2009-12

Naval expeditionary logistics support group, training and evaluation unit: an analysis of current operations while searching for training efficiencies

Eckols, Christopher W.

Monterey, California: Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

MBA PROFESSIONAL REPORT

Naval Expeditionary Logistics Support Group, Training and Evaluation Unit: An Analysis of Current Operations while Searching for Training Efficiencies

---

By: **Christopher Eckols and Jeffrey Tomaszewski**

December 2009

Advisor: **Uday Apte**
Second Reader: **Raymond Franck**

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** December 2009	**3. REPORT TYPE AND DATES COVERED** MBA Professional Report	
4. TITLE AND SUBTITLE Naval Expeditionary Logistics Support Group, Training and Evaluation Unit: An Analysis of Current Operations while Searching for Training Efficiencies			**5. FUNDING NUMBERS**
6. AUTHOR(S) Jeffrey Tomaszewski, Christopher Eckols			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT

This paper used simulation modeling and process analysis to identify efficiencies that can be gained to improve capacity and flexibility of the Naval Expeditionary Logistics Support Group Training and Evaluation Unit. The primary objectives were 1) capacity planning in the aggregate, and 2) increasing capacity by identifying instructor qualification process constraints. The researchers first used aggregate planning methodology and determined that demand exceeded capacity. Arena simulation software was subsequently utilized to simulate the instructor qualification process to determine average total time in the system and to extract the non-value added processes. The study found that newly assigned instructor candidates are subject to an inordinately long training period respective to their tour length to achieve qualification for cargo handling training and evaluation. Reasons for long training periods include a lack of feeder rates, inconsistent demand, and multiple qualification objectives for each instructor. The researchers determined that changing instructor qualification processes as well as adding civilian personnel to the training process, non-value added time can be drastically reduced, increasing the percentage of time that members are fully qualified for tasking during a prescribed assignment to TEU. These recommendations result in an effective increase in personnel for tasking without increasing personnel manning assignments.

14. SUBJECT TERMS: Expeditionary logistics, training, scheduling, Unit Level Training Assessment, NAVELSG, Feeder Rates, Shipboard Cargo, Air Cargo, Cargo Handling, Cargo Handling Battalion, NCHB, Reserve Component, Cheatham Annex, Williamsburg, FATS, Arena Simulation, Capacity, Demand, Aggregate Planning, Level, Chase	**15. NUMBER OF PAGES** 63
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution unlimited

NAVAL EXPEDITIONARY LOGISTICS SUPPORT GROUP, TRAINING AND EVALUATION UNIT: AN ANALYSIS OF CURRENT OPERATIONS WHILE SEARCHING FOR TRAINING EFFICIENCIES

Christopher W. Eckols
Lieutenant, United States Navy
MBA University of Phoenix, 2000

Jeffrey A. Tomaszewski
Lieutenant, United States Navy
BS, Embry-Riddle Aeronautical University, 2003

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

NAVAL POSTGRADUATE SCHOOL
December 2009

Author: _____
Christopher Eckols

_____
Jeffrey Tomaszewski

Approved by: _____
Uday Apte, Thesis Advisor

_____
Raymond Franck, Second Reader

_____
William Gates, Dean
Graduate School of Business & Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

This paper used simulation modeling and process analysis to identify efficiencies that can be gained to improve capacity and flexibility of the Naval Expeditionary Logistics Support Group Training and Evaluation Unit. The primary objectives were 1) capacity planning in the aggregate, and 2) increasing capacity by identifying instructor qualification process constraints. The researchers first used aggregate planning methodology and determined that demand exceeded capacity. Arena simulation software was subsequently utilized to simulate the instructor qualification process to determine average total time in the system and to extract the non-value added processes. The study found that newly assigned instructor candidates are subject to an inordinately long training period respective to their tour length to achieve qualification for cargo handling training and evaluation. Reasons for long training periods include a lack of feeder rates, inconsistent demand, and multiple qualification objectives for each instructor. The researchers determined that changing instructor qualification processes as well as adding civilian personnel to the training process, non-value added time can be drastically reduced, increasing the percentage of time that members are fully qualified for tasking during a prescribed assignment to TEU. These recommendations result in an effective increase in personnel for tasking without increasing personnel manning assignments.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I. DEFINITION OF PROBLEM AND RATIONALE 1
A. BACKGROUND 1
B. RESEARCH OBJECTIVE 3
C. SCOPE 4
D. RESEARCH METHODOLOGY 4
E. PROJECT ORGANIZATION 5

II. STAFFING AND MISSION OBJECTIVES 7
A. COMMAND STRUCTURE 7
1. Naval Expeditionary Combat Command 7
2. Naval Expeditionary Logistics Support Group 7
3. NAVELSG Expeditionary Support Unit 10
4. Training and Evaluation Unit 10
5. Naval Construction Handling Battalions 12
B. TEU MANNING 13

III. DEMAND AND CAPACITY 17
A. TEU PROCESS FLOW 17
B. EXTERNAL DEMANDS 18
C. AGGREGATE PLANNING: MATCHING DEMAND AND CAPACITY 20
1. Aggregate Planning Discussion 23
2. Demand 24
3. Capacity 24
4. Capacity Deficit 25

IV. SIMULATION MODEL DESIGN 27
A. INSTRUCTOR CANDIDATES PROCESS 27
B. SIMULATION OVERVIEW 28
C. TRAINING PROCESS DESCRIPTION 29
D. UTILIZATION OF ARENA® 31
E. NEWLY ASSIGNED PERSONNEL ASSUMPTIONS: 31
F. ARENA® ASSUMPTIONS 33

V. ARENA® MODEL RESULTS 35
A. ARENA MODEL SIMULATION 35

VI. CONCLUSIONS AND RECOMMENDATIONS 39
A. CONCLUSIONS 39
B. RECOMMENDATIONS 40
C. SUGGESTIONS FOR FUTURE RESEARCH 40

LIST OF REFERENCES 43

INITIAL DISTRIBUTION LIST 45

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF FIGURES

Figure 1. NAVELSG Span of Control and Battalion Location (Lombardo, 2003) 9
Figure 2. NAVELSG Organizational Structure (Current) (Lombardo, 2003) 10
Figure 3. NELR Organizational Chart (Lombardo, 2003) 13
Figure 4. TEU Instructor Candidate Process (Watson, TEU, 2009) 15
Figure 5. TEU Instructor Maintenance (Watson, TEU, 2009) 16
Figure 6. ULTRA B Training Schedule 20
Figure 7. Instructor Process 27
Figure 8. Utilization Rate 0 CIVPERS 37
Figure 9. Utilization Rate 1CIVPERS 37

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1. NCHB Locations (Lombardo, 2003) 12
Table 2. TEU Course List 19
Table 3. Required Instructor/Assessor Hours (Actual) 21
Table 4. OCIVPERS Wait Time in System 38
Table 5. OCIVPERS Total Time in System 38
Table 6. 1CIVPERS Wait Time in System 38
Table 7. 1CIVPERS Total Time in System 38

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

ADT	Active Duty Training
APPN	Appropriation
AT	Annual Training
AT/FP	Anti-terrorism/force protection
BOG	Boots on the Ground
CART	Command Assessment of Readiness and Training
CCIR	Commanders Critical Information Requirements
COI	Center of Influence
COCOM	Combatant Command
CONUS	Continental United States
CSE	Convoy Security Element
C2	Command and Control
C2M2	Curriculum Control Model Manager
ECO	Expeditionary Cargo Operations
ECRC	Expeditionary Combat Readiness Center
ESC	Expeditionary Support Company
FEP	Final Evaluation Problem
FRTP	Fleet Response Training Plan:
ICW	Interactive Courseware
IDT	Inactive Duty Training
IDTT	Inactive Duty Training with Travel
IEX	Integrated Exercise
JQR	Joint Qualification Requirement

LOC	Logistics Operating Center
MMV	Millennium Military Vehicle
MOB	Mobilization
MTT	Mobile Training Team
NAVELSG	Naval Expeditionary Logistics Support Group
NECC	Naval Expeditionary Combat Command
NMETL	Navy Mission Essential Task List
OCONUS	Outside of Continental United States
OIC	Officer in Charge
O&MNR	Operations and Maintenance, Navy Reserve
OPORDER	Operational Order
POE	Plan of Embarkation
POM	Program Objectives Memorandum
PQS	Personnel Qualification Standard
ROC	Required Operational Capabilities
RSO&I	Reception, Staging, Onward Movement, and Integration
RFM	Ready for Mobilization
RFT	Ready for Tasking
SME	Subject Matter Expert
SWOT	Strengths, Weaknesses, Opportunities, and Threats
T&E	Test and Evaluation
ULTRA	Unit Level Training Readiness Assessment

ACKNOWLEDGMENTS

Lieutenant Jeffrey Tomaszewski and Lieutenant Christopher Eckols would like to thank the Graduate School Business and Public Policy (GSBPP) faculty and staff for their efforts, guidance, constant support, and encouragement during our time here at the Naval Postgraduate School. We would also like to thank the many outstanding Officers of the United States Armed Forces and International students, of whom we had to pleasure to meet, establish new friendships and study countless hours with. Our time here at Naval Postgraduate School has been a career enhancing opportunity and even though at times we may question ourselves, doubt our abilities or have a feeling of becoming overwhelmed with projects and exams, you quickly realize how remarkable the GSBPP faculty, staff, and newly established friendship really are.

We would both like to take this opportunity to thank the following individuals who directly participated in our MBA Professional Report process and saw it through completion.

- Uday Apte, who provided knowledge, expertise, and concepts that allowed us to ultimately take a project with many factors and narrow our approach and provide a simple yet relevant analysis.
- Raymond Franck, for sharing our vision for this project and providing the avenues that allowed us to identify “those low hanging fruits” on which we based our analysis.
- Susan Heath, for those last minute meetings that you always made yourself available for and providing your opinion and expertise on Arena®.
- Laura Caldwell, from three thousand miles away you consistently provided us your priceless dedication, guidance, understanding, and encouragement.
- Captain Robert Caldwell, USN, for your mentorship, guidance, and most importantly friendship.

THIS PAGE INTENTIONALLY LEFT BLANK

I. DEFINITION OF PROBLEM AND RATIONALE

A. BACKGROUND

Throughout the history of the United States Navy, traditional Naval platforms—aircraft, ships, and submarines, the icons of the Navy at work—have been at the forefront of war fighting and training operations. In recent years, however, the focus has begun to shift from the traditional six-month deployment involving a set number of individuals and predetermined tasks to expeditionary logistics, with expeditionary logistics teams increasingly relied upon in contingency operations. Often these operations are geographically remote, ill-defined, and in urgent need of trained and readily deployable units in a variety of situations (Naval Expeditionary Logistics and Support Group, 2009).

