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THESIS

PROTOTYPING A WEB-ENABLED DECISION SUPPORT SYSTEM TO IMPROVE CAPACITY MANAGEMENT OF AVIATION TRAINING

by

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September 2005

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For organizations with training pipelines, this study offers insight to help identify and minimize undesirable effects which may result from often unavoidable demand variations within a resource and time constrained environment. The highly complex Naval aviation training process is used as a case study. However, any organization with a training pipeline may find this study to be useful. Within a training pipeline, like any resource constrained production line, variability may cause undesirable results to occur. Variability includes any change in the number of students to train, time-to-train, instructor availability, material availability, and other supporting factors. Undesirable effects may include: delayed time-to-train, wasted valuable resources, reduced morale, reduced quality of training, or an increase in undesirable behaviors as a result of perceived production pressures. "Wasted valuable resources" includes human capital, money, material, and time. Although other sources of variability will be discussed, this study will primarily examine the cause and effect relationships resulting from variations in the number of students to train. Potential solutions are explored.

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Gratefully,

Randall Bostick, LCDR, USN

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I. INTRODUCTION

Leaders within the Naval aviation training pipeline have the difficult responsibility of training students on schedule when both the resource availability and the student demand often changes. In the 1990s, unacceptable training delays within the Naval aviation training pipeline needed to be addressed. For this purpose, the Naval Aviation Production Process Improvement (NAPPI) began in 1998 and ultimately resulted in a great improvement in training time (Pittman, 2001). “The scope of the NAPPI effort comprised the entire "Street-to-Fleet" training continuum” (Pittman, 2001, p. 1). Despite the impressive improvements by the Thomas Group, evidence of remaining inefficiencies and bottlenecks within the pipeline created a reason to continue the search for further improvements.

In 2002, a flight training squadron was not completing students within the allotted time-to-train. Their sister squadron, which performed identical training, was in a similar predicament. The training air wing, which owns both squadrons, acted appropriately by asking the question: why were both squadrons unacceptably behind in student production?

The primary factor identified as the cause for diminished student production was that available resources were insufficient to handle the recent increase in the number of students sent into each squadron. Although the “organization” previously knew that the student loading would increase, the “organization” did not understand exactly how student loading would potentially decrease each squadron’s ability to complete students’ training within the allotted time-to-train.

Training resources may be reduced by unpredictable weather, airframe difficulties, or even the flu season. Student training demand may fluctuate as a result of multiple factors including a changing fleet demand. How may the planning process be improved to better predict or avoid training delays in consideration of the complex training environment?

A. BACKGROUND

In 1998, the Navy instituted the NAPPI project in response to six years of failure to produce fleet squadron requirements for first-tour aviators (Pittman, 2001). The three-year-long NAPPI project was implemented to achieve the following goals: (1) reduce time-to-train by 33%; (2) increase the number of pilots and NFOs sent to operational forces; and (3) install an ongoing management process. NAPPI encompasses the entire "Street to Fleet" training concept, beginning from the new aviators commissioning date and ending at the advent of their first fleet squadron assignment.

The efficiency of the Naval aviation training program declined because of an increased number of students and a longer time-to-train. The Navy, primarily due to the personnel and manning decisions, had to reduce their force structure during the years following the Cold War and Desert Storm. In the reduction process, the Navy cut the accessions of new pilots rather than forcing senior pilots into retirement, thus causing a shortage of pilots to meet fleet requirements. Upon discovering this error in force structure, the Navy increased the number of accessions, causing a back up in the training program as students competed for training resources (Pittman, 2001).

NAPPI was structured as a three-year project implemented to make training more efficient. Multiple changes were made to the existing process to decrease the time-to-train by 35 to 40 percent for a maximum of 30 months and optimize the use of training resources. The Navy employed a form of management, adopted from the commercial sector, called Total Cycle Time (TCT). TCT concentrated on processes, methods, culture, metrics, behavior, and strategy to improve efficiency in the training process instead of increasing equipment and people. By identifying and removing barriers, the TCT concept changed the training from several separate processes into a program on a single continuum from commissioning to fleet assignment. A standardized process and key metrics package was installed in order to have a consistent measure across the continuum. A management hierarchy was also put in place to regulate and unify the process. Finally, the Navy developed a coordinated Flow Management Plan to link the phases of the training pipeline (Pittman, 2001).

In order to facilitate this increased coordination, a management structure needed to be established. On the highest level, the Naval Aviator Production Team (NAPT) was formed. The goal of this organization is to view the overall training process in order to make key decisions on process-wide barriers, review performance, and coordinate actions throughout the training pipeline. The NAPT meetings are held monthly via web or video teleconference and semi-annually in person. The next level down is the Cross-Functional Teams (CFTs), comprised of representatives from all the commands involved in the training pipeline. The CFTs meet weekly to coordinate and reduce the time of students between the three phases of the training process (Pittman, 2001). These phases are identified as the accession segment, the formal training segment, and the Fleet Replacement Squadron (FRS) segment.

In order to evaluate this new system a set of key performance metrics was also adopted from the commercial sector called Dynamic Cycle Time (DCT) (Figure 1).

$$DCT = \frac{StudentsInTraining(SIT)orWorkInProgress(WIP)}{ProcessingSpeed(PS)}$$

$$WIP = \frac{BeginningWIP + EndingWIP}{2}$$

$$PS = \frac{InsPerMonth + OutsPerMonth}{2}$$

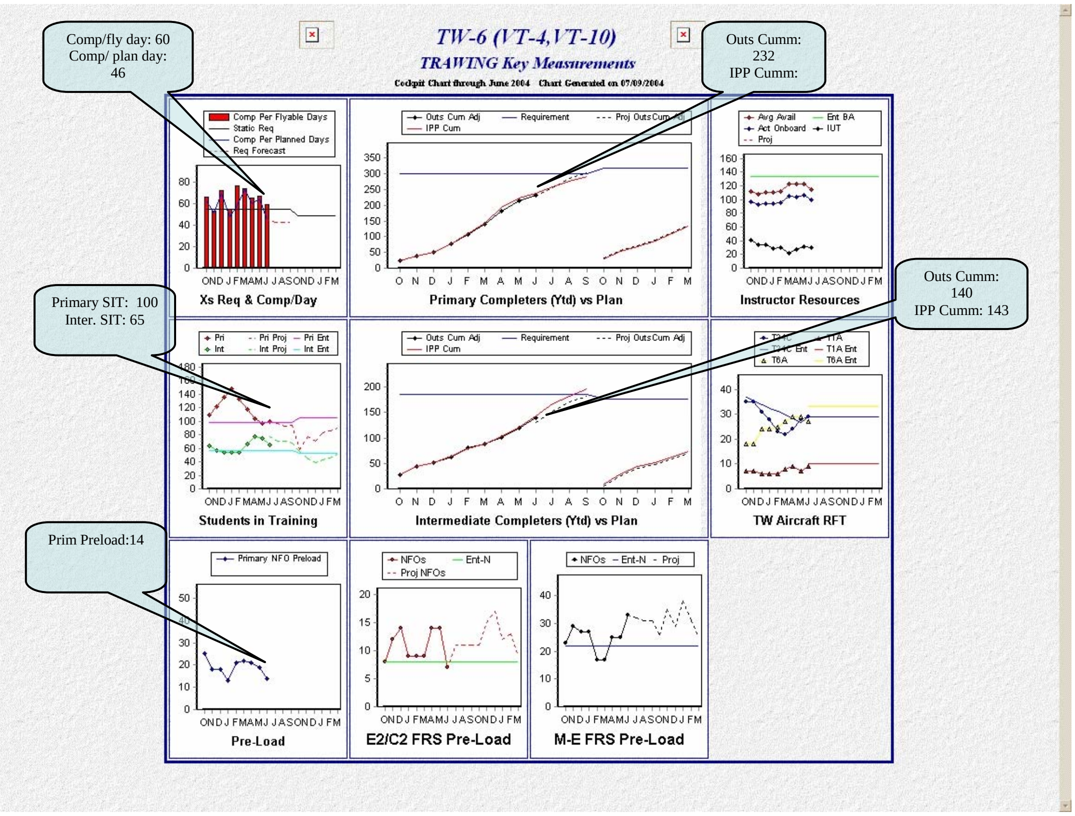
$$DCT = \frac{\frac{BeginningWIP + EndingWIP}{2}}{\frac{InsPerMonth + OutsPerMonth}{2}}$$

$$DCT = \frac{BeginningWIP + EndingWIP}{InsPerMonth + OutsPerMonth}$$

Figure 1. DCT Mathematic Derivation. (After: Thomas Group, Inc., 1997)

The WIP and PS in a training squadron is constantly changing, hence their numerical values are only an approximation based on an average for a reporting period, which is usually a month (Thomas Group, Inc., 1997).

DCT is used to evaluate cycle time to provide the NAPT and CFTs with accurate accounts of the time-to-train newly selected pilots and NFOs within each phase of the training pipeline. These new metrics are a tool that decision makers can use to examine all phases of the training cycle in order to optimize the entire cycle rather than optimizing each individual part. Currently, the Navy uses “Cockpit Charts” (Figure 2) to display all of the metrics gathered (Pittman, 2001). Figure 2 is an image of “Cockpit Charts” as displayed from the NAPP Integrated Production Data Repository (NIPDR) website.



Comp/fly day: 60
Comp/ plan day:
46

Outs Cumm:
232
IPP Cumm:

Primary SIT: 100
Inter. SIT: 65

Outs Cumm:
140
IPP Cumm: 143

Prim Preload:14

Figure 2. Cockpit Charts. (From: Training Air Wing 6, 2004)

These charts are organized in such a way as to facilitate quick interpretations and predictions from the data depicted. By evaluating these data the Navy should be able to assess the required training time for newly selected pilots and NFOs. The charts display the number of students in the training pipeline as well as the use and status of all the training resources. These metrics are suppose to provide the NAPT team with enough data that will enable them to make decisions on how to best optimize the use of planes, instructors, and other training resources within the Naval aviation training pipeline. Therefore, the clogging effect generated by uninformed accession decisions should be reduced.

B. PROBLEM DEFINITION

Avoidable training delays exist within the Naval aviation training pipeline. Delays will result when resources are insufficient to train the given number of students. Unforeseen instances of resource insufficiency may occur due to the dynamics between fluctuating resource availability and the fluctuating number of students to train. How may planning be improved to predict and/or reduce training delays that result from resource constraints?

C. PURPOSE

The purpose of this study is to explore methods for predicting training delays which may result from resource constraints. A prototype Decision Support System (DSS) will be designed to demonstrate that a predictive tool may allow for more efficient planning and use of training resources (capacity) in relation to fluctuating student loading. This web application will produce a graphed projection of one squadron’s ability to meet student training demand based on the following:

1. Estimated future production capacity due to limited resources; and
2. Projected student loading.

In order to accomplish this objective it will be necessary to analyze the training process from Aviation Pre-Flight Indoctrination (API) to FRS and determine the predictive correlations between student loading, time-to-train, and capacity limitations.

D. SCOPE

This study will focus on a subset of the overall Naval aviation training pipeline program. Naval aviation training is composed of two branches, pilot training and Naval Flight Officer (NFO) training. NFO training is centrally located in Pensacola, Florida at Training Air Wing 6 (TRAWING 6), whereas pilot training is not located in one geographic area. Specifically, this research will be an examination of the NFO training branch (Figure 3). Figure 3 is a diagram that illustrates the process flow for NFO training.

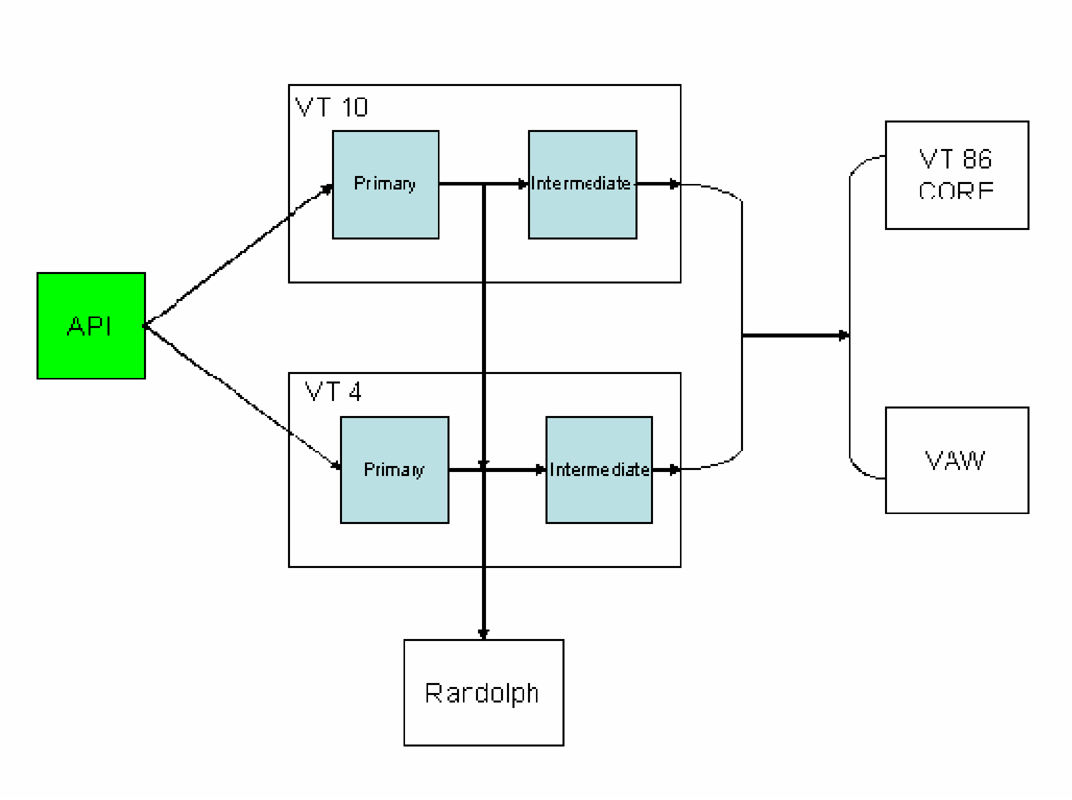


Figure 3. NFO Training Diagram.

The basic NFO training program involves two squadrons at TRAWING 6. Officers arriving from API are initially sent to either Flight Training Squadron (VT) 10 or VT 4. VT 10 and VT 4 perform the same type of training, Primary and Intermediate. Some of the students that finish Primary are diverted from Intermediate in order to start advanced training at Randolph Air Force Base in San Antonio, Texas. Upon completion of Intermediate training, officers are sent to one of two other types of advanced training at either VT 86 or an Airborne Early Warning (VAW) Unit. After these training phases, officers are assigned to a FRS and finally an operational fleet squadron, the end user aviation community. This study will use the phase student training production approach to model the DSS. The purpose of a DSS solution would be highlighting the issue of numbers of students to the squadrons responsible for student training prior to their training class start date. This information is crucial to decision makers' ability to manage student capacity.

E. RESEARCH QUESTIONS

This study is centered on one question. Can a web-enabled database DSS provide decision makers with predictive training pipeline capacity threshold indicators, so they may take preventive actions to minimize capacity-related system inefficiencies? The ability to build upon an existing application platform or develop a new DSS that can perform this function will be the sole determinant of success or failure.

There are supplementary questions that must be posed in order to properly construct this DSS. These questions are as follows:

1. Are student loading fluctuations demand or supply driven?
2. Why is level loading not possible?
3. Is there an alert system currently in place to help decision makers implement preventive actions?
4. Is it possible to start students earlier to take advantage of training resources that would otherwise be wasted?
5. Are resource limitations identical in each training air wing throughout all phases of training?

The above questions will guide the development of the proposed DSS solution.

F. NEED FOR THE STUDY

The objective for this proposed DSS is to aid decision makers in reducing training delays caused by student loading fluctuations. The proposed DSS would be able to predict under-capacity and over-capacity situations. It would also allow for modification of parameters to assist decision makers in determining the best course of action.

1. Direct Benefits

The implementation of this DSS would improve the Naval aviator production system in terms of time and financial resources. Officer time exerted on attempting to resolve production related issues would be reduced using a DSS that accurately identifies problems. The DSS would also reduce Navy funding spent on contractor overtime periods and officer pay.

Contractor overtime periods refer to conducting work during a time period that is considered beyond the normal work hours such as a weekend or evening. Some contracts establish a baseline monthly hourly usage. When usage goes above that amount, the Navy pays some percentage above that standard amount. Maintainers, civilian pilots, and simulator instructors are all paid overtime in this manner. Overtime usage would decrease because workload surges caused by peaks in student loading fluctuations would be reduced.

In addition, student officers would spend less time in the training pipeline. This translates into officer pay funding savings due to the reduced time required for officers to complete aviation training. Hence, officer pay is being appropriated for time periods actually spent training and less for time periods awaiting training.

2. Generic Application

The Literature Review chapter will show that the need for effective tools to manage human resources is not isolated to Naval aviation training. Also, the complexity and extent of a problem may require the integration of multiple DSSs. Therefore, the prototype DSS being developed in this study has potential use in other fields and with other DSSs.

G. STUDY OVERVIEW

The study’s purpose is to analyze the current Naval aviation training capacity management system in order to design a prototype web application that can provide managers with the pertinent information to mitigate problems related to training capacity inefficiencies. This study will require the development of an automated tool that can predict the following:

1. Training phase capacity limitations;

2. The probability of on-time completion for students to flow through the training pipeline based on training phase capacity limits and predicted student loading; and

3. The effects of operational decisions by changing variables such as student loading and training phase capacity.

Therefore, the technologies that will be best suited for designing the prototype DSS will have to be determined.

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II. LITERATURE REVIEW

The problem cited in this study is not isolated to only the Naval aviation community. Comparable situations can be identified within other branches of the military and the private sector. A few of these pertinent studies are delineated in the next two sections.

A. RELATED MILITARY STUDIES

In March of 2000, Joseph Grant conducted a study on “Minimizing Time Awaiting Training [MTAT] for Graduates of the…” Marine Corps Basic School (TBS). The purpose of Grant’s study was to develop a desktop computer model

> …that optimally distributes military occupational specialty quotas to all fiscal year Basic School companies and minimizes the time spent waiting by officers between graduation and the start of their occupational school; while also providing maximum equity of opportunity for all officers to seek any of the twenty-one military occupational specialties [MOSs] (Grant, 2000, p. v).

MTAT model runs exhibited “a total time savings ranging from a high of forty-five man years, to a low of twenty man years” (Grant, 2000).

The MTAT model was built with the General Algebraic Modeling System Software (Grant, 2000). Decision makers are able to use this model for executing various manpower scenarios by changing the following parameters:

1. Total number of TBS graduates per company;
2. Graduation dates for TBS companies;
3. Total yearly requirements for each MOS;
4. Minimum number of Marines with specific MOSs desired from each TBS company;
5. Maximum number of Marines with specific MOSs desired from each TBS company;
6. MOS class start date; and
7. MOS class seat capacity (Grant, 2000).

Additionally, the MTAT model employs parameter constraint mechanisms that will initiate a negative result once a threshold has been exceeded by running a particular scenario. For instance,

> …the model might determine the need to graduate a large number of officers early from TBS in order to meet MOS school start dates and reduce P2T2 [Prisoners, Patients, Trainees, and Transfers]. If graduating a large number of officers early from TBS creates an administrative burden on TBS, decision makers can quickly modify the model’s proposed solution. They can easily increase the penalty for graduating early as well as tighten the constraint on the number of days allowed to leave early (Grant, 200, pp. 49-50).

Thus, decision makers can determine the appropriate implementation of manpower policy by reviewing its impact using the MTAT computer model, which can run a scenario in two minutes.

B. RELATED NON-MILITARY STUDIES

In 2002, Pei-Shun Ho and Amy Trappey conducted a study to develop an intelligent distribution center (DC) human dispatching system for improving operational time and cost efficiency in order to meet low cost and fast delivery customer service demands. This required the integration of multiple DSS modules. One of these modules was a dispatching algorithm that mimicked the “…environment for assigning order-picking jobs to personnel resource” (Ho & Trappey, 2002, p. 64). “In DC operations, order-picking often commands 60 percent of a DC's labor force” (Ho & Trappey, 2002, p. 71). Hence, this module is a critical component to the overall DC system. The order-picking process is comprised of four major steps (Ho & Trappey, 2002). They are the following:

1. Managing the on-line data;
2. Dividing the orders into order-picking lists;
3. Dispatching human resource to the order-picking lists; and
4. Measuring worker’s performance in order-picking processes (Ho & Trappey, 2002).

In order to design a system to perform the above tasks, rules were established for the following:

1. Picking-list dividing;
2. Volume and weight distribution;
3. Vehicle assignment; and
4. Worker versus (vs.) workloads assignment (Ho & Trappey, 2002).

The objective for this order-picking module output is "…to ensure all workers have equivalent and adequate workload…" (Ho & Trappey, 2002, p. 64). These objectives were accomplished by instituting the following system heuristics for the assigning of operators:

> 1. Input the basic volume that one operator can pick each day, which establishes the basic volume capacity per operator.
>
> 2. Calculate total volume of all orders, and divide total order volumes by the basic volumes. Then, the required number of operators is approximately calculated.
>
> 3. Receive each order volume one by one. When the total amount of volume exceeds the basic volume, the order is still to be assigned to the current worker. However, the next order is assigned to the next worker in line. Thus, all operators' workload is controlled in an acceptable level (Ho & Trappey, 2002, pp. 69-70).

Another feature included in this module is an administrator capability that dynamically assigns replacement workers when individuals are absent (Ho & Trappey, 2002).

There is also a transportation module within the DC system. This component was designed for utilizing a truck as the mode of transportation. The heuristics for this module are based on two factors, truck capacity and service region (Ho & Trappey, 2002). For example,

> If the next order was put on the truck and the total volume exceeded the limit of the truck, this order would be transferred to the other truck. In the case of an urgent situation, a mobility function is set for backup. Every region has a specific truck for transferring urgent orders only (Ho & Trappey, 2002, p. 71).

This study focused on a manpower-intensive distribution center (Ho & Trappey, 2002). Business-Process Reengineering (BPR) was a key methodology used in the development of this DC human dispatching system. BPR requires an organization to scrutinize their entire processes, and then derive a means for improving the efficacy of those institutional processes. This methodology has a direct correlation to determining the appropriate application heuristics.

In February 1998, Henderson wrote about Computer Applications for Logistics, Engineering, and Business (CALEB) Technologies development of a comprehensive DSS, RecoverySuite, for Continental Airlines. There are three modules that comprise the RecoverySuite DSS. The CrewSolver system is one of the three DSS modules.

CrewSolver is a real-time management tool designed to optimally distribute flight crews during irregular operations, “enabling rapid recovery to the original crew schedule” (Navitaire, 2004). According to Anna White, director-crew systems/planning at Continental, CrewSolver was projected “to save her airline $2 million a year by optimizing redeployment of flight crews when weather or unplanned events upset daily operations” (Henderson, 1998, p. 102).

> The CrewSolver system’s solutions are calculated to comply with—and as part of the solution process are checked against—government legalities, contract obligations, specific crew qualifications, and company business rules. The CrewSolver system maintains a complete real-time view of airline operations 24/7. An in-memory database contains up-to-the-minute information on cancellations, diversions, delays, equipment swaps, crew schedules, and flight arrival and departure times. Similarly, up-to-date information is maintained for cities and stations, equipment, legalities, and qualifications. As crews are disrupted, the CrewSolver system returns one or more low-cost, least-disruptive crew solutions within the parameters chosen (Navitaire, 2004).

III. METHODOLOGY

The Business-Process Reengineering (BPR) methodology was selected to gain understanding of the current process, identify beneficial process changes and potential implementations. The Spiral Model was selected for the information technology development approach.

BPR is generally defined as the analysis and design of workflows and processes within and between organizations. Electronic (E)-Business solutions work well in geographically dispersed organizations. BPR for e-business was considered to be a potentially good match for the geographically dispersed Naval aviation training pipeline. According to Omar El Sawy (2001), “BPR for e-business involves rethinking and redesigning business processes at both the enterprise and supply chain level to take advantage of Internet connectivity and new ways of creating value” (p. 7). In this context, business process refers to “a coordinated and logically sequenced set of work activities and associated resources that produce something of value to a customer” (El Sawy, 2001, p. 16). The BPR methodology provided the best means for designing a robust process model for the Decision Support System (DSS). BPR requires the defining of an “as-is” process model, the analysis of this model, and the redesign of the “as-is” model for the formulation of a “to-be” model.

El Sawy describes the BPR as being achieved in three phases: (1) a scoping phase; (2) a modeling, analysis, and redesign phase; and (3) a planning process integration phase. A Knowledge-Value-Added (KVA) analysis was used within the second BPR phase to provide metrics for determining and ranking areas of improvement.

> The knowledge-value-added (KVA) methodology addresses a need long recognized by executives and managers by showing how to leverage and measure the knowledge resident in employees, information technology, and core processes. KVA analysis produces a return-on-knowledge [ROK] ratio to estimate the value added by given knowledge assets regardless of where they are located. This translation allows allocation of revenue in proportion to the value added by knowledge as well as the cost to use that knowledge (Bell & Housel, 2001, p. 91).

KVA recognizes that all processes implement a definable amount of knowledge. Knowledge is either implemented by a person or a machine as in for the form of software, for example. Embedding knowledge into a process has a definable cost and using the knowledge in a process has a definable cost. The relative cost metrics which result from KVA allow leaders to see where valued knowledge resides and to then consider how processes may be improved to minimize cost by maximizing the knowledge invested. For aviation training, the existing processes were examined to determine if there were ways to better use the human capital by automating some production related functions being performed by flight instructors as a part of their collateral duties.

The Spiral Software Development Model was selected because it recognizes that requirements change during the development process and encourages a customer-centric approach to software design. According to Barry Boehm (1988), the unique aspect of Spiral Software Development Modeling "…is that it creates a risk-driven approach to the software process rather than a primarily document-driven or code-driven process. It incorporates many of the strengths of other models and resolves many of their difficulties" (p. 61).

A standard cycle for Spiral-Modeling will begin with identifying the following: (1) objectives; (2) alternative means of implementation; and (3) constraints (Boehm, 1988). The subsequent steps are the evaluation of "alternatives relative to the objectives and constraints" and "the formulation of a cost-effective strategy for resolving the sources of risk" (Boehm, 1988, p. 65). This analysis determines the actual procedural development for an application, which may require an evolutionary approach (i.e., prototypes).

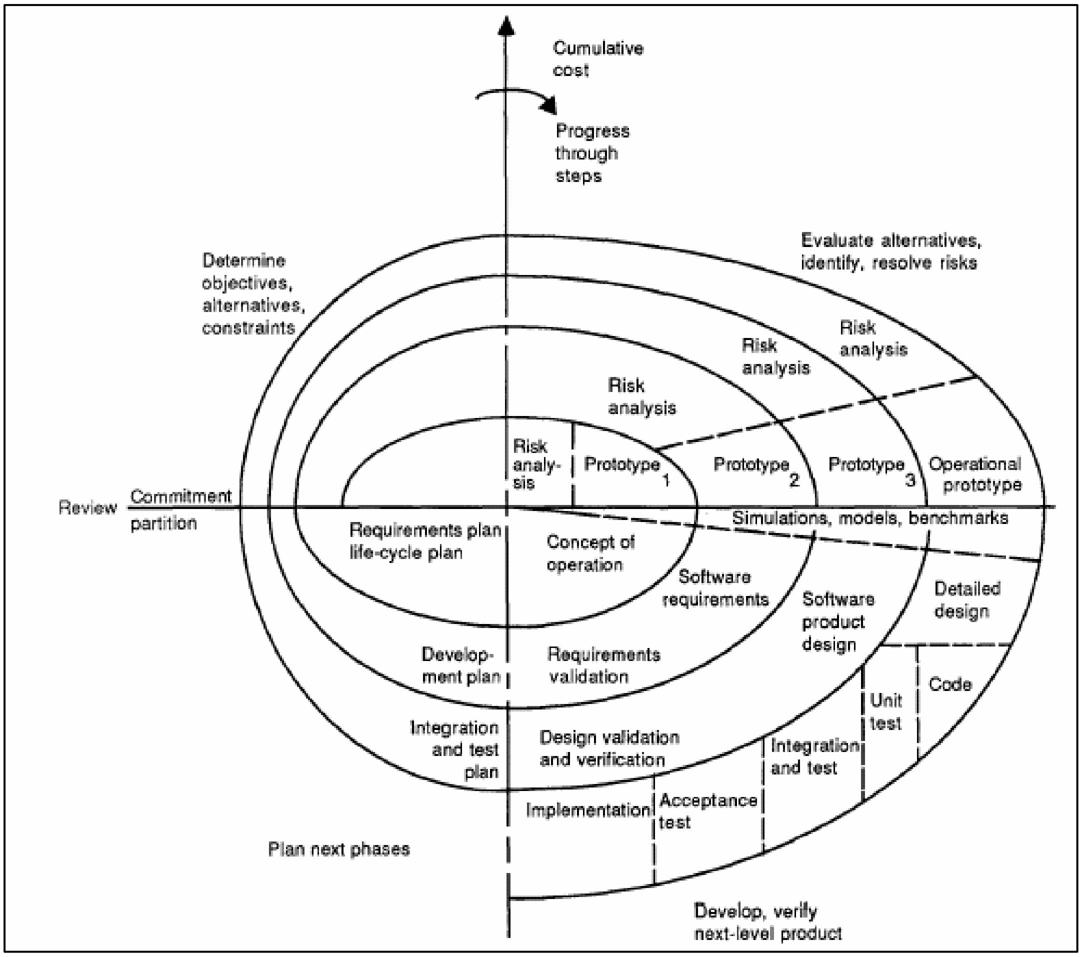

Figure 4. Spiral Software Development Model. (From: Boehm, 1988)

There is a common element that BPR, KVA, and Spiral-Modeling share. All require the participation of the primary people from the organization that the process or application is being built for use. This involvement ensures that all parties are in agreement, which mitigates the design team from going in the wrong developmental direction.

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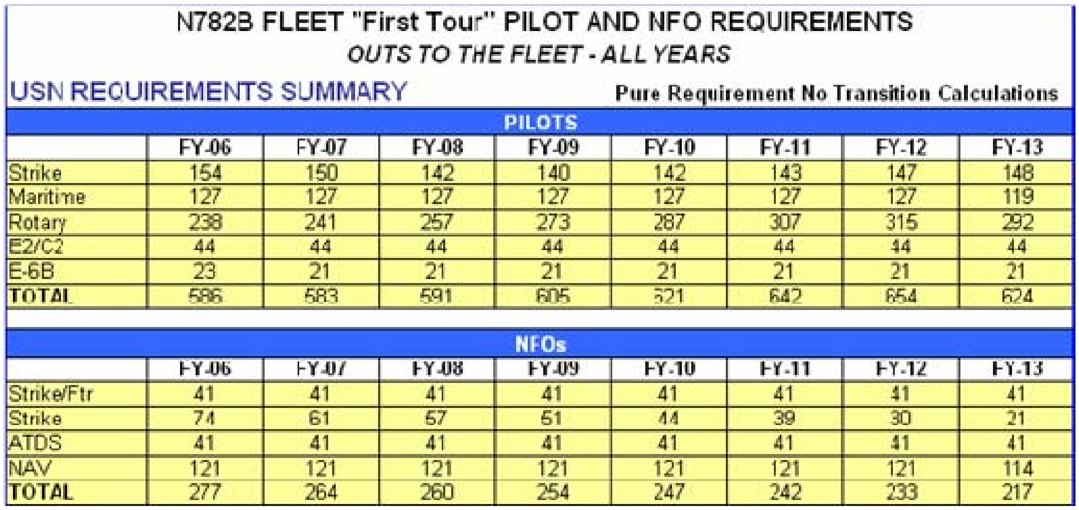
IV. THE "AS-IS" MODEL

A. CURRENT SITUATION DECISION-MAKING PROCESS

This chapter is a general overview of the current decision-making process related to pilot and Naval Flight Officer (NFO) production. The information provided in this chapter was obtained through a questionnaire (Appendix B), face-to-face interviews, phone conversations, and e-mail exchanges with individuals who work in production at the Chief of Naval Air Training (CNATRA) and Training Air Wing (TRAWING) 6. The current pilot and NFO production decision-making process is as follows:

1. The process begins with the delivery of the Office of the Chief of Naval Operations (OPNAV) "Fleet First Tour Pilot and NFO Requirements" document (Figure 5). CNATRA, the Aviation Community Manager for the Navy, and the Fleet Replacement Squadrons (FRSs) use this document to prepare the Integrated Production Plan (IPP) for the training air wings. This plan outlines the student "Planned Ins" and "Planned Outs" for each phase of Naval aviation training for the next fiscal year in order to meet the OPNAV fleet requirements. The IPP (Figure 6) required student delivery times for each phase of training is determined by subtracting training times and accounting for real-time information from Aviation Pre-Flight Indoctrination (API).



N7823 FLEET "First Tour" PILOT AND NFO REQUIREMENTS

OUTS TO THE FLEET - ALL YEARS

USN REQUIREMENTS SUMMARY **Pure Requirement No Transition Calculations**

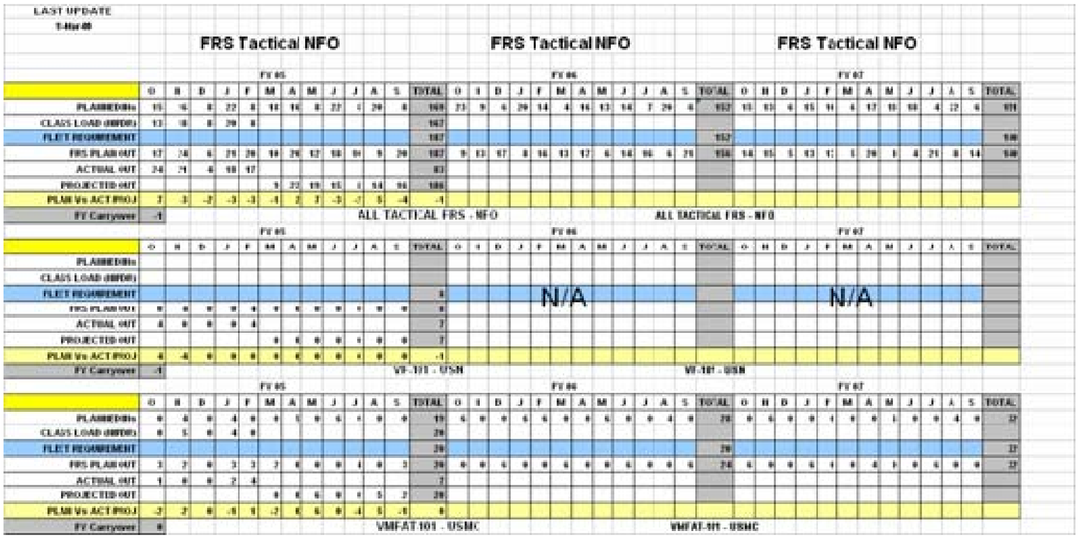
PILOTS

	FY-06	FY-07	FY-08	FY-09	FY-10	FY-11	FY-12	FY-13
Strike	154	150	142	140	142	143	147	148
Maritime	127	127	127	127	127	127	127	119
Rotary	238	241	257	273	287	307	315	292
E2/C2	44	44	44	44	44	44	44	44
E-6B	23	21	21	21	21	21	21	21
TOTAL	586	583	591	605	521	642	654	624

NFOs

	FY-06	FY-07	FY-08	FY-09	FY-10	FY-11	FY-12	FY-13
Strike/Ftr	41	41	41	41	41	41	41	41
Strike	74	61	57	51	44	39	30	21
ATDS	41	41	41	41	41	41	41	41
NAV	121	121	121	121	121	121	121	114
TOTAL	277	264	260	254	247	242	233	217

Figure 5. OPNAV Air Warfare Requirements Document. (From: CNATRA, 2005)



LAST UPDATE
1-Mar-05

FRS Tactical NFO | FRS Tactical NFO | FRS Tactical NFO

	FY 05													FY 06													FY 07												
	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL
PLANNED BIs	15	16	8	22	8	18	16	8	22	1	20	8	169	23	9	6	20	14	4	16	13	14	7	20	8	152	13	13	6	15	11	6	17	11	18	4	22	6	151
CLASS LOAD (MFDR)	13	16	8	20	8								167																										
FLEET REQUIREMENT													167													152													150
FRS PLAN OUT	17	24	6	21	20	18	26	12	18	10	9	20	182	9	13	17	8	16	13	17	6	14	16	6	21	156	14	15	5	13	12	5	20	1	4	21	8	14	150
ACTUAL OUT	24	21	6	18	17								83																										
PROJECTED OUT						9	22	19	15	1	14	16	186																										
PLAN Vs ACT PROJ	7	-3	-2	-3	-3	-1	2	3	-3	-2	5	-4	-1																										
FY Carryover	-1												ALL TACTICAL FRS - NFO													ALL TACTICAL FRS - NFO													

	FY 05													FY 06													FY 07												
	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL
PLANNED BIs																																							
CLASS LOAD (MFDR)																																							
FLEET REQUIREMENT													8					N/A														N/A							
FRS PLAN OUT	0	0	0	0	4	0	0	0	0	0	0	0	8																										
ACTUAL OUT	4	0	0	0	4								7																										
PROJECTED OUT						0	0	0	0	0	0	0	7																										
PLAN Vs ACT PROJ	4	-4	0	0	0	0	0	0	0	0	0	0	-1																										
FY Carryover	-1												VF-101 - USN													VF-101 - USN													

	FY 05													FY 06													FY 07												
	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL
PLANNED BIs	0	4	0	4	0	0	5	0	6	1	0	0	19	6	0	0	6	6	0	0	6	0	0	4	0	28	0	6	0	0	1	0	0	1	0	0	4	0	22
CLASS LOAD (MFDR)	0	5	0	4	0								28																										
FLEET REQUIREMENT													28													28													22
FRS PLAN OUT	3	2	0	3	3	2	0	0	0	1	0	3	28	0	0	6	0	0	6	6	0	6	0	0	6	28	6	0	0	6	1	0	4	1	0	6	0	0	22
ACTUAL OUT	1	0	0	2	4								7																										
PROJECTED OUT						0	0	6	0	1	5	2	28																										
PLAN Vs ACT PROJ	-2	2	0	-1	1	-2	6	6	0	-1	5	-1	0																										
FY Carryover	0												VMFAT101 - USMC													VMFAT-101 - USMC													

Figure 6. IPP Screenshot. (From: CNATRA, 2005)

2. Newly commissioned Navy officers selected for aviation are first sent to Introductory Flight Screening (IFS). IFS is used to determine if the individuals selected for Naval aviation have the "skills and attributes necessary to successfully complete Navy primary flight training" (IFS, 2005).

