfall.

This is followed by a listing of the calculated capacity for that syllabus for each resource. In cases where a particular resource is not needed by that individual syllabus, an "NA" is displayed. In the current model, no other priority is given to any syllabus in these calculations. Available capacity can be modified by changing any of the input variable values or by adjusting the number of available resources.

The calculated capacity from the model forms a critical node and input into the formalized Integrated Production Planning (IPP) process. The primary goal of this process is to ensure that all phases of the pilot, NFO, and enlisted aircrew training process are linked and coordinated from initial accession to FRS completion. This linkage is based on a "pull system" that flows from the operational squadron requirement back through each phase of training to initial accession. Each phase's capacity is used as a potential limiting factor on its planned production and therefore student input requirements from the previous phase of training. The formulation of the IPP is an iterative process that continually balances capacity and operational fleet requirements to balance production across the aviation training continuum.

STRIKE FRS
Production Planning Factors Worksheet
Estimated Capacity Analysis
FY06 ANNUAL

Estimated Resources Available in FY06			
Instructor Personnel Available	Pilots	NFOs	Enlisted
How many instructors will you have assigned?	37	15	11.3
How many IUTs assigned (if not included in above)?	9	5	
How many "Other Officers/Enlisted" assigned?	4	3	
Total Personnel Assigned	50	23	11.3
Aircraft and Flight Hours Available	Aircraft 1	Aircraft 2	
How many aircraft do you expect to have assigned?	17.4	21.2	
Expected daily average RFT aircraft available?	12.2	14.8	
How many FY06 Flight Hours are available?		25,000.0	
Simulators Available	Sim 1	Sim 2	
How many simulators will you have available?	2	2	

Syllabus / Training Track	CAT I E	CAT I F	CAT I W	CAT I W NP	CAT II OTHE
Annual Output Required	12	21	21	3	3
Adjusted Capacity Required	12.7	20.7	20.7	2.0	2.7
Estimated Annual Output Capacity	11.5	20.1	20.1	2.9	2.9
Resources Required	Capacity Vs. Resource	Capacity Vs. Resource	Capacity Vs. Resource	Capacity Vs. Resource	Capacity Vs. Resource
Pilot Instructors	11.5	20.2	20.2	2.9	2.9
NFO/WSO Instructors	11.5	20.1	20.1	2.9	2.9
Enlisted Instructors	13.6	23.7	23.7	3.4	3.4
F/A-18E Aircraft (RFT)	36.6	64.1	NA	9.2	9.2
F/A-18F Aircraft (RFT)	13.0	22.7	22.7	3.2	3.2
TOFT Simulator	12.0	21.0	21.0	3.0	3.0
WTT Simulator	12.0	21.0	21.0	3.0	3.0
Flight Hours Available	15.1	26.4	26.4	3.8	3.8

Figure 5. Sample Capacity Output

PROGRAM RESULTS

Because the institution of PPF resource requirements modeling is but one of several initiatives started by the Navy to improve its aviation training process, it is hard to segregate improvements and attribute them directly to the PPF model process. What is readily apparent is that the overall naval aviation training process has showed dramatic improvement since 1998. Institutionalization of the requirements modeling process and its embedded capacity analysis capability has enabled the Navy to initiate a cogent and comprehensive integrated production management process that has been able to effectively control student inventories, increase annual production and dramatically reduce the required time-to-train across the entire process. Figures 6 and 7 display the improvements in time-to-train by student pipeline and overall pilot and NFO production increases for the pilot and NFO training continuum against the established first tour operational requirement.