Despite the increased utilization of these units, there exists a lack of formalized doctrine and guidance for the Naval Expeditionary Logistics Support Group (NAVELSG) located in Williamsburg, Virginia. This group is charged with overseeing the training, development, and management of all 12 Naval Cargo Handling Battalions (NCHBs) and serves as a critical element in training and readiness of these forces.

Training and evaluation of these Battalions is the responsibility of the Training and Evaluation Unit (TEU), also located in Williamsburg. According to LCDR Jason Parkhouse, the Officer in Charge of TEU, personnel assigned the Unit have had to remain flexible, particularly in their training schedule, to accommodate the variability of demand, while ensuring that training and evaluations are conducted in a timely manner. Each Battalion operates at different readiness levels due to individual battalion requirements, specific requirements of combatant commanders, and mission objectives. A number of assets are leveraged to optimize capacity of the Unit including facilities for training, personnel for instruction, and support commands. However, lack of adherence to a firm critical milestone timeline, due to the unpredictable nature of today’s geopolitical climate remains a critical constraint on TEU's capacity.

This report will identify management and scheduling problems faced by TEU and focus on increasing the capacity at which TEU operates. For example, upon arrival of an instructor candidate, historically, the candidate has minimal knowledge and experience in expeditionary logistics operations. This has caused an increase in the total time necessary to qualify an Instructor Candidate, and has had a detrimental impact on TEU's capacity (Cabral, 2009). It has also been identified that an Instructor Candidate's training process is scheduled only when an evaluation at TEU is conducted and thus has caused increased wait time due to inconsistent training evolutions process.

TEU's operating structure is composed of three types of roles: classroom instructors, who teach basic knowledge skills associated with technical and non-technical skills; operators, who are responsible for operating various simulators and platforms as well as field facilities; and assessors, who are tasked with the grading evaluations using pre-defined checklists of mandatory skills. Training for each of these functions is most often conducted on an ad-hoc basis. From the perspective of LT Juan Cabral, the Assistant Officer in Charge at TEU, there either is a lack of Navy ratings (commonly referred to as feeder rates) that provide incoming personnel with the desired skills or experience required for successful assignment TEU. Unlike most Navy commands where incoming personnel tend to have a background similar to the person whose job they are assuming, few incoming personnel arriving to TEU have the experience necessary for an immediate turnover period that minimizes the disruption of daily operations. Formal training for expeditionary logisticians has not been an element in the traditional career progression of the Navy service member. Therefore, most new Instructor Candidate's lack the training and experience of expeditionary logistics (Cabral, 2009). For a new Instructor Candidate to qualify as an assessor, which increases TEU's capacity, it takes approximately one-third of an instructor's assigned tour. Consequently, the time required to progess through the qualification process results in about 67% overall capacity effectiveness at any given time within the TEU organization (Watson, 2009).

The difficulty that exists in the current instructor's training process not only is constrained by time but also lies in limited exposure and the opportunity to receive

necessary expeditionary logistics training prior to assignment to TEU. Upon arrival, man-hours are required to train instructor candidates; this further reduces the operational effectiveness for tasking. Should a sailor receive expeditionary logistics training in the course of typical rating assignments, it is likely he or she would be able to maintain skill proficiency while being assigned to an expeditionary logistics billet. The current training process seems only to allow TEU to operate at approximately 67% capacity at best, given that data has shown on average, it has taken up to 12 months to become assessor qualified for a new candidate. This percentage is based on the number of instructor candidates who have become qualified in the past two years. The goal will be to increase this percentage so that TEU can effectively operate at a higher capacity to better govern the variability in demand.

B. RESEARCH OBJECTIVE

The objective of this project is to analyze the current training process and increase the capacity of effective assessor qualified instructors at TEU. Considering both demand and capacity, this report will incorporate aggregate planning to assist in developing, analyzing and scheduling procedures for increasing TEU's operational effectiveness. Utilizing Arena®, we will model a new training process that focuses on total time in system and the utilization rates of classroom instruction, while introducing a civilian instructor to the process. By running a scenario that adds a civilian instructor, the model will decrease the total time in system and increase the instructor capacity of TEU. In order to achieve the results:

- a model will be developed to best represent efficient planning and operation;
- the model will be tested under different scenarios including past and future demand data;
- an analysis of total time in system and utilization rates will be presented.

C. SCOPE

Due to the varying schedules of battalion training phases, contingency operation requirements, and personnel manning and training requirements, it is not possible to create a model to fit every scenario. Therefore, this report will detail an Instructor Candidate's process model that emphasizes the capacity resulting from different manning and training plans within TEU. Additionally, these models will demonstrate optimized scheduling scenarios to increase capacity and determine optimized solutions and recommendations for manpower allowances, personnel types, and scheduling of NCHB's training phases.

D. RESEARCH METHODOLOGY

The overall research methodology includes:

- reviewing previous and projected capacity and demand statistics;
- reviewing published policy and operating procedures;
- conducting personnel interviews;
- formulating an optimization model(s);
- generating recommendations based of optimization models.

As a result of the normal rotation cycle of personnel, their training level, and qualification requirements, the percentage of TEU's effectiveness can vary over time regardless of the number of personnel actually assigned. An equation will be generated to capture the relationship between an instructor's qualification level and the Unit's operating capacity level. The result of this equation will be inputted into a model, which will be based on several assumptions, as each newly assigned Instructor Candidate will arrive with a varying degree of qualifications and experience. Additionally, factors such as leave, temporary assigned duty, and medical requirements will alter the operational capacity. However, these factors will not be taken into consideration when computing TEU's capacity. The focus for capacity will be addressed through an Instructor's qualification process and facilities available.

Aggregate planning and computer based simulation models will be used to demonstrate capacity, throughput, total time in system, and excess/shortages in capacity. Data for aggregate planning will be extracted from existing TEU training statistics, past evolutions, watch rotations, and proposed schedules. Arena® simulation software will be used to construct a process flow analysis to demonstrate flow rates, wait times, value added process time, and effectiveness rates.

E. PROJECT ORGANIZATION

This project is organized as follows:

Chapter II provides a detailed description of the staff, responsibilities, mission objectives and TEU's current manning document.

Chapter III discusses the demand and capacity at which TEU operates. It starts with a process flow description which identifies the internal and external demands. The specific external demands are then identified and aggregate planning methodology is used to match demand and capacity.

Chapter IV provides a simulation model overview, design of an Instructor Candidates training process and description on how Arena® is applicable and utilized.

Chapter V provides Arena® results and analysis.

Chapter VI research conclusions are presented and recommendations for further research will be provided and forwarded to the Officer in Charge, Training and Evaluation Unit.

THIS PAGE INTENTIONALLY LEFT BLANK

II. STAFFING AND MISSION OBJECTIVES

This chapter details the expeditionary logistics staff and the training process it manages. Each level is briefly described, responsibilities are highlighted, and mission tasking and objectives are addressed.

A. COMMAND STRUCTURE

1. Naval Expeditionary Combat Command

The top echelon of expeditionary logistics is the Navy Expeditionary Combat Command (NECC). Established in 2006 to consolidate all expeditionary forces under a single command, NECC is headquartered at Naval Amphibious Base Little Creek, Virginia. NECC leads all expeditionary forces (Reserve and Active units) and ensures deployable forces are ready to face a variety of contingency operations worldwide when political and environmental events require logistics support including, but not limited to, port, air, and transport functions (Commander, 2008). Currently, contingency operations are being conducted in countries including Iraq, Afghanistan, and Kuwait. NECC's mission is to realign current structure, redistribute forces, and recognize the need for expansion and capabilities (NECC Public Affairs Office, 2006).

2. Naval Expeditionary Logistics Support Group

The Naval Expeditionary Logistics Support Group is headquartered in Williamsburg, Virginia, and is staffed by a full-time and Selective Reserve headquarters staff. NAVELSG is made up of both Navy Active and Reserve personnel, consisting of approximately 3,630 total personnel (3,240 Reserve and 390 Active duty) assigned to 5 Cargo and Port Groups (NAVCHAPGRU), 11 Reserve Cargo Handling Battalions, an Active Cargo Handling Battalion, an Expeditionary Support Unit (ESU), and the Training and Evaluation Unit (TEU) (Cheatham Annex NAVELSG Headquarters, 2009).

Navy Reserve battalions and companies, located throughout the United States, are composed primarily of reserve personnel. This report focuses on the support functions within NAVELSG. Figure 1 illustrates NAVELSG's span of control and battalion locations. Each battalion serves a large geographic region for drilling reserve personnel, and hosts a variety of expeditionary logistics functions. Their mission is to provide a wide range of supply and transportation support critical for peacetime support, crisis response, humanitarian, and combat service support (Cheatham Annex NAVELSG Headquarters, 2009).

