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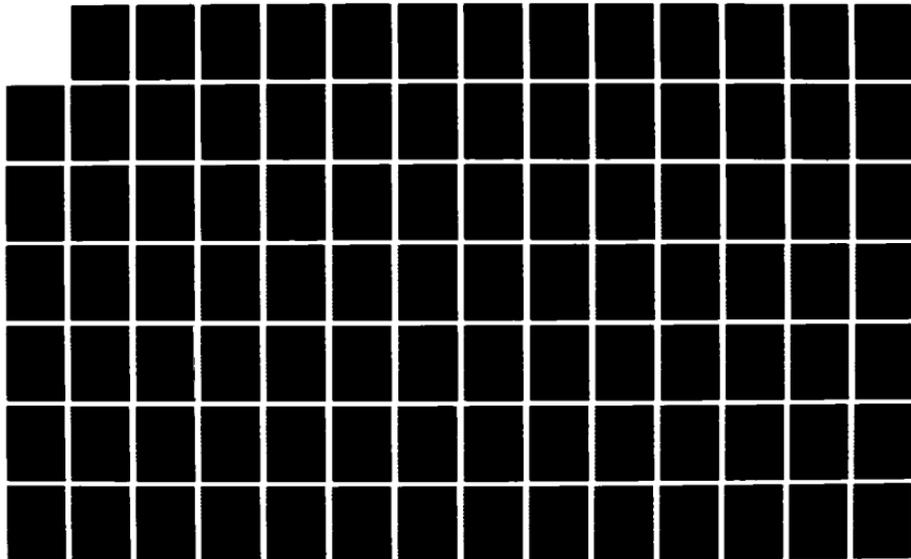
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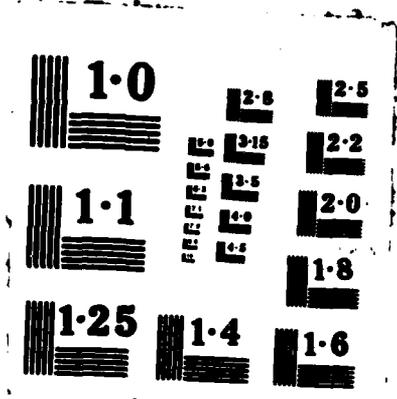
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THE PENNSYLVANIA STATE UNIVERSITY
The Graduate School
Department of Civil Engineering

United States Naval Mobile Construction Battalion
Material Resource Planning:
A Critical Investigation

An Engineering Report in
Civil Engineering and Management

100225-5-G-3278 by
Robert M. Carr

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SELECTED
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Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Master of Engineering

December 1987

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ABSTRACT

For United States Naval Mobile Construction Battalions (NMCBs), the greatest challenge for construction operations is the effective utilization of project resources. NMCBs must develop plans for efficient use of labor, equipment and material resources during deployments to overseas construction sites. Of the three resources, material resources have the greatest degree of variability and uncertainty, and over which the battalion management personnel have the least control. Sound construction material resource planning is a must for the construction management effort. The importance of the material resource plan is also emphasized because of the nature and size of NMCB operations.

A critical investigation is presented of the material resource plans recommended in Naval Construction Force directives and instructions. Also presented is an investigation into the actual operations and material resource plans employed by the active construction battalions during recent deployments. Recommendations for improvement to the material resource plans used by the NMCBs are discussed.

LIST OF ACRONYMS

BM	:	Bill of Material
CAS Sheet	:	Construction Activity Summary Sheet
CBLANT	:	Construction Battalions, Atlantic
CBPAC	:	Construction Battalions, Pacific
CEC	:	Civil Engineer Corps, United States Navy
CECOS	:	Civil Engineer Corps Officer School
COMCBLANT	:	Commander, Construction Battalions, Atlantic
COMCBPAC	:	Commander, Construction Battalions, Pacific
CONUS	:	Continental United States
CPM	:	Critical Path Method
DEP	:	Deployment Execution Plan
HVAC	:	Heating, Ventilation, & Air Conditioning
LEVEL I	:	Battalion level construction scheduling
LEVEL II	:	Project level construction scheduling
LEVEL III	:	Activity level construction scheduling
MLO	:	Material Liaison Office (Officer)
MTO	:	Material Take-Off
NAVFAC	:	Naval Facilities Engineering Command
NCB	:	Naval Construction Brigade
NCF	:	Naval Construction Force
NCFSU	:	Naval Construction Force Support Unit
NCR	:	Naval Construction Regiment
NMCB	:	Naval Mobile Construction Battalion

LIST OF ACRONYMS (continued)

OF-13	:	Occupational Field Thirteen (Enlisted Seabee Ratings)
OPS	:	Operations Officer (Department)
PCR	:	Project Control Report
PSR	:	Project Status Report
RDD	:	Required Delivery Date
S-3	:	Operations Officer (Department)
S-4	:	Supply Officer (Department)
SAMM	:	Seabee Automated Mobile Management System
SCBT	:	Special Construction Battalion Training
TOA	:	Table of Allowance

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LCDR S. W. Johnson	NMCB SIXTY-TWO
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LCDR G. R. Henderson	NMCB ONE THREE THREE

CHAPTER 1 : INTRODUCTION

Resource management is one of the key elements critical to the successful prosecution of modern construction projects. Construction management personnel strive to control the demands for resources that are generated by the construction processes, and more importantly, strive to satisfy those demands in accordance with the construction schedule. Labor, equipment and materials are the main resources that must be brought together by management and supervisory personnel to fulfill the various requirements of the construction project. Successful completion of the project comes about from the proper utilization of the resources.

Projects of all sizes require coordination of available resources. Much of the management theory in practice in the construction industry today was developed for projects that require a large input of labor, equipment and material, and occur over an extended period of time. Huge investments in such construction projects demanded the intelligent management of the construction processes. Scheduling and control techniques were developed to minimize the conflicts in an attempt to make construction an efficient operation, thereby maximizing the construction output. Construction projects of a smaller size are no exception to the concepts developed; in fact, small construction projects are particularly demanding on the control and management of resources.

Small construction projects tend to be rather inflexible toward shortages or conflicts in the supply of necessary resources. Generally, the construction develops along a narrow path of accomplishment with little slack in the schedule of activities. In spite of the fact that fewer resources are utilized, resource management takes on a greater importance in small project management because of the inflexibility of the schedule for resources.

Construction undertaken by the Naval Mobile Construction Battalions of the United States Naval Construction Force in peacetime, and in contingency situations, are typically small projects, requiring a few weeks or a few months to complete. The battalions are called on to complete many small projects as opposed to the accomplishment of one or two large projects. This tasking places a burden on the construction management personnel of the battalion to minimize the problems created by resource availability and accomplish the work. Resource planning, therefore, plays a critical role in the construction management endeavor of the Navy construction battalion.

PROBLEM STATEMENT

Project controls and project management techniques born in the 1950s have grown and evolved in response to ever larger and more complex engineering and construction endeavors. The Critical Path Method (CPM) was developed by the Integrated Engineering Control group of E. I. du Pont de Nemours to improve the planning and scheduling of their own

engineering design and construction activities. Performance Evaluation and Review Technique (PERT) was developed for the U.S. Navy's Polaris program and continued the trend in the evolution of "large" project management. Management development continued in the 60s and 70s spurred on by such complex programs as the Apollo program and the Canaveral program. Progress in the late 70s and the 80s has seen advancements in the application of sophisticated scheduling and control techniques to meet the demands of complex power plant and similar industrial construction. The driving force in the management development has always been the need to manage the complexities of the larger projects.

Construction scheduling, control and overall management clearly developed in response to ever growing projects. However, the techniques and practices developed for the large projects were applied to construction operations of all sizes and at all levels. The application of these construction management techniques is extremely beneficial to any construction management operation, but it is important that the limitations of the size of the construction be understood as well. Small construction projects have different characteristics than large, complex projects and demand slightly different approaches.

Small construction projects as considered herein and defined by Richard Westney (20) as having one or more of the following characteristics:

- Cost levels from \$5,000 to \$50,000,000
- Cost levels less than 5% of annual budget for projects
- Numerous other similar projects take place

concurrently

-Labor and equipment resources shared with other projects

-The company doing the project is, itself, small.

Small project management appears straightforward and relatively simple to administer. These projects typically do not require the coordination of large labor forces or the controlling of advanced engineering methods. They are instead characterized by making due with limited resources and producing "finish results". Many times the projects are inflexible to schedule constraints, this inflexibility resulting from the small size of the project and the lack of alternate paths of construction, i.e. the critical path being the only path.

Additionally, many small projects take place in operational environments; the projects taking place alongside the normal operations of the facility being worked on. Demands that the project be completed without stopping or hindering the normal course of operations force many small projects into less than favorable conditions. The projects must be started and proceed in a most timely manner to prevent the project from creating more problems than its ultimate utilization solves.

The small construction project demands a solid plan of action. There is not enough slack or alternate paths of construction in the project to absorb major activity delays in the schedule or delays in resources. The project management personnel must develop the most appropriate course of action, plan the resource supply and utilization.

and then take on project execution with the utmost expedience. Generally, there is no time for major revisions in the plan once it is set in motion; the plan first implemented must be carried through to the final product.

United States Navy Seabees operating in construction battalions conduct small project construction operations as training for its mission of contingency construction in support of Navy and Marine Corps forces. Naval Mobile Construction Battalions (NMCB) provide the major operational component of the Naval Construction Force. These battalions, mainly composed of Civil Engineer Corps officers and Occupational Field 13 (O.F. 13) personnel (Builders, Steelworkers, Construction Electricians, Utilitiesmen, Equipment Operators, Construction Mechanics), operate on a deployment rotational basis performing construction operations throughout the world. Nearly all of the construction projects undertaken fall into the category of small projects as defined above. Typical projects may be the erection of a pre-engineered building for storage of ammunition at a naval magazine, paving of naval station roads, or rehabilitation of enlisted berthing quarters. Such projects are typically completed during the course of a six month deployment with only a few projects lasting for more than a year. The U.S. Navy is a dynamic force in readiness; therefore, many of the projects must be completed in operational environments.

Construction battalions perform construction management on construction projects tasked to the individual battalions

in a manner similar to the management of a civilian construction firm. The project is divided into master and detailed activities, and a Critical Path analysis is performed on the construction logic. Materials and manhour estimates are generated for the construction activities. The CPM network analysis is based upon the Precedence Diagraming technique. Project controls follow the CPM and associated bar charts. In many respects, the construction is executed and managed just like any construction project taken on by a commercial construction company.

Construction battalion operations management benefits enormously from the wealth of knowledge available for construction management; much of it taught at civilian universities and Navy Civil Engineer Corps and Seabee schools. However, the fact that so much of the Seabee construction is small project construction should temper all management techniques and principles applied. The personnel managing the construction must always consider this fact and use it to direct management efforts. A CPM technique developed and refined for use in large engineering projects will not necessarily solve the problems encountered while erecting a pre-engineered building on the island of Guam or in Rota, Spain. The nature of Seabee work is small and fast. Planning for the supply and utilization of resources is of great importance. Project scheduling goes a long way toward resolving potential conflicts in the operation, but, solid resource plans for the resources of labor, equipment

and materials must complement the schedules. The integration of the project schedule and the resource plans is critical to the successful completion of the "small project" construction undertaken by Navy Seabees.

NEED FOR RESEARCH

"An organization that continually seeks to make improvements is an organization with a cooperative, creative and highly productive work force." (5)

The construction management of NMCBs is currently experiencing major efforts in updating methods and procedures. An automatic data processing system has been developed and is in the early stages of implementation. This system is called the Seabee Automated Mobile Management (SAMM) system. The system takes advantage of Microtrak software for construction management. In addition, the staff at the Civil Engineer Corps Officer School (CECOS) has developed a recommendation for implementation by the Seabee battalions that standardizes the construction management procedures. At present, each battalion develops and manages the construction tasking as the assigned personnel perceives the requirements. The standardization of procedures is a big step in the advancement of Seabee construction.

Neither the SAMM system nor the CECOS recommendation specifically address material resource planning. Material inventory control will experience improvement from both items, but the planning for material as it affects the construction schedule remains an area for review and

improvement. The nature of Seabee construction demands that close attention be paid to resources, and construction material planning is the one resource specifically that is really not planned for nor controlled as well as it could be.

RESEARCH METHODOLOGY

This study was accomplished by integrating the writer's experiences as a junior officer assigned to Naval Mobile Construction Battalion Three and as the Officer-In-Charge of Construction Battalion Unit Four Zero Seven with an investigation of the construction management procedures and policies employed by the active force Naval Mobile Construction Battalions. This experience was reinforced with a review of Naval instructions and directives providing the operating guidance under which the battalions operate. Supporting information was obtained through questionnaires and interviews with personnel presently involved with SEABEE construction, both in operations and readiness support.

The research was conducted in four phases with each phase contributing to the next phase.

PHASE ONE: Phase One consisted of a comprehensive literature search of both civilian construction management literature and Naval Construction Force directives, instructions, and guidance manuals.