3. Students who complete the IFS program requirements will report to API, and the API production manager (API-PM) asks the wings how many bodies they will need for each class and when. The API-PM then starts the number of student NFOs (SFO) and student pilots (SP) as he believes necessary to fulfill the delivery requirements.

4. The wing production managers (W-PM) decide how many students in each class they will need from API based on the FRS class start dates. They take the FRS class start dates, subtract the required training time, and determine when and how many students will need to begin training at the training squadrons within the wing in order to meet the OPNAV fleet requirements. Once students arrive from API, they wait until the next squadron class begins (API classes start each week, squadron classes start every two weeks at TRAWING 6). The wing monitors the squadrons' delivery schedule and notifies them when they are behind.

5. Training squadrons are assigned students by the wing. The squadron production manager (S-PM) then decides which classes should be given priority when resource constraints prevent student classes from proceeding as planned. Priority is often based on First-In, First-Out (FIFO), but the S-PM controls the flow of students through the training phases within the squadron.

Figure 7 is a depiction of the overall process flow for Naval aviation training.

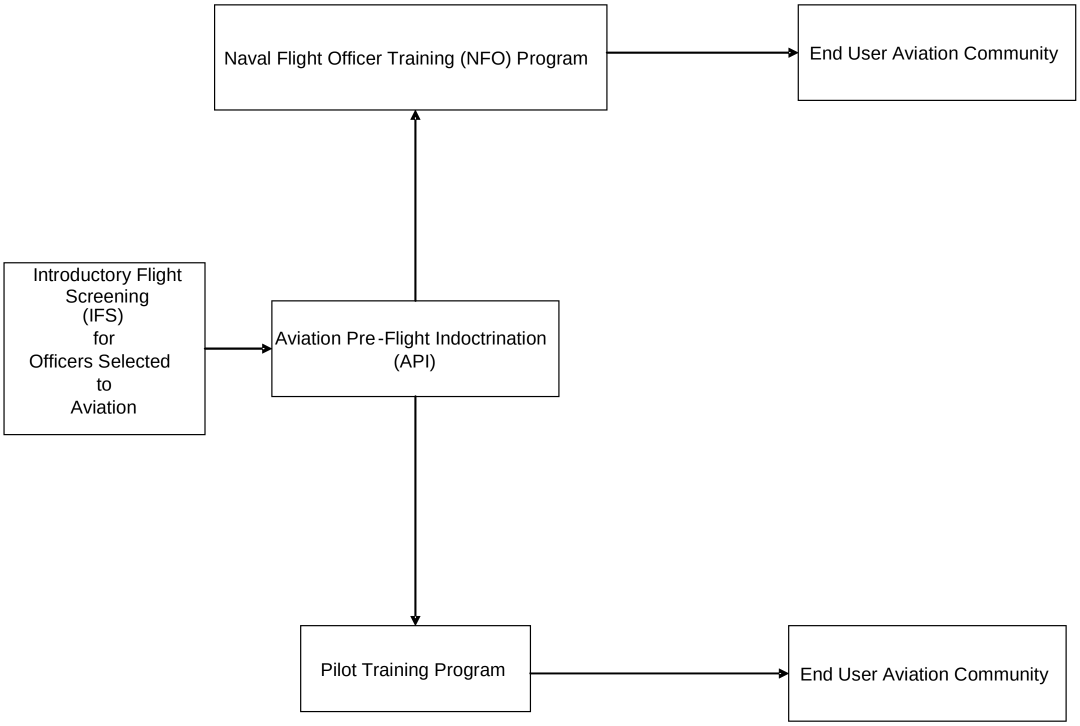

Naval Flight Officer Training (NFO) Program
End User Aviation Community
Introductory Flight Screening (IFS) for Officers Selected to Aviation
Aviation Pre-Flight Indoctrination (API)
Pilot Training Program
End User Aviation Community

Figure 7. Naval Aviation Training Flow Diagram.

Based upon one of the author's personal experience with NFO production issues at Flight Training Squadron (VT) 10 within TRAWING 6, the major concerns with the current system are:

1. It does not address wasted capacity and over-capacity related issues due to student loading fluctuations.

2. It does not effectively integrate horizontal production-related decision making across squadrons.

3. It highlights problems and does not offer solutions.

4. The current metrics are not suitable predictors or decision enablers.

B. CURRENT SITUATION DECISION-MAKING TOOLS

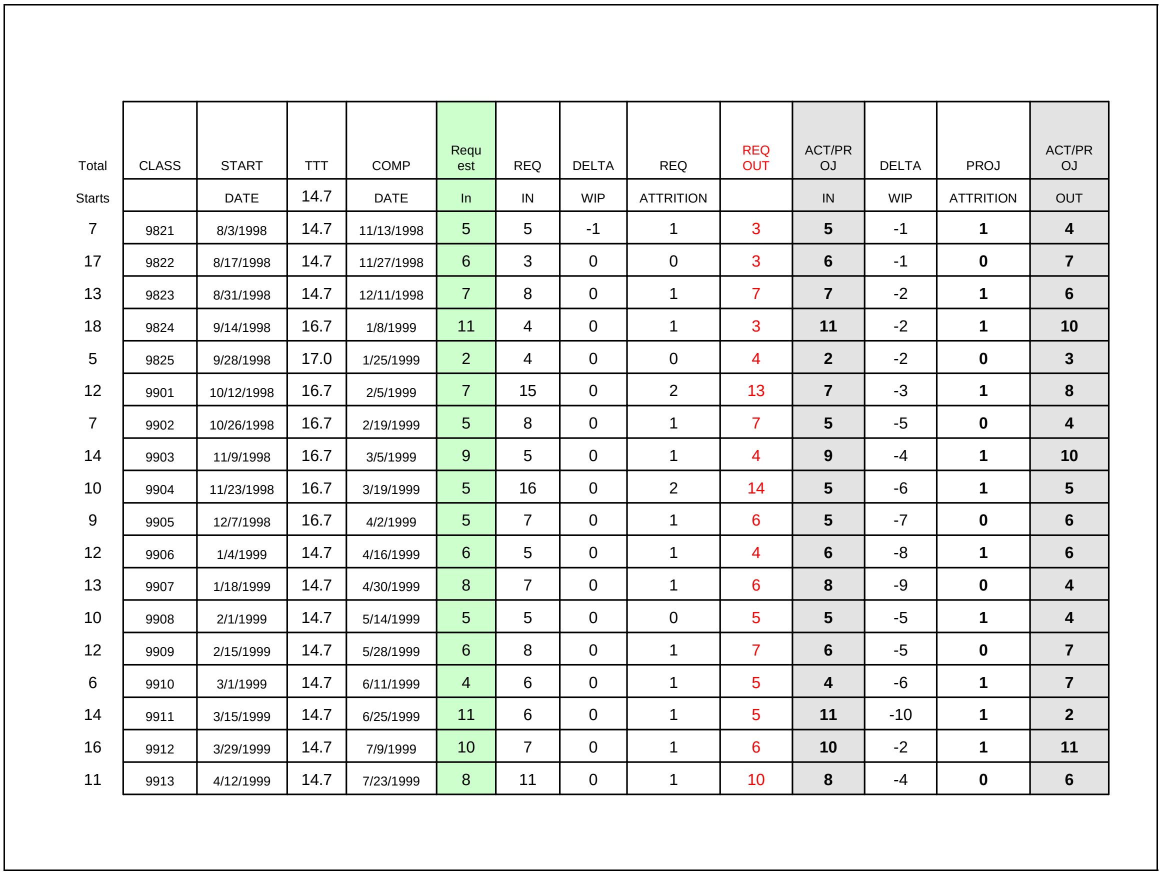
There are two primary production tools that are used within TRAWING 6. One is the "Cockpit Charts", which are used throughout Naval aviation training. The second, a TRAWING 6 specific module, is called the "Fridge Tool."

The "Cockpit Charts" are an effective way of seeing if enough students have been produced for a designated time period and if a squadron is on track to produce enough students for the year. The difficulty arises when one is required to interpret the data for making future decisions. Although it clearly indicates past performance, it does not offer recommendations for improving production. The predictive value offered by this tool is based upon the reader's interpretation of data trends.

The "Fridge Tool" (Figure 8), built on top of the Microsoft Excel application, is used to implement a "pull" or Just-In-Time (JIT) production economic system. According to Bonney (1999), Lee stated that in a "pull" system the following occurs:

> Activities at the process station are triggered by depleted output kanban stock at the process stations. Each depleted kanban [Kanban is the Japanese word for signal (The Hands-On Group, 2005).] stock constitutes a queue unit at the station. Before a job can be loaded a check is made to ensure that the precedence constraint is satisfied; that is there must be sufficient inventory in the output kanban stock of the upstream processes of that job. If so, a draw is made from the output kanban stock. Should this cause the output kanban stock to fall below the re-order level, the job is queued at that station (p. 54).

Now, the main purpose of the "Fridge Tool" is to compute the number of students that start each class for a TRAWING 6 training phase and the number of students that start classes for follow-on training phases supplied by TRAWING 6. It is based on the IPP spreadsheet data. In other words, the IPP states the number of first-tour pilots and NFOs required by the fleet and when they have to be completed with training in order to arrive at their fleet billet on time. The “Fridge Tool” recursively interprets the IPP data in order to provide NFO training phase class start dates and class sizes based upon scheduled training times, projected training phase attrition rates, and user knowledge expertise of the appropriate number of students to load in each phase of training.



Total	CLASS	START	TTT	COMP	Requ est	REQ	DELTA	REQ	REQ OUT	ACT/PR OJ	DELTA	PROJ	ACT/PR OJ
Starts		DATE	14.7	DATE	In	IN	WIP	ATTRITION		IN	WIP	ATTRITION	OUT
7	9821	8/3/1998	14.7	11/13/1998	5	5	-1	1	3	**5**	-1	**1**	**4**
17	9822	8/17/1998	14.7	11/27/1998	6	3	0	0	3	**6**	-1	**0**	**7**
13	9823	8/31/1998	14.7	12/11/1998	7	8	0	1	7	**7**	-2	**1**	**6**
18	9824	9/14/1998	16.7	1/8/1999	11	4	0	1	3	**11**	-2	**1**	**10**
5	9825	9/28/1998	17.0	1/25/1999	2	4	0	0	4	**2**	-2	**0**	**3**
12	9901	10/12/1998	16.7	2/5/1999	7	15	0	2	13	**7**	-3	**1**	**8**
7	9902	10/26/1998	16.7	2/19/1999	5	8	0	1	7	**5**	-5	**0**	**4**
14	9903	11/9/1998	16.7	3/5/1999	9	5	0	1	4	**9**	-4	**1**	**10**
10	9904	11/23/1998	16.7	3/19/1999	5	16	0	2	14	**5**	-6	**1**	**5**
9	9905	12/7/1998	16.7	4/2/1999	5	7	0	1	6	**5**	-7	**0**	**6**
12	9906	1/4/1999	14.7	4/16/1999	6	5	0	1	4	**6**	-8	**1**	**6**
13	9907	1/18/1999	14.7	4/30/1999	8	7	0	1	6	**8**	-9	**0**	**4**
10	9908	2/1/1999	14.7	5/14/1999	5	5	0	0	5	**5**	-5	**1**	**4**
12	9909	2/15/1999	14.7	5/28/1999	6	8	0	1	7	**6**	-5	**0**	**7**
6	9910	3/1/1999	14.7	6/11/1999	4	6	0	1	5	**4**	-6	**1**	**7**
14	9911	3/15/1999	14.7	6/25/1999	11	6	0	1	5	**11**	-10	**1**	**2**
16	9912	3/29/1999	14.7	7/9/1999	10	7	0	1	6	**10**	-2	**1**	**11**
11	9913	4/12/1999	14.7	7/23/1999	8	11	0	1	10	**8**	-4	**0**	**6**

Figure 8. Fridge Tool. (From: TRAWING 6, 2004)

In addition to the complexity of interpreting a large Excel spreadsheet as shown in Figure 7, the “Fridge Tool” cannot predict training time increases. Therefore, class start times are not adjusted for those situations and some students finish training late. These are not the only difficulties that exist with using this tool.

Also, the “Fridge Tool” does not predict loading fluctuations on a scale that correlates to a squadron’s production ability. For example, it would not raise a flag if student loading into a squadron increased by 15% over a 12-week period. It is solely up to the person entering the data to make that trend assessment, which depends on the user's experience and training.

C. CURRENT SITUATION DATA ANALYSIS

The initial training for pilots and NFOs is composed of two phases, Primary and Intermediate. Primary is the only training phase that is relatively indistinguishable across the five training air wings responsible for aviation training under the Department of the Navy (DoN). Figure 9 plots the total number of students that started in six classes of VT 10 Primary Training over five fiscal years versus (vs.) the number of students that became held up or pooled within VT 10 Primary Training for those same fiscal years, also called the Delta-Work-In-Progress (WIP). The six classes being compared all compete for the same training resources, primarily aircraft flights.

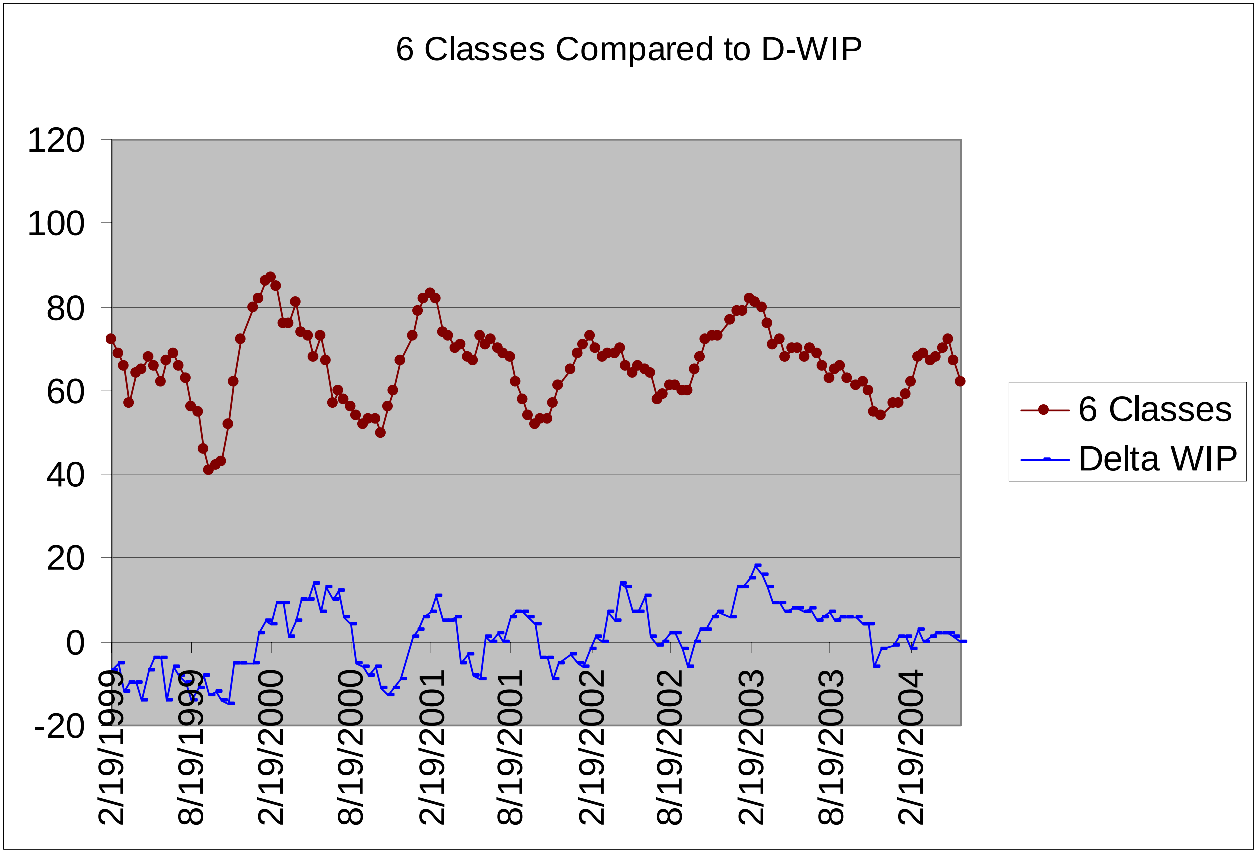


Figure 9. VT Students In vs. Delta WIP Plot.

Based upon the graphical display (Figure 9) of the VT 10 Primary Training Phase from the data delineated in Appendix A, the following empirical observations were made:

1. Student loading fluctuations contribute greatly to Delta WIP fluctuations, and those fluctuations appear to have an annual pattern. Graphing the same data using a monthly scale for the x-axis appears to show that student loading peaks around February (Appendix A).

2. It appears once student loading goes above 40, training resources become maxed out and students will begin falling behind, meaning Delta WIP increases.

3. There also exists periods where training resources are wasted due to having a less than optimum number of students in the training pipeline. Plot suggests that constant student loading over time would significantly improve student throughput due to more efficient use of training resources.

In a collaborative effort between the Naval Postgraduate School (NPS) and the Air Force Institute of Technology (AFIT), Scott Thatcher, a United States Air Force (USAF) Major, developed an Arena model that simulates the current NFO student training flow (2005). Major Thatcher was able to use his model to generate a year’s worth of data that could be compared with data from the actual NFO training system (2005). The following graph (Figure 10) displays his findings:

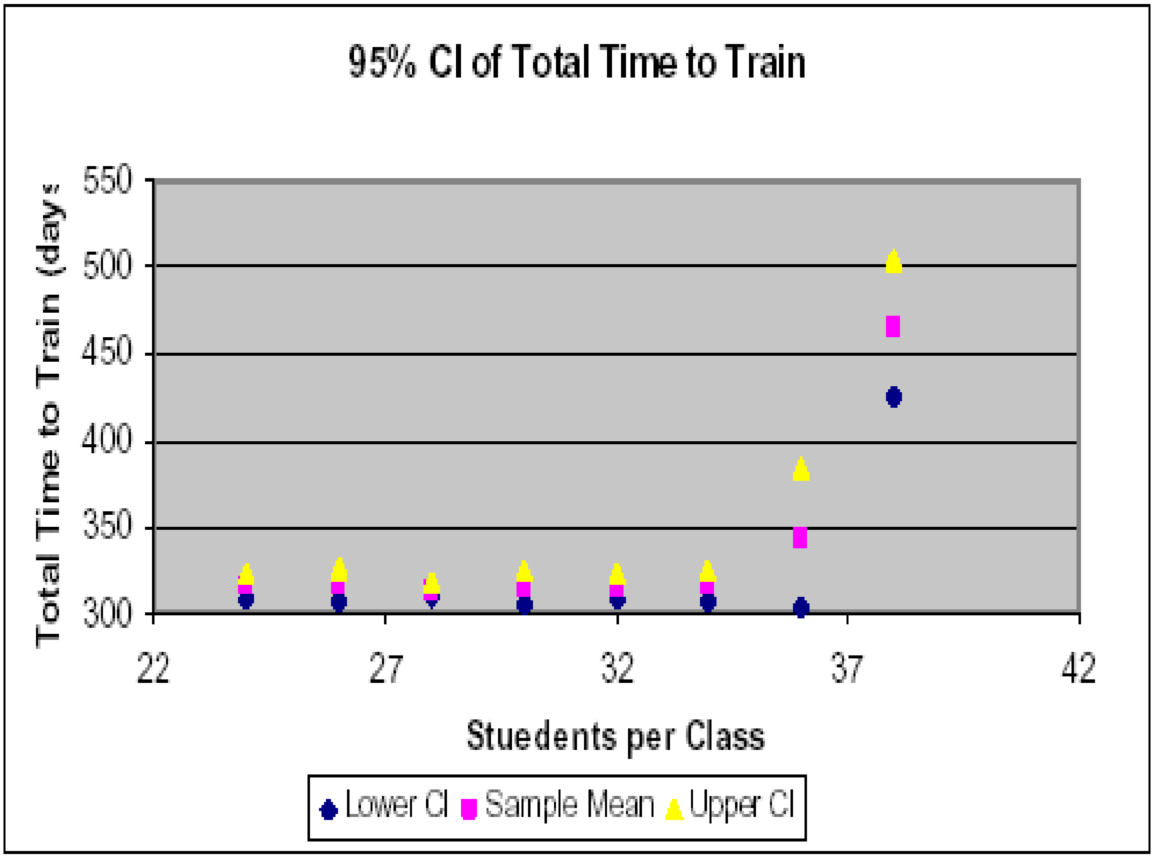


Figure 10. NFO Student Training Flow. (From: Thatcher, 2005)

The data graphed substantiate there is a "departure from efficient production when the system is overloaded" based on the total time required for student training (Thatcher, 2005). This fact is depicted at the data points "between 36 students per class and 38 students per class," which show the "Total Time to Train" increasing as opposed to remaining constant (Thatcher, 2005). This illustrates the impact of an increase between classes that is two students per class multiplied by 52 classes per year, which equates to "a total of 104 students added to the system" (Thatcher, 2005). The statistical analysis conducted by Major Thatcher supports the argument that increases in time-to-train are due in part to the number of students per class.

D. THE "AS-IS" PROCESS MODELS WITH KVA ANALYSIS

The "as-is" process model for Naval aviator training phase production capacity planning was developed in essentially two steps. The first step involved an initial draft

(Figure 11) based on one of the author's experience as chief of production at a NFO training squadron in Pensacola, Florida and phone conversations as well as e-mail exchanges between the authors and the CNATRA and the TRAWING 6 Production and Planning Departments.

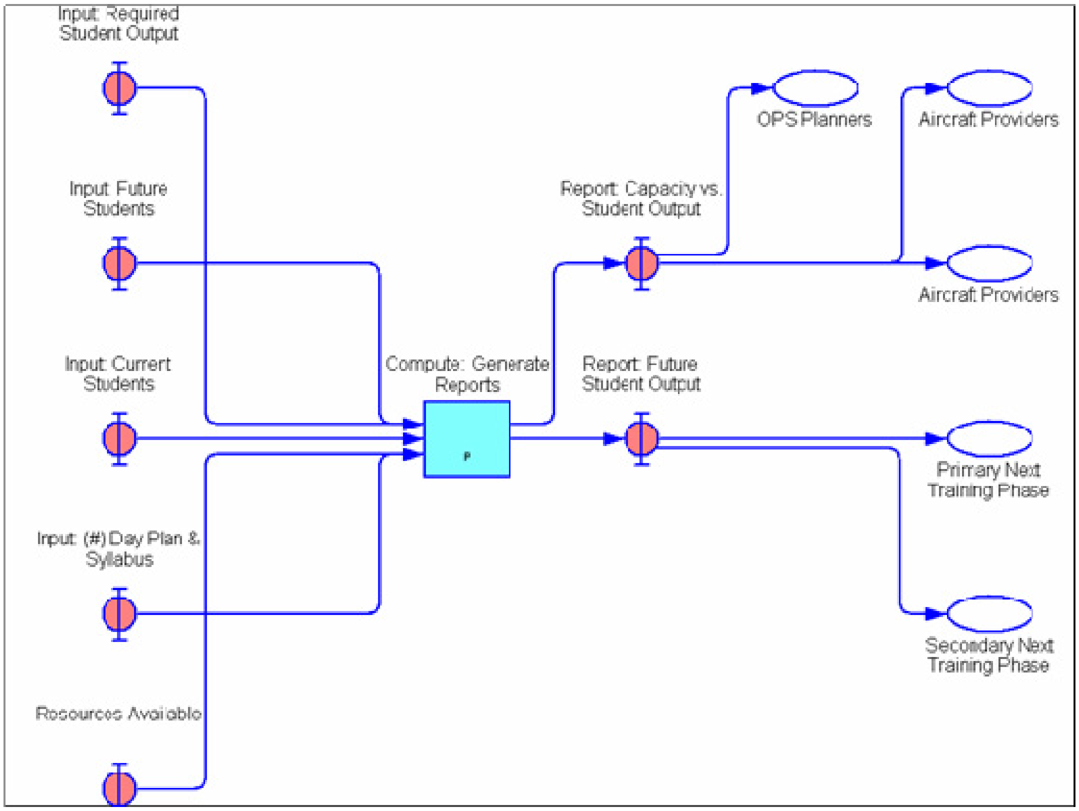

Input: Required Student Output
Input: Future Students
Input: Current Students
Input: (#) Day Plan & Syllabus
Resources Available
Compute: Generate Reports
P
Report: Capacity vs. Student Output
Report: Future Student Output
OPS Planners
Aircraft Providers
Aircraft Providers
Primary Next Training Phase
Secondary Next Training Phase

Figure 11. Theoretical "AS-IS" Process Model.

Figure 11 shows the basic data and information flow that would be necessary to perform the following tasks:

1. Generate a report or computer screen display for the planners and support elements involved in each phase of aviation training.

2. Transmit the future student output data from one phase of training to those responsible for follow on phases of training, so next phase planners and support elements can determine whether they have the capacity to train the number of students being sent by the previous training phase.

The second step involved revisions to the initial “as-is” process model based on face-to-face interviews conducted with persons in the TRAWING 6 Production and Planning Office and the TRAWING 6 squadron operation offices. The information obtained from these interviews led to the design of the two disjoint “as-is” process models (Figures 12 and 13):

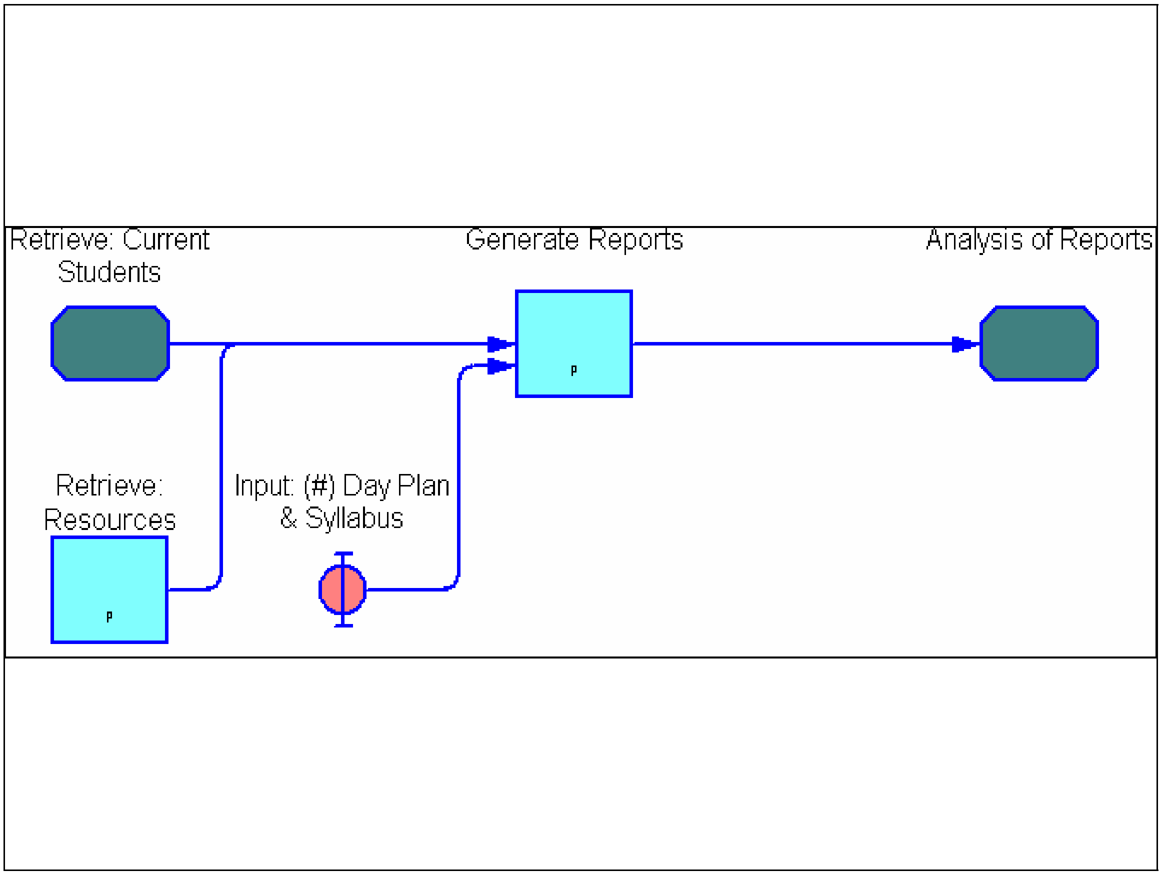


Figure 12. Squadron “AS-IS” Process Model.

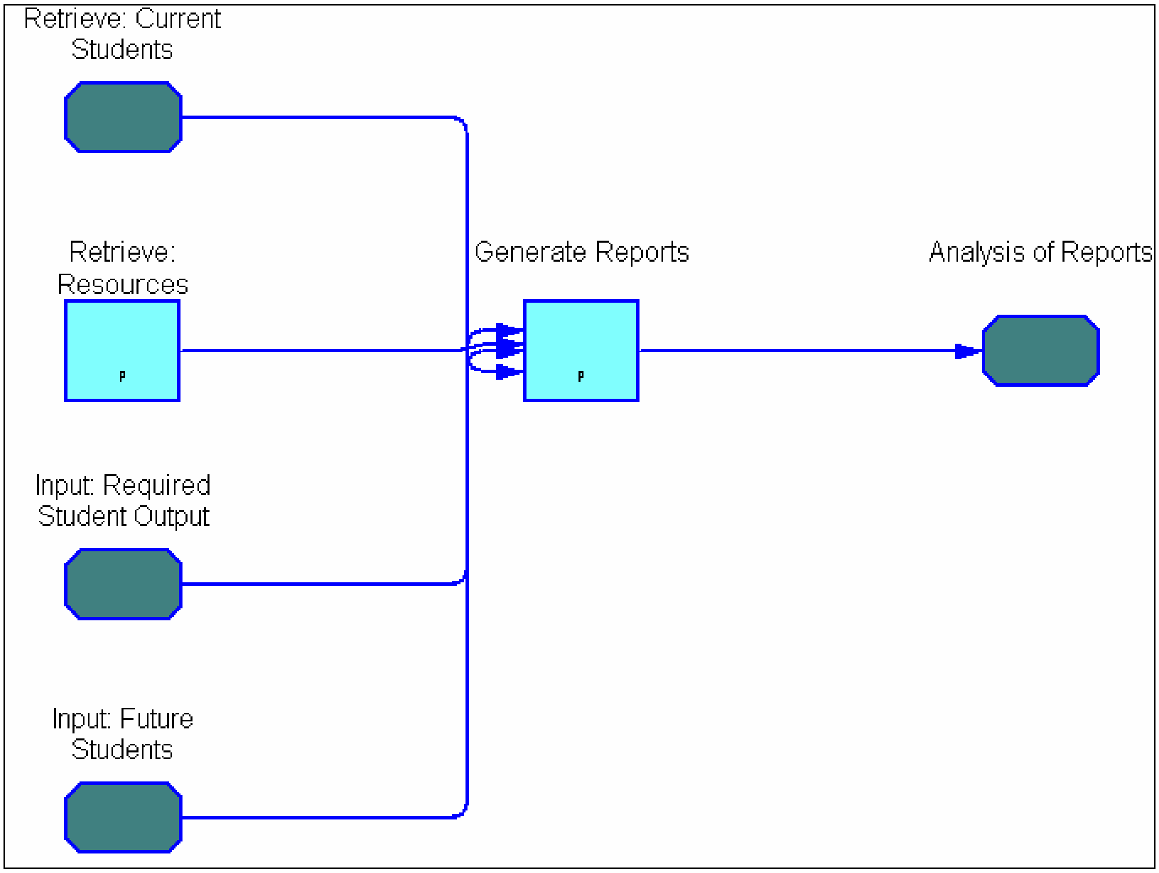


Figure 13. Wing "AS-IS" Process Model.

Figures 12 and 13 show the following:

1. The training squadrons that fall under the wing do not directly share training phase production capacity data. Also, wing production planners and operation planners cannot directly communicate with contractors that support training due to government contractual agreements. There is a designated officer and civilian government employee who are the official liaisons from the wing to the contracted supporting elements.

2. The squadron training phase production capacity planning process is actually an ad-hoc method that is only performed under circumstances in which concurrent bad weather is delaying training.

3. The wing training phase production capacity planning process is a formalized procedure that occurs once a month.

4. The number of current students is obtained from the Training Management System version 2 (TMS2) database application.

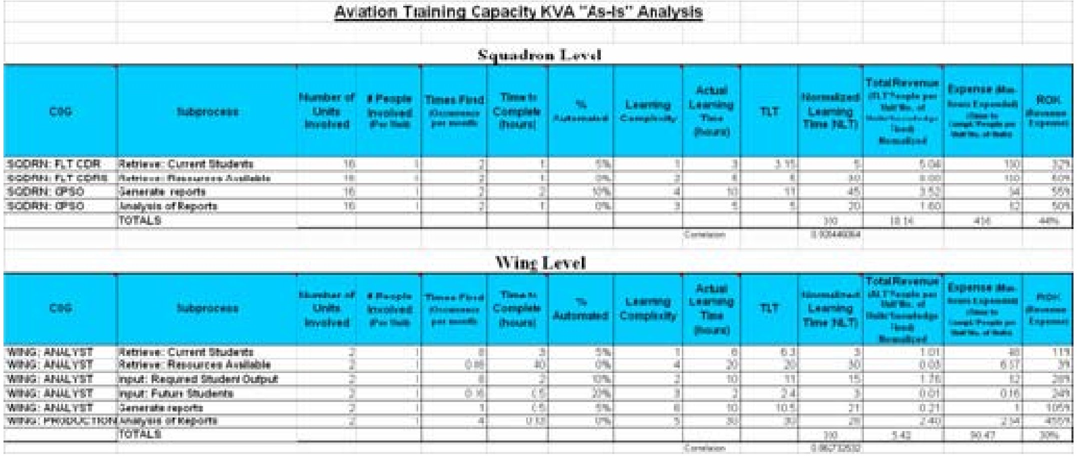
5. The process of gathering the required data, known as the Planning Factors, and performing the necessary computations to determine the available training resources occurs annually.

6. The required student output data is obtained from either the OPNAV fleet requirements document or the IPP.

7. The number of future students is obtained from the “Fridge Tool”.

Now, a Knowledge-Value-Added (KVA) analysis of the “as-is” process models will aid in constructing a “to be” process model or models by providing a standard criteria for evaluating each of the sub-processes against one another. This type of analysis will single out the sub-process or processes that have the greatest “value” and dysfunction within the organization and vice versa. Thereby, giving direction as to which sub-process or processes require some kind of change or transformation.

The Return-On-Knowledge (ROK) ratio, which is used as a means to compare the “as-is” process model to the “to-be” process model, can be derived by applying costs or time factors associated with each sub-process. The KVA analysis for the squadron and wing “as-is” process models applied time factors to each of the process models’ sub-processes. Associating time measures with a specific sub-process offered better metrics than determining the actual costs linked with a sub-process due to the non-disclosure of proprietary costs, which would have made it difficult to accurately calculate the related sub-process cost. The data included within the “as-is” process models’ KVA analysis (Figure 14) were collected through interviews with the individuals involved in the sub-processes at TRAWING 6. Then, the data were used to develop a KVA analysis that not only considered NFO training, but pilot training as well. The “as-is” process models’ KVA analysis is as follows:



Aviation Training Capacity KVA "As-Is" Analysis

Squadron Level

COG	Subprocess	Number of Units Involved	# People Involved (Per Unit)	Times Fired (Occurrences per month)	Time to Complete (hours)	% Automated	Learning Complexity	Actual Learning Time (hours)	TLT	Normalized Learning Time (NLT)	Total Revenue (ALT*People per Unit*No. of Units*Knowledge fired) Normalized	Expense (Man-hours Expended) (Time to Complete*People per Unit*No. of Units)	ROK (Revenue/Expense)
SQDRN: FLT CDR	Retrieve: Current Students	16	1	2	1	5%	1	3	3.15	5	5.04	130	329
SQDRN: FLT CDRS	Retrieve: Resources Available	16	1	2	1	0%	2	6	6	30	8.00	130	609
SQDRN: OPSO	Generate reports	16	1	2	2	10%	4	10	11	45	3.52	54	559
SQDRN: OPSO	Analysis of Reports	16	1	2	1	0%	3	5	5	20	1.60	32	509
	TOTALS									100	18.14	416	44%
								Correlation		0.93446084			

Wing Level

COG	Subprocess	Number of Units Involved	# People Involved (Per Unit)	Times Fired (Occurrences per month)	Time to Complete (hours)	% Automated	Learning Complexity	Actual Learning Time (hours)	TLT	Normalized Learning Time (NLT)	Total Revenue (ALT*People per Unit*No. of Units*Knowledge fired) Normalized	Expense (Man-hours Expended) (Time to Complete*People per Unit*No. of Units)	ROK (Revenue/Expense)
WING: ANALYST	Retrieve: Current Students	2	1	8	3	5%	1	6	6.3	3	1.01	48	119
WING: ANALYST	Retrieve: Resources Available	2	1	0.08	40	0%	4	20	20	30	0.03	6.57	39
WING: ANALYST	Input: Required Student Output	2	1	8	2	10%	2	10	11	15	1.76	32	289
WING: ANALYST	Input: Future Students	2	1	0.16	0.5	20%	3	2	2.4	3	0.01	0.16	249
WING: ANALYST	Generate reports	2	1	1	0.5	5%	6	10	10.5	21	0.21	1	1059
WING: PRODUCTION	Analysis of Reports	2	1	4	0.13	0%	5	30	30	28	2.40	2.34	4559
	TOTALS									100	5.42	90.47	30%
								Correlation		0.86732532			

Figure 14. KVA Analysis for the "AS-IS" Process Models.