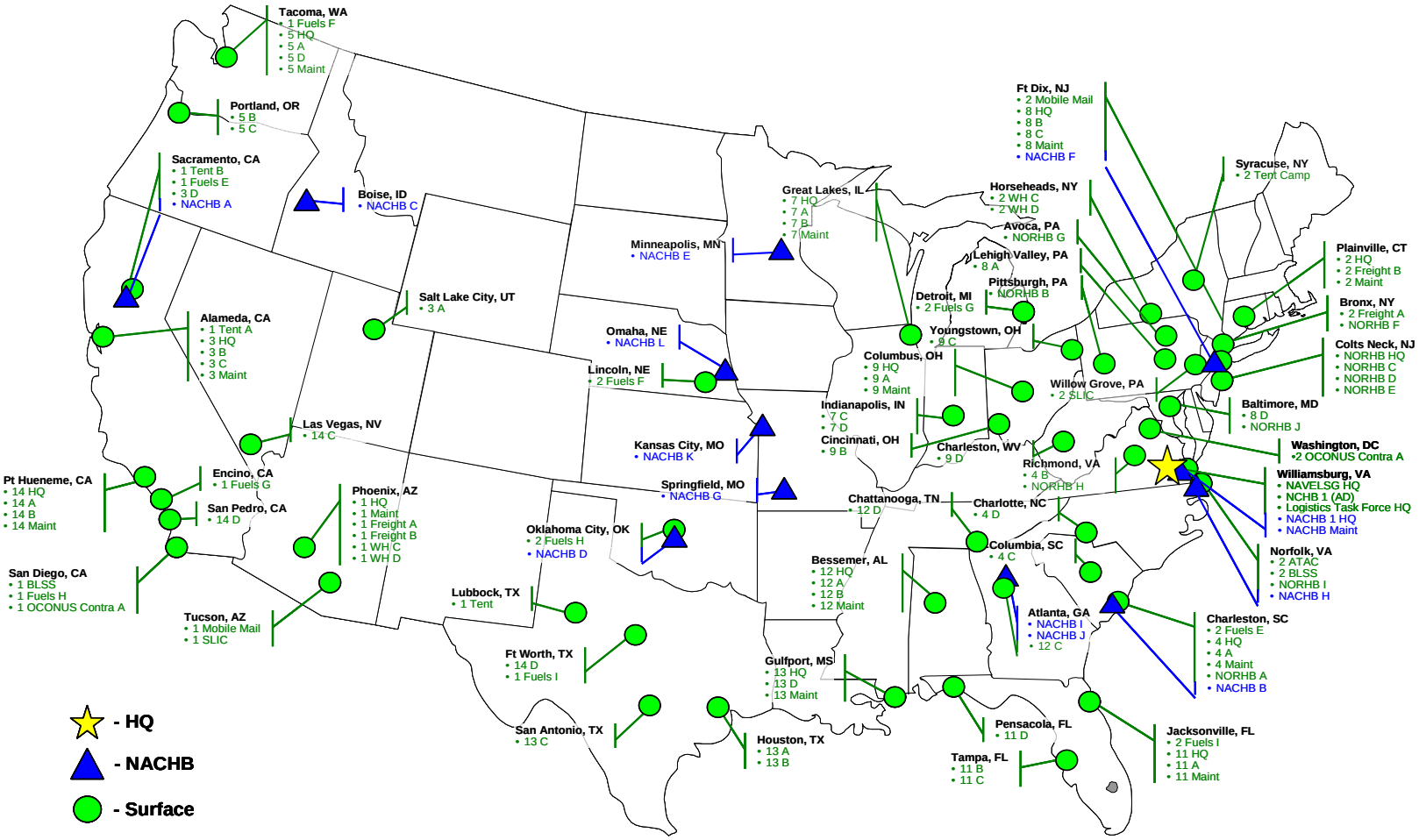

Figure 1. NAVELSG Span of Control and Battalion Location (Lombardo, 2003)

Figure 2 shows the NAVELSG Organizational structure as of this writing. NAVELSG is composed of five Naval Expeditionary Logistics Regiments (NELR).

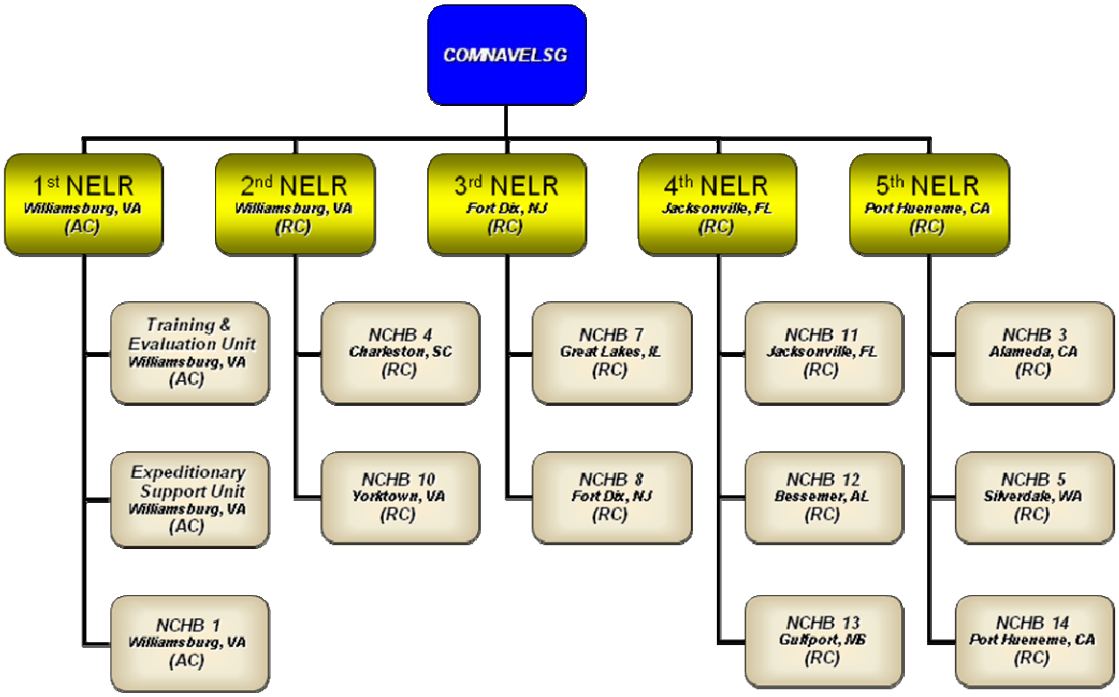

Figure 2. NAVELSG Organizational Structure (Current) (Lombardo, 2003)

3. NAVELSG Expeditionary Support Unit

The Naval Expeditionary Logistics Support Group Expeditionary Support Unit (NAVELSG ESU) provides common logistics functions, resources, and support across NAVELSG organizations, as well as deployable logistics support including tent camp support and services, warehousing, and general logistics for NAVELSG and NECC adaptive force packages. The NAVELSG ESU reports to the NAVELSG N4 Director of Logistics for financial requests.

4. Training and Evaluation Unit

The Naval Expeditionary Logistics Support Group Training and Evaluation Unit (NAVELSG TEU) evolved much like a small business. Responding to a need for consistent training and evaluation of deploying reserve units, TEU was founded to provide classroom, field training, and evaluation of exercise execution to reserve units on a periodic basis. TEU was originally established with an Officer in Charge, staff, support

personnel, and dedicated facilities. For the purposes of funding and budgeting, all requests and correspondence are coordinated through the NAVELSG N4 office and ESU (jointly referred to as N4ES).

The charter of TEU is to provide consistent and relevant training and evaluation for Naval Cargo Handling Battalions (NCHBs). TEU is charged with training and evaluating the necessary skills for battalions to maintain self-sufficiency and long-term sustainment during assignment to worldwide contingency operations. In addition to periodic onsite evaluations, TEU conducts exercises for reserve units facing imminent deployment to countries including Iraq, Afghanistan, Korea, and Africa. These exercises are conducted in Williamsburg, Virginia, onboard Cheatham Annex (CAX) (COMNAVELSG, 2009).

The mission of TEU is to serve as the training and education provider for Navy Cargo and Handling, and to support current and future missions of NAVELSG units by designing realistic and relevant scenarios that provide objective assessment of staff and units in accordance with Required Operational Capabilities and Plan of Embankment (ROC & POE) requirements. From TEU's standpoint, the focus is on deployment training (Cockerell, 2008)

These objectives are accomplished through the development of course curriculum, training plans, and exercises to prepare and certify Naval Cargo Handling Battalions to support Combatant Command (COCOM) and Navy operational requirements by:

- Producing a master training schedule and providing resources for Active Component and Reserve Component unit training attainment.
- Providing classroom instruction training as well as Mobile Training Team and Interactive Courseware (MTT and ICW) to meet requirements of the Fleet Response Training Plan (FRTP). TEU will serve as Curriculum Control Model Manager (C2M2) for nine Center of Influences (COI) and developing tailored training plans based on unit level self-assessments.

- Conducting training and readiness assessments of units utilizing NMETL and providing qualitative and quantitative analysis of training and operational programs (AMMO, Licensing, Personal Qualification Standard (PQS)

5. Naval Construction Handling Battalions

Naval Construction Handling Battalions (NCHBs) are deployable worldwide based on the needs of regional commanders. The 12 Units consist of one Active and 11 Reserve-commissioned units charged with loading and unloading all classes of cargo (with the exception of bulk petroleum) from surface ships and military-controlled aircraft for all services; performing aircraft and ground support refueling and facilitating bulk fuel storage; establishing and operating expeditionary air cargo terminals; and handling, inventory reporting, and the storing of pallets and containerized ordnance and ammunition for Navy and Marine Corps use. The single Active component, NCHB-1, is located in Williamsburg, Virginia; the remaining 11 NCHBs are located across the United States, as shown in Table 1.

BATTALION	LOCATION
NCHB 1 (Active)	WILLIAMSBURG, VA
NCHB 3	ALAMEDA, CA
NCHB 4	CHARLESTON, SC
NCHB 5	TACOMA, WA
NCHB 7	GREAT LAKES, IL
NCHB 8	FORT DIX, NJ
NCHB 10	YORKTOWN, VA
NCHB 11	JACKSONVILLE, FL
NCHB 12	BESSEMER, AL
NCHB 13	GULFPORT, MS
NCHB 14	PORT HUENEME, CA

Table 1. NCHB Locations (Lombardo, 2003)

Each battalion is composed of 303 reserve members in a variety of ratings, ranks, and experience. The composition of each Battalion is illustrated in Figure 3.

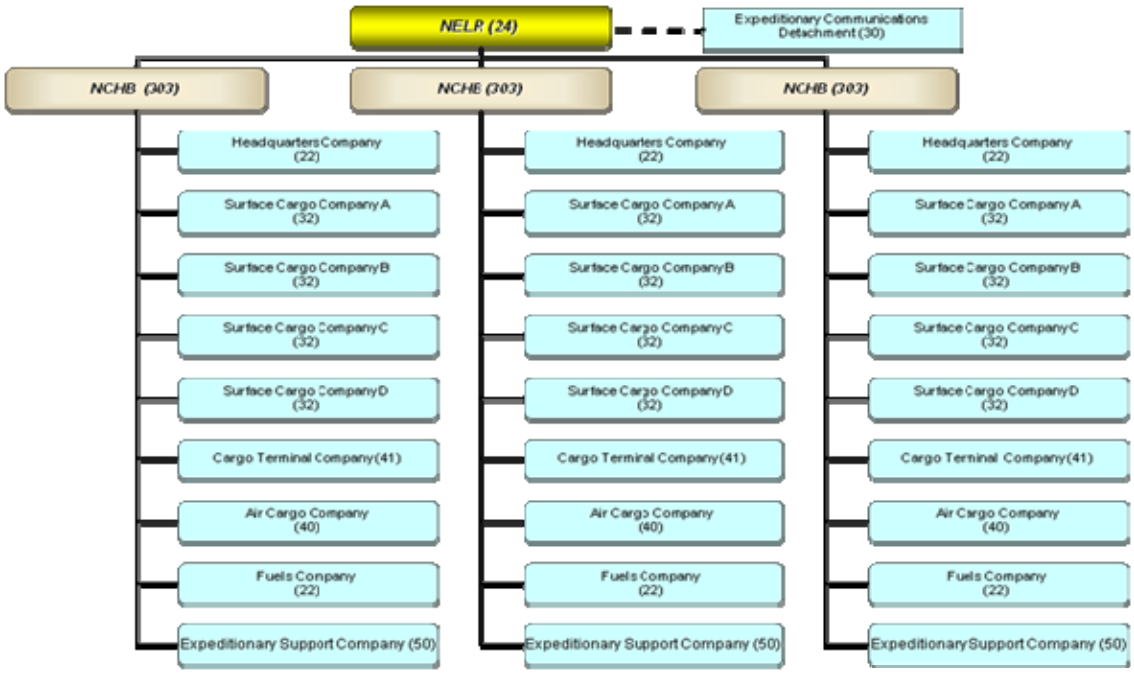

Figure 3. NELR Organizational Chart (Lombardo, 2003)

B. TEU MANNING

TEU is manned with 25 organic personnel who administer, train, evaluate, and perform all necessary functions within TEU. Three of these personnel provide administrative support exclusively, and are not available for evaluations or exercises.