PHASE TWO: Phase Two consisted of reviewing the battalion construction management instructions and procedures for material resource management. This phase included the use

of questionnaires and interviews with personnel involved in implementation of the battalion construction management program, specifically the battalion Operations Officer. The functional integration of the battalion's construction scheduling procedures and material management was reviewed during this phase.

PHASE THREE: This phase consisted of analyzing the results of the first two phases to determine the importance of material resource planning to the NMCB. Supporting information for this phase was gathered from deployment completion reports submitted by the battalions for deployments previously completed and interviews with Navy personnel involved presently in SEABEE construction.

PHASE FOUR: Phase Four of this report was the development of recommendations for the material resource planning performed by Naval Mobile Construction Battalions.

OBJECTIVES

The primary objective of this study was to investigate the integration of material resource planning with network planning (scheduling) during deployment construction operations by the Naval Mobile Construction Battalions of the United States Navy. In order to accomplish this primary objective, the following detailed objectives were contemplated:

1. Demonstrate the need for such material resource planning and the need for integrating it to the network planning (schedules).

2. Determine the extent of material resource planning practiced by the NMCBs presently. This evaluation is to include recommended procedures from the Seabee commands and Civil Engineer Corps School.

3. Develop suggested procedures for establishing the Material Resource Plan and integrating the plan with the network plan for use by NMCBs.

CHAPTER 2 : NAVAL CONSTRUCTION FORCE BACKGROUND

NAVAL CONSTRUCTION FORCE MISSION

The Naval Construction Force (NCF) is a generic term applied to that group of deployable naval organizational components which have the common characteristics of possessing the capability to construct, maintain, and/or operate shore, inshore, and/or deep ocean facilities in support of the U S Navy and U S Marine Corps, and when directed, other agencies of the United States Government. (16) The logistics pipeline plays a critical role in current operational plans for both Navy and Marine Corps forces. The mobility required of combat units demands logistic organizations capable of similar mobility. To create and maintain such mobile pipelines, there exists a requirement for a rapid, highly mobile engineer support organization. This organization must be capable of providing responsive and effective means of establishing and maintaining the flow of men and material to forward areas. This engineer force must be capable of establishing terminal facilities as early as possible in contingency operations and also must provide the operating capacity these logistics terminals require. The NCF mission does not stop with just the terminal facilities. The engineer forces must be capable of tactical construction support of combat forces in a forward area. Fulfilling this mission demands a high state of readiness in the engineer forces.

The mission of the NCF is to satisfy the critical

requirement for a responsive, mobile, modern, versatile engineer force capable of diverse tasks ranging from timber bunker construction in a forward combat environment to construction and/or operation of an advanced industrial facility in support of Naval Operating Forces and the logistics pipeline. This mission includes but is not limited to:

Navy Base Construction
Marine Corps Support
Amphibious Assault Support
Base Maintenance
Disaster Preparedness
Civic Action

In carrying out this mission, the NCF performs the following specific tasks:

1. Provides responsive military construction support to Naval, Fleet Marine, and other Military Forces, including operational, logistics, underwater, and ship-to-shore facilities construction, maintenance, and operation;
2. Provides military and amphibious assault construction support to Naval, Marine, and other forces in military operations; subsequent combat service support ashore and defense against overt or clandestine enemy attacks directed toward personnel, camps and facilities under construction.
3. Provides disaster control effort, including furnishing of assistance to civilian agencies, under conditions of emergency, disaster or catastrophe caused by enemy action or natural causes; and
4. Provides forces for civic action employment which complement the military, social and psychological programs of naval and other government agency missions. (16)

NAVAL CONSTRUCTION FORCE ORGANIZATION

The Naval Construction Force is composed of various units with specific capabilities and limitations. Each unit

contributes to the accomplishment of the overall mission of contingency construction and together, the units have the capability to perform any type of construction anywhere in the world in any kind of environment. This report will only address those elements directly involved with the organization and operation of the Naval Mobile Construction Battalions (NMCBs).

Naval Construction Force units are commanded by officers of the Civil Engineer Corps of the United States Navy and are composed for the most part of enlisted personnel with Occupational Field 13 ratings (O.F. 13), Seabees. The NCF is made up of active units, reserve units, and units that only exist on paper awaiting establishment in the event of contingency operations. Some NCF units are primarily command and control organizations, while others provide support to the actual construction units. The actual construction units such as the NMCBs provide the true construction capabilities and make up the bulk of the force. Units that provide command, control or support to the NMCBs are described briefly in the following section.

Units of the NCF :

1. Commander, Naval Construction Battalions. U.S. Pacific Fleet (COMCBPAC), U.S. Atlantic Fleet (COMCBLANT). These commanders and their staffs provide directive policy guidance to assigned NCF components in such areas as leadership and discipline; administration; contingency

planning and readiness; military and technical training; unit employment, deployment, and scheduling; operational effectiveness; development of operational doctrine and tasking tactics; equipment management; and logistics support.

2. Naval Construction Brigade. (NCB) Consists of two or more Naval Construction Regiments operating in a specific geographical area, or in support of a specific military operation. These units are not normally maintained in the active force in peacetime.

3. Naval Construction Regiment. (NCR) Exercises administrative and operational control of two or more Naval Mobile Construction Battalions operating in a specific geographical area, or operating in support of a specific military operation. NCR develops construction execution plans; assigns construction projects to NCF units; monitors progress and assures adherence to quality standards; directs redistribution of units, equipment and materials; and reviews plans and operations reports to determine specialized training and equipment requirements. There are two types of NCRs:

A. OPERATIONAL NCR : Possesses a planning, estimating and engineering capability over and above that contained in the battalions.

B. HOMEPORT NCR : Provides continuity of direction and coordination of non-operational functions such as training, outfitting, and receiving and separating of

personnel for deployed units. Most project planning is initiated or reviewed at the homeport regiment by OCCFLD 13 planners and estimators and regimental civilian engineers. Homeport regiments are normally maintained in active force both in peacetime and during a contingency operation.

4. Naval Construction Force Support Unit. (NCFSU)
Naval Construction Force Support Unit provides operational construction logistic support in the deployment area for an NCR of up to four NMCB's. NCFSU performs inventory management of construction materials; maintains inventory control, operates and performs maintenance and repair of NCF auxiliary construction and transportation equipment; performs specialized repair and overhaul of equipment components; provides the operation and maintenance capability for plants (rock crushers, asphalt and concrete batch plants). In peacetime, the NCFSU is maintained both in the active force and in the reserve (PWRMS). In peacetime operations, active units are not outfitted with personnel, only the equipment allowance is maintained

5. Naval Mobile Construction Battalion. (NMCB)
Provides responsive military construction support to Naval, Marine Corps and other forces in combat operations, constructs base facilities and conducts defensive operations as required by the circumstances of the deployment situation. These units also conduct

disaster control and recovery operations as directed.

NAVAL MOBILE CONSTRUCTION BATTALION MISSION

Naval Mobile Construction Battalions, known throughout the Navy as NMCBs and Seabees, provide the main operational components of the NCF. Presently, there are nine active battalions and 19 reserve battalions in the NCF with each battalion containing over 600 personnel and a material and equipment Table of Allowance (TOA) in excess of \$19,000,000. The typical active NMCB completes approximately \$18,000,000 equivalent contract work during the year. (2) The vast majority of this work is completed at locations throughout the world.

The guiding directive for the employment of the NMCBs is OPNAV INSTRUCTION 5450.46 series. This instruction from the Chief of Naval Operations provides the updated, basic doctrine and policy for "employment, deployment and readiness of the active Naval Mobile Construction Battalions". OPNAVINST 5450.46H defines the NMCBs' mission to be :

"provide responsive military construction support to Navy, Marine Corps and other forces in military operations, to construct base facilities, and to conduct limited defensive operations as required by the circumstances of the deployment situation."

It can be seen that the NMCB mission statement is almost the exact statement as that for the entire NCF. This situation is due to the fact that the NMCBs make up the greatest part of the NCF, and probably contribute the greatest toward accomplishing that mission.

PEACETIME CONSTRUCTION OPERATIONS

Naval Mobile Construction Battalions are no different from other naval units in that in times of peace, the true mission becomes that of training. NMCBs train during peace to carry out their contingency mission should it ever be required. Paragraph 6 of OPNAVINST 5450.46 outlines this training mission.

"Peacetime Operations. In peacetime NMCB's shall undertake construction projects which provide training in construction and managerial skills that are necessary to perform their contingency construction mission. Special emphasis will be placed upon projects which contribute directly to overall improved Navy readiness."

In carrying out the training mission NMCBs, operate in a fashion similar to their counterparts in the private sector-the self sustaining, overseas operations of large construction corporations. (16) The basic construction management concepts and procedures taught in American universities and engineering schools, and employed by private construction firms are utilized in Seabee construction management. There are, however, constraints to Seabee construction with the greatest constraint being that NMCBs must constantly consider that they are military organizations with a military mission. That mission being for the battalion to be capable of conducting operations in defense of NMCB personnel, camps, job sites, and convoys while providing construction operating in support to the Fleet Marine Forces and Naval forces. The Seabee motto of "WE BUILD-WE FIGHT" emphasizes the military aspect as well

as the construction aspect of the NMCBs' mission. Whatever is built must be defended.

NMCBs must maintain a readiness posture to carry out their contingency mission with minimal notice. As such, NMCBs must be organized to perform their military mission at any time. This situation requires the NMCB to be organizationally structured for the dual purposes of construction and military support operations, and additionally to be flexible enough to permit the rapid transformation from one mission situation to the other.

BATTALION ROTATION CYCLES

Naval Mobile Construction Battalion operate in peacetime on a rotating deployment basis much like the ships of the Navy. A period of approximately six months is spent in homeport in preparation for deployment to an overseas location. The homeport period is a time for personnel to enjoy time with family and friends as well as prepare for the next deployment. The "primary objective of the homeport period is to become prepared, in all aspects, to deploy the unit to a specific site with specific capabilities to perform a specific workload." (16) Completion of the homeport period leads to deployment of the battalion to an overseas location for execution of tasked construction operations. Current deployment sites for main body battalions are Rota, Spain; Sigonella, Sicily; Roosevelt Roads, Puerto Rico; Guam, Marianas Islands; and Okinawa, Japan. NMCB deployments may last from six to nine months with the stated Navy goal

of standardized deployments of six months.

Homeport Period :

In the operational scheme of Naval Mobile Construction Battalions, the homeport period is devoted primarily to meeting formal Navy training requirements. Personnel skill deficiencies in the battalion must be eliminated prior to deployment, and prior to declaring the battalion qualified for deployment. According to the Naval Construction Force Manual, 35 percent of battalion man-days available in a seven month homeport is required to eliminate noted skill deficiencies. (16) The identification of skill deficiencies is accomplished by the battalion training department and is beyond the consideration of this report. However, in addition to eliminating skill deficiencies, the homeport period is of extreme importance to construction operations in that construction project planning takes place during this period.

Commencing the homeport period, the battalion transfers from the organization and manning of the previous deployment to the new organization and manning developed for the upcoming deployment. This transfer begins the specific construction project planning period. At this time, the battalion is able to obtain project plans and specifications for the majority of its tasking. The company or detachment tasked with the individual projects begins to plan the project from the available plans and specifications. Many times plans are not available immediately or they are only

at the "30 percent" or "90 percent" complete phase and project planning commences based on preliminary plans. Project planning nevertheless continues.

Although many personnel assignments are complete and firm, there are still many new personnel expected to be added to the battalion during the homeport period as well as many personnel scheduled to depart the battalion during the same period. These personnel, considered PGs (prospective gains) and PLs (prospective losses), must be factored into the concept of the construction operations. A great deal of experience is available in the personnel departing the battalion and the battalion must make the most of this experience and knowledge before the personnel rotate. In many cases, these personnel are involved with initiating the project planning. Initial battalion construction operation plans may have been developed with the assistance of personnel who will not even make the deployment. On the other hand, plans may require a great deal from personnel who will not even join the battalion until it has been deployed.

Other, and possibly more serious, conflicts arise in homeport with respect to project planning. As mentioned previously, the battalion must be primarily concerned with eliminating skill deficiencies in assigned personnel during the homeport. This concern takes priority over project planning. As a result, the project planning effort is a fragmented operation at best. Personnel are in and out of

battalion control going to Special Construction Battalion Training (SCBT) courses, formal C-schools (professional skills), military training with the homeport regiment, or performing additional duties in support of the regiment and the Construction Battalion Center. Project planning teams are rarely composed of the same personnel throughout the planning effort. Project crew leaders are switched as tasking is adjusted and the crew leader who plans a project may never even see that project. In spite of all of the conflicts, the project planning must advance and be complete prior to deploying.

Deployment Period :

With deployment to the overseas deployment camp, the battalion relieves a battalion presently on site. This turn-over period is critical to successful operations. To avoid unnecessary expenses, a camp Table of Allowance (TOA) is maintained in the place of each battalion maintaining its own TOA. A battalion or camp TOA consists of the necessary construction equipment (trucks, cranes, dozers, etc.), tools (crew tool kits, power tools, etc.), and supplies (office supplies, consumables, etc.) required by the battalion to operate independently without resupply for 90 days. The TOA does not contain petroleum, oil and lubricants (POL), ammunition, nor construction materials. The camp TOA is turned over from battalion to battalion during a two week turn-over period. During the turn-over period, the relieving battalion arrives with an advance

party to inventory equipment, tools, and supplies; verify equipment status and condition; verify construction status for turn-over projects; and meet station contacts. At completion of the turn-over period, the relieved battalion departs with its personnel and the main body of the relieving battalion arrives to join the advance party and commence construction operations.