% Automated = Subjective Estimation
Learning Complexity = Level of Ranking
Actual Learning Time (ALT) = Knowledge Contained in Process
Total Learning Time (TLT) = ALT + (ALT × % Automated)
NLT = 100 Units of Time
Total Revenue (Normalized) = Number of Units Involved × People Involved per Unit × Times Knowledge Fired per Month × TLT
Expense (Man-Hours Expended) = Number of Units Involved × People Involved per Unit × Times Knowledge Fired per Month × Time to Complete
ROK (Normalized) = (Total Revenue) ÷ (Expense)

The KVA analysis highlights several issues. At both the squadron and wing levels, the most difficult sub-process is "Generate Reports." The second most difficult sub-process is "Analysis of Reports." At the squadron level, "Generate Reports" has the highest ALT value. At the wing level, "Analysis of Reports" has the highest ALT value. There are other points that could be made from the KVA analysis, but it is incumbent upon the analyzer(s) to assess which problem areas to focus on. Although "Generate Reports" and "Analysis of Reports" functions have relatively high ROK values, it is the opinion of the authors that the application of information technology (IT) could have the most significant impact on these sub-processes.

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V. THE "TO-BE" MODEL

A. THE "TO-BE" MODELS WITH KVA ANALYSIS

The derived "to-be" process models (Figures 15 and 16) encompass two characteristics, robust accuracy and communication. The "as-is" process model for the wing and squadron had no communication link between the two, nor was there any communication from one training phase to next. Even though the wing training phase production capacity planning process was a formalized one, the complexity, length, and infrequency of that process did not make it useful for the training squadrons. Therefore, a process that implements a user friendly application with minimal processing time should be well received by both the wing and training squadrons.

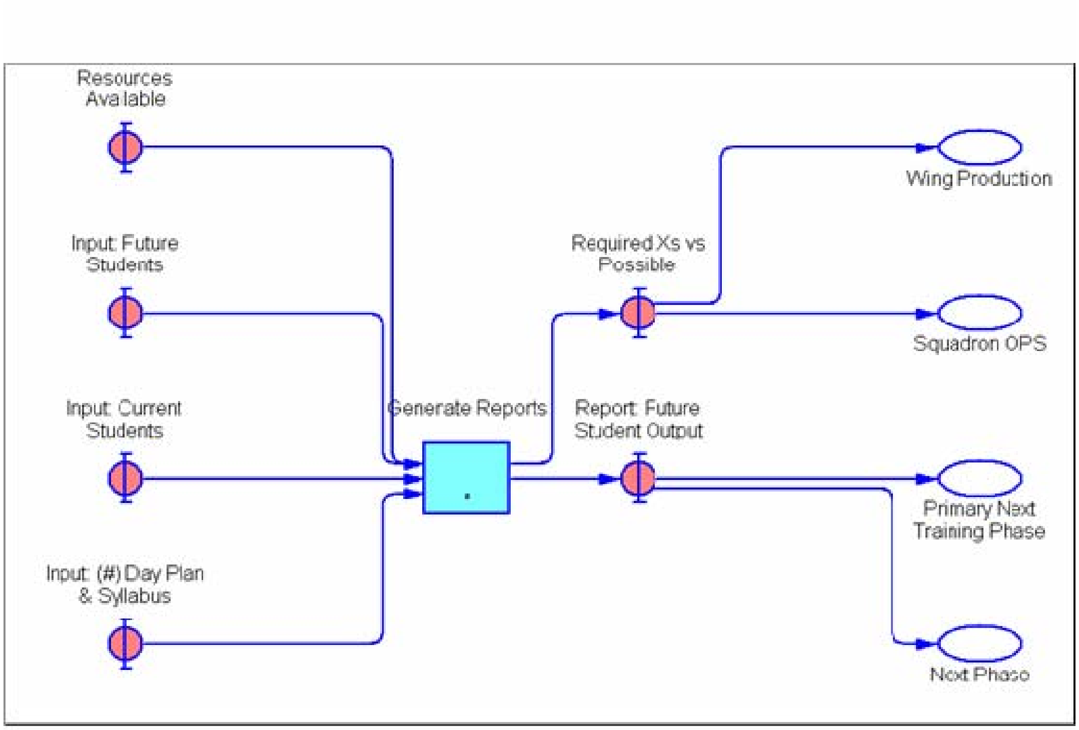


Figure 15. Wing and Squadron "TO-BE" Process Model.

Figure 15 removes the need for the wing to provide production capacity planning data to the training squadrons, because both would be granted access to the Decision

Support System (DSS) to use as each needed. The wing is concerned with long range planning, whereas the training squadrons may need to examine production capacity issues on a weekly basis. Now, the expansion of the "to-be" process model (Figure 16) across training phases includes the communication of one phase's student output number to the follow on training phase. This was another missing piece to the "as-is" process models in that there was no protocol for the sharing of student numbers from one training phase to the next. Such a procedure allows planners to properly prepare for the incoming workload, and make others aware of any potential problems that may result due to the volume of that workload. Problems that can be identified prior to their occurrence give an individual the opportunity to develop a solution that would negate any occurrence of such problems.

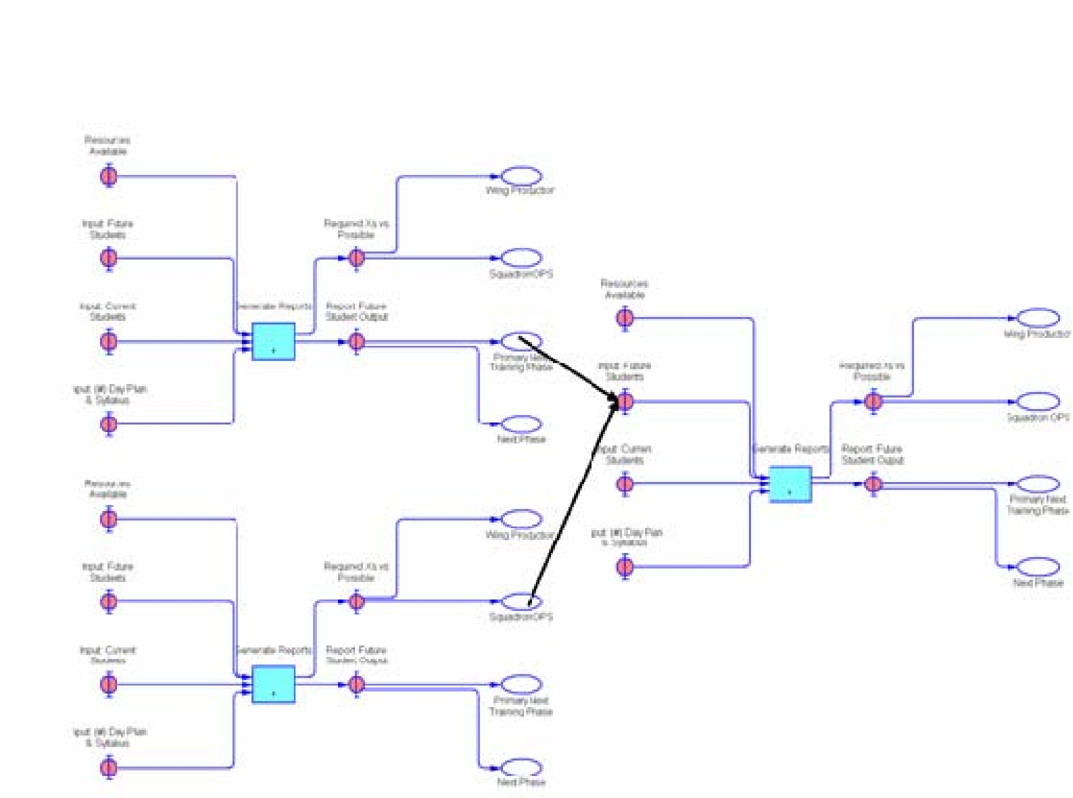
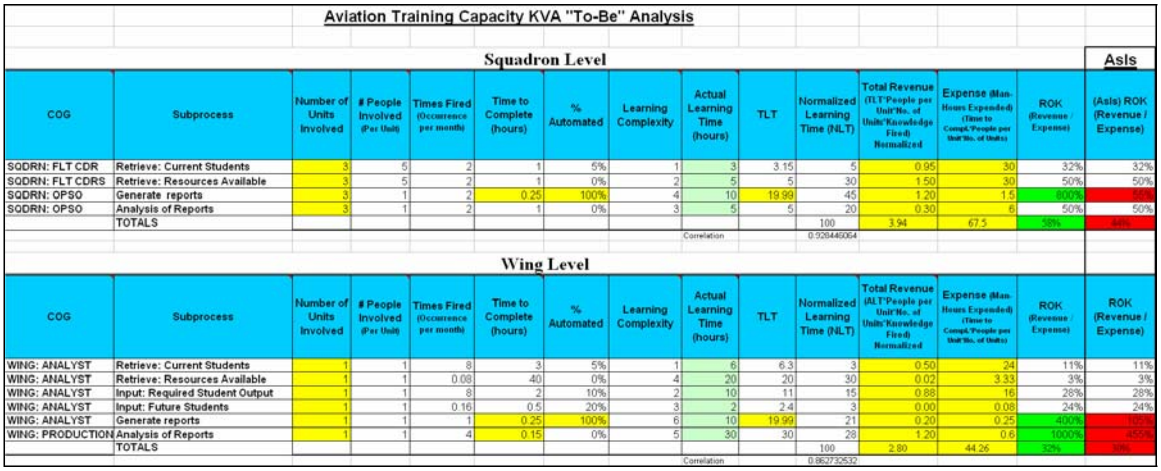


Figure 16. Phase to Phase "TO-BE" Process Model.

Now, the "to-be" Knowledge-Value-Added (KVA) analysis was only applied to Training Air Wing (TRAWING) 6, the Naval Flight Officer (NFO) training system, since there may be nuances to the geographically dispersed pilot training program that are unknown to the authors. The “to-be” process models’ KVA analysis (Figure 17) is as follows:



Aviation Training Capacity KVA "To-Be" Analysis

Squadron Level

COG	Subprocess	Number of Units Involved	# People Involved (Per Unit)	Times Fired (Occurrence per month)	Time to Complete (hours)	% Automated	Learning Complexity	Actual Learning Time (hours)	TLT	Normalized Learning Time (NLT)	Total Revenue (TLT*People per Unit*No. of Units*Knowledge Fired) Normalized	Expense (Man-Hours Expended) (Time to Compl.*People per Unit*No. of Units)	ROK (Revenue / Expense)	AsIs (AsIs) ROK (Revenue / Expense)
SQDRN: FLT CDR	Retrieve: Current Students	3	5	2	1	5%	1	3	3.15	5	0.95	30	32%	32%
SQDRN: FLT CDRS	Retrieve: Resources Available	3	5	2	1	0%	2	5	5	30	1.50	30	50%	50%
SQDRN: OPSO	Generate reports	3	1	2	0.25	100%	4	10	19.99	45	1.20	1.5	800%	55%
SQDRN: OPSO	Analysis of Reports	3	1	2	1	0%	3	5	5	20	0.30	6	50%	50%
	TOTALS									100	3.94	67.5	58%	44%
								Correlation		0.928446064				

Wing Level

COG	Subprocess	Number of Units Involved	# People Involved (Per Unit)	Times Fired (Occurrence per month)	Time to Complete (hours)	% Automated	Learning Complexity	Actual Learning Time (hours)	TLT	Normalized Learning Time (NLT)	Total Revenue (ALT*People per Unit*No. of Units*Knowledge Fired) Normalized	Expense (Man-Hours Expended) (Time to Compl.*People per Unit*No. of Units)	ROK (Revenue / Expense)	ROK (Revenue / Expense)
WING: ANALYST	Retrieve: Current Students	1	1	8	3	5%	1	6	6.3	3	0.50	24	11%	11%
WING: ANALYST	Retrieve: Resources Available	1	1	0.08	40	0%	4	20	20	30	0.02	3.33	3%	3%
WING: ANALYST	Input: Required Student Output	1	1	8	2	10%	2	10	11	15	0.88	16	28%	28%
WING: ANALYST	Input: Future Students	1	1	0.16	0.5	20%	3	2	2.4	3	0.00	0.08	24%	24%
WING: ANALYST	Generate reports	1	1	1	0.25	100%	6	10	19.99	21	0.20	0.25	400%	105%
WING: PRODUCTION	Analysis of Reports	1	1	4	0.15	0%	5	30	30	28	1.20	0.6	1000%	455%
	TOTALS									100	2.80	44.26	32%	30%
								Correlation		0.862732532				

Figure 17. KVA Analysis for the “TO-BE” Process Models.

The highlighted columns and rows denote areas that have changed from the “as-is” KVA analysis or areas of importance.

This KVA analysis cites the “as-is” ROK ratio in the last column next to the “to-be” Return-On-Knowledge (ROK) ratio. The difference between the percentages in the two columns indicates an improvement in the ROK ratio of the “to-be” processes. It is also important to note that the Actual Learning Time (ALT) has not changed from the “as-is” KVA analysis. The reason the ALT remains constant is due to the assumption that the knowledge contained in a sub-process does not change, but it can be relocated. Therefore, if a non-automated sub-process is automated, the knowledge retained in the individual(s) is now transferred to the automation.

B. FIRST DSS PROTOTYPE

The DSS prototype (Appendices C, D, and E for screenshots, schema, and processing code respectively) forecasts the resources available, resources needed (based on students), and resource actual usage (based on simulation). It determines the effects of not having enough resources (aircraft or simulators) when they are needed. Data is displayed in the form of graphs labeled by phase, class, etc. Only Flight Training

Squadron (VT) 4 and VT 10 are simulated. Students are transferred from one training phase to the next as they complete each phase of training. For a student to progress on time there must be resources available for that student when he or she needs the resources as determined by the syllabus (DayPlan). For example, when a student in Primary begins the flying stage, the "FAM1" resource needs to be available or the student will not progress. That resource is composed of, at a minimum, a T-6 aircraft. The data required to be inputted into the application is as follows:

1. Current and predicted student loading by class and phase;

2. The syllabus for each phase to determine when each student will need resources to complete an event; and

3. The predicted resource availability. (For example, how many T-6 flights are possible during a given week?)

The purpose of the DSS prototype (Appendices C, D, and E for screenshots, schema, and processing code respectively) is to provide a forecasting tool that improves the decision making process related to NFO production.

1. Requirements

The requirements for the prototype DSS were determined based upon interviews with potential system users at TRAWING 6 and the authors' interpretive understanding of the functional goal for the prototype DSS at the wing and squadron levels. Prior to delineating the requirements for user input and output the terminology for existing TRAWING 6 systems must be clearly understood.

This terminology is as follows:

1. 145 DayPlan is the student syllabus for Primary and Intermediate phases of training, which shows what a student should be doing in a class and when.

2. X is a variable used as a general reference to denote syllabus course events.

3. Analysis 05 shows historically how many student Xs were scheduled and how many were flown.

4. Total.xls shows how many students were started in and completed past classes, present classes, and predicted future classes. It includes class numbers and dates.

5. X-count is one spreadsheet showing how the required student Xs can be calculated by using the number of students in each class and the data from the “145 Day Plan.xls” in a converted form.

The user input for the prototype DSS is anticipated to be as follows:

1. Enter the syllabus plan, such as “145 Day Plan.xls”. This is a one time entry.

2. Enter the number of students in each class by class number and service branch or student type, i.e., United States Air Force (USAF), United States Marine Corps (USMC), United States Navy (USN), and International Military Training (IMT). This is a repeated action.

3. Enter the predicted maximum and minimum number of flight Xs possible for next 6 months. This is a repeated action.

4. Enter the predicted maximum and minimum number of simulator Xs possible for next 6 months. This is a repeated action.

5. Enter the number or percentage of students required to be transferred at the end of each phase and their destination. This is a repeated action.

The output for the prototype DSS should be graphical displays that will show the following:

1. Required student Xs vs. the maximum and minimum Xs possible over time.
2. Required student Xs vs. the actual predicted student Xs over time.
3. Required student outs vs. the actual predicted student outs over time.

The requirements above do not take into consideration the size of classes or the number and qualifications of instructors, because these requirements apply to the first of two prototypes that will be developed. Also, this model assumes the user knows their training resources. The second and final prototype will include the complexity that the first prototype lacks.

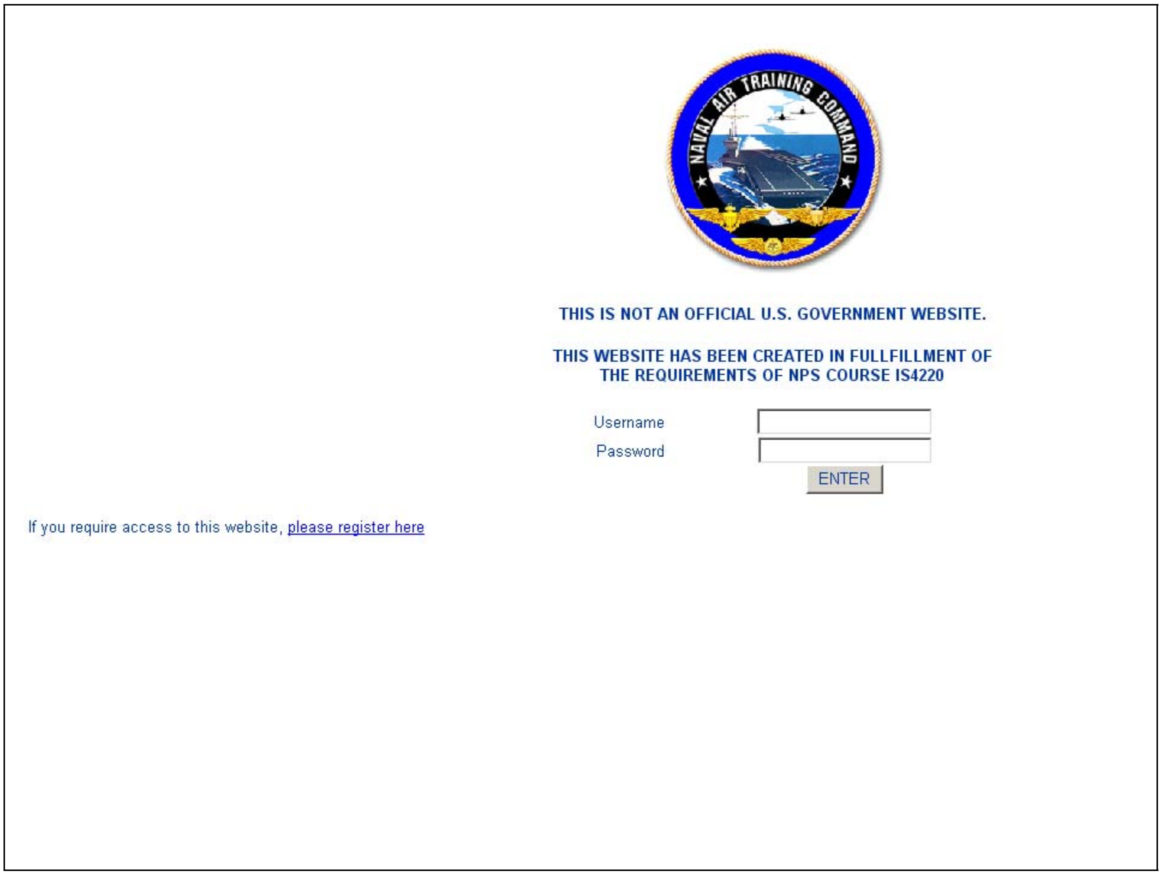
2. DSS Website Storyboard

Prior to physically designing any type of Information Technology (IT) system, it is important to articulate a concept about the operation of the system that is going to be built. The conceptual design provides a guide for each person involved in the actually development of the IT system. Hence, the following fictional scenario outlines the navigational and functional expectations for the “Aviation Training Resource Usage Forecaster” DSS website. Now, the general look and feel for the website (Figures 18 and 19) will be adopted from the existing Chief of Naval Air Training (CNATRA) website located at https://www.cnatra.navy.mil/.

Purpose: The squadron wants to know if it will be able to complete the training of students on time given the predicted resource availability.

LCDR Smith is the Operations Officer (OPSO) at VT 10. The first steps in general are as follows:

1. Get a login identification (ID).


THIS IS NOT AN OFFICIAL U.S. GOVERNMENT WEBSITE.

THIS WEBSITE HAS BEEN CREATED IN FULLFILLMENT OF THE REQUIREMENTS OF NPS COURSE IS4220

If you require access to this website, please register here

Figure 18. Sample Login Web Page.

2. Enter the basic phase information:

- Phase Name
- Syllabus
- Syllabus Resources

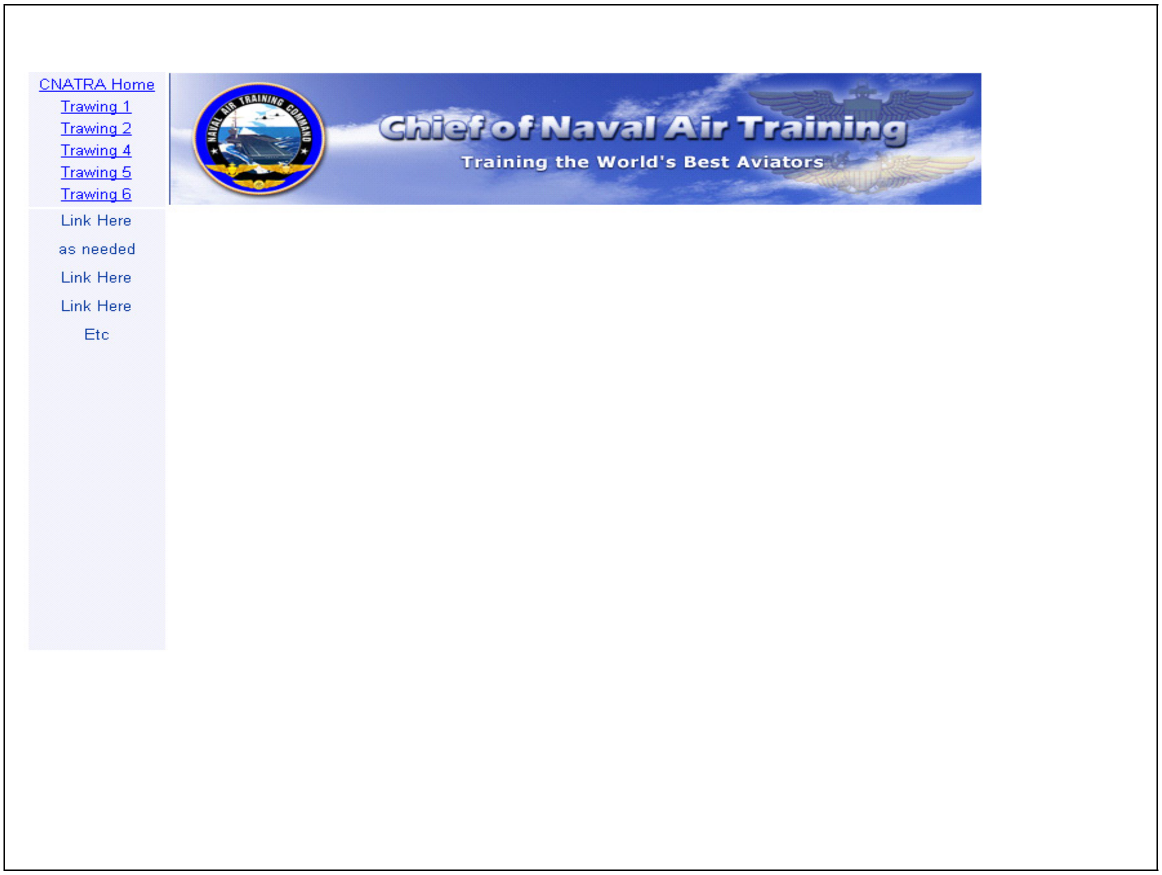


Figure 19. Sample Content Web Page.

In addition, the phases receive students and send students to follow on phases. After the general phase information is entered, the following can be entered:

1. The number of available resources and the resources availability period; and

2. The number of current students in each class.

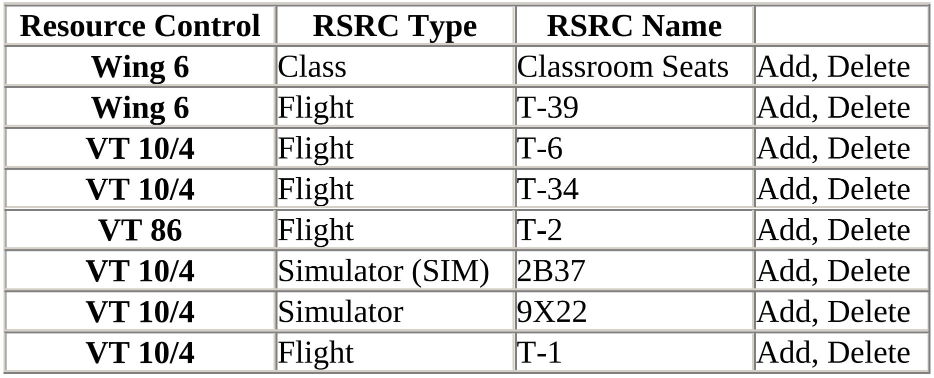
At that point, the website will save the information to a database, trigger the processing of the saved data, save the processed data back into the database, and then the processed information could be retrieved from the website. The scenario now continues as follows:

VT 10's LCDR Smith has already been given a user name and password by the administrator, as have all OPSOs. The OPSO logs in. On the next page, he has to select "Add" a phase since one has not yet been created. He enters the unit name "VT 10" and phase name "Primary."

He then selects the type as "Real", since it is neither a "Feeder" nor "Exit". "Feeders" are just spreadsheets that feed "Real" phases. For instance, Aviation Pre-Flight Indoctrination (API) is considered a "Feeder" to Primary since the web application won't track the resources, etc. for API. An "Exit" is simply a completion point within the training pipeline system.

At this point, he cannot select which phases students come from or go to since no other phases have been added yet. Then he clicks on the create button, which sends him to the page to create a real phase since that is what he selected. The basis for a phase is the syllabus. Since one is not available for selection because none have been entered in, he clicks on "Create one". No syllabus exist, therefore he must create one from scratch.

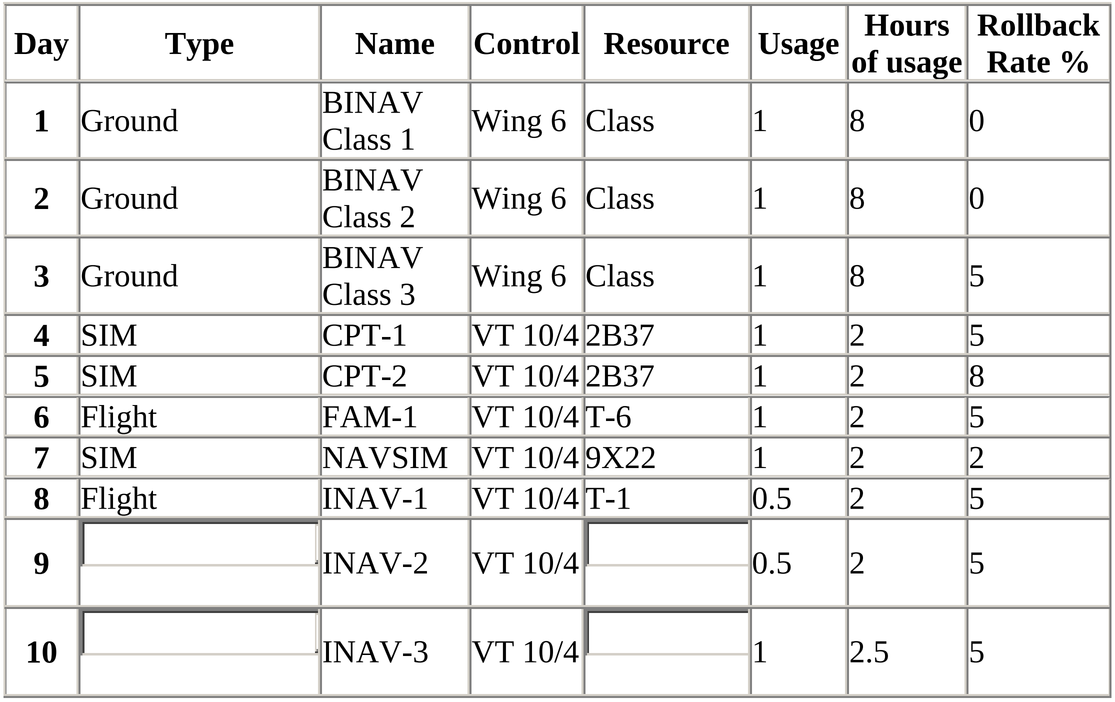
Since syllabus events are tied to resources, it makes sense to (and he must) enter the resources first. He clicks on "Add" (Figure 20) the resources. Each resource can be used by many phases. So, each resource (RSRC) is associated with a "Resource Control." "Resource Control" and name are part of the resource ID. A phase can select any resource. He enters in the basic resource information. He could also enter in the resource availability now, or later. Resource availability is the quantity for a resource that is available per week. He could click on "Resources Available per Time", but chooses to do that later.



Resource Control	RSRC Type	RSRC Name	
Wing 6	Class	Classroom Seats	Add, Delete
Wing 6	Flight	T-39	Add, Delete
VT 10/4	Flight	T-6	Add, Delete
VT 10/4	Flight	T-34	Add, Delete
VT 86	Flight	T-2	Add, Delete
VT 10/4	Simulator (SIM)	2B37	Add, Delete
VT 10/4	Simulator	9X22	Add, Delete
VT 10/4	Flight	T-1	Add, Delete

Figure 20. Add Resource Web Page Storyboard.

So, now he returns to syllabus insert page (Figure 21) in order to create the syllabus. He enters the syllabus name (syllabus name is required). Then, he adds resource related syllabus information.



Day	Type	Name	Control	Resource	Usage	Hours of usage	Rollback Rate %
1	Ground	BINAV Class 1	Wing 6	Class	1	8	0
2	Ground	BINAV Class 2	Wing 6	Class	1	8	0
3	Ground	BINAV Class 3	Wing 6	Class	1	8	5
4	SIM	CPT-1	VT 10/4	2B37	1	2	5
5	SIM	CPT-2	VT 10/4	2B37	1	2	8
6	Flight	FAM-1	VT 10/4	T-6	1	2	5
7	SIM	NAVSIM	VT 10/4	9X22	1	2	2
8	Flight	INAV-1	VT 10/4	T-1	0.5	2	5
9		INAV-2	VT 10/4		0.5	2	5
10		INAV-3	VT 10/4		1	2.5	5

Figure 21. Syllabus Insert Web Page Storyboard.

Afterwards, he can save the syllabus and the basic phase information has been added. Now, he can go back to the home page and select his phase. From there, he can enter the estimated usage per week of each resource and the number of students in the squadron. He could then run the simulation and produce the graphs. At this point, since there is no “Feeder” (inputting new students) all of the students would move out of the phase and would go nowhere. (since the next phase has not been created and associated with other phases)

3. Prototype I DSS Demonstration Feedback

“An important feature of the Spiral Model is that each cycle is completed by a review involving the primary people or organizations concerned with the product” (Boehm, 1998, p. 65). On March 22, 2005, at 1100 Pacific Standard Time, a video teleconference (VTC) was conducted between Naval Postgraduate School (NPS) and TRAWING 6 for the purposes of demonstrating the "Aviation Training Resource Usage Forecaster" website (http://131.120.176.69/wbrb/prototype_I/index.asp), the Prototype I DSS, and having a dialogue with one of the potential product customers. Viewing the demonstration from TRAWING 6 was CDR King, the Production and Planning Officer.

The initial comments received from the VTC with CDR King were all pertaining to the Prototype I DSS functional performance. CDR King's first responses were on the topic of data display. After displaying and explaining the third optional graph (see Appendix C) that can be generated from the "FORECASTED GRAPHS" hyperlink web page, King remarked that "A line and point graph indicates" a relationship between plotted points over a time period, but in actuality each point is independent from one another based on the class number labeling of the x-axis and the description given of the data used to produce the graph. "A bar graph might" be a better representation of the data.

The other functional performance comments provided from the VTC with CDR King were in response to questions posed by the demonstration presenter, one of the authors. The questions and responses were as follows:

1. Question: Would this prototype be helpful in determining how many students each training phase can produce in the required time-to-train, considering resource constraints?

Response (paraphrased): The prototype is useful for showing whether the NFO training pipeline is capacity constrained, but it is not useful for managing, tracking, and predicting the day-to-day flow of students. The prototype does show the effects of specific capacity related decisions.

2. Question: Would this prototype be helpful in determining how many students to send to follow on training phases?

Response: No.

3. Question: Would this prototype be helpful in determining future resource requirements?

Response: Yes.

4. Question: In order to make the above decisions, how far out does the forecast need to project?

Response (paraphrased): It depends on the organizational level, wing vs. training squadron, or the phases of training. The wing needs to be able to generate an 18-month forecast. If one is examining NFO phases of training, then a four-month forecast is required from the start of Primary through the start of advanced training at Randolph, and a eight-month forecast is required from the start of Primary to the start of advanced training at Airborne Early Warning Unit (VAW) 120.

C. PLANNED ENHANCMENTS FOR DSS PROTOTYPE II

The enhancements to be made from Prototype I to Prototype II (Figure 22) of the DSS is focused on incorporating additional data parameters to be factored into the application processing that produces the data output for user graphical displays.

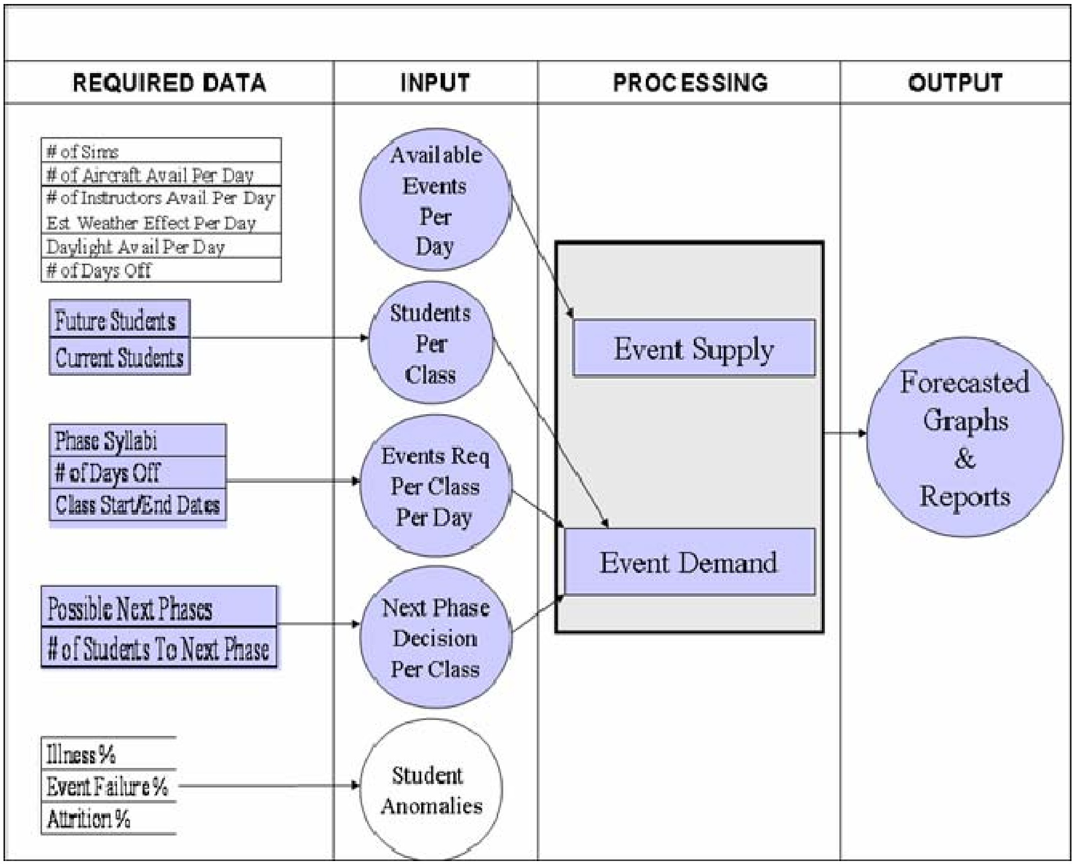


Figure 22. Prototype I Processing Data vs. Prototype II Processing Data Diagram.