Operations and Assessment divisions consist of 22 instructor personnel having experience in four areas of expertise: military skills, shipboard cargo, communications, and air cargo. These Operation and Assessment personnel are charged with field instruction, classroom training, simulator training, and ULTRA-B, ULTRA-C facilitation.

A variety of reserve personnel augment the TEU and NAVELSG staff, fulfilling the Active Duty Training (ADT), Inactive Duty Training (IDT), or Inactive Duty Training with Travel (IDTT) requirements for reserve personnel. Additional personnel may be requested and funded through NAVELSG. Although TEU has 25 personnel assigned in a permanent status, the lack of pre-qualified personnel available for

placement at TEU directly impacts the capacity at which the Unit can effectively operate, due to demand for qualified assessors to train and evaluate all 12 NCHBs. The certification process is quite lengthy for an unqualified instructor upon arrival at TEU, and places an internal demand on TEU that can compromise the TEU mission. A Navy Enlisted Classification (NEC) of 9502, which indicates an enlisted person has had necessary training to instruct naval curricula, is preferred upon arrival in order to shorten the time required for training of new personnel. Qualified and unqualified instructors follow two different training process flow charts as shown in Figures 4 and 5.

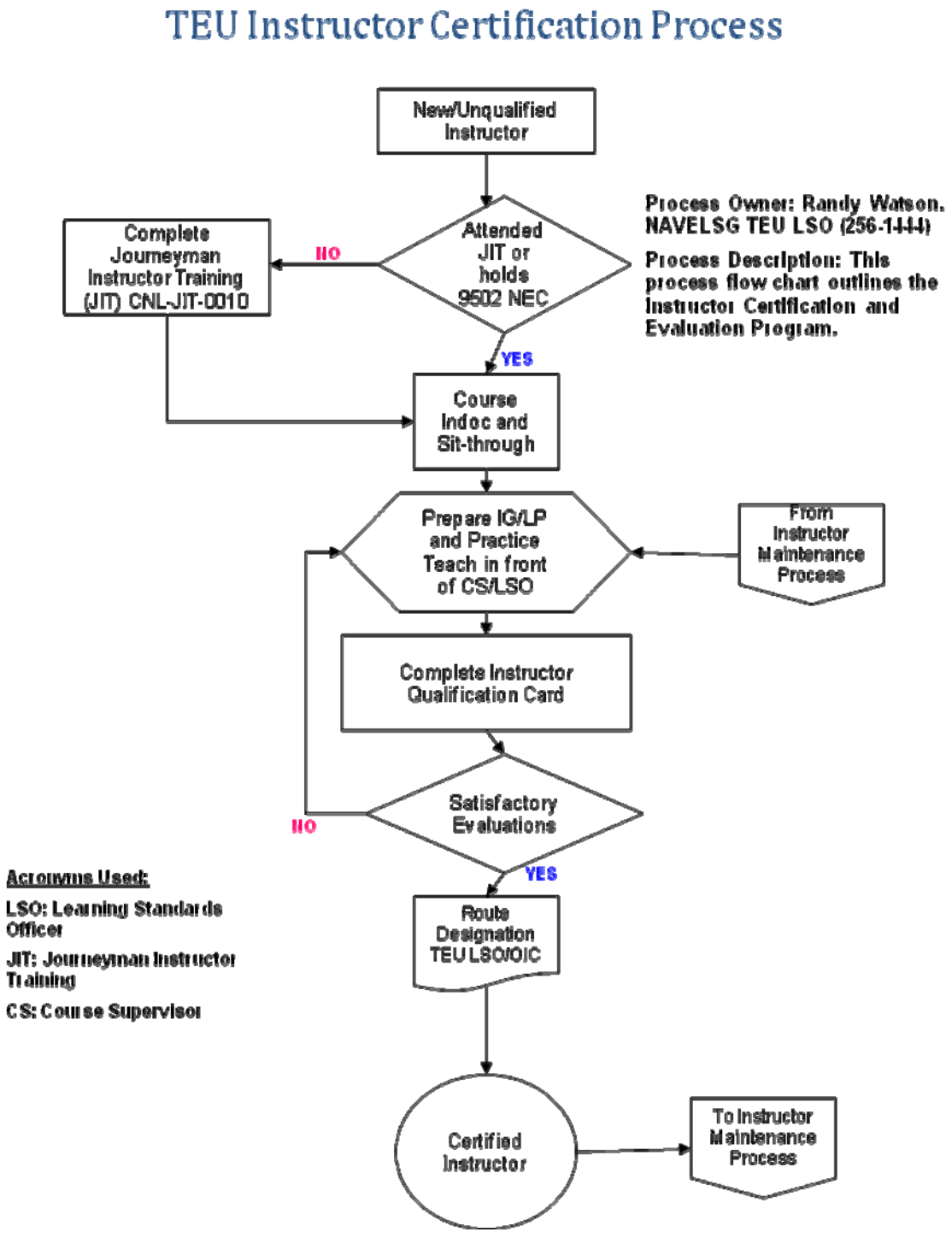

Figure 4. TEU Instructor Candidate Process (Watson, TEU, 2009)

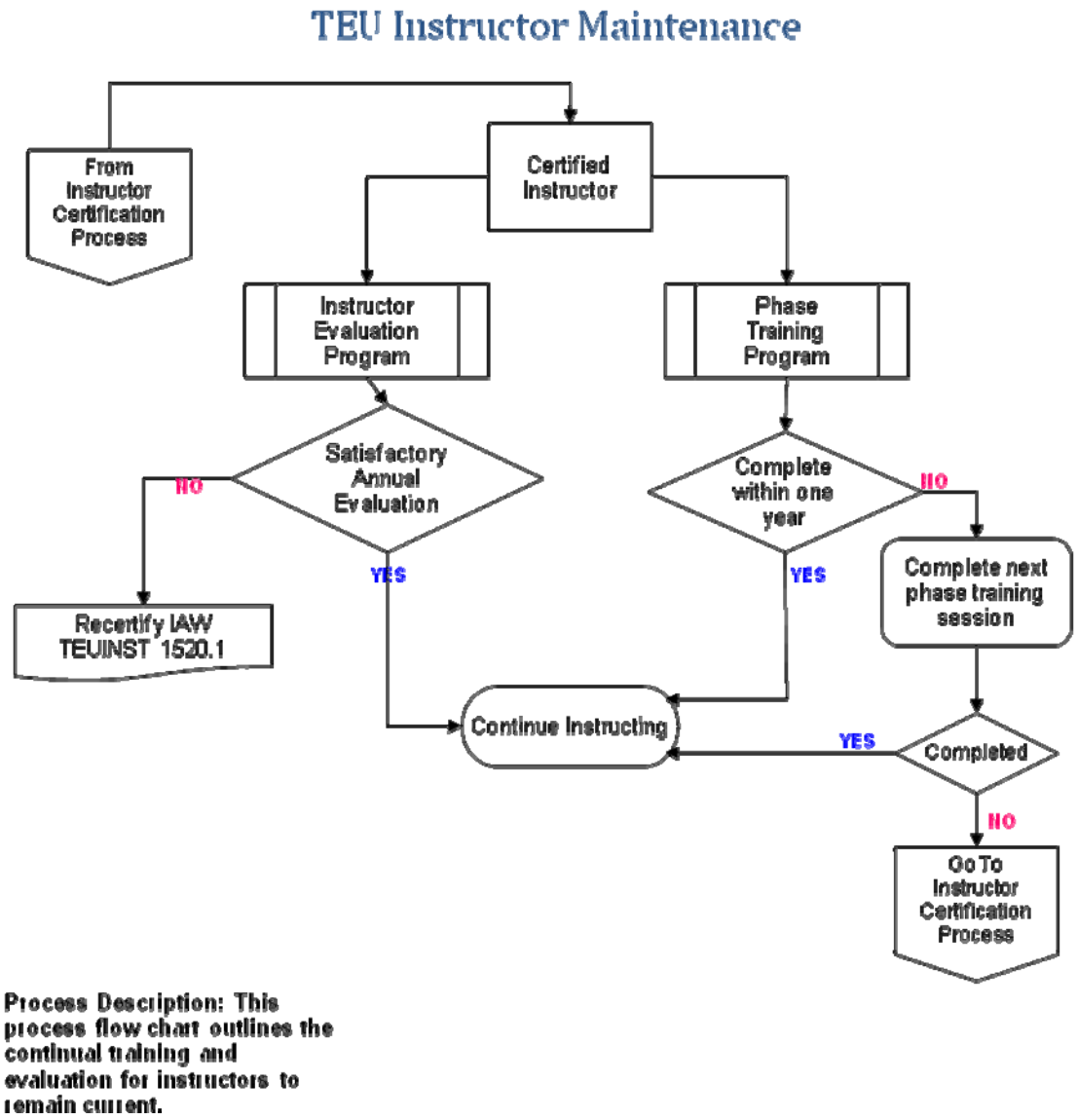

Figure 5. TEU Instructor Maintenance (Watson, TEU, 2009)

III. DEMAND AND CAPACITY

A. TEU PROCESS FLOW

As stated in the charter of TEU, the overarching goal of the unit is to provide relevant scenarios to ensure an appropriate assessment of a Battalion. Evaluation is based on the primary objective of TEU, which is to develop course curriculum, training evolutions, and graded exercises that certify NCHBs for operational requirements. Capacity has been a challenge for TEU since the separation from NAVELSG headquarters. For example, reviewing the manning document for TEU reveals there are few feeder rates that allow for personnel to arrive at TEU for assignment prepared to instruct on specialized areas required for cargo handling. The lack of immediately assignable personnel places an appreciable demand on TEU. Unlike many training commands, TEU serves a dual function of training and assessment (Parkhouse, 2009).

This report identifies two specific demands placed on TEU: external demand (services provided by TEU to the Battalions) and internal demand (the TEU training process for newly assigned personnel and internal daily requirements). External demand is one of the biggest challenges TEU faces in attempting to coordinate training and evaluation for all Battalions. This demand is generated by TEU's provision of several services to external customers, including Remote Assist Visits (RAVs), Unit Level Training Assessments (ULTRA-B/C) and coordination of follow-through of pre-deployment cycle training plans to all 12 NCHBs located throughout the United States. TEU's training objectives lead to Battalion certification as fully qualified and ready to deploy immediately in the event of mobilization. Additionally, the capacity TEU is capable of handling will be illustrated using two factors, instruction facilities including operational training areas and the current TEU manning document, which shows a portion of organic personnel and others on request (NAVELSG personnel) or who have limited time (SELRES) assigned. The ULTRA-C, a three-day exercise, is also performed on-site at CAX and is conducted 90 days after successful completion of the ULTRA-B. Upon completion of this exercise, the battalion (NCHB) will be certified Ready for Mobilization or Not Ready for Mobilization. Upon certification, battalions enter the

sustainment phase, which lasts up to two-and-a-half years before the training cycle is repeated. If called upon to support an operation, the NCHB is sent to the final deployment phase training exercise, which is facilitated by the Army at 23 Expeditionary Combat Readiness Centers.