Construction operations are the main mission for the battalion on deployment and seven day work weeks are possible. The deployment construction effort is generally only interrupted with one two-to-three week period of military readiness training. This training is commenced with an "unannounced" embarkation exercise and followed up with a field exercise. Although this exercise is the only scheduled deviation from the tasked construction operation, many times emergency situations arise that demand deviation from the construction schedule. Deployment sites in the Pacific are frequently hit with typhoons and the Seabee battalions perform their mission of contingency preparation and disaster recovery operations. However, with or without the interruptions, the battalion carries out assigned tasking within the established time frame of the deployment and at the completion of the deployment turns over the camp and the camp TOA to its relieving battalion's advance party. The cycle is thus completed and begins again.

TASKING MECHANISMS

Naval Mobile Construction Battalions are tasked with

construction by the three Commanders-in-Chief in their two and one-half year employment plans. These plans make up the NMCB Force Assignment Plan that indicates the level of NMCB effort allocated to each geographic area and the approved NMCB Deployment Schedule. In practical terms, the tasking comes to the NMCB from the Commander, Construction Battalions, either Atlantic or Pacific, through the Naval Construction Regiment. Tasking comes in the form of an OPORDER issued by COMCBLANT or COMCBPAC. An initial tasking is received by the battalion approximately two months prior to returning to homeport. The battalion is still executing construction on one deployment when it receives the tasking for the next deployment.

As the battalion progresses through the homeport period, preparing for the upcoming deployment, minor adjustments to the tasking may take place. Project planning commences and progresses based on the tasking known at the time. A Deployment Execution Plan is developed by the battalion operations department based on individual project planning completed by the construction companies for the tasked construction. The Deployment Execution Plan is the battalion's best estimate and schedule for construction execution. It considers known tasking, information gathered during a predeployment visit of the deployment site by key operations personnel, resource availability, and status of ongoing construction projects by the battalion presently on deployment.

The first 45 days of a deployment provide the battalion

with a great deal of information that it did not have in homeport. During this period of the deployment, the battalion must reevaluate its Deployment Execution Plan in light of the new information. Examples of new information are: actual availability of construction material; revision of manday estimates for turn-over projects; and different site conditions than those expected. At approximately a month and a half into the deployment, representatives of COMCBLANT or COMCBPAC visit the battalion and a revised execution plan is negotiated. This negotiated execution plan is known as the "45 day review", and becomes the standard by which the battalion's progress is measured for the duration of the deployment.

Various constraints arise during the course of just about every deployment that force final revisions in the battalion's 45 day estimates. A great many factors, ranging from materials lost or delayed in shipment to the occurrence of natural disasters, can not be realistically considered in the execution plans, and a final revision is necessary to the execution plan. This final revision is commonly referred to as the "45 day outbrief". This final tasking determines what work the battalion is required to complete, but more importantly, it gives the next battalion firmer information for its execution plan.

CHAPTER 3 : NMCB CONSTRUCTION OPERATIONS

SMALL PROJECT CONSTRUCTION

Small project construction operations, while similar in many respects to the construction of "super projects", have characteristics that differentiate them from these larger construction projects. Construction projects of a smaller nature typically have special problems associated with them that are not present on projects that involve a larger input of material and labor. (20) Managers and supervisors of small construction operations must typically deal with handling many projects at the same time, complete the construction work in a production or operational environment, and manage the operations with less than a complete and fully trained staff.

Some examples of small projects are :

- Plant maintenance
- Plant additions
- Plant modifications or improvements
- Light construction
- Projects to assure compliance with safety or environmental requirements

Project control on small project operations has some special aspects that must be considered. The projects are of a short duration that leaves little time to gather data, identify problems and correct them. Management, labor and tool resources must be shared between the ongoing projects making it difficult to obtain commitments and enforce accountability. There exists a difficulty in obtaining actual data for the project which leads to inadequate reporting. The requirement that many projects be controlled

puts the manager in the position of attempting to control projects that are at various stages in development and construction.

NMCB CONSTRUCTION AS TYPICAL "SMALL PROJECTS"

Construction operations of United States Naval Mobile Construction Battalions fit the mold of "small project" operations. NMCB construction operations can be characterized as involving many projects at one time, projects of short duration, and many occurring in operational environments. Additionally, the construction occurs at overseas locations with long logistics pipelines.

NMCB operations are limited, for the most part during peacetime, to U.S. Naval and Marine Corps facilities and bases abroad. Battalions are tasked with deployments to one of five possible main body deployment sites (Rota, Sigonella, Roosevelt Roads, Guam, and Okinawa). to carry out construction and military training.

In addition to the main body deployment sites, Seabee construction is also undertaken at various detachment sites throughout the world. A detachment is an element of the NMCB tasked with construction at a site remote to the battalion main body deployment site. It is at these main body and detachment sites that Seabees truly execute construction tasking.

Individual Seabee construction projects are typically straightforward construction projects of short duration, and for an NMCB there may be as many as 50 projects to complete

in a seven month deployment. Many of the projects are executed in entirety during the course of the battalion's six or seven month deployment; groundbreaking through turnover to the customer command. Other projects are turned over from battalion to battalion. Project durations may typically last from less than one week to more than the duration of the deployment, seven to eight months. A "long" project may be one that is worked on by three battalions on successive deployments. Figure 3-01 is intended to be a representative battalion project status summary. It shows that the battalion, NMCB 3, worked on 56 individual projects during the course of an eight month deployment to Seabee Camp Covington on the island of Guam. The projects ranged from a two manday reef surveying project to a 1770 manday project to construct the fleet amusement center. Most of the projects undertaken lasted only four or five months with no one project requiring more than 2000 mandays.

Labor crew sizes are generally small with a crew of 30 personnel being a large crew for one project. Table 3-01 shows a compilation of crew sizes and project durations for three different battalions deployed to different sites. Representative of NMCB construction operations, the information in this table demonstrates that the projects are not massive endeavors with hundreds of workers involved. Instead, it shows NMCB construction operations to be a collection of short, small projects. Although the projects are spread throughout the timeframe of the deployment, there

PROJECT STATUS SUMMARY

1 APRIL 84 - 2 DECEMBER 84		NMCB THREE MAINBODY				
NCF PROJECT NUMBER	PROJECT TITLE	DIRECT MANDATE		DATE OF		PCNT CPL
		THIS PEP	CUM TO DATE	START	CPL	
GM7-905	HARDEN POWER	W A R R A N T Y		W O R K		
GM0-839	PAVE LIMITED AREA ROAD	302	302	4 SEP 84	19 NOV 84	100
GM0-847	PAINT RPR OF OPS BLDG	96	96	1 JUL 84	30 JUL 84	100
GM0-849	RPR ELEC DIST TO PIER D	66	66	6 JUL 84	27 JUL 84	100
GM1-855	RPR ELECT DIST TO PIER E	60	60	1 AUG 84	16 AUG 84	100
GM1-860	GLASS & SIGN SHOP	W A R R A N T Y		W O R K		
GM1-862	PHASE III ROAD RPRS	1335	1966	19APR 84	23 NOV 84	100
GM1-863	CONST ASBESTOS FACILITY	62	1095	18APR 84	22 OCT 84	100
GM1-866	REPAIR SASA VALLEY ROADS	553	553	20APR 84	6 SEP 84	100
GM1-867	RPR BLDG 2016	1239	1239	18JUN 84	27 NOV 84	100
GM2-802	RPR BLDG 2001A	963	963	18APR 84	21 NOV 84	100
GM2-805	CONST LOX STORAGE	740	740	27APR 84	23 APR 84	100
GM2-874	REHAB UEPH 514	1077	1077	20APR 84	21 SEP 84	100
GM2-878	RPRS TO UEPH 519	30	30	11JUN 84	5 JUL 84	100
GM2-879	RPRS TO UEPH 520	31	31	11JUN 84	5 JUL 84	100
GM2-880	REHAB UEPH 513	1054	1054	20APR 84	21 SEP 84	100
GM2-881	REHAB UEPH 512	1007	1007	25JUN 84	15 NOV 84	100
GM2-882	REHAB UEPH 511	27	27	8 NOV 84	12 NOV 84	2%
GM2-889	REHAB UEPH 515	1136	1136	20APR 84	26 JUN 84	100
GM2-892	RPR 50FT TOWER	215	215	1 MAY 84	1 SEP 84	100
GM2-893	RPR 45FT TOWER	215	215	1 MAY 84	1 SEP 84	100
GM2-895	RENOVATE PEST FAC	1334	1334	21APR 84	31 OCT 84	100
GM3-502	ERECT ASPHALT PLANT	605	605	---- D E L E T E D ----		
GM3-503	CONST STORAGE VAULT	170	170	25APR 84	6 JUN 84	100
GM3-504	CONST POV SECURITY LOT	118	118	3 OCT 84	25 OCT 84	100
GM3-509	CONST LOADING DOCK	366	366	15APR 84	8 AUG 84	100
GM3-510	CONST HAZ MTRL STORAGE	410	410	19JUN 84	17 SEP 84	100
GM3-512	CONST FLOATING CAMELS	147	147	1 OCT 84	14 SEP 84	100
GM3-840	ARMORY PHYSICAL SEC	195	195	1 JUN 84	1 OCT 84	100
GM3-842	RPR COMM CABLE	45	45	26APR 84	12 JUL 84	100
GM4-802	REMOVE POLES/CABLE	33	33	29AUG 84	5 SEP 84	100
GM4-803	CONC ALPHA CO YARD	270	270	1 OCT 84	19 NOV 84	100
GM4-887	CONST FLT AMUS CENTER	1770	1770	21MAY 84	22 NOV 84	95%
GM4-891	ERECT KINGPOST	69	69	1 OCT 84	23 NOV 84	100
GM4-412	QUARRY OPS	168	168	1 APR 84	2 DEC 84	100
GM4-413	CENSUS OPS	397	397	1 APR 84	2 DEC 84	100

Figure 3-01 : Representative Battalion Project Deployment Status Summary

PROJECT STATUS SUMMARY

1 APRIL 84 - 2 DECEMBER 84		NMCB THREE MAINBODY				
NCF PROJECT NUMBER	PROJECT TITLE	DIRECT MANDAYS		DATE OF		PCNT CPL
		THIS DEP	CUM TO DATE	START	CPL	
GM4-414	CONC BATCH PLANT	161	161	1 APR 84	2 DEC 84	100
GM4-101	ASPHALT BATCH PLANT	57	57	1 APR 84	1 SEP 84	100
GM4-102	CONST SIDEWALKS	100	100	2 JUL 84	27 JUL 84	100
GM4-103	NOT USED					
GM4-105	NOT USED					
GM4-106	CONST ROADWAY	5	5	9 AUG 84	9 AUG 84	100
GM4-107	INSTALL POLES/LIGHTS	53	53	6 AUG 84	9 AUG 84	100
GM4-108	CONST BUS STOPS	76	76	6 AUG 84	6 AUG 84	100
GM4-109	CAP VOLLEYBALL CRT	115	115	6 AUG 84	10 AUG 84	100
GM4-110	CLEAR RUNWAY	60	60	4 AUG 84	10 AUG 84	100
GM4-111	SURVEY REEF	2	2	8 AUG 84	8 AUG 84	100
GM4-112	PLACE AGGRAGATE	6	6	9 AUG 84	9 AUG 84	100
GM4-113	CONST THEATER SLAB	100	100	3 OCT 84	16 OCT 84	100
GM4-114	INSTALL FITNESS TRL	50	50	14 NOV 84	23 NOV 84	100
GM4-115	AUGER HOLES	51	51	10 SEP 84	14 SEP 84	100
GM4-116	RPR PARKING LOT	10	10	1 OCT 84	10 OCT 84	100
GM4-117	IMPROVE INFIELD			DELETED		
GM4-118	RENOV BATH HOUSE	20	20	15 OCT 84	19 OCT 84	100
GM4-119	CONST BUS STOPS	100	100	12 NOV 84	26 NOV 84	100
GM4-120	FAB/ERECT TRUSSES	100	100	15 OCT 84	15 NOV 84	100
GM4-121	CONST WELDING SCREEN	100	100	15 NOV 84	16 NOV 84	100
GM4-122	INSTALL LIGHTING	12	12	25 OCT 84	29 OCT 84	100
GM4-123	TYPHOON PREP/RECOV	195	195	24 OCT 84	25 OCT 84	100
GM4-124	CONST SEAHUT	40	40	22 OCT 84	31 OCT 84	100
GM4-125	TYPHOON PREP/RECOV	233	233	12 NOV 84	13 NOV 84	100

Figure 3-01 (CONTINUED) : Deployment Project Status Summary

may still be as many as 20 projects in execution at any one time.