The shaded objects in Figure 22 delineate the data that is entered and processed for DSS Prototype I. The non-shaded objects are the data parameters to be added for user input and application processing for DSS Prototype II. These additional data parameters will improve the data output utility because more know variables that can impact the decisions made within the Naval aviation training system environment will have been analyzed and assessed by the DSS. The reason for not including all these data parameters in DSS Prototype I is the authors' software development view that it was better to produce an initial prototype for user evaluation than to spend too much time on the programming for a final prototype without allowing for any interim time period so the users could give feedback on the development direction for the final DSS prototype. This process replicates the Spiral Software Development Model, but more importantly it is the authors' opinion that the user feedback from the first prototype will contribute greatly to the quality for the final DSS prototype.

D. FINAL DSS PROTOTYPE

Realizing the complexity and the desired performance end state for Prototype II, the authors thought it was worthwhile to examine the application of a Commercial-Off-The Shelf (COTS) solution. It is the authors' opinion that the most suitable category of software to evaluate as a potential remedy for the problem involved in this study would be Enterprise Resource Planning (ERP) software. "ERP software systems have focused on internal process integration of traditional functions, such as sales, production, and inventory management" (Kelle & Akbulut, 2005, p. 41).

1. Refining the Requirements

The requirements for a DSS were refined based on feedback received from demonstrations given at CNATRA and TRAWING 6. These onsite visits included one-on-one interviews with potential system users. Each interviewee was presented with a survey (Appendices F and G) designed to determine the type of information that would be useful for the DSS to provide and whether that same type of information was already available from another source. The persons interviewed also provided feedback on how best to present the data output generated from the DSS.

Figures 23 and 24 display the data collected from the Likert Scale portions of the surveys (Appendices F and G) conducted at CNATRA and TRAWING 6. The graphed data is configured such that the x-axis corresponds to a specific survey participant and the y-axis corresponds to the Likert Scale as follows:

1. Strongly Disagree=1;
2. Disagree=2;
3. Not Sure=3;
4. Agree=4;
5. Strongly Agree=5; and

6. No Response=0.

This data shows the number of potential system users that agree or disagree with the survey-proposed information to be obtainable from a DSS’s data output. This collected data was essential for refining the nature of the information content that users would be extracting from the DSS’s data output.

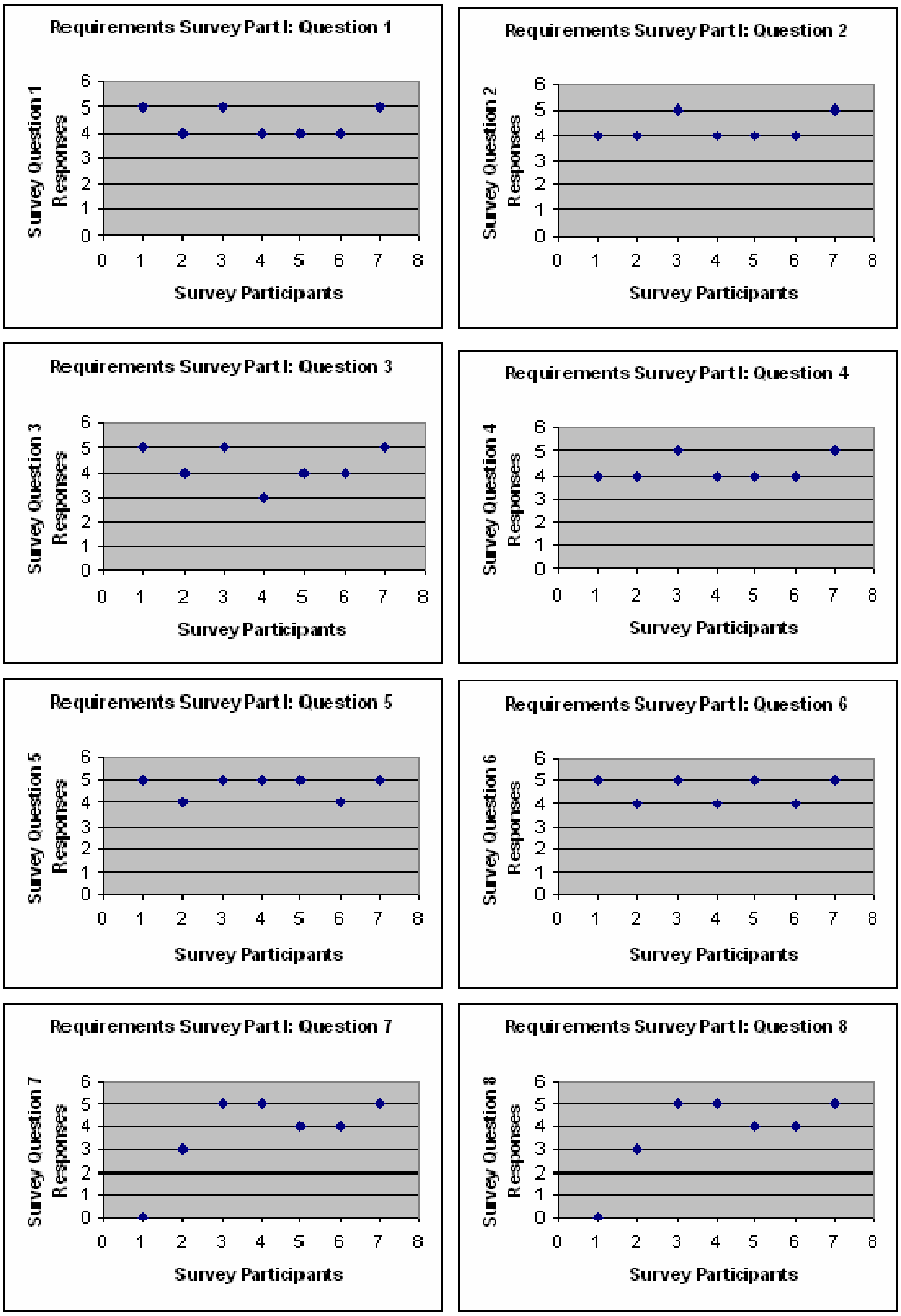


Figure 23. TRAWING 6 Survey Results.

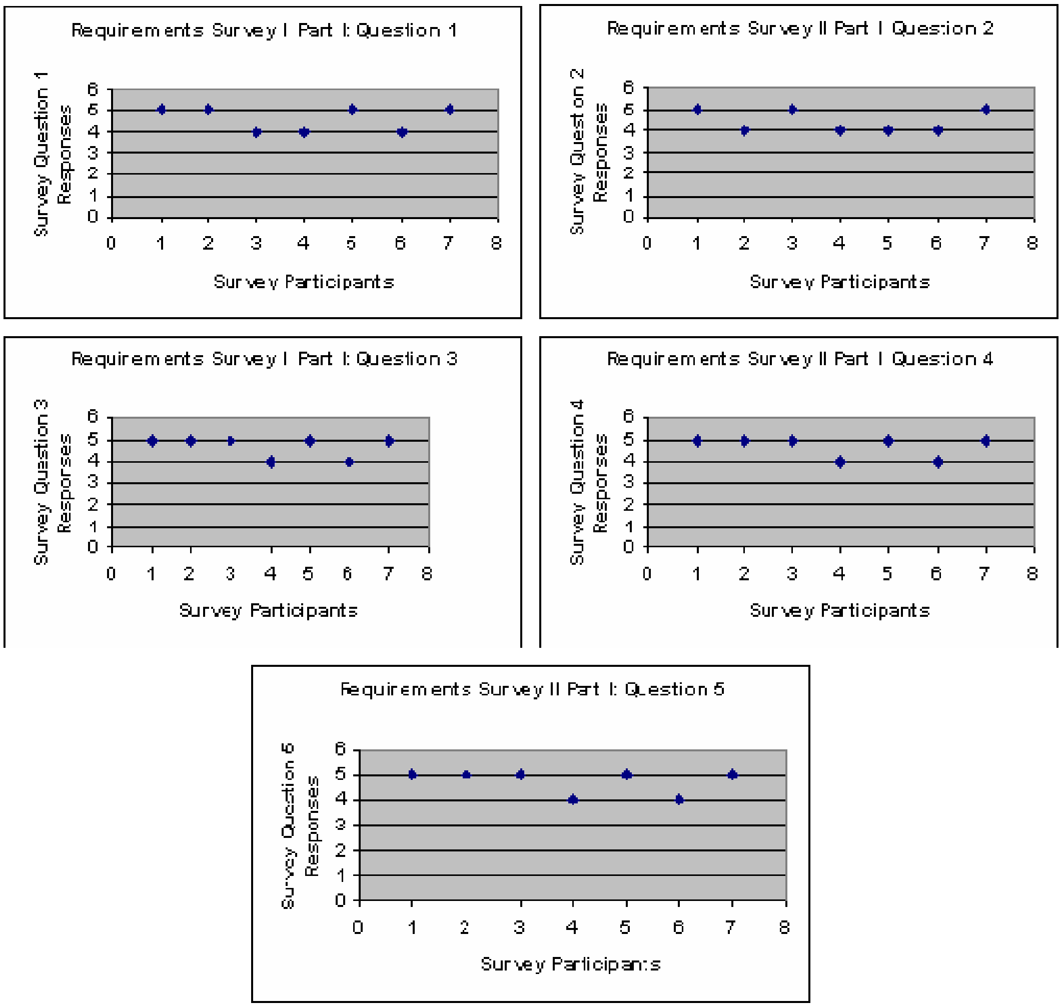


Figure 24. CNATRA Survey Results.

Figures 25 and 26 show the data collected from the "No", "Not Sure", and "Yes" portions of the surveys (Appendices F and G) conducted at CNATRA and TRAWING 6. The graphed data is configured such that the x-axis corresponds to a specific survey participant and the y-axis corresponds to the survey responses as follows:

1. No =1;
2. Not Sure=2;
3. Yes=3; and

4. No Response=0.

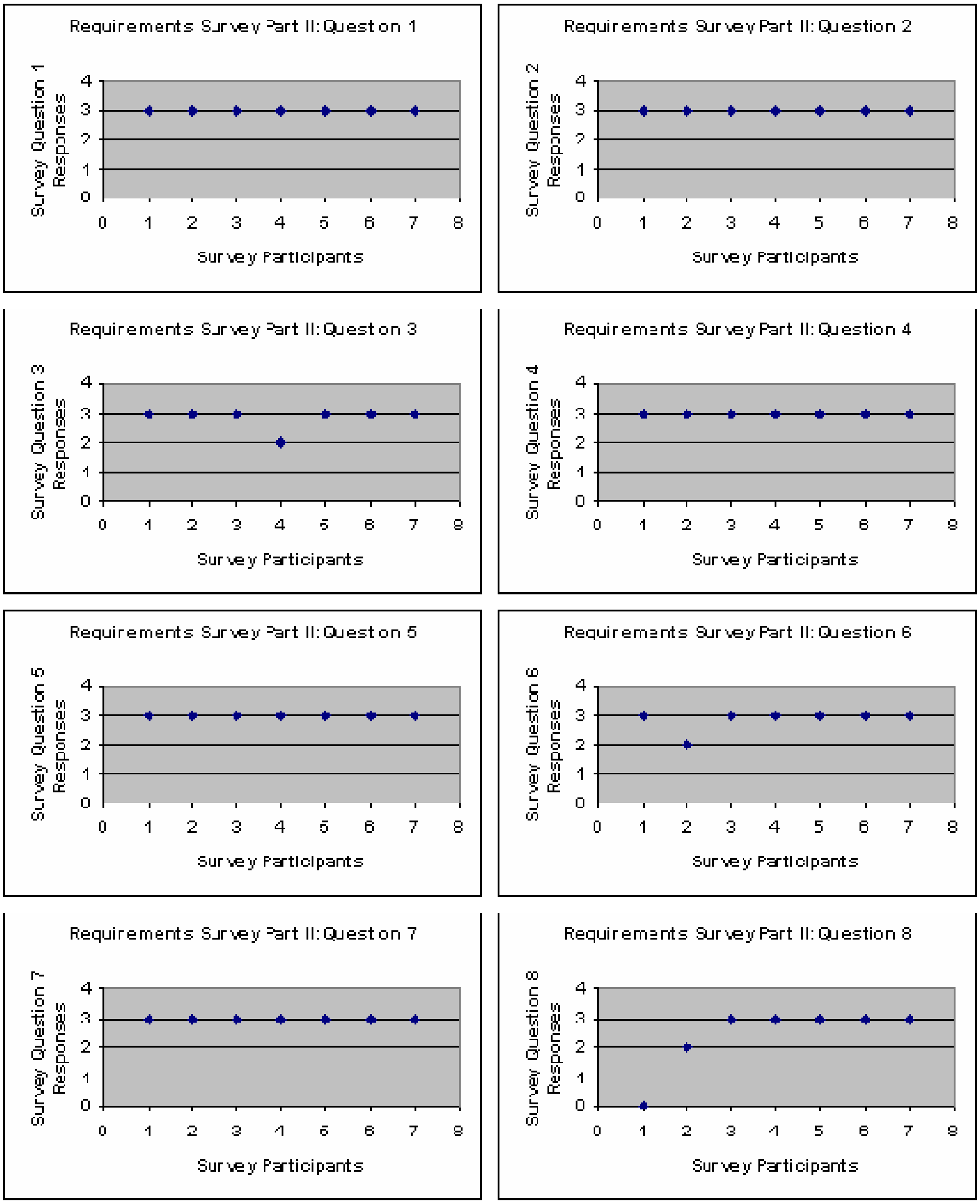


Figure 25. TRAWING 6 Survey Results.

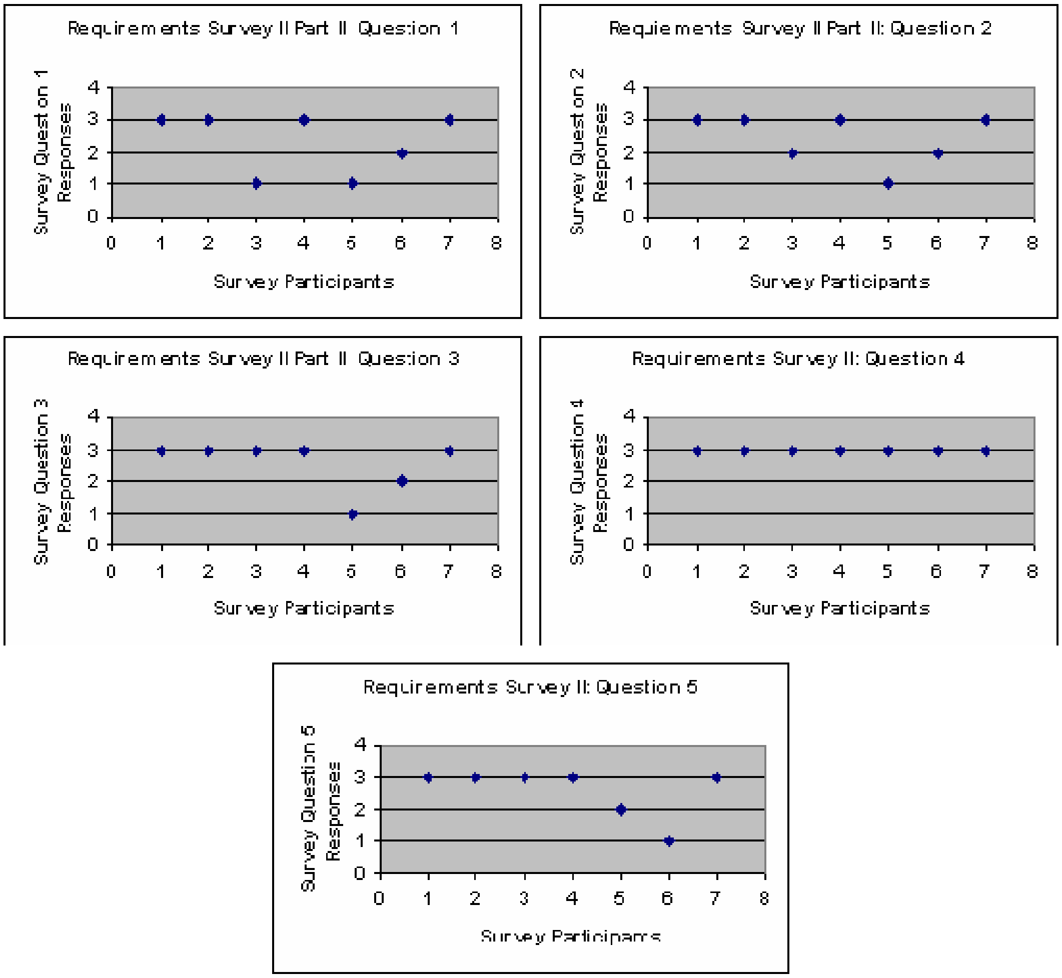


Figure 26. CNATRA Survey Results.

These data show whether or not the proposed information to be provided from a DSS is already available to potential system users. Now, Figure 27 shows the myriad of sources that CNATRA production analysts and decision makers must use in order to process and/or retrieve the data necessary to obtain the information proposed for extraction from the DSS's data output. These data show that at this time there is no one application that can provide all the information discussed in the CNATRA survey. The fact that this situation exists demonstrates there is a need for a standardized DSS that can provide data output which is flexible enough to serve multiple user information needs. This means that the presentation or display of data based on the data output from the processed data must have the ability to be adjusted by the user in order to suit whatever the user thinks is the best representation of the processed data output.

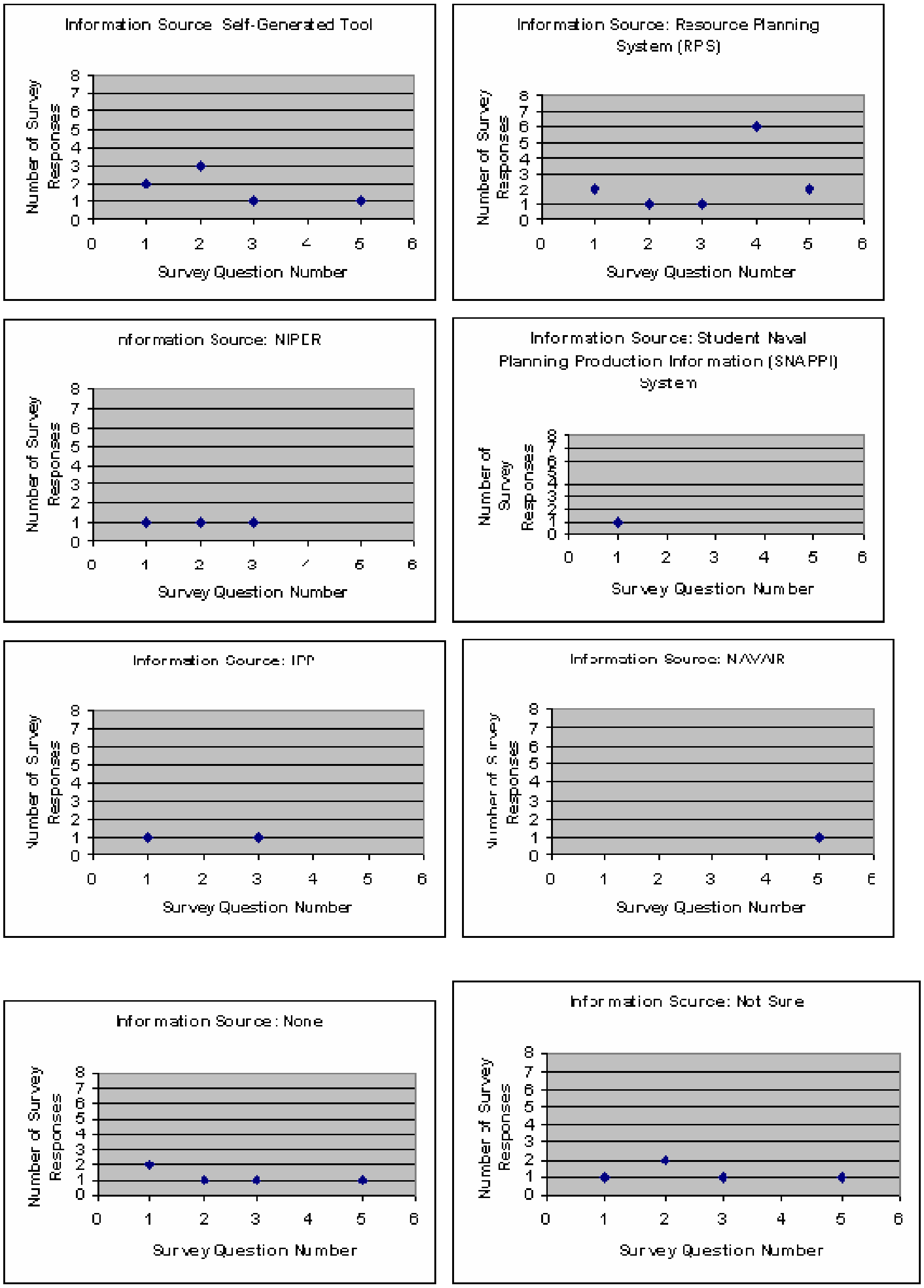


Figure 27. CNATRA Data Sources.

2. Implementation Considerations

Identifying the right IT solution to enhance an organization’s competitive advantage is a difficult decision to make. To select an IT solution for an organization under the authority of the Department of the Navy (DoN), there are three key questions that need to be answered prior to going forward with the implementation of a new IT system. The questions to be addressed are as follows:

1. Does the selected IT solution achieve the DoN Chief Information Officer’s (CIO’s) strategic objectives for IT systems?

2. Does the organization’s internal, interface, and external business processes properly align with the selected IT solution?

3. Does the selected IT solution originate from a viable company?

According to the DoN Information Management and Information Technology (IM/IT) Strategic Plan, FY 2004-2005, the Navy and Marine Corps vision is “A joint net-centric environment that delivers knowledge dominance to the Naval warfighting team” (McArthur, Thomas, & Wennergren, p. 5). One goal that supports the DoN IM/IT strategic vision is an objective from the Chief of Naval Operations’ (CNO) 2004 FORCEnet Guidance, which directs the Navy to “…investigate enterprise solutions that will exploit the power of the web and improve our productivity and return on investment” (McArthur, Thomas, & Wennergren, p. 10). A program established to facilitate this goal is the Navy Shore-Based Oracle Database Enterprise License Agreement. “This milestone agreement provided the Navy shore-based organizations, including active duty, reserve, civil service, and support contractor personnel, the right to use the Oracle database family of products” (McArthur, Thomas, & Wennergren, p. 11).

Now, a prototype application only provides an executable version of the last known understanding of the user requirements for a potential software platform. Also, the term prototype implies a system not ready for full implementation. Thus, by shifting the direction of this study from delivering a prototype application to delivering an evaluation of a COTS ERP application from “the Oracle database family of products”, the study is aligned with the IM/IT strategic vision for the DON and has the potential of providing CNATRA with a real implemental IT solution (McArthur, Thomas, & Wennergren, p. 11).

The ERP software solution is an implementation of "industry best-practices" (Nah, Tan, and Teh, 2004, p. 41). Davenport (1998, p. 123) stated, according to Nah, Tan, and Teh (2004), that the ERP software represents

> a single comprehensive database, which collects data from and feeds data into modular applications supporting virtually all of a company's business activities-across functions, across business units, across the world (p. 33).

Nah, Tan, and Teh (2004) translated the above statement to convey the following:

> In other words, the information associated with individual modules of ERP software is stored in a central database so that transactions or changes taking place in one module will automatically "trigger" related changes in other modules, and multiple departments throughout the organization can access the same data (p. 33).

Thus, an institution cannot expect to improve its organization or flow of information by integrating business processes that do not synchronize with the capabilities of their selected ERP software solution. According to Calogero (2000),

> At the root of many ERP problems lies one overlooked but critical step: new business processes must be established, thought through, and implemented before software tools are selected, purchased, and rolled out. …the success of an ERP implementation is gauged by its ability to align IT and business management objectives, demanding program management skills and a refined process for success. Organizations too often ignore the need to define an optimal process and then use the technology as an enabler for the process. In too many instances, organizations either try to adopt a process that is inherent in the ERP solution, even if it does not fit their business requirements, or they try to shoehorn their legacy processes into a software package that is not designed to support their processes. In both cases, they sub-optimize the capabilities in the technology and don't take advantage of the opportunity to streamline their business process - the entire point of technology implementations (p. 8 & 9).

Also, an organization considering the implementation of a new IT system needs to assess the financially stability of their IT solution provider. The Coast Guard spent $24 million "…to install the Human Resource (HR) Connect system, a custom version of the

HR Management System from PeopleSoft Incorporated (Inc.) of Pleasanton, California" (Mosquera, 2005). Then on December 13, 2004, after 18 months of resistance, PeopleSoft Inc. agreed to be acquired by their rival, Oracle Corporation (Corp.), for $10.3 billion (Bank, 2004). "Now PeopleSoft customers", like the Coast Guard, are "worried that they may soon have to switch software -- a time-consuming and expensive process (Bank, 2004, p. A. 1). According to Banks (2004) of the Wall Street Journal (WSJ), prior to Oracle's acquisition of PeopleSoft the global market share breakdown for the top five ERP software providers was as follows:

1. 20.0% belonged to SAP [Systeme, Anwendungen, Produkte in der Datenverarbeitung – German for Systems, Applications and Products in Data Processing (G. Cook, IS-4031 lecture, Spring 2005)]
2. 6.9% belonged to PeopleSoft
3. 5.5% belonged to Oracle
4. 2.6% belonged to Microsoft
5. 2.3% belonged to Sage Group

The percentages above show that even "a combined Oracle-PeopleSoft would still trail Germany's SAP" as a provider of ERP software (Bank, 2004, p. A. 1).

Beyond Oracle's acquisition of PeopleSoft, it most recently acquired Retek Inc., "a retail-industry software maker", on March 22, 2005 for $650 million (Hamm, 2005, p. 42). These actions have placed Oracle in a head to head battle with SAP over "…the $47 billion market for corporate applications software" (Hamm, 2005, p. 42). According to Hamm (2005) of Business Week,

> By picking a fight with SAP, though, Ellison [Oracle Chief Executive] is taking on a heavyweight that's heavily favored to punch his lights out in the applications market. With 26,000 corporate customers worldwide and a broad suite of products, SAP has become the gold standard for corporate applications. Goldman, Sachs & Co. expects that among the top four players, SAP's share of software license revenues will vault from 59% in 2003 to 70% this year. Meanwhile, the firm expects Oracle's share (with PeopleSoft included) to fall from 30% to 20%. "There will be a lot of marketing rhetoric, but at the end of the day, SAP has such momentum

> that Oracle won't be able to dislodge them," says Goldman analyst Richard G. Sherlund. SAP has definitely gone on the offensive. Before the ink had dried on the PeopleSoft merger, SAP began tempting PeopleSoft customers with a 75% discount for switching over. Last year, the 33-year-old German company lured several former Oracle customers, including PepsiCo Inc. How the two rivals perform in the coming year will probably decide the outcome. The technical challenges are huge, and either side could stumble. But the most intense pressure is on Ellison. He has set his sights on SAP before, and not much came of it. Now he's trying again, and the stakes are higher than ever (p. 42).

This discussion should bring to light the gravity of the issues that have to be addressed when a DoN organization embarks on the quest to identify, acquire, and install a new IT system. These issues are not trivial and if not dealt with appropriately can have detrimental long term effects on an organization. Despite all of these challenging issues, the search for the right IT solution can be successfully managed and accomplished.

3. ERP Software Products Evaluation

This chapter includes a summary evaluation based on publicly available product information and company representatives of ERP software providers. The products sought were ones which met the criteria defined in Chapter VB. The included information is used only as a sample of available of ERP solutions and is not intended to substitute for a formally funded evaluation process. Also, it is not intended to promote one company over another.

a. Open Source Solutions

Open source solutions initially appeared to be attractive due to their low cost. Upon further examination, the available open source products would require a great deal of costly modification and support. Because of the high costs, minimal existing customer support, and little track record, open-source solutions are not considered to be a suitable solution. However, open-source may be a viable option when the available technologies mature and are proven. Examples of open source solutions may be found at http://www.erp5.org./.

b. Commercial Solutions

Numerous potential commercial solutions were found. However, only a handful of suitable products from viable companies were identified. Oracle and SAP were companies which were consider financially viable, offered potential solutions, and have a working history with the DON.

Oracle, the number two ERP provider according to WSJ, is currently working with NAVSEA to provide ship maintenance scheduling solution. In addition to custom solutions, Oracle markets an existing product called, “Advanced Supply Chain Planning.” It claims to “perform simultaneous material and capacity planning across multiple facilities and time horizons” “…run holistic plans that span long term aggregate planning to short term detailed schedules...” (Oracle Corporation, 2005, p. 1 & 2). Most importantly, it claims to help, “…to create feasible plans that take into account your resource and material restraints” (Oracle Corporation, 2005, p. 3). It also allows multiple planners to perform simulations (Oracle Corporation, 2005). The claimed functionality appears to fulfill the requirements needed by CNATRA.

SAP offers a product called, “SAP Manufacturing”. SAP claims this product identifies changes in demand and supply and allows for rapid response to new customer requirements.

> SAP Manufacturing gives discrete and process manufacturers functionality to:
>
> -Coordinate operations with partners and suppliers
>
> -Detect and resolve exceptions and performance deviation in real time and at low cost
>
> -Institutionalize Lean and Six Sigma processes and monitor production to drive continuous improvement
>
> -Comply with environmental, health, and safety standards
>
> -Improve employee productivity and create a high-quality work environment
>
> With SAP Manufacturing, your management and production departments gain real-time visibility into key data -- enabling them to act quickly. Managers can document, track, and interpret quality and performance using rich analytics capabilities. Production teams can leverage role-based applications for plant managers, production supervisors, maintenance

> supervisors, and quality inspectors to detect and respond rapidly to exceptions and variances -- and deliver superior performance (SAP Manufacturing).

c. Assessment

Oracle and SAP each could likely provide a beneficial solution. A more thorough analysis would require official backing by a higher Navy authority to grant the time and resources needed to determine the best solution and provider for a CNATRA ERP implementation.

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VI. CONCLUSIONS AND RECOMMENDATIONS

Command effectiveness increases when its activities are closely aligned to mission objectives. A mission can be described with two often conflicting purposes: (1) primary--accomplish the task; and (2) secondary--use minimal resources. As the United States moves to reduce military costs by reducing military resources, commands may find it more difficult to “accomplish the task” without implementing more effective and efficient methods for resources allocation. Decision Support Systems (DSSs) can improve command effectiveness by providing information to better “accomplish the task” and/or decrease the resources required.

A. STUDY RESULTS

This section will address the questions posed in Chapter IE. The primary question for this study is: Can a web-enabled database DSS provide decision makers with predictive training pipeline capacity threshold indicators, so they may take preventive actions to minimize capacity-related system inefficiencies? The research results indicate the answer to this question to be yes. An application that illustrates cause and effect activity relationships has the ability to show possible outcomes based on the designed data input parameters; though, it is difficult to devise an application that generates a data output presentation which meets every user’s desires. Thus, it is important for a DSS to have a feature that either allows the user to adjust the presentation of the generated data output or allows the user to export the generated data output in order to adjust its presentation within another application of their own choosing.

Now, the supplementary questions posed in order to properly construct the DSS were as follows:

1. Are student loading fluctuations demand or supply driven? Research results reveal: Student loading fluctuations are primarily demand driven. The bulk of bodies that supply the pilot and Naval Flight Officer (NFO) training pipeline are generated in the May timeframe, which does not change from year to year; therefore, student loading is minimally affected by variation in the timing of supply. Instead, the limited number of pilot and NFO billets at the Fleet Replacement Squadron (FRS) creates

the demand within the Naval aviation training pipeline. The availability of FRS billets drives the number of students that are started within the training pipeline and the date students start training; whereas, the number of students inserted into the training pipeline by the United States Air Force (USAF), the United States Marine Corps (USMC), the Flight Surgeon program, and the International Military Training (IMT) program are based on a supply driven system. Their students can arrive at unpredictable times, but they are expected to complete training at a standard rate.

2. Why is level loading not possible? Research results reveal: Level loading is technically possible. However, the rationale for instituting a level loaded system would have to justify the potential side effects of early trainee finishers creating a pilot and NFO inventory surplus, which is an added cost to the taxpayers. Politically, the concept is a difficult sell because the Just-In-Time (JIT) inventory methodology has been ingrained into the social culture.

3. Is there an alert system currently in place to help decision makers implement preventive actions? Research results reveal: There is no standardized tool or application across all levels of the Naval aviation training organizational structure that acts as an alert system for the purpose of enabling decision makers to take preventive actions.

4. Is it possible to start students earlier to take advantage of training resources that would otherwise be wasted? Research results reveal: Yes, but there seems to be no agreement for a policy that condones the pooling of first tour pilots and NFOs beyond the training prescribed entitlement periods. An entitlement period in this context refers to set time allotments between phases of training that students are given to transition, which may include leave, a Permanent Change of Station (PCS), etc.

5. Are resource limitations identical in each training air wing throughout all phases of training? Research results reveal: No.

B. AREAS FOR FURTHER RESEARCH

As this study comes to a close, it is evident that some progress was made in showing a means to aid in the management of capacity issues related to the Naval aviation training pipeline. It is also clear that more work needs to be done in order to improve the overall Naval aviator production system. This study is just one step in several more that need to be taken in order to transform the Navy's first tour pilot and NFO production into a more efficient system than it is today.

1. Properly Linking Requirements to Production Capacity

The driving factor behind the capacity issue in this study has to do with the number of students sent into the Naval aviation training pipeline. The Office of the Chief of Naval Operations (OPNAV) N782B determines these requirements. According to Christopher Munsey (2005) of the Navy Times, the active-duty Navy will have an excess of 240 to 260 aviators "over this fiscal year and next" (p. 16). This situation is due in part to "the five-year phaseout of ten S-3B Viking squadrons, and the gradual elimination of the F-14 Tomcat" (Munsey, 2005). The central cause for this surplus of active-duty Naval aviators was the timing of OPNAV N782B's communication that the requirements for active-duty Naval aviators was going to be reduced. The Naval aviation training pipeline receives the bulk of its' commissioned officers selected for aviation in the May to June time frame. This is due to the fact that the majority of officers receive their commissions in the month of May because most commissioned officers are graduates from a collegiate academic program, whether it is the Naval Academy or a civilian higher education institution. Though some officers are commissioned in other months throughout the year that amount is insignificant when compared to the numbers of officers entering the Naval aviation training pipeline in the early summer months. The news of the reduced requirements for active-duty Naval aviators was disseminated after May aviator officer selections. If the OPNAV decision-making process had considered the timing of the supply for pilot and NFO production, then this surplus situation could have been avoided or made negligible from the standpoint of numbers of excess bodies. The OPNAV process as it relates to the capacity management of the Naval aviation training pipeline was not within the scope of this study, but it is worth examining. Manpower is one of the Chief of Naval Operations (CNO) (Clark, 2005) "Top Five Priorities" and creating excesses in manpower wastes precious funding resources.

Another problem contributing to the Naval aviation training pipeline involved the Integrated Production Plan (IPP) development process as it relates to servicing the Air Force, the Marine Corps, the Flight Surgeon program, and the IMT program. The Naval aviation training pipeline is a “pull” system; whereas, the other entities are operating based on a “push” system. According to Bonney (1999), Venkatesh stated

> In a push system, a preceding machine produces parts without waiting for a request from the succeeding machine. On the other hand, in a pull system a preceding machine produces parts only after it receives a request from the succeeding machine (p. 54).

These aspects of the IPP development process were not within the scope of this study, but their research would be of significant importance to improving the capacity management of the Naval aviation training pipeline.

2. Training Squadron Flight Scheduling Process

A crucial component of making the Naval aviation training pipeline a more efficient system on the training squadron level is the flight scheduling process. At Training Air Wing (TRAWING) 6 on the extreme end of the spectrum the flight scheduling process consumes 3 hours of the day within Flight Training Squadron (VT) 10 and only one hour within VT 4. The Navy has fewer training aircraft resources than the Air Force according to Air Force instructors at TRAWING 6. This is understandable considering that air warfare is not the only combat role performed by the Navy.

The flight scheduling tool used by the training squadrons at TRAWING 6 are “Puck” boards (Figure 28). “Puck” boards are essentially dry eraser boards that are used to track student completion of syllabus events throughout a phase of training. This is accomplished by replicating the training phase syllabus onto a dry eraser board through the use of magnetic placeholders for syllabus events and student names. Then as a student completes each syllabus event a circular magnetic device, also called a “Puck”, is placed in the appropriate area on the dry eraser board. Officers assigned the duties of planning the daily flight schedule have to deal with limitations in the number available aircraft, the number of qualified instructors available to fly, and whether the actual weather makes it permissible to conduct training flights.