In summary, the TEU process flow begins with identifying TEU's guiding mission and objective statements and attempting to determine how these two statements assist in aligning TEU's goals with those of NAVELSG, and then identifies the external demands and assessments. Fluctuation in manning has been identified as a constraint due to the inconsistent number of qualified personnel and ties into two major areas of concern: demand and capacity. Demand on TEU is exerted by both external and internal sources. The capacity of TEU has also been broken into two factors: physical and human capital. With regard to both demand and capacity, it is evident that qualified personnel are a constraint in the process and, thus, will be the main objective in our follow-on analysis.

B. EXTERNAL DEMANDS

Training provided by TEU falls into three distinct categories: RAV, ULTRA-B, and ULTRA-C. An onsite assessment (RAV) typically involves four personnel traveling to selected NCHB locations for four to five days. RAVs are typically conducted six to twelve months prior to a scheduled ULTRA-B and are conducted at all 12 NCHB locations. The objective of a RAV is to conduct a preliminary review of PQS, licenses, and weapon qualifications of all battalion personnel.

An ULTRA-B is conducted at CAX over an elapsed period of 15 days. This is a team training exercise that focuses on all areas in which a battalion may operate (surface, air, fuels), depending upon specific unit commander requirements. These requirements may vary depending on specifications of theater commanders. Depending upon the proficiency and levels of qualifications of all teams within a battalion, a series of courses is taught during the ULTRA-B using a combination of classroom instruction, field exercises, and platform training. Each NCHB is required to complete an ULTRA-B on a regular basis, usually not to exceed every 48 months. The ULTRA-B is a training evolution and requires the use of every qualified instructor and evaluator for 12 days.

Each instructor/evaluator is responsible for a multitude of events, including classroom instruction, platform training, and field exercises. The typical list of courses and detailed requirements for those classes is shown in Table 2. Each course is classified as technical or non-technical in nature. Technical courses consume more man-hours and require additional instructors.

LIST OF COURSES	LENGTH	# INSTRUCTORS	STUDENTS		PRE- REQ'S
			MIN	MAX	
TECHNICAL SKILLS					
Basic Air Cargo Handling	5 days	3	6	25	NEC 2821/9502 OR 9502 w/SME
Advanced Air Cargo Handling	5 days	3	6	25	NEC 2821/9502 OR 9502 w/SME
Basic Shipboard Cargo Handling	10 days	4	10	30	NEC 9570/9502 OR 9502 w/SME
Advanced Shipboard Cargo	5 days	2	6	25	NEC 9570/9502 OR 9502 w/SME
MPS Hagglunds Crane	10 days	5	6	25	NEC 9502 OR 9502 w/ SME
Expeditionary Cargo Operations	10 days	2	4	25	NEC 9502 OR 9502 w/ SME
Explosive Driver	5 days	2	4	12	NEC 9502 OR 9502 w/ SME
Explosive Forklift	5 days	2	4	12	NEC 9502 OR 9502 w/ SME
Field Messing	10 days	2			NEC 9502 OR 9502 w/ SME
NON-TECHNICAL SKILLS					
BUS driver	5 days	1		15	NEC 9502 OR 9502 w/ SME
MMVs	3 days	1		12	
Field Communications	4 days	1		25	
Combat Skills (Perimeter Defense)	1 day	2		25	
Hatch Team Training	1 day	2		*	* 1-3 Hatch teams (7-9 pax each)
Explosive Driver Recertification	2 days	1		12	
Explosive Forklift Recertification	.5 day	1		12	
Chemical/Biological/Radiological Def	1 day	2		25	
Basic Convoy	1 day	2		25	
FATS	.5 day	2		25	
Small Arms Familiarization	.5 days	2		25	
HMMWV	2 days	2		20	
Stake/Tractor/Trailer	4 days	3		10	

Table 2. TEU Course List

The final two days of the ULTRA-B consist of a Navy Mission Essential Task List (NMETL) exercise. An example of a typical ULTRA-B schedule is shown in Figure 6; each battalion is divided into subsections in order to balance classes. This exercise is not graded; however, it highlights specific training topics needing to be addressed prior to the final exercise, the ULTRA-C.

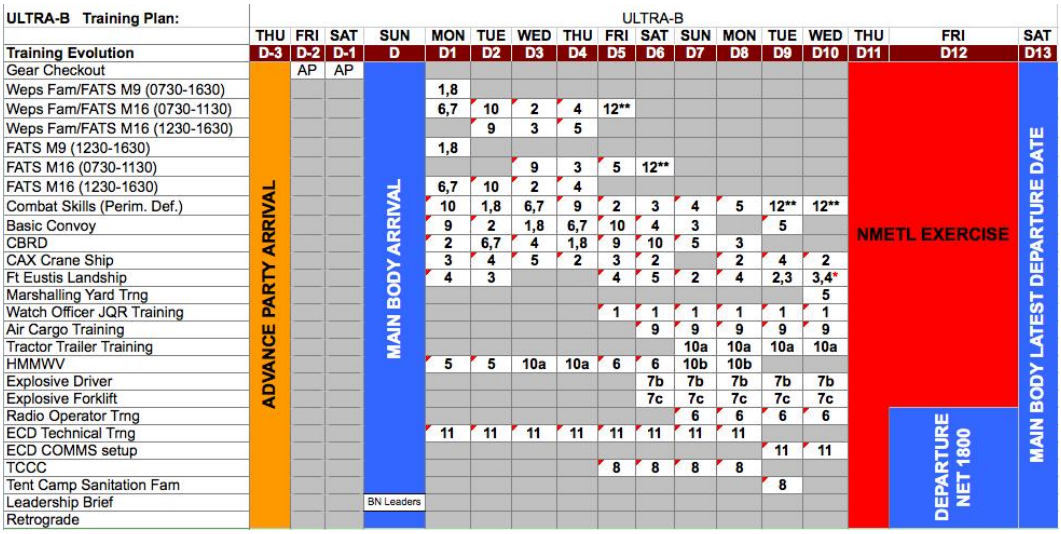

Figure 6. ULTRA B Training Schedule

The ULTRA-C, a three-day exercise, is also performed on-site at CAX, and is conducted approximately 90 days after successful completion of the ULTRA-B. Upon completion of this exercise, the battalion (NCHB) will be certified Ready for Mobilization or Not Ready for Mobilization. Upon certification, battalions enter the sustainment phase, which lasts up to two-and-one-half years before the training cycle is repeated.

C. AGGREGATE PLANNING: MATCHING DEMAND AND CAPACITY

Aggregate planning is the process of developing, analyzing, and maintaining a preliminary, approximate schedule of the overall operation of an organization. The intent of the aggregate plan is to satisfy the demand forecast at minimum cost and to make possible the adjustment of both supply and demand by adjusting production rates or workforce levels, but not by expanding facilities (Cengage, 2006). Aggregate planning is considered to be intermediate-term, as opposed to long- or short-term planning. As such, most aggregate planning covers periods from 3–18 months. Steps of aggregate planning begin with determining demand and the calculation of current capacity. If demand exceeds capacity, management can elect to increase personnel as needed, only to decrease personnel levels to pre-demand levels.

There are two basic reactive approaches to aggregate planning; the chase approach and level approach. In the chase approach, capacities are adjusted to match

demand over a time period. The level approach uses historical data to predict capacity, and attempts to keep capacity constant over a given period (Cengage, 2006). Since TEU's establishment from NAVELSG, both approaches have been applied. Focusing on our objective of this report, we evaluate the current and future capacity and explain in further detail the application of the chase approach currently utilized by TEU.

As noted in Section B, TEU's operational demand is characterized by two factors: external and internal. External demand consists of ULTRA-B, ULTRA-C, Ready Assist Visits (RAV), and Field Exercises (FIELDEX). From establishment in FY08 through FY10 projections, the numbers of events fluctuate.

- 6 events (forecasted) for FY10: (2)ULTRA-B, (2)ULTRA-C, (2)RAV
- 11 events for FY09: (4)ULTRA-B, (3)ULTRA-C, (2)RAV, (2)FEP
- 10 events for FY08: (2)ULTRA-B, (2)ULTRA-C, (5)RAV, (1)FEP

As shown in Table 3, two external demands, ULTRA-B and ULTRA-C, each are important training assessments required to evaluate a particular NCHB. Each training assessment requires a different number of instructors, which impacts the capacity of TEU, based on total hours required. The total hours required in Table 3 are derived from actual ULTRA-B/C evolutions, and will be referred to as demand for the purposes of this report.

Events	Instructors/Assessors required	Number of Days	Total Hours Required
ULTRA-B	**21 (Including Supervisory)**	**10**	**1,672**
ULTRA-C	**33**	**1.5**	**396**

Table 3. Required Instructor/Assessor Hours (Actual)

In addition to these external demands, we have identified some constraints that affect TEU internally. For purposes of this report, these constraints such as: training of Instructor Candidates, administration functions, hours lost to leave, liberty and other collateral duties have been defined as internal demand. However, due to a rapid establishment from NAVELSG, TEU had minimal documentation to support an

appropriate analysis on their internal demand. This is identified as a possible problem, and has been noted a concern and recommended for further research. Only the two events identified in Table 3 will be considered while formulating TEU's demand and identifying the capacity required.

Demand is determined by long-term planning and is heavily influenced by political and environmental issues. Due to the sensitivity and unpredictability of possible events, for purpose of this report we will use FY08, FY09, and FY10 demand schedules and focus on the operational capacity of TEU during its most relevant training scenarios, ULTRA-B/C.

The capacity of TEU can be subdivided into two distinct categories: the instructor facilities (physical facilities) and the number of qualified instructors. The instructor facilities include outlying operational training areas, platforms, field facilities, and conference/classrooms. The classroom facility provides state-of-the-art-classrooms and virtual reality rooms for small arms training. The outlying operational training areas are spread across Cheatham Annex in Virginia, and provide space for large groups to conduct specific training on field messing, perimeter defense, air cargo, land transport, and sea cargo handling. These instructor facilities are vital to the daily operation of TEU, and can significantly impact the capacity; however, the facilities have redundancies, are large enough and are capable of handling an NCHB training assessment of any sort.