TYPES OF SEABEE PROJECTS

NMCB construction projects are typically uncomplicated horizontal or vertical projects. Already shown to be of short durations, the work seldom involves complicated engineering designs and construction procedures. Generally, the work is small structure construction or renovation, or it is minor earthwork or paving overlays. During a seven month deployment to Rota, Spain in 1983-84, NMCB 1 worked on the following projects :

PROJECT TYPE	NO. OF PROJECTS
Paving overlay projects	4
CMU block buildings	3
Interior rehab projects	2
Ditch grading	1
Replace 30" AVGAS fuel line	1
Install pier lighting	1
Install golf course irrigation	1
Repair timber wharf fenders	1
Install lightning protection	1

This deployment construction tasking is fairly representative of the types of projects undertaken by construction battalions.

Much of the horizontal tasking is paving overlays. The deployment sites are well established bases that are in a "maintenance" phase rather than an "expansion" phase. Earlier in the Seabees' history, the battalions were involved with the creation of overseas facilities. The most notable accomplishment being the construction of Cubi Point Naval Air Station in the Philippines, during which more

BATTALION / DEPLOYMENT
PROJECT TYPE / CREW SIZE / DURATION

NMCB 3 / GUAM 84			NMCB 1 / OKINAWA 85			NMCB 133 / ROTA 92		
PROJ TYPE	CREW SIZE	DURATION weeks	PROJ TYPE	CREW SIZE	DURATION weeks	PROJ TYPE	CREW SIZE	DURATION weeks
PAVE	19	11	HELD			ELECT	15	10
PAINT	3	4	PAD	22	13	ELECT	8	7
ELECT	5	2	BLDG	12	9	CONC	24	22
ELECT	5	2	CONC	9	13	BLDG	23	9
ROAD			BLDG	18	18	BLDG	11	20
RPRS	10	32	BLDG	13	25	BLDG	20	32
BLDG	2	27	DITCH			CONC	17	16
ROAD			RPRS	9	20	PAVE	15	9
RPRS	10	19	REHAB	15	14	MECH	28	5
BLDG			BLDG	9	4	BLDG	31	25
RPRS	17	23	PAVE	23	9	BLDG	30	18
BLDG			IMP			ELECT		
RPRS	14	36	ROADS	12	4	MECH	20	23
BLDG	20	23	PAVE	4	2	DITCH		
REHAB	15	22	ELECT	14	15	RPRS	15	14
BLDG			BLDG	8	5	VAULT	3	4
RPRS	3	3	PAVE	14	1	BLDG	22	14
BLDG						CONC	21	9
RPRS	3	3				BLDG	6	5
REHAB	15	22				BLDG	10	6
REHAB	9	20				ELECT	4	6
REHAB	7	1				REHAB	8	14
REHAB	16	10				ELECT	7	9
TOWER						FUEL		
RPRS	3	18				TANK	9	5
TOWER						MECH	8	10
RPRS	3	18				PAVE	17	18
BLDG	18	28				CONC	14	3
VAULT	5	6						
ELECT	6	3						
DOCK	12	16						
AMUSE								
CTR	24	28						

Table 3-01 : Project Crew Sizes and Durations for Three Representative NMCB Deployments

earth was moved in constructing the airfield than was moved for the Panama Canal. The ending of Seabee construction operations on Diego Garcia in 1982 more recently marked the completion of construction of new overseas naval bases for the Seabees.

The majority of Seabee vertical work consists of the construction of CMU block additions to existing structures and the erection of pre engineered buildings. This work is prevalent for several basic reasons. First, the work is generally typical of the type of construction that would be required of the Seabees during contingency operations, and therefore, has a tremendous training value. Secondly, this type of construction is relatively inexpensive and flexible enough to accommodate a variety of needs, and lastly, the larger, more permanent facilities are generally constructed by local foreign national contractors as called for in the armed forces and base agreements signed for the various overseas bases.

In addition to the "typical" construction tasked to the battalions, many battalions become involved with projects of a one time nature. These are the projects that test the battalion's flexibility and "Can Do" capability. NMCB 3 received additional tasking after the commencement of its 84 Guam deployment. The additional tasking consisted of installation of arresting gear on the island of Wake. From deployment to Rota, Spain, NMCB 1 deployed a detachment to Beirut, Lebanon, in support of the U.S. Marines. The work consisted of constructing timber bunkers and fortified

positions.

Seabee construction operations are often involved with the rehabilitation or "revamping" of existing facilities. Westney (20) defines a "revamp" project as a change to an existing facility and is usually made to "increase the unit's capability ...improve safety, operability, or maintainability by adding such items as lighting, platforms and stairways, ...additional facilities to maintain or improve operations ...assure compliance with present or anticipated environmental requirements and ...modernization projects." The following Seabee construction projects are examples of revamping:

JK4-836 MEDICAL/DENTAL FACILITY : Change a storeroom into a dental facility consisting of a dental operatory and an X-ray room.

GM8-353 NAVMAG STREET LIGHTING : Repair and upgrade the damaged and obsolete street lighting system in the housing and admin area.

DG8-885 AIRCRAFT WASHRACK : Installation of a rinse rack to provide corrosion control for aircraft.

SA4-834 CONSTRUCT RETAINING WALL AT POL FARM : Construct a 245 foot long retaining wall at fuel storage facility.

GM2-889 REHABILITATE UEPH 515 : Renovation of enlisted berthing quarters.

These projects demonstrate that Seabee construction closely approximates the nature of the construction that Westney considers to be "small project construction", particularly "revamp" projects.

Because many of the projects are "revamps", often the construction must take place in a production or an operational environment. This constraint is common in small projects in all industries and it is very prevalent in NMCB

construction operations. Paving for the runway shoulders at Cubi Point in the Philippines was accomplished by the Seabees while the runway was fully operational because of the strategic and tactical importance of the runway. The many projects that the Seabees undertake to repair wharf and fender systems must consider the needs of the ships coming into port when a battle group comes into port. The ships must have some where to tie up regardless of the stage of construction. The operational readiness requirement of the United States Navy constantly puts Seabee construction in operational environments; a less than favorable construction environment but one that NMCBs handle almost daily.

NMCB CONSTRUCTION ORGANIZATION

The battalion Operations Officer is responsible for the execution of the construction tasked to the battalion. In accomplishing this tasking, the Operations Officer is supported by an Operations staff as well as line companies that perform the actual construction. The Operations staff basically performs the reporting and administration aspects of the construction operations. OPS staff functions include but are not limited to :

- Progress reporting
- Safety monitoring and reporting
- Quality control
- Engineering and drafting support
- Timekeeping
- Photo support

Battalions are traditionally divided into a headquarters company that provides logistics and

administrative support, and three or four line companies. The line companies perform the construction for the battalion. ALFA company is composed of Equipment Operators and Construction Mechanics and is responsible for maintaining equipment and performing all horizontal construction. BRAVO company is composed of Electricians, Utilitiesmen, Builders, and Steelworkers, and the company performs most of the electrical and mechanical work tasked to the battalion. BRAVO company is also tasked with performing camp maintenance on the facilities that the battalion works and lives in while deployed. CHARLIE company performs the majority of the direct labor construction, and its one major responsibility is executing construction tasking. This company is composed mainly of Builders and Steelworkers. Sometimes a DELTA company is created and its mission is basically the same as CHARLIE company, construction execution. In addition to the companies mentioned above, battalions typically have detachments performing construction at overseas sites different from the main body site. These detachments are semi-independent operations that are structured much like the battalion main body and they report to the Operations Officer and the Commanding Officer for command and control.

Construction management and leadership is provided by Civil Engineer Corps (CEC) officers assigned to the NMCB. A CEC officer is assigned as the company commander. His responsibilities are to ensure completion of company level tasking as well as seeing to the administration and welfare

of the personnel assigned to his company. To assist in carrying out the company construction operations, the company commander may have a company operations staff consisting of enlisted Seabee personnel functioning as project managers, project supervisors and company material expeditors. Crew leaders and the crews themselves are under the direct control of the company commander through the project managers and supervisors.

CONSTRUCTION MANAGEMENT PROCEDURES

The Civil Engineer Corps officers managing the construction operations of NMCBs have a wealth of guidance available to them. These officers come to the battalion with an educational background in an engineering discipline or a related technical discipline. Before joining the battalion, the officers receive instruction in the construction management procedures employed by the Seabees. Their training continues while attached to the battalion with refresher training, both in homeport and on deployment.

The procedures implemented by NMCBs are based on the construction management procedures developed by civilian universities and engineering colleges, and commercial construction firms. These procedures have been proven with service in the construction industry for the past 20 years. However, it must be remembered that these procedures were developed to handle the ever growing construction "super projects", and not necessarily the problems of the small construction project with a crew of only five builders.

Construction management guidance and direction comes from sources in and out of the Navy. Many of the officers, educated in civilian universities and engineering colleges, bring with them the knowledge gained there. The knowledge of the junior officers is enforced by the guidance and the experience of senior officers and senior Navy commands. Navy construction experience is consolidated in the form of Naval Instructions that promulgate policy and guidance for construction management.

NCF DIRECTIVE

Navywide policy direction for the "employment, deployment and readiness of the active Naval Mobile Construction Battalions" comes from the Chief of Naval Operations in OPNAV INSTRUCTION 5450.46(series). This instruction does not detail the type of construction management that will be implemented by the NMCBs, instead, it mainly provides for responsibilities and policy guidance for the Naval Mobile Construction Battalions. This document elaborates the mission and the capabilities of the NMCBs.

True battalion construction management direction begins at the Seabee command level. COMCBPAC provides construction management guidance for those units homeported on the west coast or deployed to Pacific sites. COMCBPAC guidance is promulgated in COMCBPAC INSTRUCTION 5200.1(series). This instruction is entitled "Construction Project Management" and its stated purpose is, "To promulgate planning, programming, material support and cost control procedures

and policies for management of construction projects assigned to Naval Construction Force units deployed in the Pacific."(11) This document provides the true guidance by which the battalions deploying to the Pacific establish their construction objectives and programs. COMCBPACINST 5200.1 is sufficient in detail to ensure some uniformity in operations from battalion to battalion, but it is not so specific as to tell the battalions which form of project scheduling they must follow.

The equivalent command instruction for battalions homeported in Gulfport, Mississippi or deployed to European or Caribbean sites is COMCBLANT INSTRUCTION 10370.1(series). Like COMCBPACINST 5200.1, COMCBLANTINST 10370.1 "is designed as an internal detailed working procedural document".(12) The two instructions are similar in form and content.

A combined COMCBPAC and COMCBLANT instruction provides further elaboration of construction management procedures. This instruction is the COMCBPAC/COMCBLANT INSTRUCTION 5200.2(series), "Operations Officer Handbook". Designed to present the role of the Operations Officer in an NMCB, the "Handbook" provides relatively specific guidance for the officer with the main responsibility for battalion construction operations. The instruction is not written to require the OPS Officer to operate in strict accordance with it. Instead, it exposes the OPS Officer to useful information for running battalion operations.

The Civil Engineer Corps Officer School (CECOS)

conducts classes in Construction Battalion Operations and has, as a result, developed comprehensive guides for the subject. These CECOS guides present a good deal of information about construction management techniques to junior officers and senior enlisted. In reality, the CECOS guides, "Construction Battalion Operations" and "Seabee Construction Management" are the most comprehensive references for the management of NMCB construction operations. These two sources address the entire spectrum of NMCB operations, from personnel administration to operations progress monitoring. The guides present topics for consideration and support the topics with listings of pertinent references and texts. Noted references and texts come from both the military and the civilian industry. For example the topic addressing "Construction Controlling" references the Operations Officer Handbook and the McGraw-Hill Scheduling Handbook.

The definitive Seabee planning and estimating reference is the NAVFAC P-405, Seabee Planner's and Estimator's Handbook. "Prepared by Seabees for Seabees, the Handbook is specifically for use in typical Seabee construction projects, and is designed for flexible application to projects of varying size, scope, and conditions." (19) The P-405 is a reference similar to the Mean's Estimating System and the Dodge System. It contains labor, material, and equipment estimation tables, explanations of Precedence Network analysis techniques, and conversion tables. Information contained in the handbook is developed from

analysis of historical Seabee construction data.

PROJECT PLANNING AND SCHEDULING

The NAVFAC P-405, Seabee Planner's and Estimator's Handbook, defines "planning" and "scheduling" as used in the NCF :

Planning is the process of determining the requirements and devising and developing methods and schemes of action for construction of a project.

Scheduling is the process of determining when an action must be taken, and when materials, equipment, and manpower will be required.

Seabee planning and scheduling is rather straightforward in concept; it is based on tried and tested methods in use throughout the construction industry. Seabee construction scheduling is based on the effective use of bar charts and Precedence Network techniques.

LEVELS OF CONSTRUCTION MANAGEMENT

NMCB deployment and project scheduling is divided into three distinct levels of management. Level I is the battalion operations level. A "level I" schedule coordinates all of the projects tasked to a battalion for a specific deployment. The second level of Seabee battalion scheduling is the level II scheduling, and it is the coordination and scheduling of "master activities" for individual projects. The most detailed level typically employed by the battalion is level III. Level III scheduling is concerned with scheduling of "detailed activities" for each tasked project.