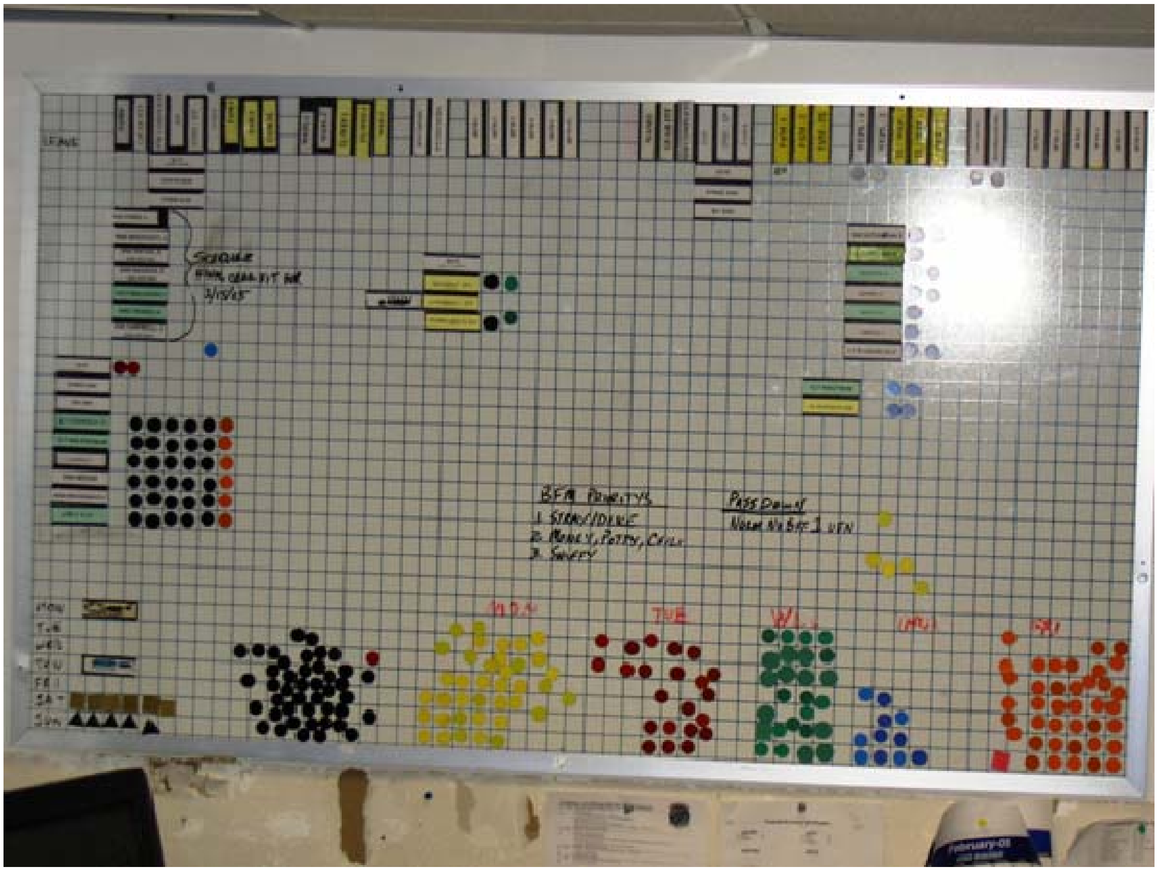

Figure 28. “Puck” Board Picture. (From: TRAWING 6, 2005)

At the training level the Navy and Air Force has invested over three years in developing an automated tool, the Training Integration Management System (TIMS), to simplify this process. The TIMS software is intended to be a

> …centralized training system that will provide cradle-to-grave management of all training assets and student accomplishments. With TIMS, a scheduler will get fully customized scheduling templates, displays and formats as well as drag-and-drop capabilities. All syllabus events will be automatically tracked so building flight schedules will be easier. When a student finishes a computer-based training lesson, TIMS will track completion of that event so a scheduler can tell from his workstation if a student is ready for the next event in the syllabus. After a flight or simulator event, an instructor will complete a student’s grade sheet in TIMS and those results will be automatically available to a squadron scheduler at another workstation. If a student is scheduled for an event before he or she is actually ready to proceed to that event, TIMS will alert the scheduler to the conflict. All of the training sites will be

> connected through TIMS so that students' records and data can be transferred electronically as they move through the aviation training pipeline. It will replace three different legacy data management systems currently in use including the Training Management System used at Naval Air Station Corpus Christi and Pensacola, the Training Integration System used at Naval Air Station Kingsville and Naval Air Station Meridian, and the Standard Training and Support System used at Naval Air Station Whiting Field (Hatcher, 2003).

According to sources at the Chief of Naval Air Training (CNATRA), there was a flaw in a key Navy requirement that this commander identified at the final test evaluation for TIMS, prior to the Air Force and Navy's acceptance of it over three years ago. This requirement was the capability for the application to compute training grades according to the Navy's standard, which is different from the Air Force's standard. The developers found an error in a parameter variable that was listed throughout the entire application code. TIMS has yet to be fully implemented throughout all naval aviation training sites, and those three legacy data management systems are still in use.

The slow development of a good automated tool for aiding OPSOs with the flight scheduling process places those officers with expertise in flight scheduling at a premium. Also, the lack of a centralized database that is integrated throughout all CNATRA training squadrons results in CNATRA production analysts having to use multiple sources (Figure 27) or highly intricate self-devised tools in order accurately account for all students within the Naval aviation training pipeline. This fact was revealed through the survey (Appendix G) conducted with individuals in the Production Department at CNATRA. The above subject matter was not within the scope of this study, but it definitely deserves further research, and it is an important element to properly managing the Naval aviation training pipeline capacity.

3. Contract Support Resources

The Naval aviation training pipeline is not only supported by military and government personnel, but also by contracted aircraft, maintainers, instructors, analysts, and consultants, just to name a few. The interviews conducted at CNATRA revealed the fact that it can take as long as 18 months to secure a contract. Comments were also made to indicate that it is sometimes in the best interest of a contractor that is providing aircraft and maintainers to sell the Navy on a higher number of aircraft in order to ensure the contractor can meet the aircraft readiness requirement for training. This could mean in certain circumstances at specific training air wings the Navy has more of a particular type of aircraft than is needed, and has inadequate numbers of other types of aircraft. The contract cost associated with the T45 aircraft alone is estimated to be $154 million for Fiscal Year (FY) 2006. The contract cost for all airframes within just the pilot training program, to include the T45, is estimated at $222 million for FY 2006. The aircraft contract cost for the entire NFO training program is estimated at $22 million for FY 2006. A study that examines the current aircraft support contract for the Naval aviation training pipeline could ensure it is structured in the Navy's best interest for obtaining the type and quantity of aircraft actually needed and for judiciously appropriating taxpayers' dollars.

4. Capacity Improvement by Organizational Change

It is the authors' opinion that the Naval aviation training pipeline has four decision-making organizational levels. These levels include OPNAV, CNATRA, the training air wings, and the training squadrons. The problems identified in this section pertain to CNATRA and training air wings.

In learning about the IPP development process, it was noted that the training air wings are allowed to determine the student numbers for their "Planned Ins" and "Planned Outs" for each phase of training under their purview. A training air wing should be more aware of their own training phase production capacity with respect to the appropriate number of students that can be loaded in a training squadron at one time, but the "Planned Outs" for meeting fleet requirements may best reside within the authority of CNATRA. Some training air wings may manage their student numbers quite well with respect to meeting fleet requirements, but if there are some that do not, then the aviation training pipeline will be burdened with unnecessary excesses in numbers of students or not meet fleet goals for first tour aviators. Neither one of these afore-mentioned situations demonstrates an efficient production system, thus the aspect of production authority deserves a more serious review.

Now in regard to the training air wing organizational structure, one of the Air Force officers interviewed at TRAWING 6 believed that the compartmentalized organizational structure of the wing hinders the overall goal of producing NFOs in a team-oriented fashion. For example, an instructor who teaches in the classroom cannot be an in flight instructor. Meaning, the academics portion of NFO training is a separate department from the actual in flight training. The persons in leadership for these two departments are the same rank. This type of leadership structure depending on the individuals who hold these positions has the potential to be an incompatible relationship. However, there are weekly meetings in which the individuals responsible for flight training and academics gather with other parties in order to resolve training organizational conflicts.

The issues that were raised by the interviews held with Air Force officers and CNATRA production staff deserves a closer examination, which is broader than the scope of this study. These issues should be taken up in another study that specifically analyzes Naval aviation training organizational problems. Sometimes, organizational change can have more of an impact than any new automated tool created to aid with mitigating system inefficiencies.

C. FINAL STATEMENT

This study has revealed that the Naval aviation training pipeline problem with capacity management has four different aspects (Figure 29), and these areas are comprised of multiple elements. Solving the problem for only one of these areas will not solve the entire aviation training pipeline capacity management problem.

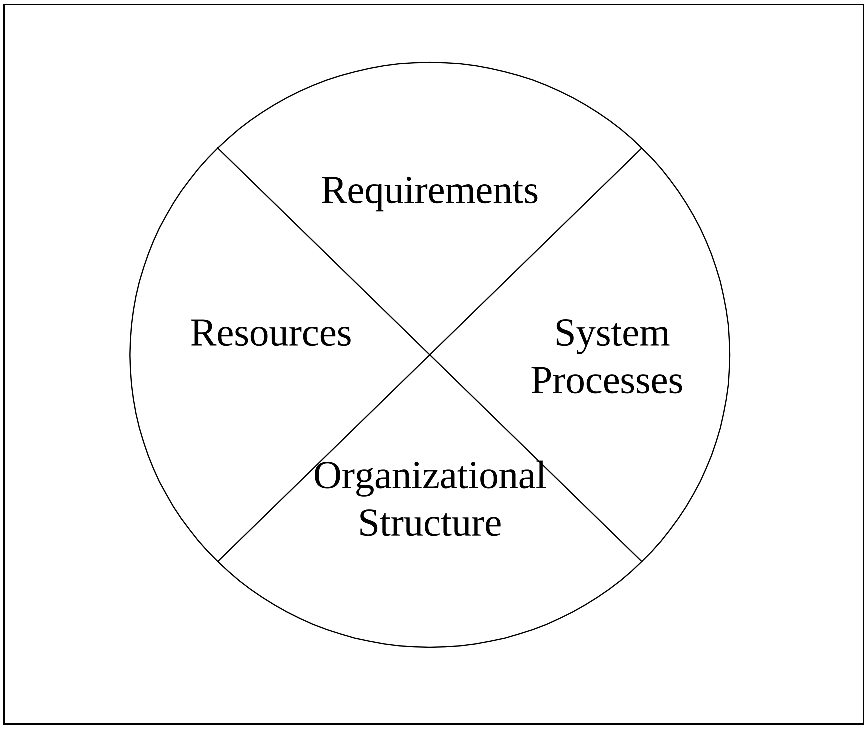

Figure 29. Naval Aviation Training Pipeline Capacity Management Diagram.

Capacity management for the Naval aviation training pipeline is more complicated than one study could ever resolve. This study presented only one potential solution for aiding with the capacity management of the Naval aviation training pipeline. Further work will definitely be required for more progress to be made in the proper methods to apply for managing the Naval aviation training pipeline capacity.

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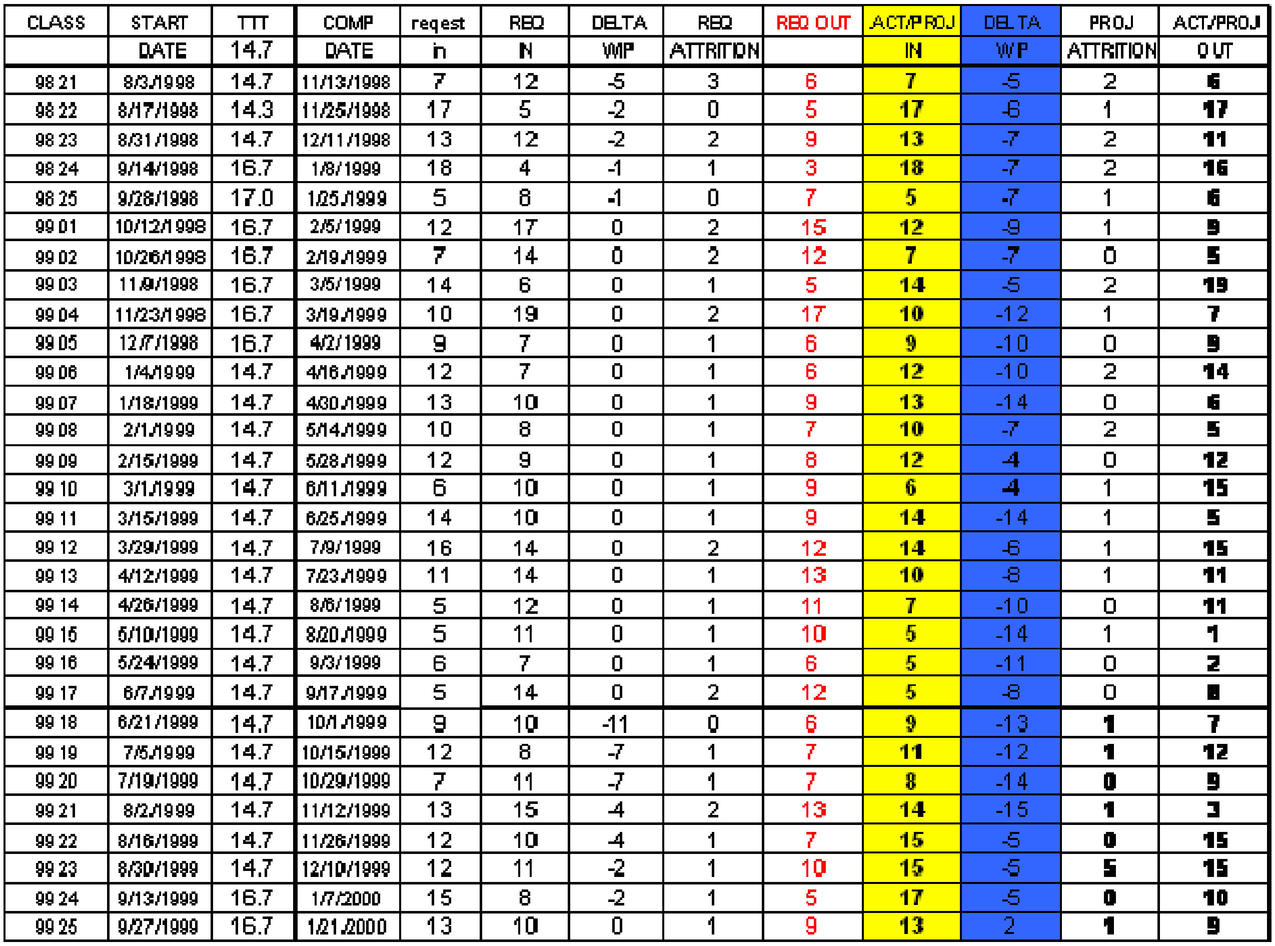
APPENDIX A. DATA ANALYSIS

The Figure 4 graph was composed in the following manner:

1. Last and third and the last columns of data from the Total.xls spreadsheet of the "Fridge Tool" used by TRAWING 6. Delta-WIP is the extra bodies in training. ACT/PROJ IN is the number of students who began the class. The Delta-WIP is created when that class finishes. For example, if 10 students begin and 9 complete, then the Delta-WIP increases by 1.



CLASS	START	TTT	COMP	reqest	REQ	DELTA	REQ	REQ OUT	ACT/PROJ	DELTA	PROJ	ACT/PROJ
	DATE	14.7	DATE	in	IN	WIP	ATTRITION		IN	WIP	ATTRITION	OUT
98 21	8/3/1998	14.7	11/13/1998	7	12	-5	3	6	7	-5	2	6
98 22	8/17/1998	14.3	11/25/1998	17	5	-2	0	5	17	-6	1	17
98 23	8/31/1998	14.7	12/11/1998	13	12	-2	2	9	13	-7	2	11
98 24	9/14/1998	16.7	1/8/1999	18	4	-1	1	3	18	-7	2	16
98 25	9/28/1998	17.0	1/25/1999	5	8	-1	0	7	5	-7	1	6
99 01	10/12/1998	16.7	2/5/1999	12	17	0	2	15	12	-9	1	9
99 02	10/26/1998	16.7	2/19/1999	7	14	0	2	12	7	-7	0	5
99 03	11/9/1998	16.7	3/5/1999	14	6	0	1	5	14	-5	2	19
99 04	11/23/1998	16.7	3/19/1999	10	19	0	2	17	10	-12	1	7
99 05	12/7/1998	16.7	4/2/1999	9	7	0	1	6	9	-10	0	9
99 06	1/4/1999	14.7	4/16/1999	12	7	0	1	6	12	-10	2	14
99 07	1/18/1999	14.7	4/30/1999	13	10	0	1	9	13	-14	0	6
99 08	2/1/1999	14.7	5/14/1999	10	8	0	1	7	10	-7	2	5
99 09	2/15/1999	14.7	5/28/1999	12	9	0	1	8	12	-4	0	12
99 10	3/1/1999	14.7	6/11/1999	6	10	0	1	9	6	-4	1	15
99 11	3/15/1999	14.7	6/25/1999	14	10	0	1	9	14	-14	1	5
99 12	3/29/1999	14.7	7/9/1999	16	14	0	2	12	14	-6	1	15
99 13	4/12/1999	14.7	7/23/1999	11	14	0	1	13	10	-8	1	11
99 14	4/26/1999	14.7	8/6/1999	5	12	0	1	11	7	-10	0	11
99 15	5/10/1999	14.7	8/20/1999	5	11	0	1	10	5	-14	1	1
99 16	5/24/1999	14.7	9/3/1999	6	7	0	1	6	5	-11	0	2
99 17	6/7/1999	14.7	9/17/1999	5	14	0	2	12	5	-8	0	8
99 18	6/21/1999	14.7	10/1/1999	9	10	-11	0	6	9	-13	1	7
99 19	7/5/1999	14.7	10/15/1999	12	8	-7	1	7	11	-12	1	12
99 20	7/19/1999	14.7	10/29/1999	7	11	-7	1	7	8	-14	0	9
99 21	8/2/1999	14.7	11/12/1999	13	15	-4	2	13	14	-15	1	3
99 22	8/16/1999	14.7	11/26/1999	12	10	-4	1	7	15	-5	0	15
99 23	8/30/1999	14.7	12/10/1999	12	11	-2	1	10	15	-5	5	15
99 24	9/13/1999	16.7	1/7/2000	15	8	-2	1	5	17	-5	0	10
99 25	9/27/1999	16.7	1/21/2000	13	10	0	1	9	13	2	1	9

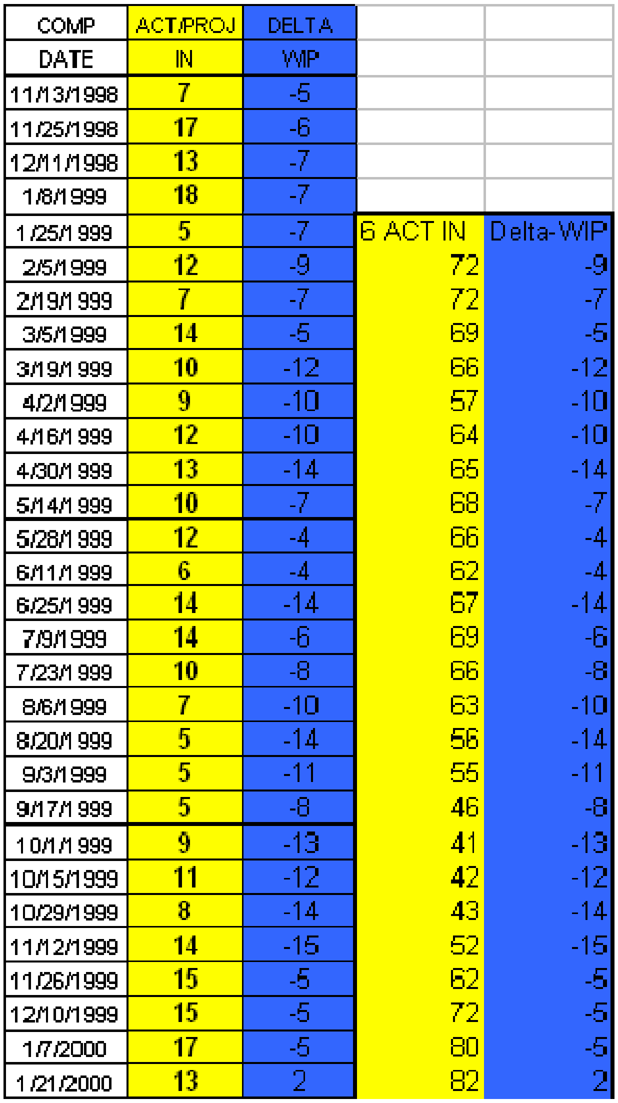
Table 1. VT 10 Primary Training Phase Data. (From: TRAWING 6, 2004)

2. Created a third column, "6 ACT IN", which ran a running sum of 6 classes or 6 rows worth of class completers.

3. Added another column, “Delta-WIP”, which was a copy of the original Delta-WIP. This step made it easier to graph the data in Excel.

4. The graph was then created with the 2 rightmost columns.

5. The x-axis label for the graph was the completion date of the class.



COMP	ACT/PROJ	DELTA		
DATE	IN	WIP		
11/13/1998	7	-5		
11/25/1998	17	-6		
12/11/1998	13	-7		
1/8/1999	18	-7		
1/25/1999	5	-7	6 ACT IN	Delta-WIP
2/5/1999	12	-9	72	-9
2/19/1999	7	-7	72	-7
3/5/1999	14	-5	69	-5
3/19/1999	10	-12	66	-12
4/2/1999	9	-10	57	-10
4/16/1999	12	-10	64	-10
4/30/1999	13	-14	65	-14
5/14/1999	10	-7	68	-7
5/28/1999	12	-4	66	-4
6/11/1999	6	-4	62	-4
6/25/1999	14	-14	67	-14
7/9/1999	14	-6	69	-6
7/23/1999	10	-8	66	-8
8/6/1999	7	-10	63	-10
8/20/1999	5	-14	56	-14
9/3/1999	5	-11	55	-11
9/17/1999	5	-8	46	-8
10/1/1999	9	-13	41	-13
10/15/1999	11	-12	42	-12
10/29/1999	8	-14	43	-14
11/12/1999	14	-15	52	-15
11/26/1999	15	-5	62	-5
12/10/1999	15	-5	72	-5
1/7/2000	17	-5	80	-5
1/21/2000	13	2	82	2

Figure 30. Six Aggregate Students In and Delta WIP Totals.

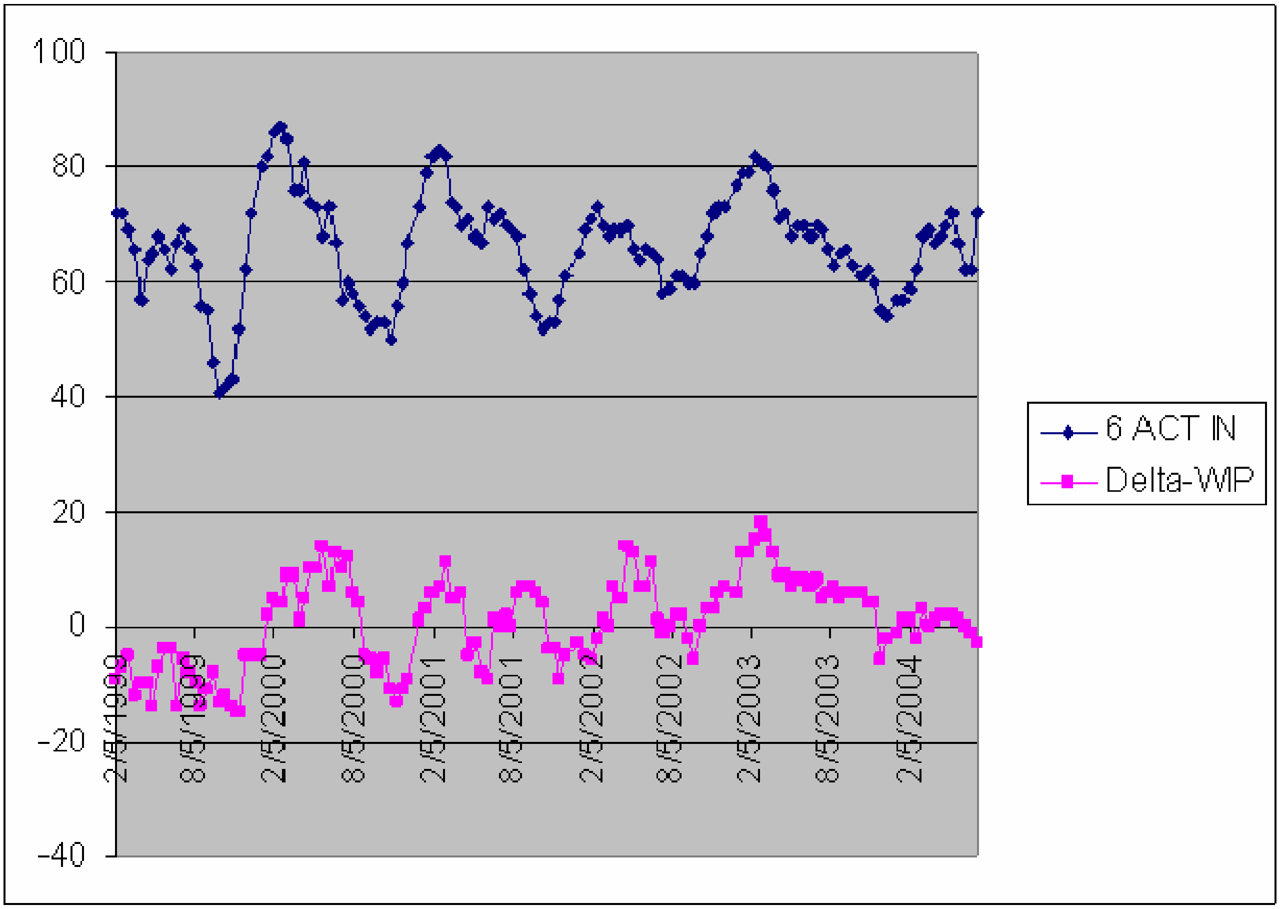


Figure 31. Six Aggregate Students In vs. Delta WIP.

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APPENDIX B. QUESTIONNAIRE

Questionnaire in support of NPS Thesis Project:
PROTOTYPING A WEB-ENABLED DECISION SUPPORT SYSTEM TO IMPROVE CAPACITY MANAGEMENT OF AVIATION TRAINING

Questions for:

CNATRA	TRAWING 6
VT 10 OPSO	VT 4 OPSO
VT 86 OPSO	

You are our customer. The success of this project largely depends on the information that you share with us. Your time is appreciated.

The purpose of the following questions is to help to advance our understanding of the decision process from generation of the IPP spreadsheets to the person(s) who decide how many students will need to start at API and when.

Please call me (LCDR Randy Bostick) @ 850-313-4019 or type your responses into this text and e-mail it to rwbostick@nps.edu. If able, please complete by 1600 Wednesday, 26 JAN. Thank you again for your time.

Project Objective: - To provide a predictive tool which allows for more efficient planning and use of training resources (capacity) in relation to fluctuating student loading.
Strategy: **- Analyze process from API to FRS. Use NAPPI work as reference.** - Determine predictive correlations between student loading, time-to-train, and capacity limitations. - Use relationships to predict periods of under/overcapacity given squadron provided data. - Train users how to use the tool in order to help them plan accordingly for future periods when other than normal rates of production will be required.

Questions

IPP

1) How far into the future does the IPP predict demand?

2) How often is the IPP produced?

3) Who is involved in deciding IPP Requirements/numbers?

4) Who physically creates the IPP spreadsheet?

5) Who would be considered an IPP “Expert” and could you please provide their contact information?

6) How is the IPP Distributed to the Wings?

7) How often do students begin at a time not predicted by the IPP? For example, do all services / countries follow the IPP? If not, how often do they deviate? How much time in advance do they let API know that they are sending students?

8) Are there any easily accessible documents/presentations that you can think of that would help? If so, could you let us know and e-mail the document / link / or location?

CNATRA

9) What does CNATRA do with the IPP? Is someone in charge of Wing production?

10) How are the NIPDR charts currently being used? By who?

11) How are future Wing manning / resource level requirements figured?

12) How is it predicted (what process is used to determine) that resources will or will not meet future production demands?

13) How often does CNATRA communicate with the FRSs concerning production?

14) Are there any easily accessible documents/presentations that you can think of that would help? If so, could you let us know and e-mail the document / link / or location?

Wings

15) What does your Wing do with the IPP? Is someone in charge of Wing production?

16) Who in each wing is involved in the process of converting the IPP to actual numbers of needed students to start each class?

17) How is this process completed? Spreadsheet? Other?

18) How are the start numbers sent to API? If by meeting, how often? By e-mail? Does API ever deny requests? If so, why?

19) How are the NIPDR charts currently being used? By who?

20) How is Wing manning / resource levels figured?

21) How is it currently predicted that resources will or will not meet future production demands?

22) What is the current process to determine the number of students that will start in each primary class?

23) Are there any easily accessible documents/presentations that you can think of that would help? If so, could you let us know and e-mail the document / link / or location?

Squadrons

24) What are the main factors that cause students (on average) not to finish within their allotted Time-to-Train?

25) What would you suggest changing to ensure that the required number of students are consistently graduating on time?

26) How is it currently predicted if resources will or will not meet future production demands? Is someone in charge of this? If so, who?

27) When writing the flight schedule, is it always the case that **ALL** students who need flights are scheduled for a flight? (In other words, can every student who needs a flight be scheduled for one?) If not, how are students prioritized to fly or not fly?

28) How are the NIPDR charts currently being used? By who?

29) How are future Wing manning / resource levels figured?

30) What is the average percentage of failed tests per class?

31) What is the percentage of roll backs caused by failed tests?

32) What are the other factors that may prevent a student from staying with his or her class during ground school?

33) What is the current process for determining how many flights are possible for the next week? Month? Year?

34) Is it known how many flights will be required for a class in a given time period?

35) How are the total flights required in a given time period determined? For example, how is it determined how many flights will be required next month?

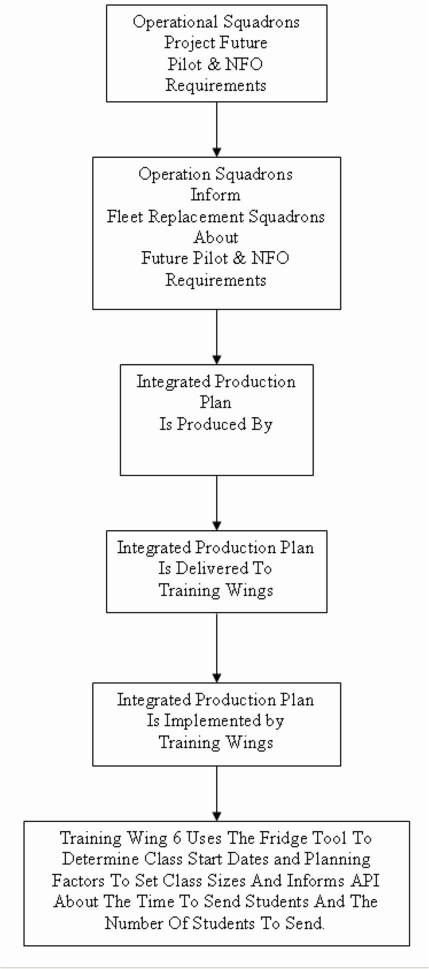
36) Is the following determined: The number of flights that will be required to be scheduled given that some percentage will be cancelled due to certain variables? If so, how is it determined?

37) What is the current process to determine the number of students that will start in each primary class?

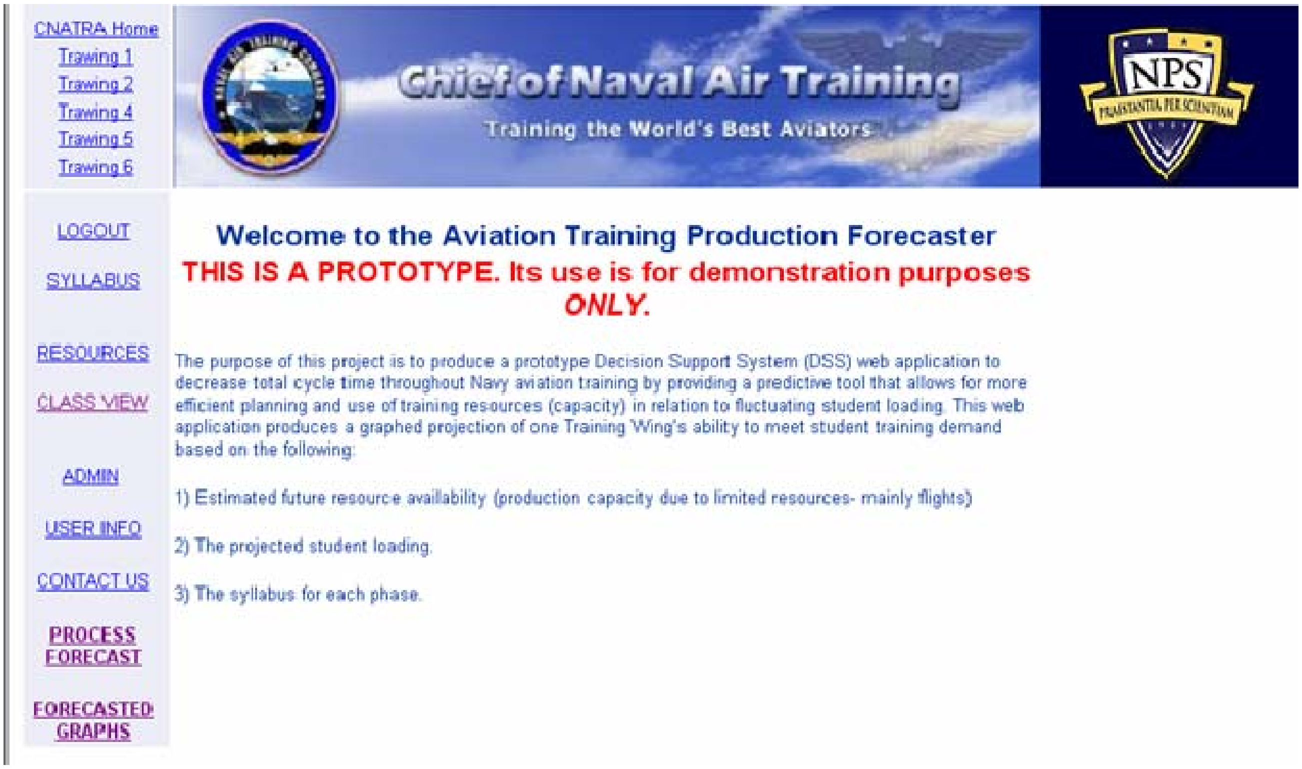
38) Are there any easily accessible documents/presentations that you can think of that would help? If so, could you let us know and e-mail the document / link / or location?

39) All,

40) Below is the process IPP to API process which we need to fully understand. Please add any who, what, where, and "interacts with" information that you can to ensure that we have an accurate view of the process. Thank you.


Operational Squadrons Project Future Pilot & NFO Requirements
Operation Squadrons Inform Fleet Replacement Squadrons About Future Pilot & NFO Requirements
Integrated Production Plan Is Produced By
Integrated Production Plan Is Delivered To Training Wings
Integrated Production Plan Is Implemented by Training Wings
Training Wing 6 Uses The Fridge Tool To Determine Class Start Dates and Planning Factors To Set Class Sizes And Informs API About The Time To Send Students And The Number Of Students To Send.

APPENDIX C. PROTOTYPE I SCREENSHOTS AND CAPTIONS



Welcome to the Aviation Training Production Forecaster

THIS IS A PROTOTYPE. Its use is for demonstration purposes ONLY.

The purpose of this project is to produce a prototype Decision Support System (DSS) web application to decrease total cycle time throughout Navy aviation training by providing a predictive tool that allows for more efficient planning and use of training resources (capacity) in relation to fluctuating student loading. This web application produces a graphed projection of one Training Wing's ability to meet student training demand based on the following:

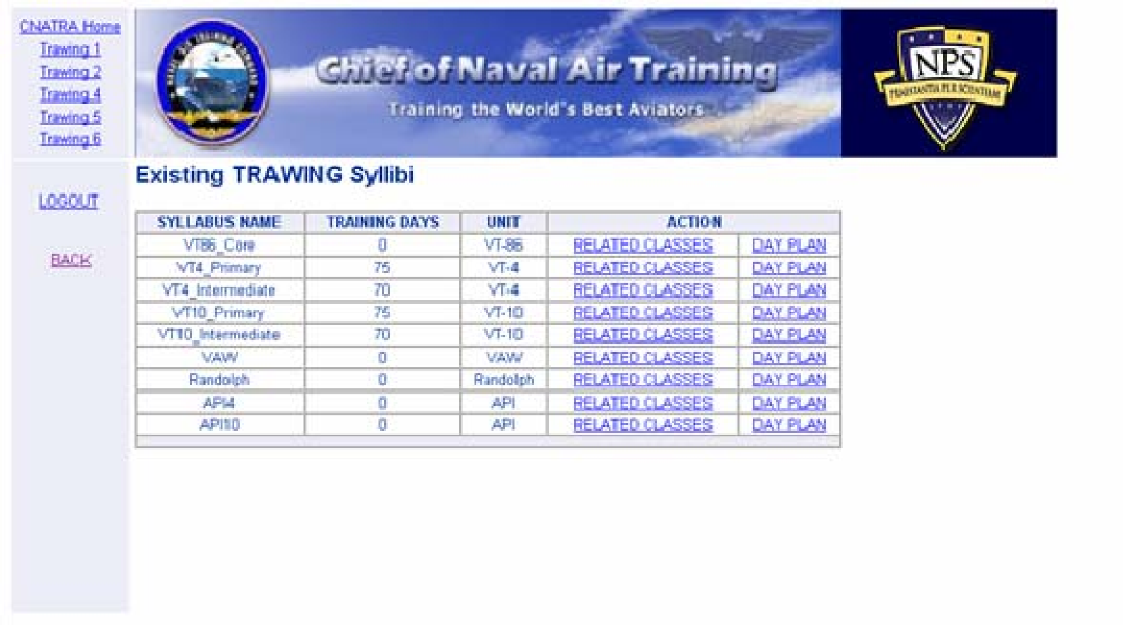
1) Estimated future resource availability (production capacity due to limited resources- mainly flights)

2) The projected student loading.

3) The syllabus for each phase.

Figure 32. Prototype I DSS Website Screenshot 1.

This page is viewed after the user enters their username and password. This is the home or main page of the "Aviation Training Resource Usage Forecaster" website.