Qualified assessors thus become a capacity-limiting constraint. By utilizing Little's Law (I=R x T), we expect approximately eight new instructor candidates, two per quarter, to arrive at TEU per year. The formula is (I)=25 permanently assigned active-duty personnel, typically assigned for a three-year rotation cycle; (T)=new instructor candidates can be expected to arrive every three months, with one qualified assessor leaving at approximately the same frequency, based of FY08 and FY09 incoming and outgoing personnel data ((25 = (R x 3yrs)) = ((25 / 3) = R) = (R = 8.333) rounding to the nearest whole number eight will be inputted for computing assessor's operational capacity rate. Even though a few Instructor Candidates arrive with some knowledge or experience, it has not increased or benefited TEU's operational effectiveness and capacity, according to Randy Watson, Learning Standards Officer (LSO) for TEU.

Indications on the Arena® outputs in Chapter IV show delays exist in the training process which, unless streamlined to some degree, will continue to affect TEU's capacity.

This lengthy qualification process limits the number of effective personnel that are available for assignment. As identified earlier, an instructor/assessor spends one-third of his or her time in the qualification process before TEU can effectively utilize them fully. The delay is significant and unique to TEU because each instructor is required to be an assessor, which allows TEU to assign an instructor to any assessment process while an NCHB is being evaluated. An additional constraint arises when the number of qualified instructors is fewer than the number of personnel assigned to TEU. Historically, there have been 25 instructors assigned, each with an average one-year qualification time. This provides an effective rate of 0.667 and, therefore, translates to an effective number of qualified instructors to 16.675 (25 x 0.667), which decreases available manning and detrimentally affects TEU's operational capacity.

An additional 14 Selective Reserve (SELRES) personnel are intermittently assigned on an *ad-hoc* basis and do not follow any predictable rotation. These individuals may have desired skills and experience, but are not considered part of TEU's asset pool since they cannot be predictably scheduled. Although these personnel are potentially available during times of heightened demand, there is a disadvantage associated with utilizing such an approach for future scheduling and forecasting capacity to meet demand. By fluctuating personnel numbers this chase approach, which adjusts to match demand requirements over a planned horizon, increases the constraints that TEU must constantly address, solve and adjust while conducting or scheduling either personnel or NCHB's training assessments.

1. Aggregate Planning Discussion

In our aggregate plan, we will concentrate on two specific events, ULTRA-B and ULTRA-C. Instead of calculating internal and external demand on an annual basis, we will concentrate on these two events since they are the primary basis of the operation of TEU and because annual throughput of classroom instruction fluctuates widely. Additionally, the number of ULTRA evolutions varies from year to year, and would thus impact internal capacity calculations unpredictably.

ULTRA-B has two main functions: training and evaluation. The training portion of ULTRA-B consists of technical and non-technical skills, which are taught over a 10-day period. At the end of the 10-day training period, the battalion enters an evaluation phase called NMETL. This NMETL is a 36-hour continuous scenario that tasks the unit in a variety of situations. The NMETL process is duplicated 90 days later in an evolution called ULTRA-C. The ULTRA-C is purely an evaluative process, where no classroom instruction takes place and for this analysis will mathematically mirror NMETL data.

Capacity and demand calculations in this aggregate plan have been generated by extracting data from Table 3 (ULTRA-B training schedule) and actual NMETL watch bills from FY09 events.

2. Demand

Classroom/field instruction required hours, as extracted from previous evolutions and Table 3, for the instruction portion of ULTRA-B are 1,672 hours over a 10-day period. The NMETL portion of the event requires 33 positions to be filled for 12-hour shifts (continually for 36 hours). Therefore, (33 x 12) =396 personnel hours. The total demand for the ULTRA-B then can be calculated by (1,672+396) =2,068 actual personnel hours. Demand during the ULTRA-C mirrors that of the NMETL and, as such, will be the same 396 actual personnel hours.

3. Capacity

We have assumed that our effective number of instructors is calculated by multiplying the number of instructors assigned by an effectiveness factor of .667, based on up to one-third of the assignment being non-qualified in all areas. Given the current number of personnel assigned (25), we arrive at 16.675 (25 x 0.667) effective instructors. Therefore, capacity shall be derived from (16.675 x 8 x 10) =1,334 instructor hours available for the instruction phase of ULTRA-B. The NMETL event requires 27 TEU positions, each for 12 hours. Several of TEU staff will fill more than one position and will, therefore, be tasked for 24 of the 36-hour evolution. Therefore, this capacity is calculated by (27 x 12) =324 evaluator hours required. Total capacity of an ULTRA-B is

then calculated by (1,334 + 324) =1,658. Instructors are, understandably, assignable in whole numbers only, but figures will not be rounded until Chapter VI in order to achieve the most accurate results.

4. Capacity Deficit

Comparing demand and capacity yields a difference between what is available and what is required for proper execution of the ULTRA-B/C evolutions. The demand exceeds capacity by (1,672 - 1,334) =338 instructor hours over the course of the 10-day ULTRA-B training portion, and (396 - 324) =74 evaluator hours over the course of the NMETL/ULTRA-C event.

Exceeded capacity of the instruction phase (338 hours) can be translated into a personnel deficit by (deficit/days)/ (hours per day) or (338/10)/ (8) =4.225 personnel. The same calculation for NMETL/ULTRA-C shows (74/1.5)/ (24) =2.05 personnel are deficit. These deficits cause the chase approach, whereby the deficit must be covered to match actual demand. In the case of TEU, this gap is made up on an ad-hoc basis and results in a perceived capacity/demand match.

THIS PAGE INTENTIONALLY LEFT BLANK

IV. SIMULATION MODEL DESIGN

A. INSTRUCTOR CANDIDATES PROCESS

Arena® simulation modeling will allow us to follow the training path of an Instructor Candidate from the required training checkpoints through receipt of the letter of qualification from the OIC. Figure 7 illustrates each requirement an instructor candidate must fulfill to become assessor qualified at NAVELSG TEU.

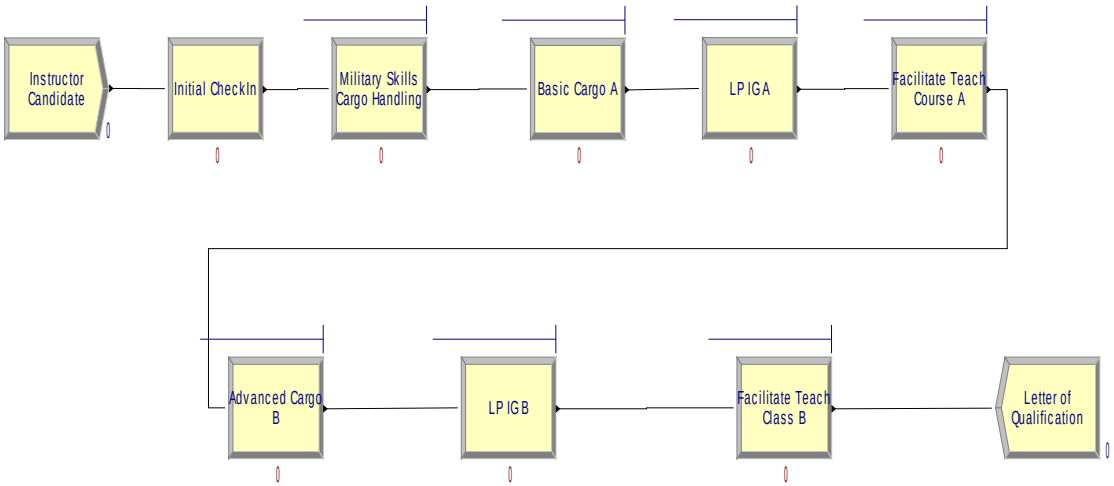

Figure 7. Instructor Process

Kelton, Sadowski, and Sturrock (2007) define simulation as, "a broad collection of methods and applications to mimic the behavior of real systems." Simulation can be applied across many fields, industries, and applications (Kelton, Sadowski & Sturrock 2007). Given the recent advances in computer technology, simulation can generate useful data to support necessary changes that can potentially make dramatic improvements to a system and its overall function. People often study a system to measure its performance or to improve its operation. Simulation has increasingly gained in popularity due to its flexibility, versatility, and low cost association from the most simple process model to the most complicated. Prior to the advent of computerized modeling software, modeling simulations were considered lengthy, cost-prohibitive processes. Companies could potentially spend thousands of dollars to evaluate process flow without realizing any improvements for their investment. Today, organizations can analyze system operations,

generate random scenarios, and make adjustments to predictions to improve effectiveness, eliminate redundancies, and lower costs (Kelton, Sadowski & Sturrock 2007).

In order to generate and design a simulation to accurately model current processes and procedures at TEU, the following guidelines apply:

- In-depth understanding of how the system is utilized.
- Clear and well-defined goals.
- Formulate the model representation.
- Translate into modeling software.
- Verify the computer representation accurately represents the conceptual model.
- Validate the model.
- Design the experiments.
- Run simulations.
- Analyze the results.

B. SIMULATION OVERVIEW

TEU trains and evaluates 12 NCHBs on a rotating basis to ensure adequate readiness levels to support contingency planning efforts worldwide. Proper utilization of instructors is essential to maximize TEU capacity. As mentioned in Chapter I, instructors are typically assigned to TEU for 36 months; typically, it requires up to 12 months to fully qualify a newly assigned Instructor Candidate. This delay can lead to inconsistencies and variation in the training process, since the only available time to process a candidate through the qualification process is during an active evaluation of an NCHB, which directly affects the capacity of TEU. The Arena® model discussed in this report compares utilization rates and total time in system as an instructor candidate progresses through the required checkpoints. The effect of adding civilian personnel (CIVPERS) to the training process, which can decrease the total time in system, will also be analyzed.

C. TRAINING PROCESS DESCRIPTION

An Instructor Candidate's training and qualification process can vary widely, depending on initial qualifications, prior experience, and course availability. Data from fiscal years 2008, 2009, and 2010 encompasses a total of 150 weeks and assumes a 44-hour workweek, Monday thru Friday. This data will be compiled and reviewed to provide input to the instructor candidate training process.

Prior to the instructor candidate's arrival, he or she should have been screened at their prior command in accordance with MILPERSMAN 15560, which ensures qualified candidates. Individuals ordered to instructor duty for the first time shall take the Journeyman Instructor Training (JIT) course offered by the Center for Personal and Professional Development as part of the instructor-delivery training continuum (NAVELSGTEU, 2009). Additionally, CPR training, safety training, and operational risk management should ideally be completed prior to arrival to TEU. Unfortunately, this is not always the case. Transfer dates, timing requirements, and unexpected losses and gains of personnel, among other difficult-to-control factors, can affect training prior to transition.

When an instructor candidate arrives, TEU screens the individual's initial qualifications, demonstrated in the first create module (Instructor Candidate). The instructor candidate enters the initial training track and progresses through the first process module. This initial check-in process module is a delay action and given a triangular distribution with a minimum 10- days, most likely 20- days, and maximum 30-days to complete the screening process and paperwork.