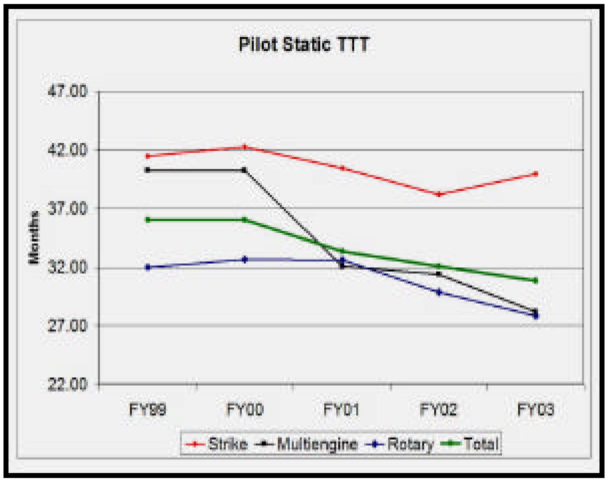

Figure 6. Pilot Static Time-to-Train

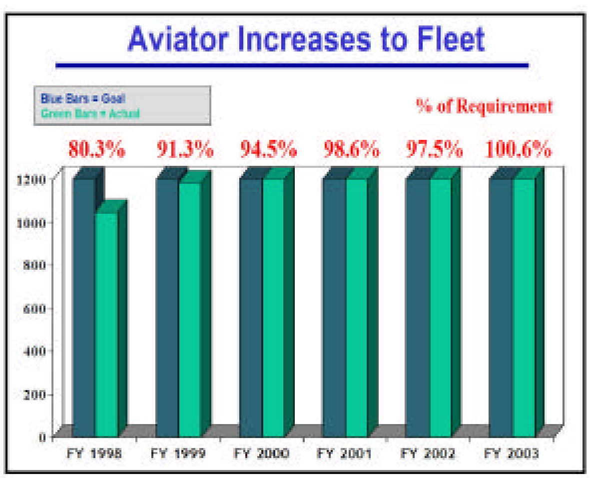

Figure 7. Annual Aviator Production

In consonance with the improvements in training throughput and time-to-train, the inventory of students in training has also decreased significantly. Overall process improvements since 1998 include:

- 17% Decrease in Average Time-to-Train
- 33% Increase in Annual Student Output
- 9% Reduction in Student Inventory
- 111% Increase in the Number of Navy Ensigns (O-1's) Receiving Their "Wings of Gold"

The 9% reduction in student inventory equates to annual Navy Student Individuals Account (IA) cost avoidance exceeding $30 Million. This amount does not include any additional savings that may have been generated from improved student performance due to reduced wait-times or other training process improvements.

FUTURE MODEL ENHANCEMENTS

The current Excel-based PPF model has several shortcomings. FRS units that have complicated training programs are often required to use multiple PPF workbooks and models to capture and adequately address their training requirement and resources. This is further aggravated by the current limits on having only three types of aircraft or simulators available in the model. The ability to use single aircraft or simulator resources differently across the syllabi in some FRS units has also generated the need for several complicated, and sometimes difficult, workarounds when using the current model.

The model currently does not address the other training resources that may have an impact on a unit's training capacity. These include computer-based training (CBT) or computer aided instruction (CAI) workstation requirements, classrooms, and other audio-visual equipment requirements.

In addition, the model has matured and been modified several times since its initial implementation. The presence of multiple versions across the various FRS has generated an issue with configuration and version control.

Lastly, the failure to address the enlisted maintenance or other support personnel requirements has been identified as a shortcoming by several units. The length of time required for revised manning requirements to make it through the extended approval and analysis process and eventually result in additional manpower at the unit directly impacts the unit's capacity to produce RFT assets and therefore its annual capacity. This impact is not captured in the existing model.

Future enhancements and modification to the Excel-based PPF resource model stem from these identified shortcomings.

Transition of the Current Excel-based Model to a Web-based Application

This modification will address many of the aforementioned limitations of the current spreadsheet model. Transition to a web-based application will not only facilitate the ability to expand the number of options available for aircraft, simulators, and instructors but simplify the process for addition of the other training resource media such as classrooms, etc. into the PPF computation process. The availability of a web-based application will also simplify configuration control and provide relief from the current requirement for FRS units to maintain numerous versions of various scenarios as separate Excel files.

Transition to a web-based application will also improve the current PPF submission and approval process by eliminating the requirement to transmit multiple electronic or hard copy files between the various commands on the approval chain. This should speed the process and effectively eliminate delays due to lost files or miscommunication.

Work is ongoing on this enhancement with a web-based prototype expected by early Fall 2004.

Modification to Include Enlisted Maintenance and Other Support Personnel

Work is also ongoing in an attempt to identify the requisite algorithms and computations that are necessary to enable the model to address these resources. In addition to identifying the resource requirement, the calculations to permit the model to complete valid and verifiable capacity impacts are also being investigated. Once completed it will document the impacts of maintenance manning levels on capacity and provide increased visibility into the enlisted training process.

SUMMARY

The development and implementation of a standardized, quantitative resource requirements modeling program has enabled Naval Aviation to significantly improve its pilot, NFO, and enlisted aircrew training process management. Through the use of a COTS application, standardized assumptions, and historical data, individual FRS units have the ability to identify specific resource requirements and annual training capacity that are directly linked to their required training throughput. These resource requirements and capacity values are then vetted through an approval process that not only allows sufficient time to potentially mitigate resource and training shortfalls but also effectively synchronize a long lead time, multi-year, training pipeline that extends from initial accession to initial fleet assignment. These improvements have directly resulted in shortened time-to-train, increased student production, and reduced student inventories across the entire aviator training continuum.

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