There is a clear flow of information through the three scheduling levels. Initially, the Operations department develops a rough level I schedule based on rough man-day and resource estimates provided with the tasking. The rough level I is basically a start to the battalion planning and estimating process. Operations passes the tasking and the rough level I schedule to the company commanders who will develop the list of master activities, if they have not already been developed for the project. The company commander is also responsible for scheduling the master activities. Company level operations personnel, project supervisors and crew leaders, review the master activities for the project and further divide those master activities into level III detailed activities. The level III activities are estimated and scheduled, and the information thus created is fed back up the chain of command for review and revision of the initial level II and level I schedules. A free flow of information up and down the chain of command is essential for the process to function as designed.

Level I deployment scheduling is generally accomplished using bar charts. Figure 3-02 is an example of a level I schedule generated by NMCB 74 for its deployment to Guam. Level I bar charts provide a simplified means for identifying man-hour requirements per month of deployment. These monthly battalion manpower estimates are critical for labor resource leveling. Operations manipulates the level I schedule in the effort to level deployment labor requirements.

This aspect is an important difference between Seabee construction operations and most commercial construction operations. Although Seabee construction is somewhat task oriented, the true basis for the construction is full employment of a set number of personnel for a definite period of time. Seabee construction consists of making the tasking match the resources, and commercial construction involves making labor resources match the tasking. The OPS Officer has a degree of freedom in manning the main body and the detachments as he sees fit, but the total available labor remains fairly constant and must fit the deployment tasking.

The level I bar charts also provide the primary means by which battalion construction is monitored by higher commands. Prior to deployment, the battalion develops a "deployment execution plan" that forms the battalion's plan of action for completing the assigned tasking. The "deployment execution plan" contains a deployment level I schedule supported by individual project level II schedules. The Seabee commands, Pacific and Atlantic, and the two present regiments monitor battalion Situation Reports (SITREPS) for tasking progress and potential problems in tasking. Information in the SITREPS address overall project progress and project progress per level II activities.

Level II scheduling may typically involve both bar charts and Precedence Networks. Level II bar charts are used as a convenient means for reporting progress while the Precedence Networks provide the means for determining

project durations and manpower requirements. A typical Seabee level II bar chart is shown in Figure 3-03. Precedence Network techniques employed for level II schedules are relatively simple and involve the development of a CPM schedule for project master activities. The level II schedule is more or less an intermediate step toward development of the level III CPM.

Level III scheduling is concerned with scheduling the project detailed activities. Most often developed by the project supervisor and the crew leader, the level III Precedence Network is the most detailed plan of action for accomplishing a specific project. This schedule becomes the crew leader's tool for controlling project execution as well as providing the best estimate for manpower requirements and project duration. Approval of the level III network sets in motion the process for revising level II and level I bar charts. Revised bar charts become the standard for project monitoring and controlling while deployed. Figure 3-04 is a typical level III precedence diagram for a 40-by 100 foot rigid frame building.

One particularly important tool used in developing the level III precedence schedule is the Construction Activity Summary (CAS) Sheet. Completed for each detailed activity, the CAS Sheets provide the library of project information. Labor, equipment and material resource requirements are defined on a separate sheet for each individual detailed activity. A copy of the Construction Activity Summary Sheet.

LEVEL II

PAGE 2 OF 3

PROJECT No. JX5-350
 DESCRIPTION INSTALL HVAC BEQ 6041

SCHEDULE

NMCB - THREE

			AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR																		
ACT. No.	DESCRIPTION	MD	% OF JOB	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	% COMP
10	SITE PREP	150 227	16																								100%	
																											80%	
20	STRUCTURAL	300 475	32																								80%	
																											70%	
30	MECHANICAL	375 609	41																								80%	
																											60%	
40	ELECTRICAL	84 134	9																								80%	
																											40%	
50	MOVE-OUT 30	14 30	2																								80%	
																											60%	
	265 M/D 40's 100% COMPL																										100%	
																											100%	
TOTAL MD		922 1485	100%	351	558	686	904	1116	1164	1198																		
SCHEDULED MD THIS MONTH				96	207	128	218	212	48	24																		
ACTUAL MD THIS MONTH				23%	37%	46%	61%	75%	78%	80%																		

Figure 3-03 : NMCB 3 LEVEL II Project Schedule

as proposed in the Civil Engineer Corps Officer School technical guide, is included as Figure 3-05. These CAS Sheets perform an invaluable service in forming the foundation for integration of schedules and resource plans.

CONSTRUCTION ACTIVITY SUMMARY SHEET

PROJECT TITLE: _____

B.M. CODE: _____ PREPARED BY: _____ CHECKED BY: _____

START SCHEDULED: _____ FINISH SCHEDULED: _____
ACTUAL: _____ ACTUAL: _____

ACT. NO. _____ ACT. CODE _____

ACT. TITLE: _____

DESCRIPTION OF WORK METHOD: _____

DURATION: ESTIMATED _____ MANDAYS: ESTIMATED _____ WORKWEEK: _____
ACTUAL _____ ACTUAL _____

LABOR RESOURCES:

NO.	DESCRIPTION	QTY	NO.	DESCRIPTION	QTY

EQUIPMENT RESOURCES:

NO.	DESCRIPTION	QTY	NO.	DESCRIPTION	QTY

MATERIAL RESOURCES:

L/I	DESCRIPTION	U/M	QTY	L/I	DESCRIPTION	U/M	QTY

ASSUMPTIONS: _____

Figure 3-05 : Construction Activity Summary (CAS) Sheet

CHAPTER 4 : INVESTIGATION RESULTS

PRESENTATION OF INVESTIGATION RESULTS

It is important at this point to briefly restate the objectives of this research. The primary objective being the investigation of material resource planning and its integration with network planning as practiced by U. S. Naval Mobile Construction Battalions. Specifically, to look at the extent of material planning employed, the need for such material resource planning and the need for integration with the schedule. Firsthand observation of a construction battalion was not feasible. The investigation had to be completed by reviewing directives and instructions that establish battalion construction management procedures, and conducting interviews and questionnaire surveys with the personnel involved with battalion construction management. These methods were chosen so as to identify the degree of implementation of the established and recommended procedures by the battalions, and also, to identify problems and constraints associated with the actual operations.

The research did not produce a collection of hard data for an exact, critical analysis of battalion management, and such was not the intent of the research. The intent of the research was to establish a foundation for continued interest in the subject of battalion construction material and operations planning. The true understanding of Seabee construction management is retained in the experiences of the CEC officers who "have been there". This research was

intended to bring the subject into the open for discussion, debate, and circulated research.

The results of this investigation are classified into three categories, 1) DIRECTIVES AND POLICY; 2) MATERIAL RESOURCE PLANNING; and 3) ACTUAL OPERATIONS. The first category, DIRECTIVES AND POLICY, corresponds to Phase Two research as described in the methodology. This category presents the information compiled from the review of battalion construction management instructions and NCF directives. The second category, MATERIAL RESOURCE PLANNING, is a discussion of the material resource plan as established in the directives and instructions. The third category, ACTUAL OPERATIONS, presents the information collected from the interviews and questionnaires completed with the battalion Operations Officers. This information was Phase Three of research methodology.

DIRECTIVES AND POLICY

Phase Two of the research involved a search of Naval Construction Force instructions, guides and publications for guidance to battalions on material control and planning, and project scheduling. The specific documents looked at were :

NAVAL CONSTRUCTION FORCE INSTRUCTIONS:

- OPNAV INSTRUCTION 5450.46 ,
"Doctrine and Policy Governing U.S. Naval Mobile Construction Battalions (NMCBs)"
- COMCBPAC/COMCBLANT INSTRUCTION 5200.2 ,
"NMCB Operations Officer Handbook"
- COMCBPAC/COMCBLANT INSTRUCTION 4440.4 .
"Project Material Inventory Management"
- COMCBPAC INSTRUCTION 5200.1 ,
"Construction Project Management"
- COMCBLANT INSTRUCTION 10370.1 ,
"Construction Programming, Planning, Material Support, and Cost Control"

NAVAL SCHOOL, CIVIL ENGINEER CORPS OFFICERS GUIDES:

- "Student Guide for Construction Battalion Operations"
- "Student Guide for Seabee Construction Management"

NAVAL FACILITIES ENGINEERING COMMAND PUBLICATIONS:

- NAVFAC P-315, "Naval Construction Force Manual"
- NAVFAC P-405, "Seabee Planner's and Estimator's Handbook"

The sources listed above are readily available to every officer assigned to a Seabee battalion. Naval instructions promulgate policy and outline procedures for all aspects of Naval operations and administration. The student guides were developed by the Civil Engineer Corps Officer School (CECOS) with the intended purpose of familiarizing officers newly assigned to NMCBs with battalion operations and construction management procedures. The NAVFAC publications "provide technical guidance" from the Chief of Civil Engineers and the Naval Facilities Engineering Command (NAVFAC).

This review was considered to be critical to the research in that any attempt to analyze battalion material resource planning without understanding the directions under which they are operating would be shortsighted. All naval units operate under a myriad of directions, and NMCBs are no exception. Distinct chains of command exist along which responsibility and accountability flow. Responsibility and accountability entail direction and guidance. Before looking critically at actual battalion operations, it was necessary to understand the guidance that the battalions received from higher and/or support commands. That guidance in the Navy is typically in the form of operating directives and instructions.

Intent of Operating Instructions:

In reviewing the sources, it was important to remember that the intention of the instructions, guides and publications is not micro-management of battalion operations by a higher command such as COMCBPAC, COMCBLANT, or NAVFAC, but instead is intended to provide a common direction to the nine active battalions. The interface between the various battalions during turnover periods, the relationship between the battalions and the homeport regiments, the relationship between the deployed battalions and the Seabee commands, and the interface between the battalions and the customers at the deployment sites require that the battalions operate collectively in a somewhat standardized manner. As stated in the COMCBLANT INSTRUCTION 10370.1, "To effectively execute the peacetime construction effort, it is necessary to provide appropriate guidance to units involved in this process." (12) However, while ensuring that smooth turnovers and similar operations occur from battalion to battalion, the instructions, guides and publications do not rigidly dictate the absolute procedures the battalions are to follow. This type of leadership is best implemented by the officers assigned to and commanding the individual battalions. This thinking is evident in the sources. For example, in the introduction to the "Seabee Planner's and Estimator's Handbook" it is stated :

The procedures described herein are suggested methods that have been proven with use and can result in effective planning and estimating. How and when these procedures are applied is left to the discretion of the user." (19)

Operations Officer Handbook:

Of the materials reviewed during this phase of the research, the "Operations Officer Handbook" presented the clearest picture of the importance of construction material resource planning to efficient NMCB construction operations:

"The effective utilization of materials provided is a key element in the efficient management of any construction project." (17)

Construction material for deployed NMCB construction is shown to be the one resource over which the battalion Operations Officer has the least control. The "handbook" reads:

"Unlike tools and equipment, the materials, both permanent and consumable, for construction and camp maintenance are not contained within the TOA (Table of Allowance) and are a function of each individual project undertaken. Additionally, the control of material flow up to the point of receipt at the deployment site is generally outside the cognizance of either the S-3 (NMCB Operations Officer) or the S-4 (NMCB Supply Officer), hence, placing an additional burden on the battalion for close coordination with other agencies to ensure timely receipt and information feedback." (17)

The Operations Officer exercises direct control over the utilization of tools, equipment, and labor for the duration of a deployment, but, as stated in the "handbook", he is limited in material control until the material is received at the deployment site and in the hands of the battalion Material Liaison Office (MLO). The size of the Navy supply and shipping system tends to overwhelm what little control the battalion Operations or Supply Officers may have over material procurement and shipping. The fact that material control rests mainly outside the battalion until the

material is received places that much more importance on the material resource plan. Quality material resource planning can lessen the impact on operations of the minimal control the battalion has over CONUS procurement and shipping.

Material resource planning is further stressed in the "Ops Officer Handbook" under the section on "Deployment Planning". The battalion material resource plan begins basically during the "Preliminary Evaluation Step" with the receipt of Bills of Material generated by the homeport regiment. It is also recommended in the handbook that "the battalion should begin receiving material status reports with updates at this time so they can monitor the material availability for all projects." (17) Battalion material resource planning continues with the individual companies of the battalion reviewing the regimental bills of material for completeness, and allocating the materials to network activities. Here the "Operations Officer Handbook" emphasizes the need, and importance, of integrating the material resource plan with the construction schedule.

According to the handbook :

"The network is the basic management tool for control, monitoring, and distribution of all resources which are directly related to time."

"Utilizing the network...a complete analysis must be made, activity by activity, to determine the total resource requirements for each individual activity. It is only when this procedure is completed that the material requirements can be brought forward." (17)

It is during the "Pre-final Evaluation Step" described in the handbook that this integration is to be created:

"The allocation of material on the BM to each network activity is required to determine the resources necessary to accomplish the activity and to monitor the material availability. This is an important step which involves a great deal of effort and is often overlooked by the battalion." (17)

The "Operations Officer Handbook" makes note of a constraint that is a major hindrance to the integration of the material plan and the network schedule. The handbook notes :

"...the BM is primarily a procurement document that contains all the information required to procure the specified items of material and assure that adequate submittals are provided."