The next process module is Military Skills and Cargo Handling, a seize delay release action based on a triangular distribution, minimum 10- days, most likely 20-days, and maximum 30- days. Resource utilization can either be a classroom or CIVPERS personnel for training and signoff requirements. Once this process is complete, instructors are routed to the basic cargo process module. This module is set to constant 10- days whether utilizing a classroom under instruction and/or CIVPERS personnel. At this point, an instructor candidate will prepare a lesson plan and instructor guide (LP/IG) to be evaluated for qualification of practical knowledge and understanding of lecture

material. Time, which in this case allows Arena® to assign an average, is calculated using a triangular distribution 2/4/6 days to allow completion. Once approved, the LP/IG requires a qualified assessor's signature to move on.

The Facilitate Teach Course is an evaluated process module specific to a particular class and, until the instructor candidate successfully demonstrates the capabilities required of an instructor, he or she is considered in an under instruction (UI) status. This process module is given a constant 2- days, satisfying the current instruction NAVELSGTEU 1520.1 that mandate two days of facilitate and instruct while UI prior to sign-off. As an Instructor Candidate processes through this module, a qualified assessor retains the overall responsibility for ensuring the material is properly delivered (NAVELSGTEU, 2009).

With the successful completion and demonstration of understanding the basic cargo instruction, candidates are able to instruct but only the basic instruction. Once basic concepts are understood, the instructor candidate will process to the advanced cargo module. Since this is a required 5-day course, the module is assigned a constant 5- days utilizing a seize delay release action. Required resources are either a classroom or CIVPERS personnel. The same format and requirements are associated with advanced cargo training as in basic cargo. A lesson plan and instructor guide, however, will utilize a triangular distribution of 1/2/3 days since the classroom or instruction time is half of the basic requirement. Facilitate teach course will remain the same 2- days under instruction prior to sign-off. Finally, as an instructor candidate has processed though both basic and advanced cargo instruction, their letter of assessor qualification is sent to the OIC for approval.

Each instructor candidate has to qualify individually for each of eight mandatory courses taught at TEU. Once an instructor candidate is qualified to teach each individual course, TEU is now able to assign additional requirements and, as such, increases the capacity of TEU and broadens each instructor's knowledge base. Becoming an assessor-qualified instructor is the first step of responsibility for an instructor candidate into TEU. For TEU to be operating at maximum capacity, it needs all personnel to achieve assessor

qualification so that under any demand, personnel can be utilized to support the many training objectives involved while an NCHB is processed through and evaluated.

D. UTILIZATION OF ARENA®

Arena® modeling will assist us in demonstrating TEU's current instructor candidate's qualification process capacity. Focusing on total time in system and utilization rates, we can progressively track an instructor candidate through the qualification process until assessor qualification letter is signed by OIC. Utilizing that data and running multiple scenarios from a demand prospective, we can quantitatively show the minimum, average and maximum time spent for an instructor candidate to qualify as an assessor. We will then take these numbers and compare them to the FY08/09 data on time spent qualifying new instructors and, potentially, show the capacity at which TEU can effectively operate. During our analysis we ran four scenarios, two on an entity arrival rate of three years set to a triangular distribution 50/75/90 days, which allowed us to output an average of 25 instructors over a 3-year period. Next, we decreased the arrival rate of the entity into the system to 90/120/150 days and increased the number of years to 5. The replication length is run in hours: 44 hours x 50 weeks x 3 years and 44 hours x 50 weeks x 5 years, respectively. This analysis can potentially allow TEU to determine the correct number of civilian and military personnel to effectively meet the demand from NAVELSG.

E. NEWLY ASSIGNED PERSONNEL ASSUMPTIONS:

New personnel are assigned as instructors and are expected to ultimately fulfill roles as both trainer and evaluator. Rarely does a new candidate arrive fully qualified. Instead, each arrives with some portion of qualification or experience completed. The lack of fully qualified individuals stems from the lack of "feeder ratings" into expeditionary logistics skills. This is the result of the limited number of cargo handling billets throughout the navy. For example, a Boatswain mate arriving to fulfill a cargo handling training and evaluation billet is unlikely to have had any cargo handling experience outside rudimentary skills.

Once reported to TEU, the newly assigned person is expected to have knowledge and expertise to both train and evaluate. As such, the manning document shows that the position is filled (1.0 qualified) but the reality is that the individual is not fully qualified for the required billet (0-.99 qualified.) Instead, the candidate requires TEU assets (time, personnel, and TAD funds) in order to meet qualification requirements. This person, although pursuing qualification, is essentially not effective.

Although TEU does not assign or categorize personnel in this manner, we assign three levels of qualification, from 1 to 3. Since each person arrives with a different level, it is not possible to predict the exact amount of time required to reach level 3 qualification. Each step in the qualification process is detailed in the process flow Arena® diagram, as well as in the NAVELSGTEU 1520.1 instruction. For our analysis, we will not track minor progress in the qualification process. As such, each person will be assigned to a level assignment with a corresponding effectiveness value (.33, .667, and 1.0), as well as a minimum and a maximum time to qualify to level 3.

Level 1 refers to a non-qualified individual. At level 1, an "instructor candidate" does not have experience or skills necessary to teach classes, or evaluate trainees' skills. This person is at the beginning of the training and certification process, and is assigned an effectiveness value of .33. Assuming this level of qualification, the minimum time to qualify is 4 months and a maximum acceptable time to qualify is 12 months. Based on previous years' data, approximately 25% of new personnel fall into this category.

Level 2 refers to a partially qualified candidate. This candidate may have technical skills, training experience, or past knowledge of the billet that he now fills. Additionally, he may have served as an instructor at a previous command and possesses the skills to teach, but may lack the specific knowledge of the course that he may be required to present. Although not fully qualified, this candidate may have limited experience with the current billet or he may be very near being fully qualified. A level 2 candidate will be able to perform routine tasks of a level 1 and may also be able to teach a limited number of topics, depending on past technical experience and knowledge. A level 2 is assigned an effectiveness value of .667. Assuming this level of qualification,

the minimum time to qualify is 4 months and a maximum acceptable time to qualify is 6 months. Based on previous years' data, approximately 65% of new personnel fall into this category.

Level 3 personnel are fully qualified both to teach and provide evaluation to classroom and field operation environments. This level of qualification is commensurate with the skill level of a subject matter expert and an individual with extensive background in cargo handling and expeditionary logistics. The level 3 individual has been typically assigned to as a NAVELSG claimant. Since TEU is predominantly manned with active component personnel, the level 3 candidate will most likely be transferred from NCHB-1 located in Yorktown, Virginia. A level 3 candidate is fully qualified to train and evaluate all required courses and is assigned an effectiveness value of 1.0. Assuming this level of qualification, the level 3 candidate has 1 month to fulfill all check-in (familiarization and safety demonstrations) outlined in NAVELSGTEU 1520.1 instruction and be ready to perform at full capacity. Based on previous experience, approximately 10% of new personnel fall into this category.

F. ARENA® ASSUMPTIONS

Arena® simulation statistical reference points assume that all instructors work 44 hours per week for 50 weeks in the year and are available every workday of the entire year. The simulation takes into account only the number of non-supervisory personnel that are assigned to the air cargo and shipboard cargo classroom. Each instructor is assumed to be available two-thirds of the time, which equals 1467.4 hours per year per instructor.

The researchers also assume that all training aids, platforms, classrooms, and instruction aids are 100% available for the scheduled model.

Delays simulated by Arena® are intentionally limited to a minimum, maximum, and most likely time delay. These three limits are the result of reviewing FY08, FY09 historical data, as well as FY10 projected activity.

The initial check-in process has been condensed to capture all variables for the instructor candidate with variation automatically simulated by Arena®. This random

variation is necessary because of the lack of a defined and standardized check in process. Additionally, the varied experience and skill level of each instructor candidate cannot be accurately calculated based on historical data figures.

Because of the variability of scheduling of each exercise, evolution and class scheduling, the researchers developed a simulation that generates random variability in delays between one processes to another. Therefore, we have a generic named process that generates random delays between initial check-in, military cargo handling skills, basic cargo and advanced cargo. This process will simply be referred to as “instructor candidate cargo handling.”

Arena® simulation with civilian personnel is created to limit the time delay between processes. This effect assumes a subject matter expert is available during all working hours throughout the year, and the delays inherent in the system can be effectively reduced as much as possible.

V. ARENA® MODEL RESULTS

A. ARENA MODEL SIMULATION

Two models were developed in Arena®; each designed to track an Instructor Candidate through a qualification process, focusing on time in system and utilization rates. In order to become as efficient as possible, TEU must be able to task assigned personnel to the maximum extent possible. This is achieved by ensuring each and every person assigned has reached full qualification as quickly as practical. The first model has zero civilian personnel and the second model adds one civilian. The models have been designed using existing assets and each entity arrives based on a triangular distribution. The addition of a civilian reduces and practically eliminates the "total wait time in system" that incoming instructor candidates experience. The researchers surmised that the addition of a full-time civilian would effectively eliminate the time delay between qualification steps and would result in rapid instructor and assessor qualification. Therefore, TEU's operational capacity would increase and would allow the Unit to better prepare for the unpredictable external demand schedule.

The Arena® simulation tracked entities as they proceeded through the system. An entity in Arena is an input into the system; in this case, a new instructor candidate. The system is the instructor/assessor qualification process. As each entity enters the system, it encounters value and non-value added time, wait time, transfer time, class in process time, and results in an output called "total time in the system." This is shown in Table 5 and 7, for 0CIVPERS and 1CIVPERS respectively.

Value added time is any process that changes the product and enhances its quality or worth. In this case, value-added would be any process that contributes to the candidate's qualification progress. In the case of both models, this value added time is 518.72 hours. This value added time is the sum of the time each required process step takes. Broken down, this equates to 10.37 weeks of actual value added process. This value added process is identical in both models and as a result have the same value.

The total time in the system indicates the average amount of time that it takes an instructor candidate to enter the training process, wait the necessary time for the next

process step to take place, and to ultimately become qualified. The wait times were based on Arena's® calculated average of the process replicating itself 1,000 times. Each wait time constraint was defined within Arena® based on the minimum, most likely, and maximum possible delay times and were generated using average wait time from data verified from TEU's FY08, FY09 statistics as well as forecasted activity for FY10.