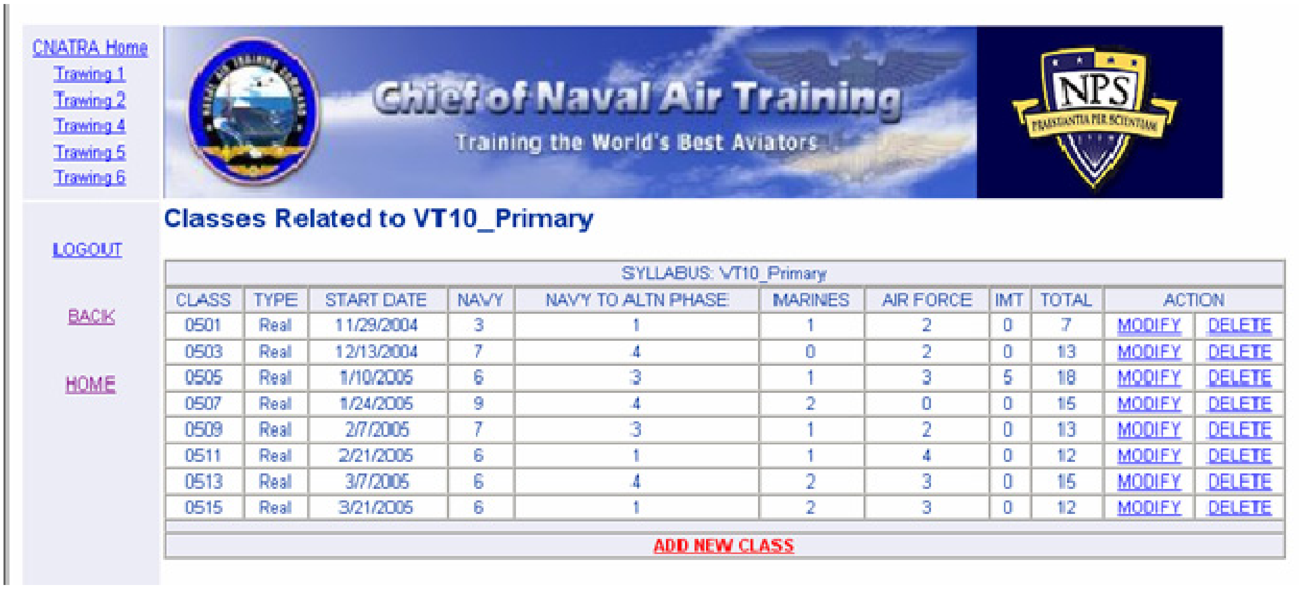


Existing TRAWING Syllibi

SYLLABUS NAME	TRAINING DAYS	UNIT	ACTION	
VT86_Core	0	VT-86	RELATED CLASSES	DAY PLAN
VT4_Primary	75	VT-4	RELATED CLASSES	DAY PLAN
VT4_Intermediate	70	VT-4	RELATED CLASSES	DAY PLAN
VT10_Primary	75	VT-10	RELATED CLASSES	DAY PLAN
VT10_Intermediate	70	VT-10	RELATED CLASSES	DAY PLAN
VAW	0	VAW	RELATED CLASSES	DAY PLAN
Randolph	0	Randolph	RELATED CLASSES	DAY PLAN
API4	0	API	RELATED CLASSES	DAY PLAN
API10	0	API	RELATED CLASSES	DAY PLAN

Figure 33. Prototype I DSS Website Screenshot 2.

This page is viewed by clicking on the "SYLLABUS" hyperlink located on the "Aviation Training Resource Usage Forecaster" home page. The "SYLLABUS" page displays a listing of the training phases associated with the NFO training pipeline, the allotted time-to-train for each one of the those training phases, and the name of the unit responsible for hosting the listed training phases.


CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
Chief of Naval Air Training
Training the World's Best Aviators
NPS
PRAESTANTIA PER SCIENTIAM
LOGOUT
BACK
HOME

Classes Related to VT10_Primary

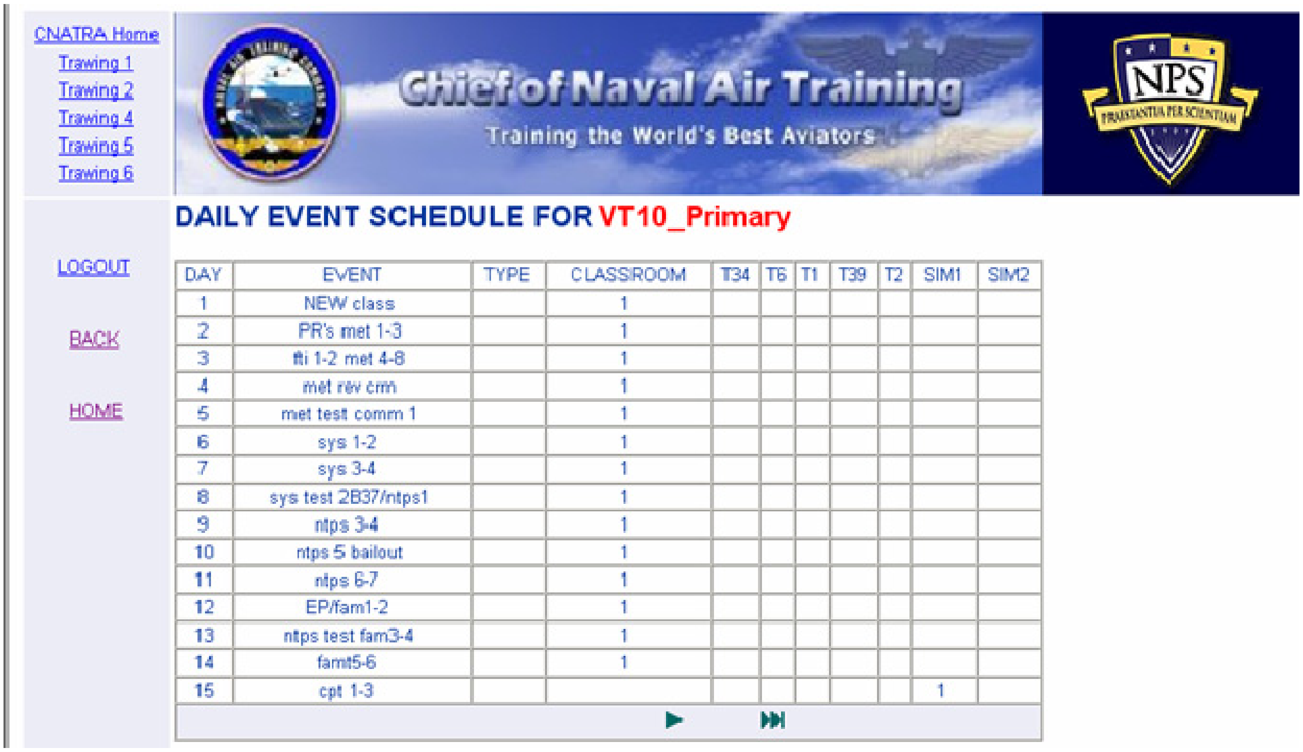
SYLLABUS: VT10_Primary

CLASS	TYPE	START DATE	NAVY	NAVY TO ALTN PHASE	MARINES	AIR FORCE	IMT	TOTAL	ACTION	
0501	Real	11/29/2004	3	1	1	2	0	7	MODIFY	DELETE
0503	Real	12/13/2004	7	4	0	2	0	13	MODIFY	DELETE
0505	Real	1/10/2005	6	3	1	3	5	18	MODIFY	DELETE
0507	Real	1/24/2005	9	4	2	0	0	15	MODIFY	DELETE
0509	Real	2/7/2005	7	3	1	2	0	13	MODIFY	DELETE
0511	Real	2/21/2005	6	1	1	4	0	12	MODIFY	DELETE
0513	Real	3/7/2005	6	4	2	3	0	15	MODIFY	DELETE
0515	Real	3/21/2005	6	1	2	3	0	12	MODIFY	DELETE

ADD NEW CLASS

Figure 34. Prototype I DSS Website Screenshot 3.

This page is viewed by clicking on any of the "RELATED CLASSES" hyperlinks located on the "SYLLABUS" page. The "RELATED CLASSES" page displays breakdown of the student numbers associated with a specific NFO training class, training phase, and training unit. This page also gives a user the capability to "ADD NEW CLASS".



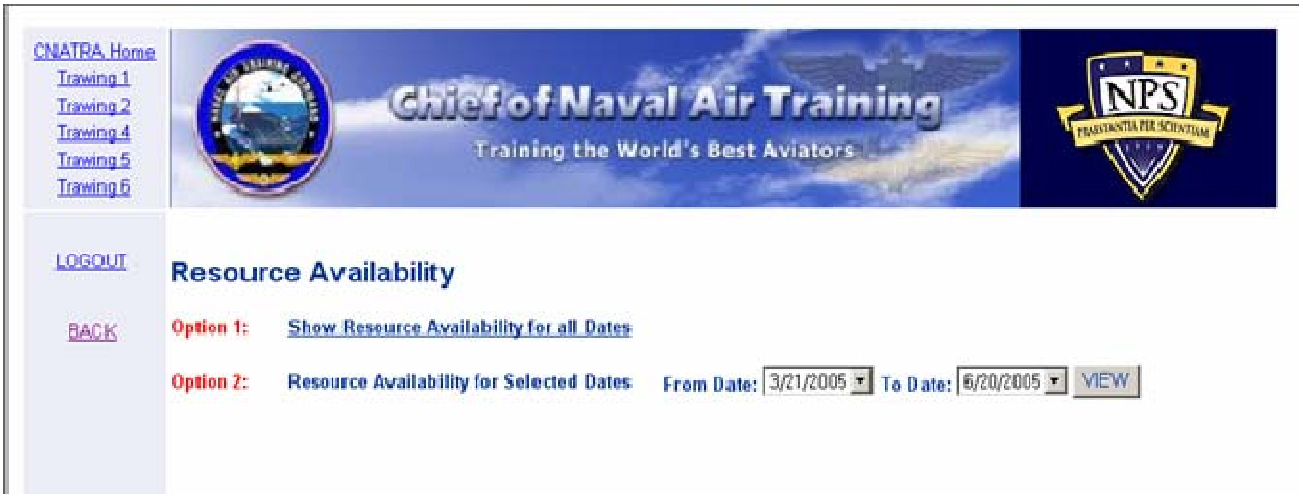
CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
Chief of Naval Air Training
Training the World's Best Aviators
NPS
PRAESTANTIA PER SCIENTIAM
LOGOUT
BACK
HOME

DAILY EVENT SCHEDULE FOR VT10_Primary

DAY	EVENT	TYPE	CLASSROOM	T34	T6	T1	T39	T2	SIM1	SIM2
1	NEW class		1							
2	PR's met 1-3		1							
3	fti 1-2 met 4-8		1							
4	met rev crm		1							
5	met test comm 1		1							
6	sys 1-2		1							
7	sys 3-4		1							
8	sys test 2B37/ntps1		1							
9	ntps 3-4		1							
10	ntps 5 bailout		1							
11	ntps 6-7		1							
12	EP/fam1-2		1							
13	ntps test fam3-4		1							
14	famt5-6		1							
15	cpt 1-3								1	

Figure 35. Prototype I DSS Website Screenshot 4.

This page is viewed by clicking on any of the “DAY PLAN” hyperlinks located on the “SYLLABUS” page. The “DAY PLAN” is essentially a day for day breakdown of the syllabus for a specific training phase at a specific training unit. The listing on this web page shows the specific event that must be accomplished for each day of the training phase syllabus. Every training phase event is associated with a specific resource.



CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
Chief of Naval Air Training
Training the World's Best Aviators
NPS
PRAESTANTIA PER SCIENTIAM
LOGOUT
BACK
VIEW

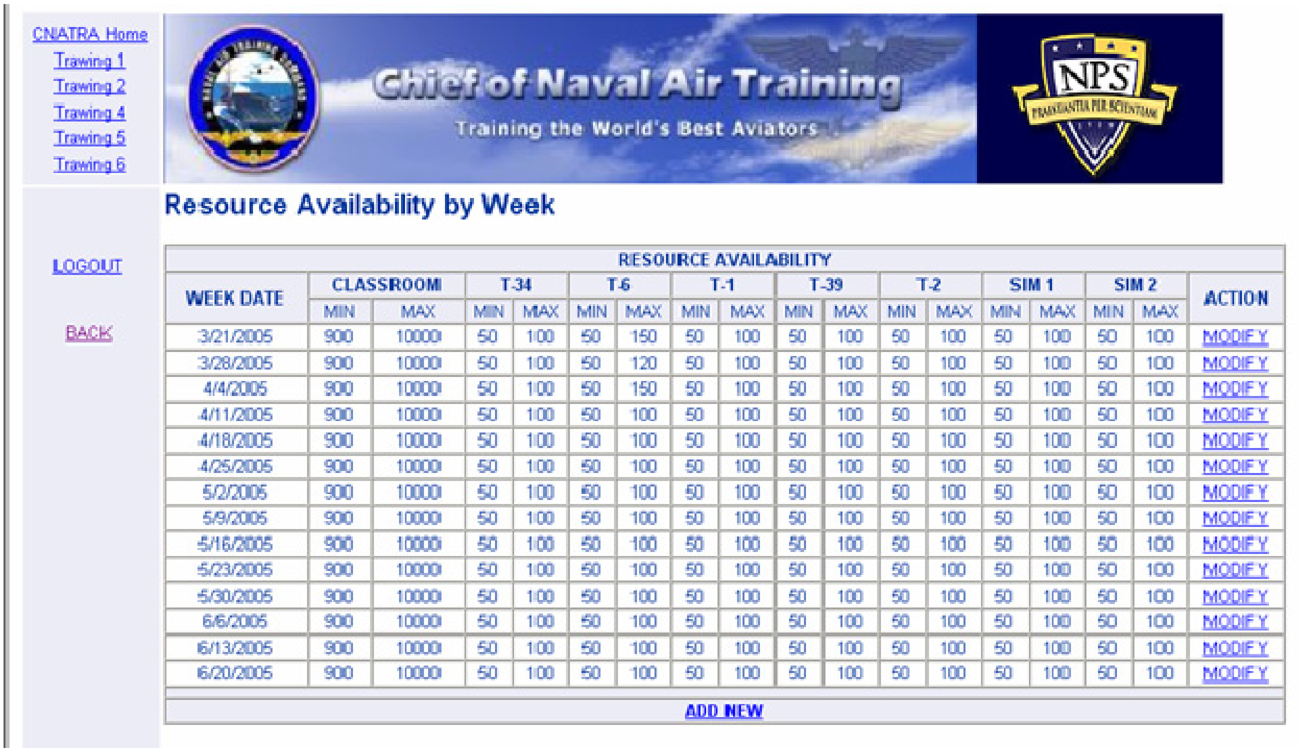
Resource Availability

Option 1: Show Resource Availability for all Dates

Option 2: Resource Availability for Selected Dates From Date: 3/21/2005 To Date: 6/20/2005

Figure 36. Prototype I DSS Website Screenshot 5.

This page is viewed by clicking on the "RESOURCES" hyperlink located on the "Aviation Training Resource Usage Forecaster" home page. The "RESOURCES" page provides the user with the capability for viewing resources by one of two listed options.


CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
Chief of Naval Air Training
Training the World's Best Aviators
NPS
PRAESTANTIA PER SCIENTIAM
LOGOUT
BACK

Resource Availability by Week

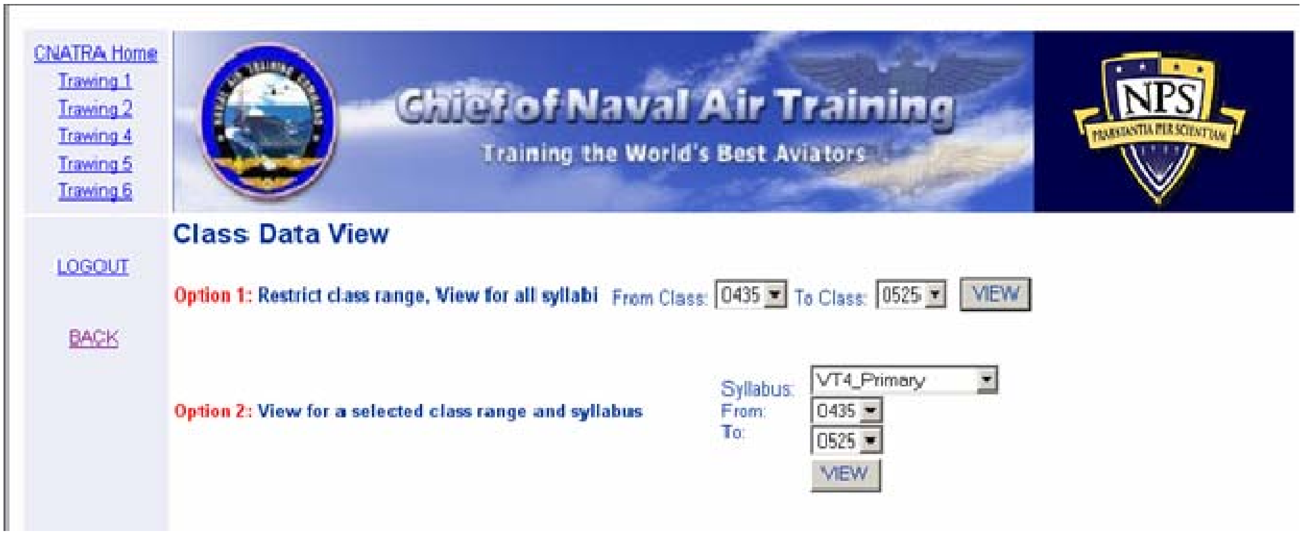
RESOURCE AVAILABILITY

WEEK DATE	CLASSROOM		T-34		T-6		T-1		T-39		T-2		SIM 1		SIM 2		ACTION
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
3/21/2005	900	10000	50	100	50	150	50	100	50	100	50	100	50	100	50	100	MODIFY
3/28/2005	900	10000	50	100	50	120	50	100	50	100	50	100	50	100	50	100	MODIFY
4/4/2005	900	10000	50	100	50	150	50	100	50	100	50	100	50	100	50	100	MODIFY
4/11/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
4/18/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
4/25/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
5/2/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
5/9/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
5/16/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
5/23/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
5/30/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
6/6/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
6/13/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY
6/20/2005	900	10000	50	100	50	100	50	100	50	100	50	100	50	100	50	100	MODIFY

ADD NEW

Figure 37. Prototype I DSS Website Screenshot 6.

This page is viewed by clicking on the "Show Resource Availability for all Dates" hyperlink located on the "RESOURCES" page. The "Show Resource Availability for all Dates" page displays the minimum and maximum numbers associated with a NFO training resource for a specific week. The user must derive this data. This page also gives a user the capability to "ADD NEW" resources to the listing.


CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
Chief of Naval Air Training
Training the World's Best Aviators
NPS
PRAESTANTIA PER SCIENTIAM
LOGOUT
BACK
VIEW
VIEW

Class Data View

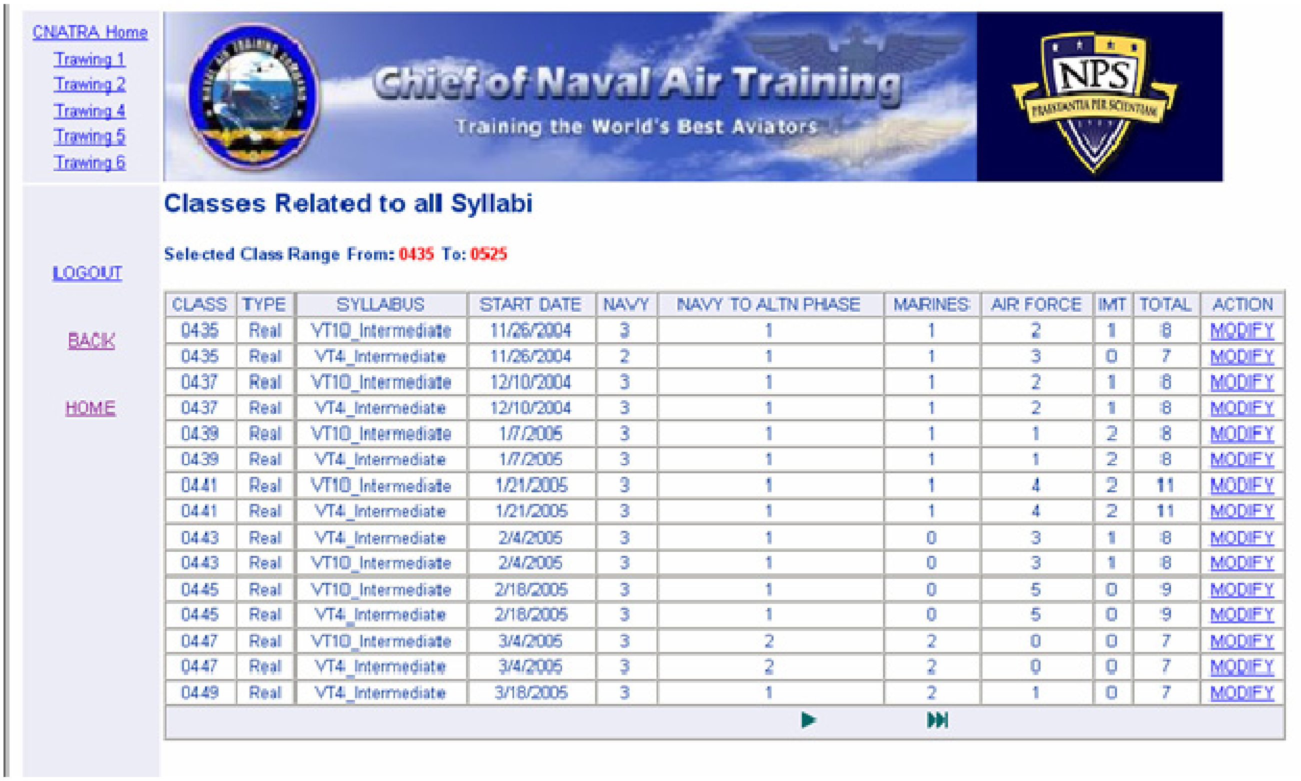
Option 1: Restrict class range, View for all syllabi From Class: 0435 To Class: 0525

Option 2: View for a selected class range and syllabus

Syllabus: VT4_Primary
From: 0435
To: 0525

Figure 38. Prototype I DSS Website Screenshot 7.

This page is viewed by clicking on the "CLASS VIEW" hyperlink located on the "Aviation Training Resource Usage Forecaster" home page. The "CLASS VIEW" page provides the user with the capability for viewing classes by one of two listed options.


CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
Chief of Naval Air Training
Training the World's Best Aviators
NPS
PRAESTANTIA PER SCIENTIAM
LOGOUT
BACK
HOME

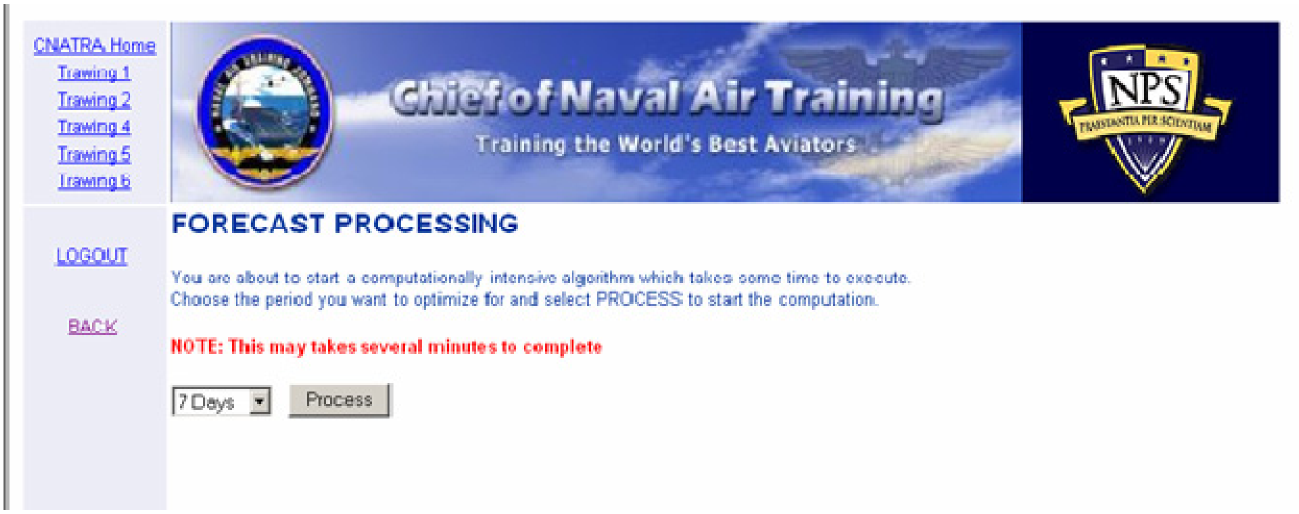
Classes Related to all Syllabi

Selected Class Range From: 0435 To: 0525

CLASS	TYPE	SYLLABUS	START DATE	NAVY	NAVY TO ALTN PHASE	MARINES	AIR FORCE	IMT	TOTAL	ACTION
0435	Real	VT10_Intermediate	11/26/2004	3	1	1	2	1	8	MODIFY
0435	Real	VT4_Intermediate	11/26/2004	2	1	1	3	0	7	MODIFY
0437	Real	VT10_Intermediate	12/10/2004	3	1	1	2	1	8	MODIFY
0437	Real	VT4_Intermediate	12/10/2004	3	1	1	2	1	8	MODIFY
0439	Real	VT10_Intermediate	1/7/2005	3	1	1	1	2	8	MODIFY
0439	Real	VT4_Intermediate	1/7/2005	3	1	1	1	2	8	MODIFY
0441	Real	VT10_Intermediate	1/21/2005	3	1	1	4	2	11	MODIFY
0441	Real	VT4_Intermediate	1/21/2005	3	1	1	4	2	11	MODIFY
0443	Real	VT4_Intermediate	2/4/2005	3	1	0	3	1	8	MODIFY
0443	Real	VT10_Intermediate	2/4/2005	3	1	0	3	1	8	MODIFY
0445	Real	VT10_Intermediate	2/18/2005	3	1	0	5	0	9	MODIFY
0445	Real	VT4_Intermediate	2/18/2005	3	1	0	5	0	9	MODIFY
0447	Real	VT10_Intermediate	3/4/2005	3	2	2	0	0	7	MODIFY
0447	Real	VT4_Intermediate	3/4/2005	3	2	2	0	0	7	MODIFY
0449	Real	VT4_Intermediate	3/18/2005	3	1	2	1	0	7	MODIFY

Figure 39. Prototype I DSS Website Screenshot 8.

This page is viewed by clicking on either one of the two “VIEW” buttons located on the “CLASS VIEW” page. This page displays a breakdown of the student numbers associated with a specific NFO training class, training phase, and training unit.


CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
LOGOUT
BACK
Chief of Naval Air Training
Training the World's Best Aviators
NPS
PRAESTANTIA PER SCIENTIAM
7 Days
Process

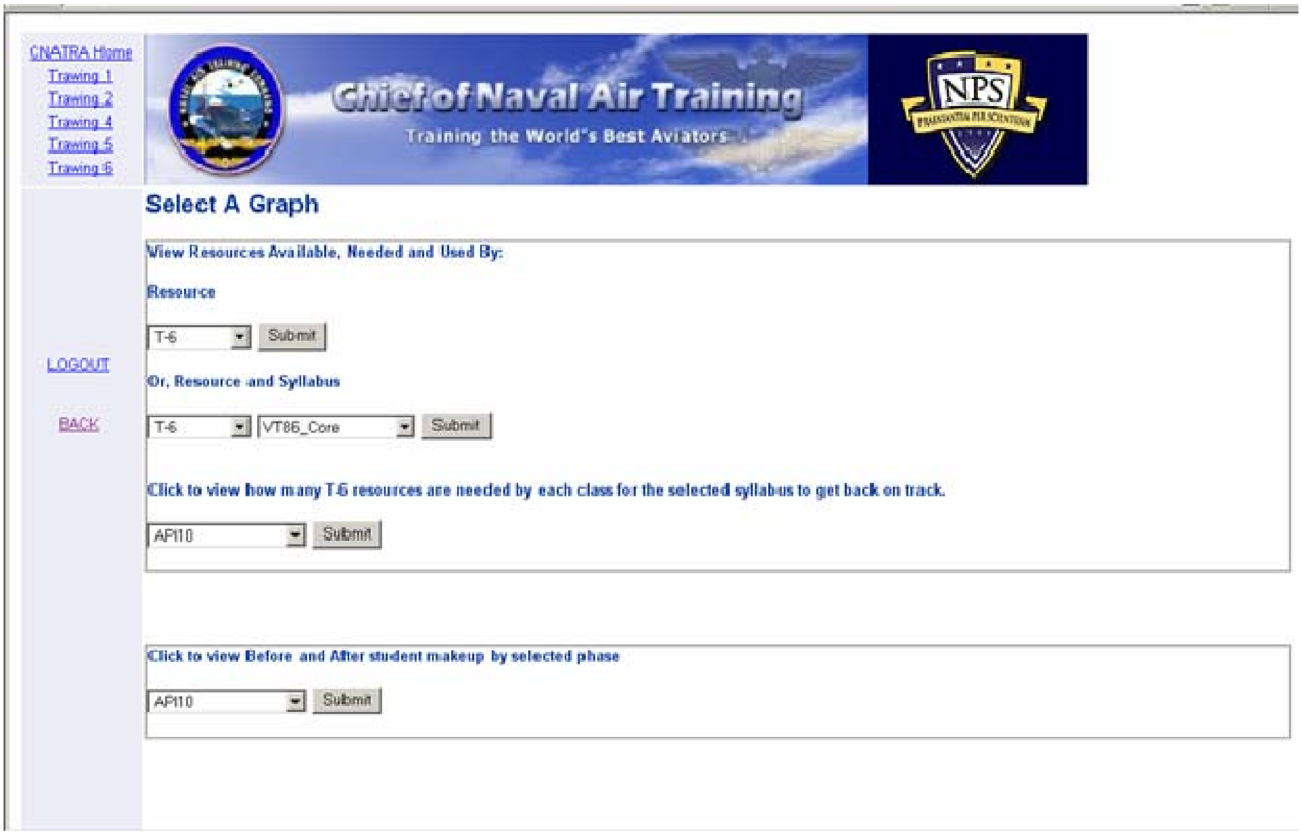
FORECAST PROCESSING

You are about to start a computationally intensive algorithm which takes some time to execute.
Choose the period you want to optimize for and select PROCESS to start the computation.

NOTE: This may takes several minutes to complete

Figure 40. Prototype I DSS Website Screenshot 9.

This page is viewed by clicking on the “PROCESS FORECAST” hyperlink located on the “Aviation Training Resource Usage Forecaster” home page. The “PROCESS FORECAST” page provides the user with the capability to select number of days for the projected forecast that will be processed by using the drop down menu.



Select A Graph

View Resources Available, Needed and Used By:

Resource

T-6

Or, Resource and Syllabus

T-6 VT86_Core

Click to view how many T-6 resources are needed by each class for the selected syllabus to get back on track.

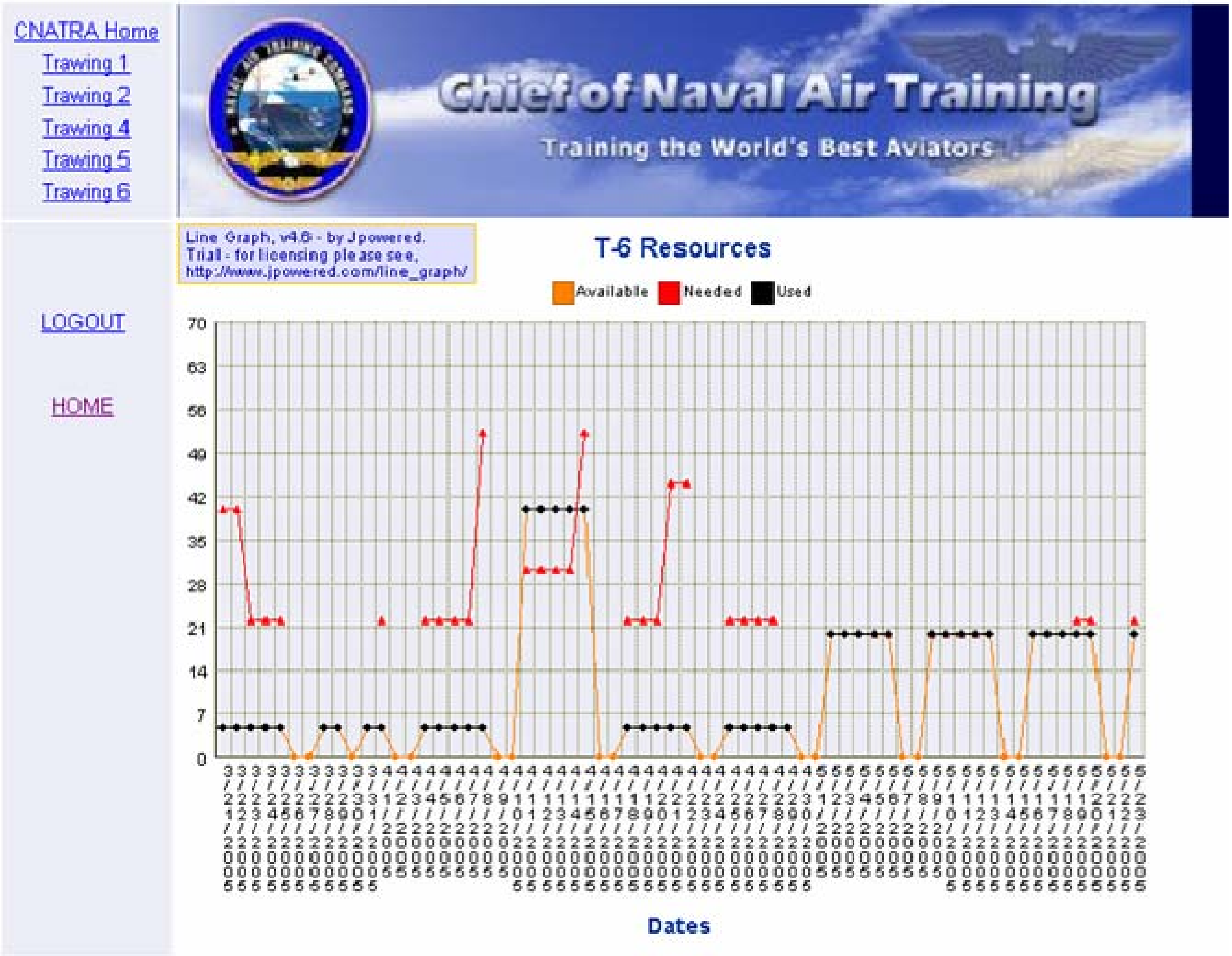
API10

Click to view Before and After student makeup by selected phase

API10

Figure 41. Prototype I DSS Website Screenshot 10.

This page is viewed by clicking on the “FORECASTED GRAPHS” hyperlink located on the “Aviation Training Resource Usage Forecaster” home page. The “FORECASTED GRAPHS” page provides the user with the capability to plot a graphical display of the processed data by selecting one of the four options presented within the content of the page.



Line Graph, v4.6 - by Jpowered.
Trial - for licensing please see,
http://www.jpowered.com/line_graph/

Figure 42. Prototype I DSS Website Screenshot 11.

This graph was produced from the first option on the “FORECASTED GRAPHS” page. The graph displays data for a resource, like T-6 aircraft, selected from the drop down menu. The selected resource data is displayed in the color format of orange, red, and black. Orange data points indicate the numerical amount available for use of the selected resource on a specific date. Red data points indicate the numerical amount needed for use of the selected resource on a specific date. Black data points indicate the numerical amount being used of the selected resource on a specific date.