The fact that the BM is a procurement document tends to make it somewhat difficult to read and track by operations personnel not intimately familiar with supply notations and procedures. It is easy enough to determine the material on order, but other critical information necessary for the resource plan is not so easy to extract. Information such as requisition numbers, BM numbers and BM line item numbers, and Navy Stock Numbers do not have a great deal of significance to the operations and supervisory personnel, however they are critical to material tracking. This constraint is most burdensome in material tracking in that the material is identified on material status reports (Project Control Report / Project Material Status Report) by requisition numbers or BM line item numbers. Generally, only the MLO personnel are familiar enough with the system to quickly read and comprehend the status reports. After all, the OPS Officer does not have the luxury to become familiar with shipping codes and requisition numbers, his

concern is simply with where is the "project material".

But, as the handbook also notes :

"However, this document is readily cross related to the actual construction requirements by annotating the network with the line items and quantities of materials required for each particular network activity. This annotation should be made on each network activity, either on the network itself or on the BM. In later scheduling efforts this annotation of the network aids in establishing or verifying delivery dates and helps monitor the utilization of materials." (17)

This cross relationship appears to be the key to successful integration of material planning and network scheduling.

COMCBPAC/COMCBLANT INSTRUCTION 5200.2, "NMCB Operations Officer Handbook", thus shows itself to be important guidance for battalion construction material resource planning operations. It develops and emphasizes the importance of sound material resource planning, and the importance of integration of the material plan with the project schedule.

COMCBPAC and COMCBLANT Project Management Instructions:

The two command instructions, COMCBPAC INSTRUCTION 5200.1, "Construction Project Management", and COMCBLANT INSTRUCTION 10370.1, "Construction Programming, Planning, Material Support, and Cost Control" have the expressed purpose of promulgating planning, programming, material support, and cost control procedures and policies for management of construction projects. These instructions are the definitive sources for construction operations for NMCBs. The foundation for the battalion material resource plan is laid with these two instructions.

The resource plans outlined in the two instructions are very similar. Basically, the plans are initiated by the regiments with the preparation of material take-offs (MTO) and bills of material (BM). The bills of material are screened for CONUS versus local procurement by the regiments. (Local procurement being local to the deployment site). With receipt by the battalions of the regimental BMs, a "bounce" is made between the battalion generated MTO, the battalion's material estimate, and the regimental BM to ascertain add-on and reorder material requirements. The "bounce" is a check and balance procedure where estimate prepared by the battalion is compared to the material estimate prepared by the regiment.

Both instructions establish CONUS material tracking reports. For units deployed to a Pacific site, the 31st Naval Construction Regiment maintains and provides to the battalions the Project Control Report (PCR). Likewise, the 20th Naval Construction Regiment maintains material status for Atlantic and Caribbean deployment sites and reports the status in the Project Status Report (PSR). Both reports are updated and copies distributed bi-weekly. The PCR and the PSR are well known to any officer who has been assigned as the battalion Material Liaison Officer because the reports serve as the basic material tracking tool.

According to the two instructions, the battalions have the following responsibilities with respect to material control : (11,12)

1. Review RDD's (Required Delivery Date of material to the point of embarkation for the material) on the BMS and the PMSR/PCR and advise the regiments of all changes.
2. Monitor shipping status of all materials.
3. Coordinate with local support activity to receive status cards.
4. Advise receipt of CONUS-procured materials.
5. Request special expediting action as required.

These responsibilities act as a tie between the regiment procuring the material and the battalion receiving and utilizing the material. Responsibilities 1., 2., and 5. are truly critical elements of the battalion material resource plan.

The COMCBLANT INSTRUCTION 10370.1 supports the contention that the integration of the material resource plan and the schedule must receive important consideration. In enclosure (2), under the section entitled "Battalion Review", it states :

"The battalion shall identify each BM line item (CONUS and local) to a specific CPM activity."

The remainder of the instructions, publications and guides add little more to the material resource plan as a construction management tool. The remaining sources reviewed contribute to the peripheral aspects of the resource plan.

Project Material Inventory Management Instruction:

COMCBPAC/COMCBLANT INSTRUCTION 4440.4, "Project Material Inventory Management", defines the inventory management of project material and is less concerned with the project utilization of material than the previously

reviewed instructions. The instruction establishes procedures for material accountability which is so vital to "judicious material management". The material inventory management is an important aspect of the overall material plan; however, it does not play a critical role in the construction management of the project and will not be considered at length herein.

CECOS Student Guides:

Topic 3221 of the two CECOS student guides is entitled, "Material Management" and provides an overview of the information provided about material resource planning in the instructions previously reviewed. Supplement 3221.1 of the guides is worthy of noting. Shown as Figure 4-01, it presents the "SUPPLY CHAIN", the flow chart for the battalion material resource plan in essence.

Seabee Planner's and Estimator's Handbook:

The NAVFAC P-405, "Seabee Planner's and Estimator's Handbook is a technical guide for planning and estimating construction projects undertaken by the Naval Construction Force (NCF)". (19) Its intent is to act as a guide much like the Mean's and Dodge manuals, providing estimating and planning reference material in the forms of tables and diagrams. Beyond that purpose, the publication does not contribute a great deal of information to the material resource plan.

Naval Construction Force Manual:

The P-315, "The Naval Construction Force Manual" aids

SUPPLY CHAIN

-IDENTIFY MATERIALS AND COST-SPECIFICATION-

-FUNDING-

-PURCHASE-

-FOLLOW UP-

-EXPEDITE-

-TRANSPORT-

-RECEIVE-

-FEEDBACK-

-STORE-

-ACCOUNTABILITY-

-IDENTIFY PROJECT NEEDS-

-ISSUE-

-DELIVER-

-RECEIVE-

-STORE-

-INSTALL-

-RETURN-

-NMCB TURN-OVER-

Figure 4-01 : NMCB PROJECT MATERIAL SUPPLY CHAIN

no new information to the question of material resource planning. The NCF manual is concerned basically with the organizational aspects of the battalion and the NCF.

KEY ELEMENTS OF THE NMCB MATERIAL RESOURCE PLAN

The resources looked at in this research lay the foundation for a solid battalion material resource plan. Although not specifically outlined in any of the material collectively as comprising the battalion material plan, the elements listed below are considered to form the foundation for battalion material resource planning :

- Project Plans and Specifications : define the material requirements.
- Regimental Bills of Material : first consolidation of the material estimates for the project. Initiates procurement of CONUS procured project material.
- Battalion Material Take-Off : independent material estimate prepared by the battalion and "bounced" against the Regimental BM to identify additional or different material requirements.
- Construction Activity Summary Sheets : activity summary sheets prepared for each network activity listing resources required for the activity.
- Precedence Network : project planning network showing the dependencies and sequencing of the work activities. Determines when material resources are needed on the project.
- Project Control Report and Project Material Status Report : provides procurement, supply and shipping status for CONUS procured material on a bi-weekly basis.
- Excess Project Material Listing : compilation of excess project material available for new project utilization at each deployment site and most detachment sites.
- Project Estimates at Completion : projected estimate of the total costs for the project material and services. One completed by the Regiment for CONUS materials and one completed by the battalion for local materials.
- Material Receipt Reports : Bi-weekly reports initiated by the battalions advising the the regiments of receipt of CONUS procured material.
- Memorandum Financial Records : financial record for project funds; maintained by the battalion MLO.

Battalion Material Resource Planning
Procedures per Instruction:

The battalion's material resource plan actually begins with the regiment's action. Material estimates are first generated by the NCR responsible for the deployment site. At present, the 31st Naval Construction Regiment handles material procurement for continental United States (CONUS) supplied materials destined for Pacific and Alaskan deployment sites. The 20th NCR provides CONUS material support for Atlantic, European and Caribbean deployment sites. Personnel assigned to the regiments perform preliminary planning and estimating on NCF projects. These preliminary estimates are used for making tasking decisions by the regiments and the Seabee commands. Material estimates are used to generate BMs for the individual projects. Generation and approval of regimental BMs begins the actual procurement phase of the material plan. Approved and signed BMs are used for preparing purchase documents or to draw against existing supply stocks.

The BM is annotated with document or requisition numbers for each line item of material. This number is the most important component of the material resource plan in the opinion of the writer. A requisition number is assigned to each and every item requisitioned in the U.S. Navy supply system. That requisition number identifies the unit that requisitioned the item, identifies the Julian date that the item was requisitioned, and, for NMCB project material, it identifies the project the material is destined for and the

specific item. The Navy supply system has a worldwide computer system that can immediately provide updated status on each requisition number. As will be shown later, the material status reports track material by the requisition numbers.

Battalion material estimating begins with receipt of project plans and specifications. Regimental estimates may already have been completed while the battalion is performing its estimate, or the regiment may still be working on the estimate as the battalion completes its estimate. The independence of the two estimates is considered to be a "check and balance" process. Planners and estimators, in either the battalion operations' department or the individual companies, prepare material estimates from the available plans and specifications. Battalion estimators utilize "Estimating Worksheets" similar to that shown in Figure 4-02 for their initial material estimates. These forms are designed to facilitate material estimation by master and detailed activities. A "Material Take-Off" sheet, Figure 4-03, known throughout the NCF as well as the construction industry as the "MTO", is completed based on the information on the estimating worksheets. On the MTO, similar materials may or may not be consolidated into line items. Battalion MTOs are used to generate Bills of Material, Figure 4-04, which when signed, become official procurement documents allowing the expenditure of project funds. For CONUS procured materials, the regiments retain control of project funds, and therefore, control of BM

authorization. Battalions submit MTOs or suggested BMs to the regiments. Battalions also submit "Add-on" and "Reorder" Bills of Materials to the regiments. "Add-on" BMs are requests for material identified by the battalions but not included on the regimental BMs. "Reorder" BMs are identification of additional quantities of materials on the regimental BMs but in insufficient quantities.

DRAWN BY: E.B. JASON		PROJ. LOCATION: DIEGO CASCIA		SHEET 1 OF 5		DRAWING NO. 1,337,494/1,00498		PROJ. TITLE: CAUTIONMENT AREA INTERIM WATER SYSTEM BLDG.	
CHECKED BY: T.J. ABERNATHY		PROJ. SECTION: ARCHITECTURAL		ACTIVITY NO. NODE 71 TO NODE 104		BM NO. DIW-112		MTO NO.	
								DATE PREPARED: 19 FEB 83	
ITEM NO.	DESCRIPTION	PREFAB FORMS	REFER TO SECT. V	DWG QD. PAG. B1C PP 7/8	BM NO.	BM LINE ITEM NO.	UNIT OF ISSUE	TOTAL QTY	REMARKS
	BUILDING FOOTING	L W T							SLAB/FOOTING
		26'-6" 20'-0" 12"							EDGE FORMS-TO BE
1.	3/4" PLYWOOD BB EXTERIOR TYPE 4'x8'	2 (26'-6") x (20') x (12") = 53'-4" x 40' x 93'-4"				1	SH	0 3	USED AT TRANSMITTER SITE BLDG.
		8'x4' PLYWOOD RIPPED 12" x 32"							
		98.33/32' = 3 SHEETS							
2.	LUMBER 1x6x RL GR 2 OR BETTER	6 LENGTH x 2 EA. CORNER x 4 CORNERS = 8 PCS / 6 LONG				2	BF	15 30	BLDG LAYOUT BATTER BOARDS
3.	LUMBER 2x4x RL	16' - 48 PCS - 16' x 2 x 4 x 48 PCS				3	BF	15 590	USE REUSABLE 2x4 AT TRANSMITTER SITE BUILDING
	RAMP AND DOOR STOOP FORMS								
4.	3/4" PLYWOOD 4'x8'	(13'-8") x 2 (6') + 3 (4') = 37'-8"				1	SH	0 1	EDGE FORMS REUSE AT TRANSMITTER SITE BUILDING
		RIP PLYWOOD INTO 8" STRIPS = 6 x 8 = 48							
	BEAMS								
	B-1	2 EACH 26'-8" BOND BEAMS							
5.	3/4" PLYWOOD GR BB EXT TYPE 4'x8'	26'-8" x 4 SIDES = 106'-8"				1	SH	0 10	B-1 SIDE FORMS REUSE AT TRANSMITTER SITE BUILDING

Figure 4-02 : Typical Battalion Estimating Worksheet

MATERIAL TAKE OFF SHEET

1.337,494/7.604.988

ESTIMATE NO. **1938.97** PROJECT **CANTONMENT AREA, INTERIM WATER SYS BLDG/ARCHITECTURAL** CONTRACTOR **E. B. JASON**

CONTRACTOR **DIEGO GARCIA** DATE **19 FEB '83** DRAWING NO. **31ST NCR** SHEET NO. **1 - 5**

LINE NO.	QTY	UNIT	DESCRIPTION	PRICE	TOTAL	REMARKS
1	1200	SM	PLYWOOD, 3/4" X 4' X 8' BB EXTERIOR TYPE SUGGESTED VENDOR: THOMPSON LUMBER CO	69.00	82800	
2	18	BF	LUMBER, SOFTWOOD, 1" X 6" X 12' STANDARD CONSTRUCTION GRADE 2 OR BETTER. SUGGESTED VENDOR: THOMPSON LUMBER CO	307.90	5542.2	
3	28	BF	LUMBER, SOFTWOOD, 2" X 4" X 16' STANDARD CONSTRUCTION GRADE 2 OR BETTER. SUGGESTED VENDOR: THOMPSON LUMBER CO	2422.70	67835.6	
4	28	BF	LUMBER, SOFTWOOD, 2" X 6" X 16' STANDARD CONSTRUCTION GRADE 2 OR BETTER. SUGGESTED VENDOR: THOMPSON LUMBER CO	1447.90	40541.2	
5	33	BF	LUMBER, SOFTWOOD, 2" X 6" X 16' STANDARD CONSTRUCTION GRADE 2 OR BETTER. SUGGESTED VENDOR: THOMPSON LUMBER CO	11737.90	387351.7	