As shown in the Tables 4 and 6, the differentiating factor for both models is average wait time. Table 4, 0CIVPERS demonstrates that the most time consuming process in the instructor qualification standard is waiting for the next step in the process. In this model, each instructor candidate will wait an average of 1520.44 hours (30.4 weeks) waiting for sequential steps in the qualification process. As shown on Table 6, 1CIVPERS model, average wait time was reduced to nearly zero, thus reducing the average instructor qualification time from 2039.58 hours to 520.44 hours. The 0CIVPERS model is representative of, and is consistent with the reports from the TEU OIC and LSO, where estimated instructor/assessor qualification process has taken an average of one year for each Instructor Candidate. Tables 5 and 7 demonstrate the total time in system for both OCIVPERS and 1CIVPERS respectively. The reduction or elimination in wait time demonstrated in 1CIVPERS model allows TEU to increase the qualification output and increase the Units operational capacity rate. Utilization rates for instructors are shown in Figures 8 and 9, for 0CIVPERS and 1CIVPERS respectively.

The current system for Instructor Candidates has continuously experienced delays from one step in the process to the next. The delays are due to an unpredictable external demand placed on TEU from NAVELSG and can sometimes be as short as one week to as long as five months. The delays between NCHB evaluations convening have been verified from FY08, FY09 statistics as well as the forecasted activity for FY10. The effect is demonstrated below where the current process can be significantly reduced, going from an average of 33% of the tour qualifying to an estimated 11% after reducing wait time.

Scheduled Utilization	Average	Half Width	Minimum Average	Maximum Average
ACBLimit	0.06997235	0.00	0.06060606	0.07878788
BCALimit	0.1397	0.00	0.1212	0.1659
CIVPERS	0.00	0.00	0.00	0.00
Class in Process	3.7705	0.01	3.3038	4.3904
FCBLimit	0.02794307	0.00	0.02424242	0.03151515
FTCALimit	0.02793225	0.00	0.02424242	0.03151515
LPGIALimit	0.05592572	0.00	0.04198164	0.06924312
LPIGBLimit	0.02786715	0.00	0.02183379	0.03495591
MSCHLimit	0.2795	0.00	0.2178	0.3469

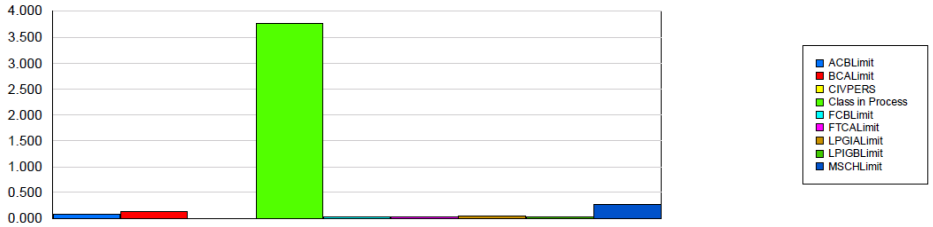

Figure 8. Utilization Rate 0 CIVPERS

Scheduled Utilization	Average	Half Width	Minimum Average	Maximum Average
ACBLimit	0.06985766	0.00	0.06060606	0.07878788
BCALimit	0.1396	0.00	0.1212	0.1576
CIVPERS	0.6105	0.00	0.5048	0.7283
Class in Process	0.1053	0.01	0.00	0.4891
FCBLimit	0.02792785	0.00	0.02424242	0.03151515
FTCALimit	0.02792551	0.00	0.02424242	0.03151515
LPGIALimit	0.05578625	0.00	0.04114125	0.06970289
LPIGBLimit	0.02789676	0.00	0.02118754	0.03593967
MSCHLimit	0.2791	0.00	0.2225	0.3478

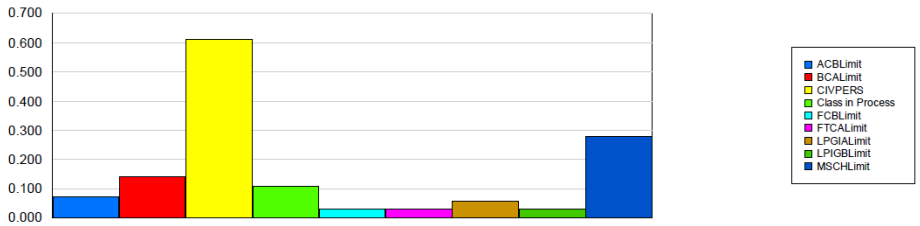

Figure 9. Utilization Rate 1CIVPERS

WAIT TIME IN SYSTEM	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Instructor	1520.44	<2.30	1421.05	1643.18	1249.83	1843.70

Table 4. OCIVPERS Wait Time in System

TOTAL TIME IN SYSTEM	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Instructor	2039.58	<2.32	1925.48	2160.39	1740.52	2332.80

Table 5. OCIVPERS Total Time in System

WAIT TIME IN SYSTEM	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Instructor	0.6130	<0.20	0.00	29.5752	0.00	275.04

Table 6. 1CIVPERS Wait Time in System

TOTAL TIME IN SYSTEM	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Instructor	520.44	<0.90	473.83	572.20	364.27	933.43

Table 7. 1CIVPERS Total Time in System

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The intent of this study was to analyze the business practices of TEU and to determine if efficiencies could be realized in its training and evaluating processes. The model developed provided a good understanding into the major constraints that make scheduling and assignment within TEU difficult. The model showed that the major time constraint, and thus capacity constraint comes from the instructor qualification and assessor qualification process. The extensive and often unpredictable time delays from one process to another add significant time, as much as 75% to the qualification process.

Beginning the training phase of the study, the steps to qualify and instructor and assessor were identified and defined. Delays to the model were calculated by using previous and forecasted year's external demand data, and qualification records. In the next step of the analysis, Arena® modeling and simulation software was used to simulate the qualification process through 1000 replications of the process. Simultaneously, Microsoft Excel® was used to calculate and organize historical statistics and projected schedules to determine opportunities for instructor and assessor qualifications. These models simulated a throughput of the replacement of all 25 TEU personnel during a standard 36-month tour.

The results of aggregate planning show that a shortage of four instructors in the training process and two in the evaluation process. An increase of the current 66.7% effectiveness rate to 83.6% effectiveness would eliminate this shortage of instructor personnel without increasing the actual number of assigned personnel. The result is an increase in effective personnel without adding excess capacity during periods of reduced demand.

Finally, the results of both Arena® and Microsoft Excel® were interpreted as each pertained to the IQ and AQ processes. By removing non-value added wait time in the instructor qualification process, Arena® provided a potential 89% effectiveness rate.

B. RECOMMENDATIONS

Based on analysis and conclusions within the research, we recommend the following to TEU in order to reduce the time to qualification for instructors and assessors thus increasing overall effectiveness and capacity:

- Develop a comprehensive and streamlined instructor qualification process that allows progress for multiple qualifications simultaneously in order to reduce the impact of schedule fluctuations. The streamlined process should afford the instructor candidate an opportunity to pursue both an instructor and an assessor qualification without experiencing current delays in the process.
- Hire or contract civilian subject matter experts to serve as trainers for all aspects of cargo handling. The effect would be a dramatic reduction in the waiting period that is now common in the qualification process. Additionally, these civilian personnel would offer long-term continuity in assignment.
- Re-examine the applicability of NAVELSGTEUINST 1520.1 and the current real-world training process. In the event civilian contractors are added, ensure the instruction reflects added qualification standards afforded by civilian personnel and permanently assigned subject matter exerts.
- Increase the number of Remote Assist Visits conducted by TEU in order to decrease the required classroom instruction hours necessary during ULTRA assessments. Using increased RAV tempo, TEU will more likely be able to identify training deficiencies within battalions and affords the battalion the opportunity to correct deficiencies prior to the training/assessment phase of the training cycle.

C. SUGGESTIONS FOR FUTURE RESEARCH

The simulation in Arena® and Microsoft Excel® used in this analysis reveal a number of possible research topics for future researchers. These include the following:

- Increase tour length of enlisted personnel from the current 36 months to 48 or 60 months. This increased tour length will increase the percentage of time that an instructor/assessor is fully qualified for all desired skills within TEU. This extension or lengthened tour may be managed under special programs.
- An optimization program may be developed that considers more defined constraints including the addition of contingency operation planning, reserve personnel augmentation, and profiles of classroom composition and constraints. If these data can be randomly generation, the effect of excess capacity followed by excess demand may be better planned.
- A cost benefit analysis of contracted/civilian personnel for the operation of TEU. These potential contracted civilians may have skills and experience beyond the capability of military personnel and as such can fulfill multiple roles within TEU.
- Purchase or lease additional simulators to be used within TEU and throughout NAVELSG. Although a significant investment in capital, each simulator is easily transported between battalions and can be used to dramatically decrease the necessity of classroom instruction during ULTRA assessments. Additionally, liberal use of simulators reduces transportation expenses associated with transporting battalions to CAX for training.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

Cabral, L. J. (2009, June 29). AOIC TEU. (L. T. LT Eckols, Interviewer).

Cengage, G. (2006). *"Aggregate Planning." Encyclopedia of Management. Ed. Marilyn M. Helms.* . Retrieved November 28, 2009, from eNotes.com: http://www.enotes.com/management-encyclopedia/aggregate-planning.

Cheatham Annex NAVELGS Headquarters. (2009, September 21). Retrieved October 12, 2009, from Naval Expeditionary Logistics and Support Group: http://www.comnavelsg.navy.mil/background.html.

Cockerell, P. (2008, August). The Navy Reservist. *War Time or WorldWide NAVELSG Gets the Job Done* , p. 4.

Commander, N. (2008, October). *COMNECC.* Retrieved December 01, 2009, from http://www.nmcphc.med.navy.mil/downloads/EPM/FDPMU_References/miscellaneous/NECC_mission_functions_tasks.pdf.

COMNAVELSG. (2009, June). *Naval Expeditionary Logistics and Support Group.* Retrieved August 22, 2009, from http://www.comnavelsg.navy.mil/background.html.

Jason, L. P. (2009, June 28). OIC. (L. C. Eckols, Interviewer).

Kelton, D.W., Sadowski, R.P., & Sturrock, D.T., (2007). *Simulation with Arena, 4th Edition.* New-York (Headquarters): McGraw-Hill Science Engineering.

Lombardo, G. (2003, May). Deputy's Welcome Aboard Juliet. *Juliet Company Arrival Lecture* . Williamsburg, VA, USA: Lombardo.

Naval Expeditionary Logistics and Support Group. (2009, January). Retrieved July 15, 2009, from COMNAVELSG: http://www.comnavelsg.navy.mil/background.html.

NAVELSGTEU. (2009). NAVELSGTEUINST 1520.1. Williamsburg, VA, USA: Naval Expeditionary Logistics and Support Group.

NECC Public Affairs Office. (2006, October). Retrieved July 12, 2009, from www.navy.mil: http://www.navy.mil/navco/speakers/currents/NECC_Fact_Sheets.pdf.

Watson, R. (2009, September). TEU Instructor Certification Process. *Instructor Process* . Williamsburg, VA, USA: Randy Watson.

Watson, R. (2009, November). LSO. (L. C. Eckols, Interviewer).

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California