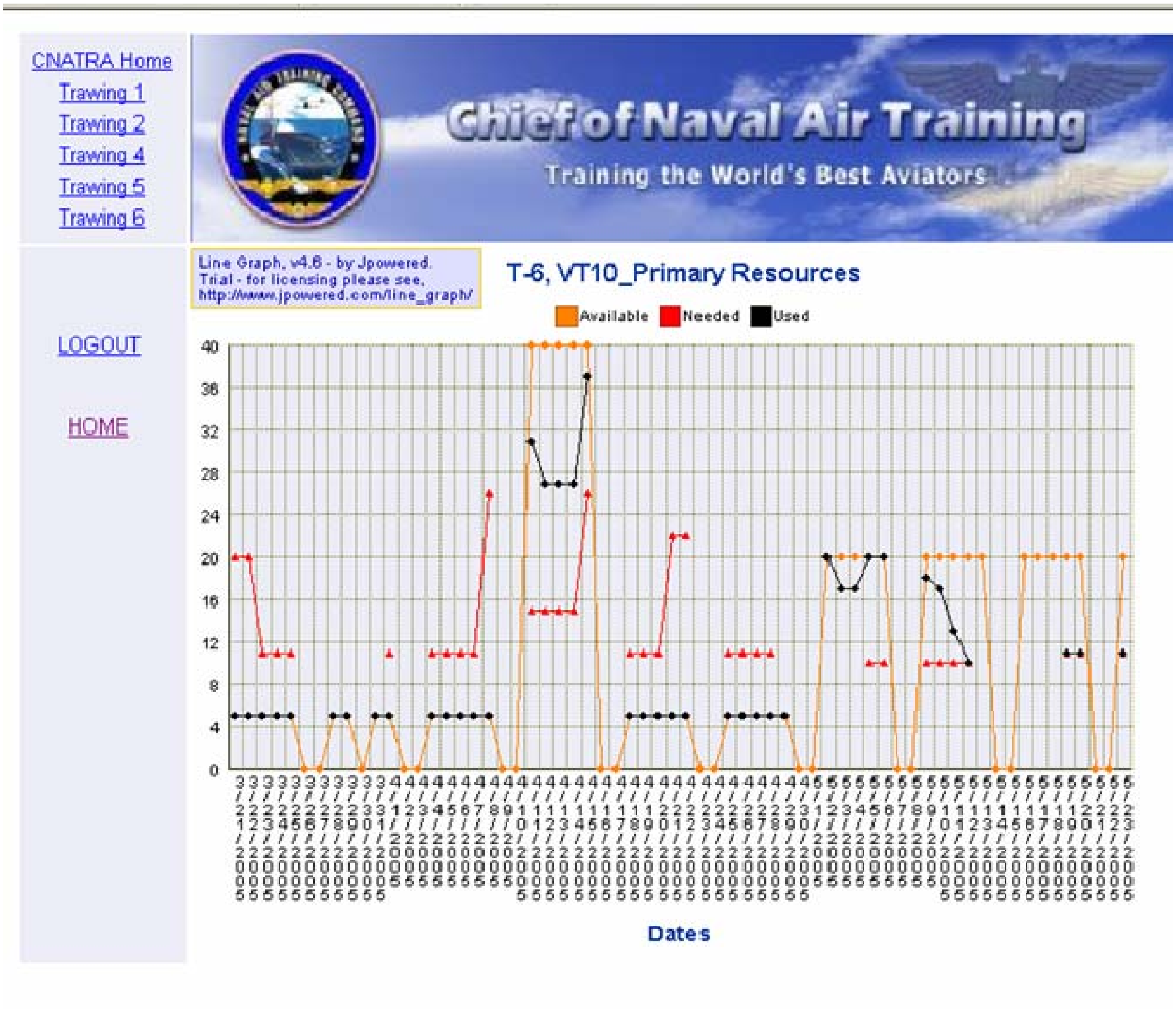
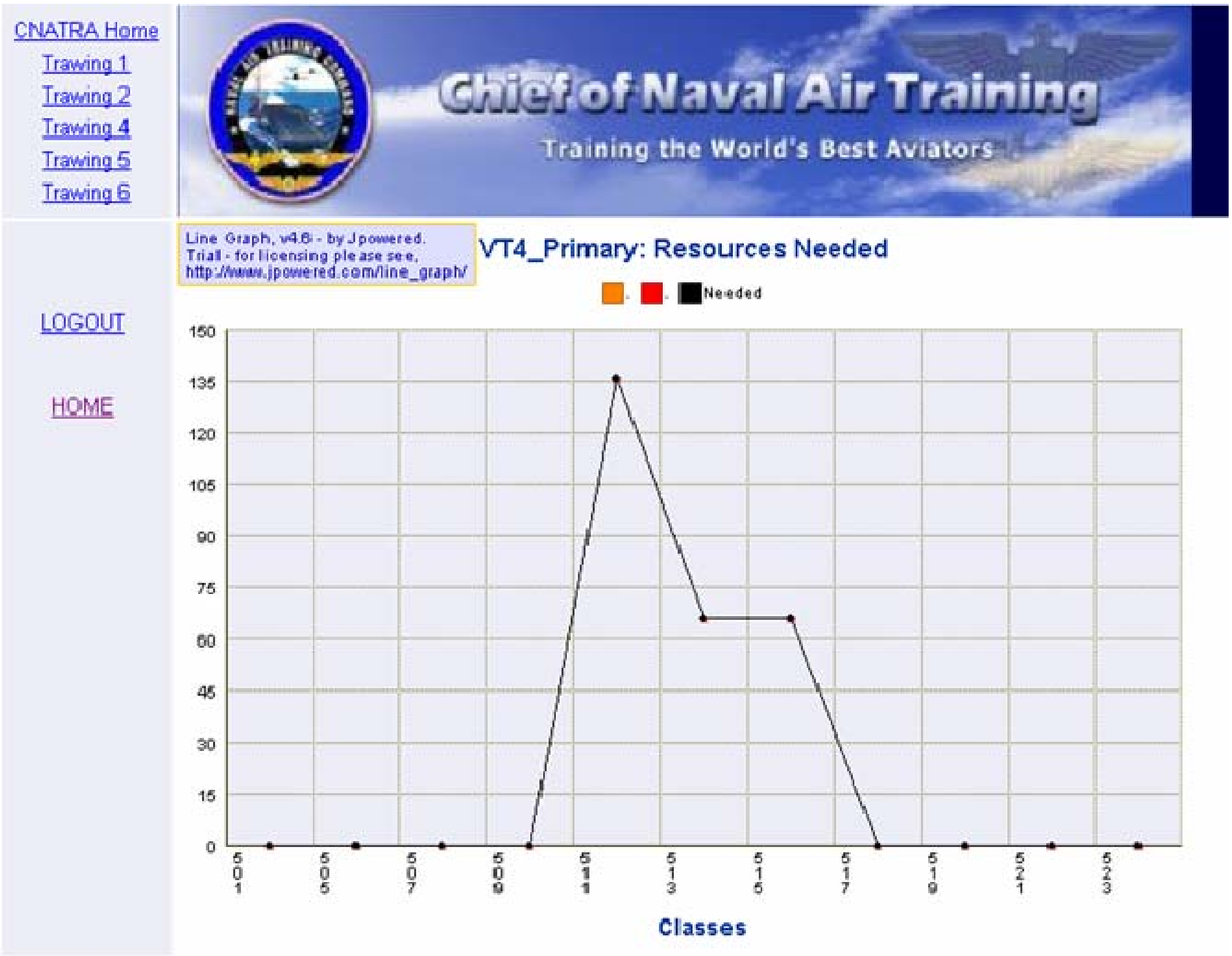


Figure 43. Prototype I DSS Website Screenshot 12.

This graph was produced from the second option on the “FORECASTED GRAPHS” page. The graph displays resource data for a specific training squadron during a specific training phase, like VT 10 Primary T-6 aircraft, selected from the two drop down menus. The selected resource data is displayed in the color format of orange, red, and black. Orange data points indicate the numerical amount available for use of the selected resource on a specific date. Red data points indicate the numerical amount needed for use of the selected resource on a specific date. Black data points indicate the numerical amount being used of the selected resource on a specific date.



Line Graph, v4.6i - by Jpowered.
Trial - for licensing please see,
http://www.jpowered.com/line_graph/

Figure 44. Prototype I DSS Website Screenshot 13.

This graph was produced from the third option on the "FORECASTED GRAPHS" page. The graph displays T-6 resource data for a specific training squadron during a specific training phase, like VT 4 Primary, selected from the drop down menu. The selected resource data is displayed in the color format of black only. The data points indicate the numerical amount of T-6 resources needed for use by a specific class number.

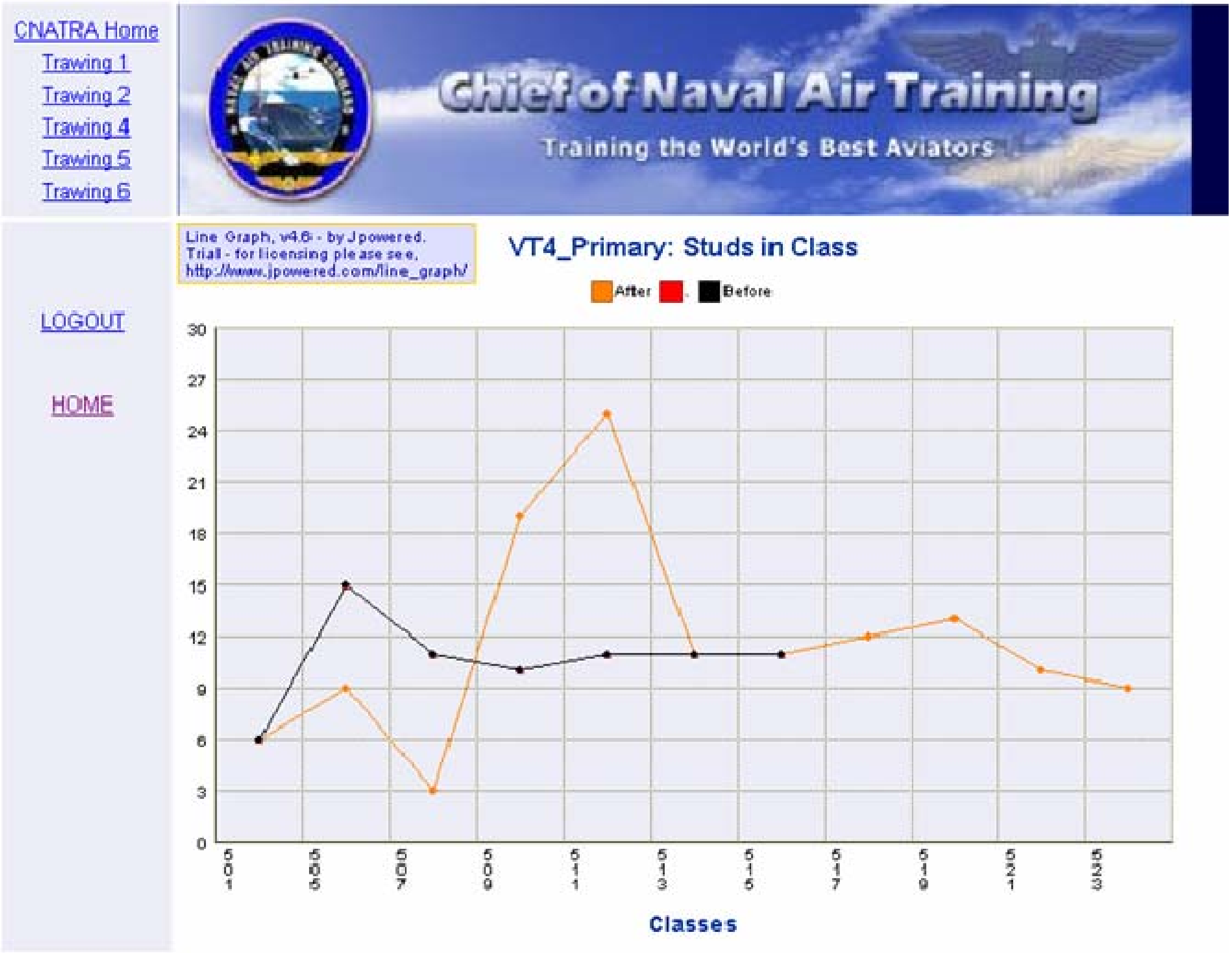

CNATRA Home
Trawing 1
Trawing 2
Trawing 4
Trawing 5
Trawing 6
Chief of Naval Air Training
Training the World's Best Aviators
LOGOUT
HOME
Line Graph, v4.6 - by Jpowered.
Trial - for licensing please see,
http://www.jpowered.com/line_graph/
VT4_Primary: Studs in Class
After
Before
30
27
24
21
18
15
12
9
6
3
0
501
505
507
509
511
513
515
517
519
521
523
Classes

Figure 45. Prototype I DSS Website Screenshot 14.

This graph was produced from the forth option on the “FORECASTED GRAPHS” page. The graph displays classes’ data for a specific training squadron during a specific training phase, like VT 4 Primary, selected from the drop down menu. The selected classes’ data is displayed in the color format of orange and black. Orange data points indicate the number of students in a specific class after a training phase. Black data points indicate the number of students in a specific class before a training phase. The numbers generated to produce the displayed data points are based on the minimum and maximum numbers associated with a NFO training resource for a specific week. Those minimum and maximum numbers are used to compute the minimum and maximum events that can be accomplished for a training phase.

APPENDIX D. PROTOTYPE I DATABASE SCHEMA

Microsoft Access was the software chosen to implement the database for the prototype DSS. The primary purpose for establishing a database behind the website was the necessity for a repository to store required data that will be used in the application processing in order to display output to the user, which they can use to make decisions. Figure 40 is an actual screen shot of the prototype Microsoft Access database schema.

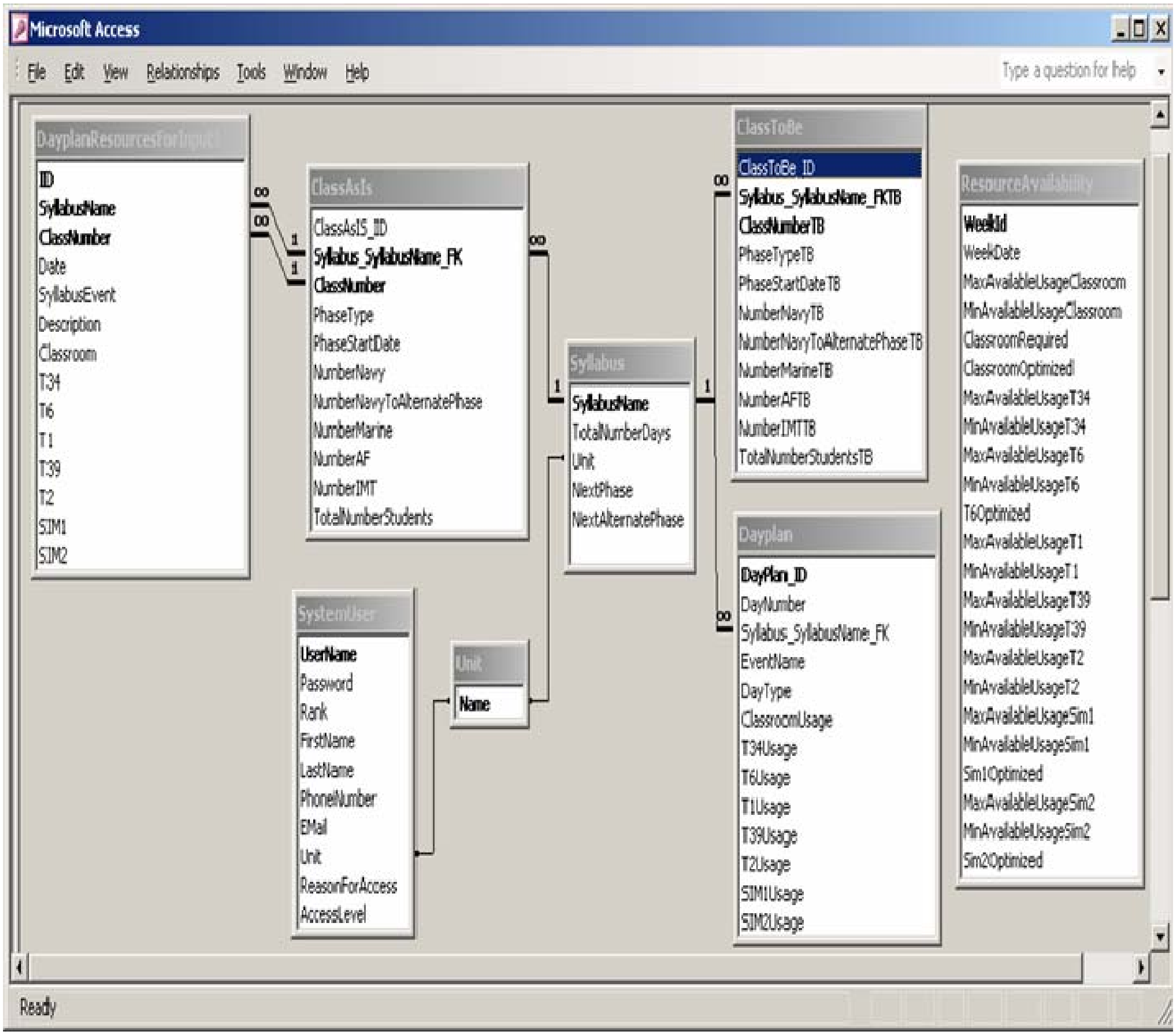


Figure 46. Prototype 1 Schema.

ClassAsIs

- Identified by class number and syllabus (can use for both actual and predicted)
- Contains information on the number of students, the type of students (i.e., branch of military service or international designation), and the date they start their next phase of training.
- This object contains the data entered by the user prior to processing. Before processing, the data is copied to ClassToBe and all data processing and resulting data will be stored in ClassToBe while ClassAsIs does not change during processing.

DayPlanResourceFor Input1

- Pertains to all classes within a phase.
- A DayPlan corresponds to each day of the syllabus.
- Each day within a syllabus corresponds to an event.
- An Event uses a resource (i.e., aircraft, simulator, or classroom).

Syllabus

- TotalNumberDays in syllabus are dates determined by the class end date – class start date.
- Syllabus is owned by a unit.
- Each phase should have one and only one syllabus. Each class should be in one and only one phase at a time. (phase and syllabus are synonymous in the schema)

ClassToBe

- Identified by class number (can use for both actual and predicted)
- Contains information on the number of students, the type of students, and the date they start their next phase of training.
- This type of class is considered to be in an “Exit” training phase.

DayPlan

- DayPlan is for a specific day of a specific syllabus for a specific phase.
- Includes auto ID, SyllabusName, and DayNumber
- DayType refers to Classroom, Simulator, Flight, or Classroom/Flight.
- A resource’s usage refers to the number of units that are available for that resource in a given week.
- Each resource has the following:
    - Unique name or model number; and
    - Type. (classroom, simulator, or aircraft)
- Before processing, the data is copied from ClassAsIs to ClassToBe and all data processing and resulting data will be stored in ClassToBe, while ClassAsIs does not change during processing.

ResourceAvailability

- Many resources can be available during a given week.
- Records the minimum and maximum X completions achievable based on the available resources.
- Each resource has the following:
  - Unique name or model number.
  - Type (classroom, simulator, or aircraft)

SystemUser

- Independent from the other tables, specifically for web access.
- Username is a unique identifier.
- Password, Rank, Name, Email, and Unit are required entries.
- Phone Number is optional.
- ReasonForAccess is required.
- AccessLevel is required, but entered by a database administrator. (default permission is Read only)

Unit

- Expected to be a simple lookup table.

APPENDIX E. PROTOTYPE I NON-HTML CODE

A. ACODE.ASP

Description: This page is called from the website and is passed a forecast length number. It calls all vbscript code to process the forecast.

```
<%@ LANGUAGE="VBSCRIPT" %>
<% Option Explicit %>
<meta http-equiv="refresh" content="1; URL=aGraphSelect.asp">
<% Server.ScriptTimeout = 2400 '<meta http-equiv="refresh" content="1; URL=aGraphSelect.asp">%>
<html>

<body>
Standby!!!
<p>
        <!--#include file="Connections/Conn_is4220Primary.asp" -->
        <!--#include file="code/PublicDeclarations.inc"-->
        <!--#include file="code/ArrayReferences.inc"-->
        <!--#include file="code/GeneralSubroutines.inc"-->
        <!--#include file="code/LoadFromDatabase.inc"-->
        <!--#include file="code/ConvertToDays.inc"-->
        <!--#include file="code/ConvertFromDatabase.inc"-->
        <!--#include file="code/ProcessStudents.inc"-->
        <!--#include file="code/SaveToDatabase.inc"-->
<%
Call LoadFromDatabase()
Call ConvertFromDatabase()

'Call DisplayArrayInTable (StudentArray)
'Call DisplayArrayInTable (ResourcesAvailabilityDailyArray)
Call ProcessStudents()
'Call DisplayArrayInTable (ResourcesAvailabilityDailyArray)

'Call SaveArrayAsTable(StudentArray, "TrackStudents")

'Call DisplayArrayInTable (StudentArray)

Redim Preserve TrackResourcesNeededTable(3, Ubound(TrackResourcesNeededTable,2)-1)
Redim Preserve TrackResourcesUsedTable(3, Ubound(TrackResourcesUsedTable,2)-1)
Call SaveArrayAsTable(TrackResourcesNeededTable, "TrackResourcesNeeded")
Call SaveArrayAsTable(TrackResourcesUsedTable, "TrackResourcesUsed")
Call SaveStudentArrayAsTable(StudentArray, "TrackStudentsFinish")
%>
***** Processing Completed *****
</body>
</html>
```

B. PUBLICDECLARATIONS.INC

Description: Initialized variable used throughout code.

```
<%
response.write "<p></p><p></p><strong>PublicDeclarations Started .. </strong></p><p></p>"

'The following variables are Public and can be accessed by all subroutines.

' ======= Variables from database ==========
' Syllabus array will be loaded with the table of the same name from the Database
Public SyllabusArray

' DayplanResources array will be loaded with the table of the same name from the Database
Public DayplanResourcesArray

' DayplanResources array will be loaded with the table of the same name from the Database
Public DayplanArray

' ClassAsIs array will be loaded with the table of the same name from the Database
Public ClassAsIsArray

' ResourceAvailability array will be loaded with the table of the same name from the Database
Public ResourceAvailabilityArray

' ClassDatesArray will be loaded with the table of the same name from the Database
Public ClassDatesArray

' NormalOffArray array will be loaded with the table of the same name from the Database
Public NormalOffArray

' ======= used for processing ===========
' Student array - each student will be processed individually.  ClassAsIs will be converted into this array.
Public StudentArray

' ResourcesAvailabilityDaily Array - ResourceAvailabilityArray (Weekly) will be converted to a Daily
Array
Public ResourcesAvailabilityDailyArray

' ResourcesAvailabilityWeekly Array - ResourceAvailabiltyDailyArray will be converted to a Weekly
Array.
Public ResoucesAvailabilityWeeklyArray

' ResourceUsage Array - Used to track resource usage
Public ResourceUsageArray

' =========== used to store information back into the database ===========


Public ClassToBeArray                  'Empty and will be filled during processing and then saved to
DB
Public ResourcesByClassArray     'will be saved later to the table of the same name from the Database
Public ResourcesByPhaseArray     'will be saved later to the table of the same name from the Database
Public ResourcesByWeekArray      'will be saved later to the table of the same name from the Database
```

```
' =========================== Declarations ================================
' Inlude file which has row references for each table column name

Dim StartDate
Dim EndDate

StartDate = 38432
'EndDate = 38439
EndDate = StartDate + Session("RunLength")
response.write("<br>**************************************** Start: " & StartDate & " EndDate: "
& EndDate)

'if IsDate(StartDate) then
'  response.write(CDate(StartDate))
'  response.write(Year(StartDate))
'end if

response.write "</p><strong>PublicDeclarations Completed .. </strong></p>"

%>
```

C. ARRAYREFERENCES.INC

Description: More public variable definitions. Names all pertinent array variables to match up with database names to make code more readable.

```
<%
'The following variables are Public and can be accessed by all subroutines.

' ======= Variables from database ==========
'Table is DayplanResourcesForInput1
Public D_ID
Public D_SyllabusName
Public D_ClassNumber
Public D_Date
Public D_SyllabusEvent
Public D_Description
Public D_Classroom
Public D_T34
Public D_T6
Public D_T1
Public D_T39
Public D_T2
Public D_SIM1
Public D_SIM2

'Table is ResourceAvailability
Public R_ID
Public R_Date
Public R_MaxAvailableUsageClassroom
Public R_MaxAvailableUsageT34
Public R_MaxAvailableUsageT6
Public R_MaxAvailableUsageT1
Public R_MaxAvailableUsageT39
Public R_MaxAvailableUsageT2
Public R_MaxAvailableUsageSim1
Public R_MaxAvailableUsageSim2

'Table is Syllabus
Public S_SyllabusName
Public S_TotalNumberDays
Public S_Unit
Public S_NextPhase
Public S_NextAlternatePhase

'Table is ClassAsIs
Public C_ClassAsIS_ID
Public C_SyllabusName
Public C_ClassNumber
Public C_PhaseType
Public C_PhaseStartDate
Public C_NumberNavy
Public C_NumberNavyToAlternatePhase
Public C_NumberMarine
Public C_NumberAF
Public C_NumberIMT
Public C_TotalNumberOfStudents
'==============================================
'Now set them to a number
'Table is DayplanResourcesForInput1
D_ID = 0
D_SyllabusName=1
D_ClassNumber=2
D_Date = 3
D_SyllabusEvent = 4
D_Description = 5
D_Classroom = 6
D_T34 = 7
D_T6 = 8
D_T1 = 9
D_T39 = 10
D_T2 = 11
D_SIM1 = 12
D_SIM2 = 13
'=====================================
'Resources names and NumberOf
Public D_ResourceName(7)   '8 resources
Public D_NumberOfResourceTypes
Public D_FirstResourceIndex      'From the DayplanResourcesArray, the 1st one that is a Resource
D_NumberOfResourceTypes = 8
D_FirstResourceIndex = 6

D_ResourceName(0) = "Classroom"
D_ResourceName(1) = "T-34"
D_ResourceName(2) = "T-6"
D_ResourceName(3) = "T-1"
D_ResourceName(4) = "T-39"
D_ResourceName(5) = "T-2"
D_ResourceName(6) = "SIM1"
D_ResourceName(7) = "SIM2"
'=====================================
'Table is ResourceAvailability
Public R_FirstResourceIndex
R_FirstResourceIndex = 2
Public R_ResourceRefToResourceAvailabilityArray(7)   '8 resources

R_ResourceRefToResourceAvailabilityArray(0) = 2
R_ResourceRefToResourceAvailabilityArray(1) = 6
R_ResourceRefToResourceAvailabilityArray(2) = 8
R_ResourceRefToResourceAvailabilityArray(3) = 11
R_ResourceRefToResourceAvailabilityArray(4) = 13
R_ResourceRefToResourceAvailabilityArray(5) = 15
R_ResourceRefToResourceAvailabilityArray(6) = 17
R_ResourceRefToResourceAvailabilityArray(7) = 20

R_ID = 0
R_Date = 1
R_MaxAvailableUsageClassroom = 2
R_MaxAvailableUsageT34 = 6
```

```
R_MaxAvailableUsageT6 = 8
R_MaxAvailableUsageT1 = 11
R_MaxAvailableUsageT39 = 13
R_MaxAvailableUsageT2 = 15
R_MaxAvailableUsageSim1 = 17
R_MaxAvailableUsageSim2 = 20

'Table is Syllabus
S_SyllabusName = 0
S_TotalNumberDays = 1
S_Unit = 2
S_NextPhase = 3
S_NextAlternatePhase = 4

'Table is ClassAsIs
C_ClassAsIS_ID = 0
C_SyllabusName = 1
C_ClassNumber = 2
C_PhaseType = 3
C_PhaseStartDate = 4
C_NumberNavy = 5
C_NumberNavyToAlternatePhase = 6
C_NumberMarine = 7
C_NumberAF = 8
C_NumberIMT = 9
C_TotalNumberOfStudents = 10


'=========================================
        Dim TypeToC(10)                 'Used to convert ClassAsIs Column into a number
representing Student Type
        Const CTypes = 4

        TypeToC(0)=5    'Navy
        TypeToC(1)=7    'Marine
        TypeToC(2)=8    'AF
        TypeToC(3)=9    'IMT

'=========================================
'StudentArray References
        Public ST_SyllabusRef
        Public ST_StartClassNumber
        Public ST_CurrentClassNumber
        Public ST_PhaseStart
        Public ST_Type
        Public ST_InPhase
        Public ST_TotalResourcesRequired
        Public ST_PhaseEnd
        Public ST_FirstResourceIndex

        ST_FirstResourceIndex = 8     'First column that is a resource in the StudentArray

        ST_SyllabusRef = 0
        ST_StartClassNumber = 1
        ST_CurrentClassNumber = 2
        ST_PhaseStart = 3           'Class date students class started the phase.
        ST_Type = 4     'Navy, Marine, AF, IMT
        ST_InPhase = 5  'T/F Is the student currently in phase?  or not.
        ST_TotalResourcesRequired = 6
        ST_PhaseEnd = 7'Class date students are planned to end the phase.
        '8 onward is Specific required resources.
        'Here, we have eight, as defined by D_NumberOfResourceTypes defined in TableColumn..inc
        'So, 8 through 15 will be filled with Classroom to SIM2 reference values.

'Refs for ResourceTableStorage
Public TrackResourcesNeededTable
Public TrackResourcesUsedTable
ReDim TrackResourcesNeededTable(3,0)
ReDim TrackResourcesUsedTable(3,0)

response.write "</p><strong>ArrayReferences Completed .. </strong></p>"

%>
```

D. GENERALSUBROUTINES.INC

Description: Routines that were used by different .inc files were placed here.

```
<script language="JScript" runat="server">
  function UDim(vbarr) { return vbarr.dimensions(); }
</script>
<%
Private Sub DisplayArrayInTable (NameOfArray)
        Dim Counter
        Dim Filler
        'Display Results
        Dim lnRowCounter, lnColumnCounter
        Response.Write ("<br>" & "FYI:"".""" = 0")
        Response.Write ("<table width=""100%""  border=""1"" cellspacing=""0"" cellpadding=""0"">")

        Response.Write ("<tr bgcolor=""#99CCFF"">")
        Response.Write ("<th width=""200"" scope=""col"">" & "Ref#" & "</th>")
        For lnColumnCounter = 0 To Ubound(NameOfArray,1)
                Response.Write ("<th width=""200"" scope=""col"">" & lnColumnCounter & "</th>")
        Next
        Response.Write("</tr>")

        For lnRowCounter = 0 To Ubound(NameOfArray,2)
                Response.Write ("<tr>")
                Response.Write ("<th width=""200"" bgcolor=""#99CCFF"" scope=""col"">" &
lnRowCounter & "</th>")
                For lnColumnCounter = 0 To Ubound(NameOfArray,1)
                        Filler = NameOfArray(lnColumnCounter, lnRowCounter)
                        If IsNull(Filler) then
                                Filler = "&nbsp"
                        ElseIf IsNumeric(Filler) then
                                If Filler= 0 then
                                        Filler = "."
                                End If
                        End If
                        Response.Write ("<th width=""200"" scope=""col"">" & Filler & "</th>")
                Next
                Response.Write("</tr>")
        Next
        Response.Write ("</table>")
        response.write "</p></p>"
End Sub

Private Sub DisplayArrayInTableOneColumn(NameOfArray)
        Dim Counter
        Dim Filler
        'Display Results
        Dim lnRowCounter, lnColumnCounter
        'Response.Write (UDim(NameOfArray))
        Response.Write ("<table width=""100%""  border=""1"" cellspacing=""0"" cellpadding=""0"">")

        Response.Write ("<tr bgcolor=""#99CCFF"">")
```

```
    Response.Write ("<th width=""200"" scope=""col"">" & "Ref#" & "</th>")
    lnColumnCounter = 0
    Response.Write ("<th width=""200"" scope=""col"">" & lnColumnCounter & "</th>")
    Response.Write("</tr>")

    For lnRowCounter = 0 To Ubound(NameOfArray,1)
        Response.Write ("<tr>")
        Response.Write ("<th width=""200"" bgcolor=""#99CCFF"" scope=""col"">" &
lnRowCounter & "</th>")
        lnColumnCounter = 0
            Filler = NameOfArray(lnRowCounter)
            If IsNull(Filler) then
                Filler = "&nbsp"
            ' A failed attempt to display dates instead of numbers
            'Elseif IsNumeric(Filler) then
            '   If Filler > 30000 then
            '       Filler = DateValue(Clng(Filler))
            '   End If
            End If
            Response.Write ("<th width=""200"" scope=""col"">" & Filler & "</th>")
        Response.Write("</tr>")
    Next
    Response.Write ("</table>")
    response.write "</p></p>"
End Sub

Private Sub DisplayArrayInTableRows(NameOfArray, StartRow, EndRow)
    Dim Counter
    Dim Filler
    'Display Results
    Dim lnRowCounter, lnColumnCounter
    'Response.Write (UDim(NameOfArray))
    Response.Write ("<table width=""100%""  border=""1"" cellspacing=""0"" cellpadding=""0"">")

    Response.Write ("<tr bgcolor=""#99CCFF"">")
    Response.Write ("<th width=""200"" scope=""col"">" & "Ref#" & "</th>")
    For lnColumnCounter = 0 To Ubound(NameOfArray,1)
        Response.Write ("<th width=""200"" scope=""col"">" & lnColumnCounter & "</th>")
    Next
    Response.Write("</tr>")

    'Make sure Start to EndRow are in range
    If StartRow < 0 then
        StartRow = 0
    End If
    If EndRow > Ubound(NameOfArray,2) then
        EndRow = Ubound(NameOfArray,2)
    End If

    For lnRowCounter = StartRow To EndRow
        Response.Write ("<tr>")
        Response.Write ("<th width=""200"" bgcolor=""#99CCFF"" scope=""col"">" &
lnRowCounter & "</th>")
        For lnColumnCounter = 0 To Ubound(NameOfArray,1)
            Filler = NameOfArray(lnColumnCounter, lnRowCounter)
            If IsNull(Filler) then
                Filler = "&nbsp"
            ' A failed attempt to display dates instead of numbers
            'Elseif IsNumeric(Filler) then
            '   If Filler > 30000 then
            '       Filler = DateValue(Clng(Filler))
            '   End If
            End If
            Response.Write ("<th width=""200"" scope=""col"">" & Filler & "</th>")
        Next
        Response.Write("</tr>")
    Next
    Response.Write ("</table>")
    response.write "</p></p>"
End Sub

Private Sub LoadArray (NameOfArray, NameOfTable)
'Fills an array from the given NameOfTable
    Dim Table
    Dim lnRowCounter, lnColumnCounter
    Set Table = Server.CreateObject("ADODB.Recordset")
    Table.Open "SELECT * FROM " & NameOfTable, MM_Conn_is4220Primary_STRING
    NameOfArray = Table.GetRows()   'Sucks the entire table into an Array
    Response.Write("Table: " & """ & NameOfTable & """ & " Successfully Loaded into an array" &
"<br>")
    Table.Close
End Sub

Private Sub LoadArrayByDate (NameOfArray, NameOfTable, NameOfDateField)
'Send it the Field name where the date is stored, and it will load only the dates between StartDate and
EndDate
    Dim Table
    Dim lnRowCounter, lnColumnCounter
    Set Table = Server.CreateObject("ADODB.Recordset")
    Table.Open "SELECT * FROM " & NameOfTable & " WHERE " & NameOfTable & "." &
NameOfDateField & ">=" & StartDate & " And " & NameOfTable & "." & NameOfDateField & "<=" &
EndDate & " ORDER BY " & NameOfTable & "." & NameOfDateField,
MM_Conn_is4220Primary_STRING

    'Modified to account for times where no record existed between Start and EndDates: Errors occur
otherwise
    'Table.Open "SELECT * FROM " & NameOfTable & " ORDER BY " & NameOfTable & "." &
NameOfDateField, MM_Conn_is4220Primary_STRING
    NameOfArray = Table.GetRows()
    Response.Write("Table: " & NameOfTable & " Successfully Loaded into an array" & "<br>")
    Table.Close
End Sub


Function ReturnClassEndDate(SyllabusRef, ClassNumber)
'Given the SyllabusRecord row number in SyllabusArray, it returns the last date for the Class in that
Syllabus
    'Find Syllabus and Class then get the Date
    Dim Found
    Dim Count
    Dim TempDate
    Dim SyllabusName
    Found = False
    Count = 0
    SyllabusName = SyllabusArray(0, SyllabusRef)
    'Response.Write("<br>" & "Syllabus: " & SyllabusName)
    TempDate = Cdate("10/10/2020")
    Do
        If (ClassDatesArray(0, Count) = SyllabusName) and (ClassDatesArray(1,
Count)=ClassNumber) then
        'If  (ClassDatesArray(1, Count)= ClassNumber) then
            TempDate = ClassDatesArray(3, Count)
            Found = True
        End If
        Count = Count + 1
    Loop While (Found=False) and (count <= Ubound(ClassDatesArray, 2))
    'Response.Write("<br> *************TEMP DATE " & TempDate)
    ReturnClassEndDate = TempDate
End Function

Function ReturnClassStartDate(SyllabusRef, ClassNumber)
    'Find Syllabus and Class then get the Date
    Dim Found
    Dim Count
    Dim TempDate
    Dim SyllabusName
    Found = False
    Count = 0
    SyllabusName = SyllabusArray(0, SyllabusRef)
    'Response.Write("<br>" & "Syllabus: " & SyllabusName)
    TempDate = Cdate("10/10/2020")
    Do
        If (ClassDatesArray(0, Count) = SyllabusName) and (ClassDatesArray(1,
Count)=ClassNumber) then
        'If  (ClassDatesArray(1, Count)= ClassNumber) then
            TempDate = ClassDatesArray(2, Count)
            Found = True
        End If
        Count = Count + 1
    Loop While (Found=False) and (count <= Ubound(ClassDatesArray, 2))
    ReturnClassStartDate = TempDate
End Function

Function IsInPhase(SyllabusRef, ClassNumber, DateValue)
'If the given ClassNumber, and Date, it returns if the class is still in the Phase on that Date
    Dim Date
    Dim Found
    Found = False

    Date = Clng(DateValue)
    If (Date >= (ReturnClassStartDate(SyllabusRef, ClassNumber))) and (Date <=
(ReturnClassEndDate(SyllabusRef, ClassNumber))) then
        Found = True
    End If
    IsInPhase = Found
```

```
End Function

Function GetSyllabusNumber(SyllabusName)
'Given the text name of a syllabus, it will return the equivelant row number in the SyllabusArray, or 999 if
not found.
        Dim X
        Dim Temp
        Temp = 999
        For X=0 to ubound(SyllabusArray, 2)
                'Response.Write("<br>" & X & "Syllabus: " & SyllabusArray(0, X))
                'Response.Write("<br>" & X & cstr(SyllabusName) & " : " & cstr(SyllabusArray(0, X)))
                If cstr(SyllabusName)=cstr(SyllabusArray(0, X)) then
                'If X=3 then
                        'Response.Write("Yeyaaaaa")
                        Temp = X
                End If
        Next
        GetSyllabusNumber = Temp
End Function


Function ReturnRowValues1(InArray, Column1, Value1)
'Returns the row given (1) An Array (2) Column Number (3) Value seeking
'Returns 99999 if none found
'Best used for columns of data where there are no duplicate values.
        Dim Found
        Dim Count
        Dim TempRow

        TempRow = 99999
        Found = False
        Count = 0
        Do
                If InArray(Column1, Count) = Value1 then
                        TempRow = Count
                        Found = True
                End If
                Count = Count + 1
        Loop While (Found=False) and (count <= Ubound(InArray, 2))
        ReturnRowValues1 = TempRow
End Function

Function ReturnRowValues2(InArray, Column1, Value1, Column2, Value2)
'Returns the row given where Value1,Value2 are found for the given corresponding columns
'Returns 99999 if none found
'Best used for columns of data where there are no duplicate values.
        Dim Found
        Dim Count
        Dim TempRow

        TempRow = 99999
        Found = False
        Count = 0
        Do
        If (InArray(Column1, Count) = Value1) and (CInt(InArray(Column2, Count)) =
CInt(Value2)) then 'CInt used as temp fix for Rollback, ConvertFromDatabase
            TempRow = Count
            Found = True
        End If
        Count = Count + 1
    Loop While (Found=False) and (count <= Ubound(InArray, 2))
    ReturnRowValues2 = TempRow
End Function

Function ReturnRowValues3(InArray, Column1, Value1, Column2, Value2, Column3, Value3)
'Returns the row given where Value1,Value2 and Value3 are found for the given corresponding columns
'Returns 99999 if none found
'Best used for columns of data where there are no duplicate values.
    Dim Found
    Dim Count
    Dim TempRow
    TempRow = 99999
    Found = False
    Count = 0
    Do
        If (InArray(Column1, Count) = Value1) then
            If (InArray(Column2, Count) = Value2) then
                If(InArray(Column3, Count) = Value3) then
                    TempRow = Count
                    Found = True
                End If
            End If
        End If
        Count = Count + 1
    Loop While (Found=False) and (count <= Ubound(InArray, 2))
    ReturnRowValues3 = TempRow
End Function
%>
```