Figure 4-03 : Typical Battalion Material Take-Off (MTO)

SHIP APRIL '83

PROJECT: INTERIM WATER SYSTEM REINFORCER STATION (CANTONMENT AREA) -- 1-4-112

BILL OF MATERIAL
110-200-000 (REV. 1-77)
FORM NO. 10-1

LINE NO.	QTY	UNIT	DESCRIPTION	PRICE	TOTAL	REMARKS
AVE	69	SM	PLYWOOD, 3/4" X 4' X 8' BB EXTERIOR TYPE SUGGESTED VENDOR: THOMPSON LUMBER CO	1200	82800	
	30	BF	LUMBER, SOFTWOOD, 1" X 6" X 12' STANDARD CONSTRUCTION GRADE 2 OR BETTER. SUGGESTED VENDOR: THOMPSON LUMBER CO	18	5542.2	
	2242	BF	LUMBER, SOFTWOOD, 2" X 4" X 16' STANDARD CONSTRUCTION GRADE 2 OR BETTER. SUGGESTED VENDOR: THOMPSON LUMBER CO	28	67835.6	
	144	BF	LUMBER, SOFTWOOD, 2" X 6" X 16' STANDARD CONSTRUCTION GRADE 2 OR BETTER. SUGGESTED VENDOR: THOMPSON LUMBER CO	28	40541.2	

E. B. JASON
T. J. ABEL
3-11-83

Figure 4-04 : Regimental Bill of Material (BM)

Material estimators estimate the quantities of material for each level III activity. In addition to annotating the material to the MTO or the estimating worksheet, the material is identified on the Construction Activity Summary (CAS) Sheet for the particular activity that requires that particular material item. The CAS sheets serve as the tools for identifying all of the resources required for the completion of the work activity. This identification of material by level III activity on the CAS sheet is the link for the integration of the material plan and the network schedule.

The precedence network and the CAS sheets together tie material to the activities during which the material is to be used and to the timeframe when the material is required. The CAS sheets list the resources for the activity and the schedule identifies when the resources are needed within the context of the activities needed to complete the construction.

The material resource planning mentioned thus far pertains to the establishment of the plan during the planning phase of the project. For the majority of the construction tasking, these operations occur while the battalion is still in homeport. The next step in the material resource plan begins in homeport and carries through the duration of the deployment. Battalion generated MTOs and BMs, and regimental BMs serve as the basis for the battalion material resource plan. Regimental material status reports provide updated information or

material procurement and shipment. Generated by the regiments responsible for the deployment site, the reports are generated biweekly. The report sent out by the 31st NCR is known as the Project Control Report (PCR) and the report sent out by the 20th NCR is known as the Project Status Report (PSR). The PCR and the PSR are the battalion Material Liaison Officer's (MLO) main source for hard info on material status. However, due to the lead time required in updating and mailing the reports, the reports are typically limited in usefulness to planning for material needed in several weeks or months in the future. Current material status for materials needed immediately by the battalion must come from other sources.

Battalions begin following the material status at some point during the homeport period. Attention is directed towards the material necessary for projects scheduled for the first portion of the deployment. Project Control Reports and Project Status Reports are forwarded to battalion in homeport as well as the to the deployed battalions. The PCR and the PSR provide bi-weekly material updates for material tracking throughout the project cycle, homeport planning to deployment execution.

Project execution demands the proper distribution of material to the projects. This part of the material resource plan calls for the control and allocation of project material at the deployment site. Inventory management is a well established system in the Navy.

Project material inventory management is carried out in accordance with procedures established by the Navy Supply Corps.

Material receipt reports by the battalion while on deployment assist in the control of material in shipment. The battalion bi-weekly reports the material it has received at the site. This receipt report is bounced against the status report for material shipped that should have been received. This check on shipping helps identify possible lost materials and initiate corrective actions before the lost material creates project progress conflicts.

Excess material from projects can accumulate. This material provides an important function in the material resource plan. Although discouraged as indicative of poorly planned or executed construction, the excess material built up at each deployment site is beneficial to later projects. Many times material is delayed in procurement or shipping and a similar material is available in the excess material. This material can be used on the project in the place of the delayed material. Excess material plays an even more important role in resolving problems for material requirements not identified until the project has begun. The time required for CONUS procurement and shipping of material identified late in the cycle could cause serious disruptions in the project schedule. The availability of the excess material helps to lessen these problems.

ACTUAL OPERATIONS

The actual procedures employed by the battalions are somewhat similar to the directive prescribed procedures, but they are adjusted to fit the realities of the operational Navy. The actual managers of construction battalions are faced with the realities of unexpected losses of material in shipping and project sites being somewhat different from those described in the plans.

In order to ascertain the true application of construction management procedures in the operational battalions, requests were sent to the nine active battalions for any instructions or directives that the battalions have in place that direct their operations and construction management. Five of the nine battalions responded with packets of assorted instructions, forms, manuals, and execution plans.

The most obvious fact evident from the information received was that no two packets of information were identical. The request asked for "any construction management instructions or directives" the battalion operates with. Although this request was somewhat general, it was specific enough to limit the request to construction management. Nevertheless, each battalion responded differently to the request. The nature of information received ranged from a "Construction Management Manual" submitted by NMCB 40 to mere collections of forms used in construction operations. The only true similarity among the information received was the use of standard forms taken

from command instructions or CECOS guides; i.e. level I and II schedules, Construction Activity Summary Sheets, or sheets for listing activities. A consistency from battalion to battalion was not evident.

The lack of similar information tends to demonstrate that the battalions all perform individually. Each battalion has its own style, or specific format, for performing construction management and, even this procedure may vary from Operations Officer to Operations Officer.

The information received supported the idea that material resources do not receive the level of attention that labor resources receive. The majority of the information supplied pertained to the scheduling of construction activities and the analysis of labor requirements used throughout a deployment. This result reflects the fact that the battalion Operations department is concerned with fully employing a set number of workers for a definite period of time. During the project planning period, showing effective use of available labor for the deployment is most likely the number one goal.

Having reviewed the initial information received from the battalions, a questionnaire, Figure 4-05, was developed to solicit current opinions about NMCB construction operations and material resources planning from battalion Operations Officers. The questionnaire was designed to draw out opinions about the material resource plan. The answers to the questionnaire added invaluable information to the

knowledge gained from the battalion instructions and directives about the extent of battalion material resource planning. Battalion Operations Officers provided first hand experience with the battalion operations and material planning, and accordingly, contributed a great deal of information that only could have been alternatively provided by first hand observation of the active battalions for a year or more. The questionnaires were sent to the nine active battalion Operations Officers. Seven of the Operations Officers completed and returned the questionnaires. Four of the questionnaires were supplemented with additional comments. The comments tended to show a true interest in the topic (material resource planning) being pursued. The questionnaires are included as Appendix A.

OPERATIONS OFFICER QUESTIONNAIRE SURVEY

Deployment Sites Represented:

Question number 1 was included in the survey to determine the most recent experiences of the respondents, specifically which deployment sites were represented by the respondents most recent deployment. A good coverage of deployment sites would ensure that the results would include information and opinions about both Seabee commands, CBPAC and CBLANT, and both support regiments, 20th NCR and 31st NCR. A good representation of deployment sites would also help to identify material problems possibly unique to, or characteristic of a particular deployment site.

Existence of Serious Material Problems:

Questions 2, 3, and 13 of the survey were designed to establish whether material resource problems were plaguing the battalion construction operations, and if so, just how serious were the problems considered to be by the battalion Operations Officers.

Question 2 was included in the survey to determine whether the battalions experienced material related problems on a fairly consistent basis. This question was designed to question whether material related problems were serious enough to warrant an indepth analysis. Positive answers to the question by the majority of the respondents would indicate that the battalions were experiencing troubles with construction material and that some form of corrective action might be necessary; the standard operating procedures were not doing the job.

Question 3 was asked in order to provide a subjective evaluation of the character of material problems that were being encountered by the deployed battalions. The logic being that material delays and shortages may indeed be prevalent, but that they could possibly be of minor consequences and be considered as more of a nuisance than a serious concern by the Operations Officers.

Question 13 was included to find out which of the resources the Ops Officers considered as creating the most problems. The answers to this question would help to facilitate material resource planning with respect to the other resources, tools, equipment, and labor.

11. To which deployment site did your battalion last deploy

12. Were material delays and shortages prevalent during deployment construction operations? (YES) (NO)
13. How would you characterize those material problems?
 Check one:
 NONE
 MINOR CONCERN
 MODERATE CONCERN
 SERIOUS CONCERN
14. Which period of deployment seemed to have the most material problems?
 Check one:
 FIRST 45 DAYS
 FIRST HALF OF DEPLOYMENT
 SECOND HALF OF DEPLOYMENT
 LAST 45 DAYS
15. How many tracking reports did you and your staff develop during the deployment?
 developed with the battalion
16. How were the materials segregated?
 NONE
 PROJECT MASTER LIST
 PROJECT DETAIL MATRIXX
 SOME OTHER METHOD
17. In the operations department, what material was tracked?
 ALL PROJECT MATERIALS
 ITEMS OF VALUE TO THE BATTALION
 MATERIALS RELATED TO THE PROJECT
 OTHER
18. Was a material resource plan that tied materials to the schedule developed for the deployment? (YES) (NO)
19. If so, was the material resource plan related directly to segregated or construction activities? (YES) (NO)
20. As Operations Officer, were you so interested in the percent material received per project or just the status of critical items?
 Check one:
 PERCENT MATERIAL RECEIVED
 STATUS OF CRITICAL ITEMS

Figure 4-05 : Operations Officer Questionnaire Survey

11. Did Operations and MLO have accurate accounts of material on site prior to deploying? YES _____; NO _____.
12. At what month during the homeport did MLO or Operations begin closely tracking material status:
 (Check one)
 ___ FIRST THREE MONTHS
 ___ FOURTH MONTH
 ___ FIFTH MONTH
 ___ SIXTH MONTH
 ___ LAST MONTH OF HOMEPORT IF LONGER THAN SIX MONTHS
 ___ NOT PRIOR TO DEPLOYMENT
13. Rate the following areas with respect to the level of problems experienced with deployment construction operations:
 (1 - MOST PROBLEMS to 3 - LEAST PROBLEMS)
 ___ MATERIAL UNAVAILABILITY
 ___ EQUIPMENT SHORTAGES OR CONFLICTS
 ___ MANPOWER SHORTAGES OR OVERMANNING
 ___ OTHER _____
14. From your battalion experiences, which material group has created the greatest material constraints:
 RATE THE TOP THREE (1, 2, 3) GROUPS CREATING PROBLEMS
 ___ LUMBER
 ___ PAINTS
 ___ DOORS/WINDOWS
 ___ PRE-ENGINEERED BUILDING COMPONENTS
 ___ FINISH ELECTRICAL
 ___ PIPE
 ___ ROUGH ELECTRICAL
 ___ PIPE FITTINGS
 ___ FINISH PLUMBING
 ___ CONCRETE
 ___ ROUGH PLUMBING
 ___ ASPHALT
 ___ DRYWALL/INTERIOR FINISHES
 ___ REINFORCING STEEL
 ___ HVAC EQUIPMENT
 ___ OTHER _____
15. What three materials groups would you most recommend tracking?
 1. _____
 2. _____
 3. _____
16. Would development of a material resource plan that tracked material by detail level (i.e. activities by or use in battalion operation) be
 YES _____; NO _____

Figure 4-05 (continued) : OPS Officer Questionnaire Survey

Timing of Material Related Problems:

Questions 4, 11, and 12 were all concerned with the timing of battalion material problems or the timing of commencement of material tracking as part of the material resource plan. The cyclical nature of battalion operations has been shown to place additional burdens on the construction operations; therefore, the identification of critical planning or execution periods would be helpful in resolution of such material problems.

Question 4 was included to determine whether material problems were associated with a particular timeframe of the deployment. Identification of a particular period of the deployment when material problems were prevalent would add insight into resolving those problems and improving material resource planning. For instance, if all of the material problems were associated with the first few months of the deployment, then it is possible that the problems were closely associated with the battalion turnover.

Question 11 was included to ascertain if the battalions were receiving sufficient material information while still in homeport. Because of the hectic nature of the homeport period, material tracking could be neglected. Construction execution may seem far off to battalion personnel at this time; the construction operations seem somewhat removed from the day-to-day routine of homeport inspections and formal technical/military training. Adding to the problem of following material status during homeport

is the fact that many battalion personnel are temporarily assigned to duty outside the battalion. Organizational continuity is not as strong in homeport as it is while deployed.