E. CONVERTFROMDATABASE.INC

Description: Converts the raw arrays loaded from database into usable form.
(1) Converts weekly availability into daily.
(2) Converts classes into individual students.

```
<%
Private Sub ConvertFromDatabase()
        'Converts weekly resource values to Daily
        ResourcesAvailabilityDailyArray = ConvertToDays(ResourceAvailabilityArray,NormalOffArray)
        response.write "</p></p><strong>Weekly Availability Table</strong>"
        Call DisplayArrayInTable (ResourceAvailabilityArray)

        Call ClearRecords("TrackResourcesAvailableDaily")
        Call SaveDailyArrayAsTable(ResourcesAvailabilityDailyArray,"TrackResourcesAvailableDaily")

        response.write "</p></p><strong>Daily Availability Table</strong>"
        Call DisplayArrayInTable (ResourcesAvailabilityDailyArray)

        Call ConvertClassesToStudents(ClassAsIsArray, StudentArray)
        Call SaveStudentArrayAsTable(StudentArray, "TrackStudentsStart")
        'Call DisplayArrayInTable (StudentArray)
End Sub

Private Sub ConvertClassesToStudents(ClassAsIsArray, StudentArray)
' Subroutine will go row by row through the ClassAsIsArray and convert
' ALL classes in that table into the corresponding invididual students.
        Const TempHighStudentRange = 100000
        Const NumberOfAttributes = 15
        Redim StudentArray(NumberOfAttributes, 1)
        Dim CurrentClass
        Dim StudentType
        Dim NumberStudentsInClass
        Dim CurrentID   'increments one for each student added
        Dim Student_ID   'Temporary used for loop
        Dim Column
        Dim Temp                        'Used for loop

        CurrentID = 0
        For CurrentClass = 0 To Ubound(ClassAsIsArray,2)
                For StudentType = 0 to CTypes-1 'C_ refers to the ClassAsIs reference#
                        Column = TypetoC(StudentType)
                        NumberStudentsInClass = ClassAsIsArray(Column, CurrentClass)
                        For Student_ID = CurrentID to (CurrentID + NumberStudentsInClass-1)
                                Redim Preserve StudentArray(NumberOfAttributes, Student_ID)
                                StudentArray(ST_SyllabusRef, Student_ID) =
GetSyllabusNumber(ClassAsIsArray(C_SyllabusName,CurrentClass))
                                StudentArray(ST_StartClassNumber,Student_ID) =
ClassAsIsArray(C_ClassNumber, CurrentClass)
                                StudentArray(ST_CurrentClassNumber,Student_ID) =
StudentArray(ST_StartClassNumber, Student_ID)
                                StudentArray(ST_PhaseStart, Student_ID) =
ClassAsIsArray(C_PhaseStartDate, CurrentClass)
```

```
                StudentArray(ST_Type, Student_ID) = StudentType
                StudentArray(ST_InPhase, Student_ID) =
IsInPhase(StudentArray(ST_SyllabusRef, Student_ID), ClassAsIsArray(C_ClassNumber, CurrentClass),
StartDate)
                StudentArray(ST_TotalResourcesRequired, Student_ID) = 0
                StudentArray(ST_PhaseEnd, Student_ID) =
ReturnClassEndDate(StudentArray(ST_SyllabusRef, Student_ID),ClassAsIsArray(C_ClassNumber,
CurrentClass))
                'response.write("****** PhaseEnd = " & StudentArray(ST_PhaseEnd,
Student_ID))
                For Temp = ST_PhaseEnd+1 to ST_PhaseEnd +
D_NumberOfResourceTypes
                    StudentArray(Temp, Student_ID) = 0
                Next
            Next
            CurrentID = CurrentID + NumberStudentsInClass
        Next
    Next
    'ReDim Preserve StudentArray(13, CurrentID)
End Sub

Sub CreateStudent(SyllabusName, ClassNumber, StudentType)
    Const NumberOfAttributes = 15
    Dim Temp
    Dim ClassDates_Row
    Dim Student_ID
    'response.write("<br>" & SyllabusName & " " & ClassNumber & " " & StudentType)

    Student_ID = Ubound(StudentArray,2)+1
    ClassDates_Row = ReturnRowValues2(ClassDatesArray, 0, SyllabusName, 1, ClassNumber)
    'response.write(" -Row : " & ClassDates_Row)
    'ClassDates_Row = 10
    Redim Preserve StudentArray(NumberOfAttributes, Student_ID)
    'Student_ID = 1
    'response.write("<br> Redim StudentArray(15, " & Student_ID & ")")
    StudentArray(ST_SyllabusRef, Student_ID) = GetSyllabusNumber(SyllabusName)
    StudentArray(ST_StartClassNumber,Student_ID) = ClassNumber
    StudentArray(ST_CurrentClassNumber,Student_ID) = ClassNumber
    StudentArray(ST_Type, Student_ID) = StudentType
    StudentArray(ST_InPhase, Student_ID) = TRUE
    StudentArray(ST_TotalResourcesRequired, Student_ID) = 0
    If ClassDates_Row <> 99999 then
        StudentArray(ST_PhaseStart, Student_ID) = ClassDatesArray(2, ClassDates_Row)
        StudentArray(ST_PhaseEnd, Student_ID) = ClassDatesArray(3, ClassDates_Row)
    Else
        StudentArray(ST_PhaseStart, Student_ID) = "1/1/2010"
        StudentArray(ST_PhaseEnd, Student_ID) = "1/1/2010"
    End If
    For Temp = ST_PhaseEnd+1 to ST_PhaseEnd + D_NumberOfResourceTypes
        StudentArray(Temp, Student_ID) = 0
    Next
End Sub
%>
```

F. CONVERTTODAYS.INC

Description: Converts weekly availability numbers into daily numbers.

```
<%
Private Function ConvertToDays (InArray,DateArray)
    'InArray Counters
    Dim lnRowCounter, lnColumnCounter
    lnRowCounter = 0

    'ResultantArray Counters
    Dim DailyRowCounter, DailyColumnCounter

    'Declaring Resultant Array to be multidimensional of variable row length
    Dim ResultantArray()
    DailyColumnCounter = 22
    DailyRowCounter = 0
    ReDim Preserve ResultantArray(DailyColumnCounter, DailyRowCounter)

    'Declaring Day Counters
    Dim WeekDayCounter, WeekDayCounter2

    'DateArrayCounters
    Dim DateRowCounter, DateColumnCounter, DateRowCounter2

    'Used to calculate Total Days of Work in One Week
    Dim DaysOn

    'Begin Filling Resultant Table by beginning with Start Date
    WeekDayCounter = StartDate
    For WeekDayCounter = StartDate To EndDate       'FLAW Causes problem with
LoadArrayByDate if no values in range.  Use Ubound

        'Determine number of work days in the week every Monday Date
        If DateArray(1,DateRowCounter) = "MON" Then

            DaysOn = 0      'must reinitialize

            'Determine number of work days in the week by counting days of work
            'NOT CURRENTLY USED since DailyAvailable = WeeklyAvailable divided
by DaysOn, we
            'want to assume the users enter in the WeeklyAvailable while thinking on
            'a full week basis.  As a result, setting DaysOn=5 will prevent
            'users from entering standard weekly values and then the program
            'giving each day of a 4 day week more than a 5 day week

            'For WeekDayCounter2 = WeekDayCounter To WeekDayCounter + 6
            '
            '   If DateArray(4,DateRowCounter2) = False Then
            '       DaysOn = DaysOn + 1
            '   End If
            '
                'Prevents DateRowCounter from going beyond total size of array
            '   If Not DateRowCounter2 = Ubound(DateArray,2) Then

            '       DateRowCounter2 = DateRowCounter2 + 1
            '   End If

            'Next

            DaysOn = 5          'Set to 5 for above mentioned explaination
        End If

        'Fill the table according to available Data
        If DateArray(4,DateRowCounter) = False Then 'Determine Work Day Availability by
pulling out of InArray

            If DateArray(0,DateRowCounter) >= InArray(1,lnRowCounter) AND
DateArray(0,DateRowCounter) <= InArray(1,lnRowCounter) + 6 Then

                For lnColumnCounter = 0 To 0
                    ResultantArray(lnColumnCounter, DailyRowCounter) =
DailyRowCounter
                Next

                For lnColumnCounter = 1 To 1
                    ResultantArray(lnColumnCounter, DailyRowCounter) =
WeekDayCounter
                Next

                For lnColumnCounter = 2 To Ubound(InArray,1)
                    ResultantArray(lnColumnCounter, DailyRowCounter) =
InArray(lnColumnCounter, lnRowCounter)/DaysOn
                Next

                DailyRowCounter = DailyRowCounter + 1
                ReDim Preserve ResultantArray(DailyColumnCounter,
DailyRowCounter)

            Else    'Work, but no entries for Availability = 0 Availability

                For lnColumnCounter = 0 To 0
                    ResultantArray(lnColumnCounter, DailyRowCounter) =
DailyRowCounter
                Next

                For lnColumnCounter = 1 To 1
                    ResultantArray(lnColumnCounter, DailyRowCounter) =
WeekDayCounter
                Next

                For lnColumnCounter = 2 To Ubound(InArray,1)
                    ResultantArray(lnColumnCounter, DailyRowCounter) = 0
                Next

                DailyRowCounter = DailyRowCounter + 1
                ReDim Preserve ResultantArray(DailyColumnCounter,
DailyRowCounter)
```

```
            End If

        Else    'No Work, therefore 0 Availability

            For lnColumnCounter = 0 To 0
                ResultantArray(lnColumnCounter, DailyRowCounter) =
DailyRowCounter
            Next

            For lnColumnCounter = 1 To 1
                ResultantArray(lnColumnCounter, DailyRowCounter) =
WeekDayCounter
            Next

            For lnColumnCounter = 2 To Ubound(InArray,1)
                ResultantArray(lnColumnCounter, DailyRowCounter) = 0
            Next

            DailyRowCounter = DailyRowCounter + 1
            ReDim Preserve ResultantArray(DailyColumnCounter, DailyRowCounter)


        End If

        'Huge hassle to get thing to work right...
        If DateArray(0,DateRowCounter) = InArray(1,lnRowCounter) + 6 Then
            If Not lnRowCounter = Ubound(InArray,2) Then
                lnRowCounter = lnRowCounter + 1
            End If
        End If

        DateRowCounter = DateRowCounter + 1
    Next
    Redim Preserve ResultantArray(Ubound(ResultantArray,1), Ubound(ResultantArray,2)-1)
    ConvertToDays = ResultantArray

End Function
%>
```

G. LOADFROMDATABASE.INC

Description: Loads database tables directly into arrays.

```
<%

Private Sub LoadFromDatabase()
        Dim TableName
        Dim FieldName
        response.write "</p><strong>LoadFromDatabase Started .. </strong></p>"

        TableName = "Syllabus"
        Call LoadArray (SyllabusArray, TableName)
        Call DisplayArrayInTable (SyllabusArray)

        TableName = "DayplanResourcesForInput1"
        Call LoadArray (DayplanResourcesArray, TableName)
        'Call DisplayArrayInTable (DayplanResourcesArray)

        TableName = "Dayplan"
        Call LoadArray (DayplanArray, TableName)
        'Call DisplayArrayInTable (DayplanResourcesArray)

        TableName = "ClassAsIs"
        Call LoadArray (ClassAsIsArray, TableName)
        'Call DisplayArrayInTable (ClassAsIsArray)
        Dim ClassToBeArray()
        Redim ClassToBeIsArray(Ubound(ClassAsIsArray,1), 0)

        TableName = "ClassStartEndDates"
        Call LoadArray (ClassDatesArray, TableName)
        'Call DisplayArrayInTable (ClassDatesArray)

        TableName = "ResourceAvailability"
        FieldName = "WeekDate"
        Call LoadArrayByDate (ResourceAvailabilityArray, TableName, FieldName)
        'Call DisplayArrayInTable (ResourceAvailabilityArray)

        TableName = "NormalOff"
        FieldName = "Date"
        Call LoadArrayByDate(NormalOffArray, TableName, FieldName)
        'Call DisplayArrayInTable (NormalOffArray)

        response.write "</p><strong>LoadFromDatabase Completed .. </strong></p>"
End Sub
%>
```

H. PROCESSSTUDENTS.INC

Description: Processes events day by day for each student and decides where they go next.

```
<%
'Student processing occurs from the StartDate to EndDate for each day, including daysoff
'Generally, it operates in the following fashion
'- A students required resources are retrieved, and added to the students required resources
'- A student may use 1 sim, 1 class, or 2 flights per day.
'           -Used resources are subtracted from the ResourceAvailabilityArray
'- If no resources are available, none are used and required resources build up for that student.
'- A student rolls back a class when their ClassEndDate passes and they still have required resources
'   FUTURE: also, a student does not start classroom if other resources are still required - so they are rolled
'       FUTURE: also, a student will roll one 10 classes or more behind.

'Once a student (1) has reached the ClassEndDate, they are passed to the next syllabus as determined by
SyllabusArray and ClassAsIs
'Students in DUMMY syllabii (API, Core, etc..) are not processed because their syllabus length is 0
'Students will be drawn into Primary from API

'Stats will be saved to arrays as the program progresses.  These arrays will later be saved to the database.

Public RandomListArray()

Sub ProcessStudents()
    Dim SCount
    Dim SCounter
    Dim CurrentDate
    Dim UpperBound
    Call ClearRecords("TrackResourcesNeeded")
    Call ClearRecords("TrackResourcesUsed")

    For CurrentDate = StartDate to EndDate      'Process for specified range of dates.
      Call RandomList()   'randomizes the array
        'Response.write("<br>### RandomListArray: " & " " & RandomListArray(0) & " " &
RandomListArray(1))
        UpperBound = Ubound(StudentArray, 2)
        For SCounter = 0 to UpperBound      'Process ALL students from StudentsAsIs
            SCount = RandomListArray(SCounter)
            'Scount = SCounter
            If SyllabusArray(S_TotalNumberDays, StudentArray(ST_SyllabusRef,
SCount)) <> 0 then   'If not Dummy Syllabus
                Call AddStudentRequired(Scount, CurrentDate)        '-Sub to add reqs
to a student
                Call ApplyResources(Scount, CurrentDate)        'Takes resources
from ResourceAvail.. and applies to student req.
            End If
            Call Stay_Roll_orNextphase(Scount, CurrentDate)
        Next
    Next
    'Call DisplayArrayInTable (StudentArray)
End Sub
```

```
Function RandomNumber(intHighestNumber)
        Randomize
        RandomNumber = Int(Rnd * intHighestNumber) + 1
End Function

Sub RandomList()
        Dim ArrayLength
        Dim Counter
        Dim SwapWith
        Dim Temp
        Call PopulateList()
        'Response.write("<br>### Populated RandomListArray")
        'DisplayArrayInTableOneColumn(RandomListArray)
        ArrayLength = Ubound(RandomListArray)
        For Counter = 0 to ArrayLength
                SwapWith = RandomNumber(ArrayLength)
                Temp = RandomListArray(SwapWith)
                RandomListArray(SwapWith) = RandomListArray(Counter)
                RandomListArray(Counter) = Temp
        Next
        'Response.write("<br>### RandomedListArray")
        'DisplayArrayInTableOneColumn(RandomListArray)
End Sub

Sub PopulateList()
        Dim Temp
   Redim RandomListArray(Ubound(StudentArray, 2))
        For Temp = 0 to Ubound(RandomListArray)
                RandomListArray(Temp) = Temp
        Next
End Sub

Sub Stay_Roll_orNextphase(StudentID, Date)
        'If Student has reached the last date of the Syllabus, and has no more required resources, then they
move to next phase.
        '- If still requires more resources, then they roll back a class (CurrenClass attribute increases by 2)
        '-
        Dim RCount
        Dim TotalResources

        If StudentArray(ST_PhaseEnd, StudentID) = Date then                         'Check to see if
they have completed all events (resources)
                TotalResources = 0
                For RCount = 0 to D_NumberOfResourceTypes-1
                'Counts the resources up
                        TotalResources = TotalResources +
StudentArray(ST_FirstResourceIndex+Rcount, StudentID)
                Next
                If TotalResources = 0 then
                                Call GotoNextPhase(StudentID, Date)
                                'Response.write("<br>GotoNextPhase(StudentID): " & StudentID)
                        Elseif TotalResources > 0 then
                                Call RollBack(StudentID, Date)
                                'Response.write("<br>RollBack(StudentID): " & StudentID)
                        Else
                'Response.write("<br>Student:" & StudentID & " had negative
resources at phase end = " & TotalResources)
        End If
    End If
End Sub

Sub RollBack(StudentID, Date)
    Dim Column1
    Dim Column2
    Dim Value1
    Dim Value2
    Dim Row
    StudentArray(ST_CurrentClassNumber, StudentID) = StudentArray(ST_CurrentClassNumber,
StudentID) + 2     'FIX THIS LATER!!!!
    Value1 = SyllabusArray(S_SyllabusName, StudentArray(ST_SyllabusRef, StudentID))
    'Value2 = SyllabusArray(StudentArray(ST_CurrentClassNumber, StudentID))
    Value2 = StudentArray(ST_CurrentClassNumber, StudentID)
    Row = ReturnRowValues2(ClassDatesArray, 0, Value1, 1, Value2)
    Response.write("<br> ********* Row **********: " & Row & " Value1: " & Value1 & "
Value2: " & Value2)
    'SyllabusArray(ST_PhaseEnd, StudentID) = ClassDatesArray(3, Row)
    StudentArray(ST_PhaseEnd, StudentID) = ClassDatesArray(3, Row)
End Sub

Sub GoToNextPhase(StudentID, Date)
    'A new student will be created in the Syllabus he/she is going to, depending on student type and
Primary/Alternate
    ' next setting in the ClassAsIsArray.
    'Find which next phase.  Only applies to Navy.

    Dim NextSyllabusName
    Dim Primary   'True or False
    Dim ClassNumber
    Dim StudentType
    Primary = True
    If StudentArray(ST_Type, StudentID) = 0 then   '0 is defined as Navy - See ArrayReferences.inc
        If ClassAsIsArray(C_NumberNavyToAlternatePhase, StudentArray(ST_SyllabusRef,
StudentID)) >0 then  '(How Many, Studs Syllabus)
            ClassAsIsArray(C_NumberNavyToAlternatePhase,
StudentArray(ST_SyllabusRef, StudentID)) = ClassAsIsArray(C_NumberNavyToAlternatePhase,
StudentArray(ST_SyllabusRef, StudentID)) - 1
            Primary = False
        End If
    End If
    If Primary = True then
        NextSyllabusName = SyllabusArray(S_NextPhase, StudentArray(ST_SyllabusRef,
StudentID))
    Else
        NextSyllabusName = SyllabusArray(S_NextAlternatePhase,
StudentArray(ST_SyllabusRef, StudentID))
    End If
    'CreateStudent(NextSyllabusName, ClassNumber, StudentType)
    ClassNumber = StudentArray(ST_CurrentClassNumber, StudentID)
    StudentType = StudentArray(ST_Type, StudentID)
```

```
        Call CreateStudent(NextSyllabusName, ClassNumber, StudentType) 'Sub in
ConvertFromDatabase.inc
        Redim preserve RandomListArray(Ubound(StudentArray, 2))  'Random Array also needs to be
redimmed for additional students
        RandomListArray(Ubound(StudentArray, 2)) = Ubound(StudentArray, 2)
        'Response.write("<br>Next: " & NextSyllabusName & " Class#: " &
StudentArray(ST_CurrentClassNumber, StudentID) & " Type: " & StudentArray(ST_Type, StudentID))
End Sub


Sub TrackResourcesNeeded_Sub(Date, Syllabus, ClassNumber, Resource)
        Dim TrackResourcesNeeded(3)
        TrackResourcesNeeded(0) = Date
        TrackResourcesNeeded(1) = cstr("'" & Syllabus & "'")
        TrackResourcesNeeded(2) = cstr("'" & ClassNumber & "'"  )
        TrackResourcesNeeded(3) = cstr("'" & (D_ResourceName(Resource)) & "'")
        Call StoreTable(TrackResourcesNeededTable, TrackResourcesNeeded)
End Sub

Sub TrackResourcesUsed_Sub(Date, Syllabus, ClassNumber, Resource)
        Dim TrackResourcesUsed(3)
        TrackResourcesUsed(0) = Date
        TrackResourcesUsed(1) = cstr("'" & Syllabus & "'")
        TrackResourcesUsed(2) = cstr("'" & ClassNumber & "'"  )
        TrackResourcesUsed(3) = cstr("'" & (D_ResourceName(Resource)) & "'")
        Call StoreTable(TrackResourcesUsedTable, TrackResourcesUsed)
End Sub

Sub ApplyResources(StudentID, Date)
        ' This subroutine will apply available resources for each student
        '- A student may use 1 sim, 1 class, or 2 flights per day.
        '                       -Used resources are subtracted from the ResourceAvailabilityArray
        '- If no resources are available, none are used and required resources build up for that student.
        '- A student rolls back a class when their ClassEndDate passes and they still have required
resources
        '   FUTURE: also, a student does not start classroom if other resources are still required - so they
are rolled
        '               FUTURE: also, a student will roll one 10 classes or more behind.

        Dim Rcount
        Dim Row
        Dim SyllabusRef
        Dim Syllabus
        Dim ClassNumber

        'Return row in the array where the R_Date value in the array = Date
        Row = ReturnRowValues1(ResourcesAvailabilityDailyArray, R_Date, Date)

        'Call DisplayArrayInTableRows(ResourcesAvailabilityDailyArray, Row, Row)
        If Row <> 99999 then
                For RCount = 0 to D_NumberOfResourceTypes-1
                        If StudentArray(ST_FirstResourceIndex+Rcount, StudentID) > 0 then
                                Response.write("<br>Date" & Date & "Avail:" &
ResourcesAvailabilityDailyArray(R_ResourceRefToResourceAvailabilityArray(RCount), Row))
```

```
                                If
ResourcesAvailabilityDailyArray(R_ResourceRefToResourceAvailabilityArray(RCount), Row) > 0  then
                                        Response.write(": Is over 0")
                                        If RCount = 2 and StudentID=359 then
                                                Response.write("<br>Date: " & Date & ", ID#" &
StudentID & " Needs " & StudentArray(ST_FirstResourceIndex+Rcount, StudentID))
                                                Response.write("<br>Available: " &
ResourcesAvailabilityDailyArray(R_ResourceRefToResourceAvailabilityArray(RCount), Row))
                                        End If
                                        StudentArray(ST_FirstResourceIndex+Rcount, StudentID) =
StudentArray(ST_FirstResourceIndex+Rcount, StudentID)-1

        ResourcesAvailabilityDailyArray(R_ResourceRefToResourceAvailabilityArray(RCount), Row) =
ResourcesAvailabilityDailyArray(R_ResourceRefToResourceAvailabilityArray(RCount), Row) - 1

                                        'Track resources usage
                                        Syllabus = SyllabusArray(S_SyllabusName,
StudentArray(ST_SyllabusRef, StudentID))  'Convert Syllabus ref# to a Name
                                        ClassNumber = StudentArray(ST_CurrentClassNumber,
StudentID)
                                        Call TrackResourcesUsed_Sub(Date, Syllabus, ClassNumber,
RCount)
                                Else
                                        Response.write("<br>*** Date" & Date & "Missed one: " &
D_ResourceName(RCount))
                                End If
                        End If
                Next
                'Response.write("<br>From StudentArray + DayplanResources")
                'Call DisplayArrayInTableRows(StudentArray, StudentID, StudentID)
        End If
End Sub

Sub AddStudentRequired(StudentID, Date)
        ' This subroutine will find how many resources that student needs for that day, and add to the
studentsrequired
        Dim Column1
        Dim Column2
        Dim Column3
        Dim Value1
        Dim Value2
        Dim Value3
        Dim NeededResources()
        Dim Rcount
        Dim Row
        Dim SyllabusRef
        Dim ResourceValue
        Redim NeededResources(D_NumberOfResourceTypes-1)

        Column1 = D_Date
        Column2 = D_SyllabusName
        Column3 = D_ClassNumber
        Value1 = Date
        SyllabusRef = StudentArray(ST_SyllabusRef, StudentID)
        Value2 = SyllabusArray(S_SyllabusName, SyllabusRef)  'Convert Syllabus ref# to a Name
```

```
	Value3 = StudentArray(ST_CurrentClassNumber, StudentID)
	Row = ReturnRowValues3(DayplanResourcesArray, Column1, Value1, Column2, Value2, 
Column3, Value3) 'INEFFICIENT !!!
	If Row <> 99999 then
		For RCount = 0 to D_NumberOfResourceTypes-1
			ResourceValue=DayplanResourcesArray(D_FirstResourceIndex+Rcount, Row)
			If ResourceValue > 0 then
				StudentArray(ST_FirstResourceIndex+Rcount, StudentID) = 
StudentArray(ST_FirstResourceIndex+Rcount, StudentID) + ResourceValue
				If RCount = 2 and StudentID=359 then
						Response.write("<br>Adding Needed, currently: " & 
StudentArray(ST_FirstResourceIndex+Rcount, StudentID))
				End If
				Call TrackResourcesNeeded_Sub(Date, Value2, Value3, Rcount)
			End If
		Next
		'Response.write("<br>From StudentArray + DayplanResources")
		'Call DisplayArrayInTableRows(StudentArray, StudentID, StudentID)
	End If
End Sub

'Function ReturnRow(Array, Column, Value)
'Returns the row given (1) An Array (2) Column Number (3) Value seeking
'Returns 99999 if none found
'Best used for columns of data where there are no duplicate values.

Sub SQuote(ByVal InString)
	SQuote = "" & "'" & Cstr(Instring) & "'" & ""
End Sub
%>
```

I. SAVETODATABASE.INC

Description: Saves processes arrays back to the database

```
<%
Private Sub ClearRecords(NameOfTable)
        Dim Table
        Set Table = Server.CreateObject("ADODB.Recordset")

        Table.Open "DELETE * FROM " & NameOfTable, MM_Conn_is4220Primary_STRING
End Sub
'OLD** Private Sub ClearRecords(NameOfTable,NameOfDateField,ConnectionStr)
'OLD** Table.Open "DELETE * FROM " & NameOfTable & " WHERE " & NameOfTable & "." &
NameOfDateField & ">=" & StartDate & " And " & NameOfTable & "." & NameOfDateField & "<=" &
EndDate & ";", ConnectionStr


Private Sub SaveArrayAsTable(NameOfArray,NameOfTable)
        Dim Table
        Dim lnRowCounter, lnColumnCounter
        Dim CommString
        Call ClearRecords(NameOfTable)
        Set Table = Server.CreateObject("ADODB.Recordset")
        For lnRowCounter = 0 To Ubound(NameOfArray,2)
                CommString = "INSERT INTO " & NameOfTable & " VALUES("
                For lnColumnCounter = 0 to Ubound(NameOfArray, 1)-1
                        CommString = CommString & NameOfArray(lnColumnCounter,
lnRowCounter)& ","
                Next
                CommString = CommString & NameOfArray(Ubound(NameOfArray, 1),
lnRowCounter)&")"
                'response.write ("<br>*!*!*" & CommString)
                Table.Open CommString, MM_Conn_is4220Primary_STRING
        Next
End Sub

Private Sub SaveArrayColumnIntoTable(NameOfArray,NameOfTable)
        Dim Table
        Dim lnRowCounter, lnColumnCounter
        Dim CommString
        Set Table = Server.CreateObject("ADODB.Recordset")
        CommString = "INSERT INTO " & NameOfTable & " VALUES("
        For lnRowCounter = 0 To Ubound(NameOfArray)-1
                CommString = CommString & NameOfArray(lnRowCounter)& ","
        Next
        CommString = CommString & NameOfArray(Ubound(NameOfArray))&")"
        response.write ("<br>***" & CommString)
        Table.Open CommString, MM_Conn_is4220Primary_STRING
End Sub

Private Sub SaveDailyArrayAsTable(NameOfArray,NameOfTable)
        Dim TempArray
        Dim Counter
        Dim Resource
        Dim Ref
```

```
    Counter = 0
    Redim TempArray (2, 0)
    For Ref = 0 to Ubound(NameOfArray,2)
        For Resource = 0 to Ubound(R_ResourceRefToResourceAvailabilityArray)
            Redim Preserve TempArray(2, Counter)
            TempArray(0, Counter) = NameOfArray(R_Date, Ref)
            TempArray(1, Counter) = "'" & D_ResourceName(Resource) & "'"
            TempArray(2, Counter) =
NameOfArray(R_ResourceRefToResourceAvailabilityArray(Resource), Ref)
            Counter = Counter + 1
        Next
    Next
    response.write ("<br>*************** SaveArrayAsTable ******************")
    Call SaveArrayAsTable(TempArray,NameOfTable)
End Sub


Private Sub StoreTable(TableData, DataArray)
    Dim Row
    Dim Column
    Dim Temp
    Row = Ubound(TableData, 2)
    Column = Ubound(TableData, 1)
    'response.write ("<br>")
    For temp = 0 to Column
        TableData(Temp, Row) = DataArray(temp)
        'response.write ("<br> !!!Temp," & Temp & ", Row: " & Row & "DataArray(temp)=" &
DataArray(temp))
    Next
    Redim Preserve TableData(Column, Row+1)
End Sub

Private Sub SaveStudentArrayAsTable(NameOfArray,NameOfTable)
    Dim Table
    Dim lnRowCounter, lnColumnCounter
    Dim CommString
    Call ClearRecords(NameOfTable)
    Set Table = Server.CreateObject("ADODB.Recordset")
    For lnRowCounter = 0 To Ubound(NameOfArray,2)
        CommString = "INSERT INTO " & NameOfTable & " VALUES("
        CommString = CommString & "'" & SyllabusArray(0, NameOfArray(ST_SyllabusRef,
lnRowCounter))& "'" & ","
        CommString = CommString & NameOfArray(ST_StartClassNumber, lnRowCounter)&
","
        CommString = CommString & NameOfArray(ST_CurrentClassNumber,
lnRowCounter)& ","
        CommString = CommString & NameOfArray(ST_PhaseStart, lnRowCounter)& ","
        CommString = CommString & NameOfArray(ST_Type, lnRowCounter)& ","
        CommString = CommString & NameOfArray(ST_InPhase, lnRowCounter)& ","
        CommString = CommString & NameOfArray(ST_TotalResourcesRequired,
lnRowCounter) & ","
        CommString = CommString & "'" & NameOfArray(ST_PhaseEnd, lnRowCounter) &
"'"& ","
        CommString = CommString & NameOfArray(8, lnRowCounter)& ","
        CommString = CommString & NameOfArray(9, lnRowCounter)& ","
        CommString = CommString & NameOfArray(10, lnRowCounter)& ","
        CommString = CommString & NameOfArray(11, lnRowCounter)& ","
        CommString = CommString & NameOfArray(12, lnRowCounter)& ","
        CommString = CommString & NameOfArray(13, lnRowCounter)& ","
        CommString = CommString & NameOfArray(14, lnRowCounter)& ","
        CommString = CommString & NameOfArray(15, lnRowCounter)& ")"
        Table.Open CommString, MM_Conn_is4220Primary_STRING
        'response.write ("<br>" & CommString)
    Next
End Sub
%>
```

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APPENDIX F. REQUIREMENTS REFINEMENT SURVEY I

Chief of Naval Air Training

Training the World's Best Aviators

NPS

PRAESTANTIA PER SCIENTIAM

OPS Survey: Aviation Training Forecaster Project

LCDR Randall Bostick & LCDR William Booth

Good production-related decisions require usable and timely information. The project goal is to provide better information to enable the best possible production related decision making. Your thoughtful responses will help us create the best product possible for you. Thank you for your time.

NAME/RANK:	EMAIL / PHONE#:
Command:	Interest in Project (1-Low, 5-High):

1	2	3	4	5
Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree

Information for Decision Making	The information would be useful (Circle One)	We already have access to this information. (Circle One)
1) The number of events (flight, simulator, classroom) needed per week for the next **1-4 weeks** to get/keep students on track.(IAW TTT.)	1 2 3 4 5	No / Not Sure / Yes
2) The number of events (flight, simulator, classroom) needed per week for the next **1-12 months** to get/keep students on track (IAW TTT.)	1 2 3 4 5	No / Not Sure / Yes
3) The negative or positive effect on production due to planning to fly less or more. Example: Flying over the weekend will help to catch up by how much (what number of events.) Example: How will taking a Friday off effect production. Example: After X weeks of high cancellations due to weather, Y number of events need to be produced to catch up.	1 2 3 4 5	No / Not Sure / Yes
4) The maximum number of students a phase can handle (at one time while continuing to produce students within required TTT)	1 2 3 4 5	No / Not Sure / Yes
5) Number of students to send to each next phase. Example: Phase completing X amount of students in a class may be unnecessary since the next phase cannot handle all of the students in that class.	1 2 3 4 5	No / Not Sure / Yes
6) Identifying possible resource sharing opportunities. Example: Phase A uses the same airplanes as phase B. In a few weeks, phase B is projected not to need all of their planes for events. Phase A is projected to need more	1 2 3 4 5	No / Not Sure / Yes

aircraft at that time.		
7) Syllabus Design: Production effects of lengthening or shortening the syllabus TTT.	1 2 3 4 5	No / Not Sure / Yes
8) Syllabus Design: Identification of varying event demand driven purely by event placement within the syllabus.	1 2 3 4 5	No / Not Sure / Yes

Additional Comments:

APPENDIX G. REQUIREMENTS REFINEMENT SURVEY II

Chief of Naval Air Training

Training the World's Best Aviators

NPS

PRAESTANTIA PER SCIENTIAM

Aviation Training Forecaster Project

LCDR Randall Bostick & LCDR William Booth

The primary project goal is to develop a tool to generate useful information for assessing the impact of alternative production strategies through forecasting and "what-if" analysis. Your thoughtful responses will help us create the best product possible for CNATRA. Thank you for your time.

NAME/RANK:	EMAIL / PHONE#:
Command:	Interest in Project (1-Low, 5-High):

1	**2**	**3**	**4**	**5**
Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree

Information for Decision Making	**The information would be useful** **(Circle One)**	**We already have access to this information.** **(Circle One)**
1) The impact of alternative production strategies to meet changing fleet requirements. Example: Suddenly, fewer aviators are needed in a pipeline. What impact would the following have, for example: a. Raising the NSS to increase attrition in certain stages. b. Allowing students to complete training even if there is no slot for them. c. Diverting some students to another pipeline, etc..	1 2 3 4 5	No / Not Sure / Yes Is so, what is the source? ________________ ________________
2) The impact of reducing TTT while maintaining the same training requirements. Example: To enable better reaction to fluctuating fleet demands, it may be advantageous to reduce TTT as much as practicable without reducing the quality of training. How would production be effected if a given number of non-event days (fluff) were removed from each phase? Example: How much would increasing or decreasing TTT effect the on-time completion rate?	1 2 3 4 5	No / Not Sure / Yes Is so, what is the source? ________________ ________________
3) If pipeline changes are being considered, how might production be effected? Example: New training requirements due to changing fleet aircraft requires new training phases or existing phases to be modified. How will production be effected?	1 2 3 4 5	No / Not Sure / Yes Is so, what is the source? ________________ ________________
4) The number of resources (aircraft, instructors, simulators, etc) required in each phase of training to meet TTT.	1 2 3 4 5	No / Not Sure / Yes Is so, what is the source?

5) The fiscal impact of alternative production strategies. Example: To enable the most cost efficient structuring of training related support contracts, would it be advantageous to project training demand fluctuations? Example: Given current contract stipulations, how much will overtime (or surge) situations costs? Could overtime situations be reduced? If so, by how much?	1 2 3 4 5	No / Not Sure / Yes Is so, what is the source? ________________ ________________

Additional Comments:

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