Question 12 was closely related to question 11. The intent being to identify at what point during the homeport material tracking began in earnest.

Battalion Material Tracking Mechanisms:

Questions 5, 6, 7, and 10 of the questionnaire survey centered on the battalion material tracking system. The Project Status Report and the Project Control Report are the foundation for NMCB material status updating. However, experience has shown that the PSR and the PCR must be supplemented with other means, phone calls, tracking boards, listing of critical items, or some other control process.

Question 5 dealt with battalion initiated material tracking. The question was intended to help identify whether the battalions were employing material tracking methods in addition to the PCR and the PSR. Positive answers to the question would indicate that the battalions had individually developed some means to track material.

Question 6 was associated with question 5. Its intent was to show how the battalion initiated material tracking systems in use were constructed. For positive answers to question 5, question 6 asked how the material was segregated for tracking. The possible answers to the question identified the various levels of detail for

material tracking, from project segregation to detailed activity segregation.

Question 7 was included to help to identify the degree of involvement of the Operation department in the material tracking function. Material tracking is essentially a function of the MLO and the company level construction supervisory personnel. The degree of involvement of the Operations department provides some insight into the seriousness of the problems encountered by the battalions. More firsthand involvement by OPS may indicate serious weaknesses in the methods employed.

Question 10 was included to address whether material status should be tracked by "percent material received" or by "status of critical items". "Percent material received" provides a general overview of the material status for a project, but it has shortfalls in that it weights each line item of material equally, from a box of nails to an air handling unit. "Status of critical items" is a more specific tool requiring more work initially in determining what items should be considered critical; and therefore, should be tracked. This method also requires the continual evaluation as to what is critical.

Material Planning and Activity Scheduling Integration:

Questions 8 and 9 were designed to show the extent of integration between material planning and project scheduling employed by the battalions. The material resource plan can increase in effectiveness if the material is readily related

to the time when the material is needed. Linking material and time produces a plan that can foresee material constraints before they become problems.

Question 8 developed the idea of material resource-network schedule integration. The importance of this integration may be a key to the material resource plan. The responses would indicate the extent of material resource plan and network schedule integration practiced by the battalions.

Question 9 was related to question 8, specifically positive answers. This question was intended to determine if the material resource-network schedule integration was accomplished at the detailed activity level.

Material Groups Contributing to Material Constraints:

Questions 14 and 15 were designed to identify those material groups that were responsible for the greatest material constraints; and therefore, should be the focus of attention in any suggested material resource plan.

Question 14 asked the OPS Officers to identify the material group with which they experienced the "greatest material constraints". Question 15 asked for their opinions as to which three groups they would recommend tracking. The answers to these two questions would be helpful in establishing the priorities of the material resource plan.

Interest in Development of Integrated
Material Resource Plan:

Question 16 was included in the survey to see if the battalion Operations Officers believed development of a material resource plan closely integrated with the network schedule, level III activities, would be of use to the battalions.

PRESENTATION OF SURVEY RESULTS

Deployment Sites Represented :

As shown in Figure 4-06, all five main body deployment sites were represented in the survey by the most recent experiences of the respondents. This complete coverage of deployment sites ensured that both Seabee commands and both support regiments influenced the results as submitted by the OPS Officers.

Question 1. To which deployment site did your
battalion last deploy ?

<u>NMCB</u>	<u>DEPLOYMENT SITE</u>
1	Fuerto Rico
2	Okinawa, Japan
4	Sigonella, Sicily
41	Okinawa, Japan
62	Rota, Spain
74	Guam
100	Fuerto Rico

Figure 4-06 : Question 1 Results

Existence of Serious Material Problems:

In response to question 2, (see Table 4-01) five of the seven respondents noted that "material delays and shortages were prevalent during construction operations". The sixth respondent, NMCB 3, qualified his "no" with the statement,

"We had our share but not prevalent."

It would be anticipated that material problems would be encountered on many construction projects. The very nature of the construction industry places a high demand on the planning and utilization of construction materials. However, the construction operations of United States Naval Mobile Construction Battalions appear to be extraordinarily burdened

NMCB	1	3	4	40	62	74	133

Question 2. Were material delays and shortages prevalent during deployment construction operations ?							

-YES	x		x	x	x	x	
-NO		x					x

Question 3. How would you characterize those material problems :							

-MERE NUISANCE							
-MINOR CONCERN TO S-3				x			x
-MAJOR CONCERN TO S-3.							
HOWEVER PROBLEMS HANDLED INHOUSE	x	x				x	
-SERIOUS ENOUGH TO CAUSE TASKING CHANGES					x	x	x

Question 13. Rate the following areas with respect to the level of problems experienced with deployment construction operations : (1 - MOST PROBLEMS to 3 - LEAST PROBLEMS)							

-MATERIAL NONAVAILABILITY	1	1	1	1	1	1	
-EQUIPMENT SHORTAGES OR CONFLICTS	3	3	2	3	3	2	3
-MANPOWER SHORTAGES OR OVERMANNING	2	3	3	2	3	3	2
-OTHER					2*		1*
* "SKILL LEVEL SHORTAGES" or "SKILL LEVEL OF CREW LEADERS"							

Table 4-01 : Questions 2, 3, & 13 Results

with material related problems. The respondents acknowledged that the problems they encountered were frequent enough to be considered as "prevalent". NMCB

construction operations place a heavy burden on the material resource plan, more so possibly than many other types of construction.

The responses to question 3 (see Table 4-01) of the survey indicate that the material problems encountered were, for the most part, serious enough to be a major concern to the Operations Officers. Three of the seven respondents checked the option that material problems were of major concern but that the problems were resolved inhouse, within the battalion organization. The NMCB 62 Operations Officer checked both the option that problems were "major, but handled inhouse", and that the problems were "serious enough to cause tasking changes". In additional comments supplied by that Ops Officer, it was explained that one electrical distribution project was possible only because the material needed, transformers, was available on a borrow-pay back basis from the station public works department. Another project undertaken by NMCB 62, 53 percent of the tasking was dropped because steel piles due on board the third month of deployment did not arrive until the last month of deployment.

Two other respondents noted that material problems were serious enough to cause tasking changes. Tasking changes disrupt the level I schedule and the entire deployment schedule is threatened, depending on the seriousness of the tasking change. In many cases, tasking changes cause battalions to begin construction on projects that are not

truly ready from a material standpoint, and some material expediting is usually required.

One of the respondents, NMCB 4, stated that material problems were of a minor concern; however, the answer was qualified with the statement, "But this is a time dependent problem. At the beginning of deployment, I can work around them, but at the end of deployment, unresolved problems create a crisis." It appears from the answers received that the battalions are all encountering material problems that are serious enough to warrant the attention of the battalion Operations Officer, and many times, the attention of the tasking command, either CBPAC or CBLANT.

Question 13 (see Table 4-01) responses for six battalions rated material nonavailability as the cause for most frequently encountered problems with deployment construction operations. The resources of equipment and labor were rated as contributing less to construction problems than material resources. The reality of this response was stated in a note attached to the survey by the Ops Officer for NMCB 3. He wrote, "Material is the only problem I have since I 'own' equip & manpower resources."

Timing of Material Related Problems :

The problems experienced by the battalions were evenly distributed during the deployment according to the responses received for question 4 (see Table 4-02). Three of the battalions reported problems associated with the first half of the deployment, two of the battalions reported material

problems associated with the last half of the deployment, and two battalions reported problems mainly associated with the last 45 days of the deployment. The OPS Officer for NMCB 62 annotated his reply with the following statement. "The nature of our problems endured throughout. After midpoint, however, necessary adjustments had been effected to mitigate impact."

The comment helps to explain that material problems would be expected earlier in the deployment when personnel were becoming familiar with their jobs and necessary contacts were being made. With problems seemingly prevalent during the entire deployment, the importance of the material resource plan is emphasized.

NMCB	1	2	3	4	5	6	7	8	9	10	11	12

Question 4. Which period of deployment seemed to have the most problems with material nonavailability :												

-FIRST 45 DAYS												
-FIRST HALF OF DEPLOYMENT	X	X		X	X							
-SECOND HALF OF DEPLOYMENT	X			X								
-FINAL 45 DAYS										X	X	

Question 11. Did Operations and MLD have accurate accounts of material on site prior to deploying :												

-YES	X	X		X	X							
-NO										X	X	

Question 12. At what month during the homeport did MLD or Operations begin closely tracking material status :												

-FIRST THREE MONTHS	X	X										
-FOURTH MONTH												
-FIFTH MONTH												
-SIXTH MONTH												
-LAST MONTH OF HOMEPORT												
-IF LONGER THAN SIX MONTHS												
-NOT PRIOR TO DEPLOYMENT												

Table 4-02 : Questions 4, 11, & 12 Results

Five of the seven respondents, in answering question 11, (see Table 4-02) noted that they did have accurate accounts of the material on site prior to deployment. The early tracking of material status would be expected to be critical to the material resource plan, and knowing what material is on site is extremely important in that regard. The five battalions with good information at "material on site" could concentrate on the material that they were to be shipped. The other two battalions without this information could not limit their scope and instead had to concentrate on tracking all of the CONUS procured material for their projects. The material on site plays a vital role in providing the battalion with a firm start on their construction tasking. Early scheduled project requirements material on site when the battalion main body arrives at construction execution.

The answers to question 12 (see Table 4-03) were varied somewhat. Four of the responses stated that material was tracked from the start of the homeport, the first three months. One respondent answered that material tracking began in earnest during the fourth month of the homeport. The last two responses noted material tracking beginning during the sixth month.

Four of the battalions with accurate accounts of "material on site" began their material tracking during the first three months of homeport, and the fifth battalion with an accurate account of "material on site" began material tracking during the fourth month of homeport.

Obviously, early establishment of material tracking while in homeport leads to beneficial results in having a good account of material on site, and from that a good start on the construction tasking.

Battalion Material Tracking Mechanisms :

The responses to question 5 (see Table 4-03) were evenly split with four Ops Officers reporting the use of a supplemental material tracking system and three Ops Officers reporting that no additional tracking method was employed. Two of the positive responses were annotated with supporting comments that material status was tracked via telephone between the battalion MLO and the supporting regiment.

For question 6 (see Table 4-03), two of the responses indicated material segregated by project, another segregated by project detail activity (on the CAS sheets), and the third segregated by some other means, noted to be "separate board on wall with all necessary info". The respondent that noted that material was segregated by project also noted that segregation by project detail activity "would be best". This demonstrates that only one of the seven battalions that responded was tracking material in accordance with recommended procedures. A good deal of planning effort is expended allocating material to the project detailed activities during planning and estimating. This effort should be followed up with and maximized by tracking the material and updating the status in relation to the detailed activities.

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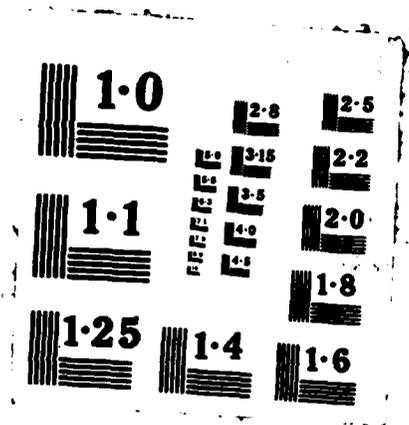
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NMCS	1	3	4	40	62	74	133

Question 5. Other than tracking material via the "Project Status Report" or the "Project Control Report", was a system for tracking material status developed within the battalion ?							

-YES	x		x		x		x
-NO		x		x		x	

Question 6. If so, was the material segregated by :							

-PROJECT					x		x
-PROJECT MASTER ACTIVITY							
-PROJECT DETAIL ACTIVITY				x**			
-SOME OTHER IDENTITY	x*						
* "Separate board on wall with all necessary info"							
** "(C.A.S.) Sheets"							

Question 7. In the Operations Department which material was tracked ?							

-ALL PROJECT MATERIAL							
-ITEMS CRITICAL TO THE SCHEDULE	x	x		x		x	
-MATERIAL PRESENTLY DELAYING OPERATIONS				x		x	x
-OTHER							x**
* "MICRO COMPUTER GENERATED MATERIAL REPORT"							

Question 10. As Operations Officer, were you <u>more</u> interested in the "percent material" received per project, or just the status of critical items ?							

-PERCENT MATERIAL RECEIVED				x			
-STATUS OF CRITICAL ITEMS	x	x	x		x	x	x

Table 4-03 : Questions 5, 6, 7, & 10 Results

The majority answer for question 7 (see Table 4-03) was that the Ops Officer became involved with tracking those items "critical to the schedule". Four of the seven

respondents answered in this manner. The three remaining respondents indicated that Ops only became involved with the material "currently delaying operations".

For question 10 (see Table 4-03) five of the seven responses indicated that the "status of critical items" is more important to the construction management than knowing "percent material received". There are no surprises in this response; obviously the battalion Ops Officers are aware of the shortfalls of "percent material received" and recognize that it is a small percentage of material, those items critical to the schedule, that has the real potential to drastically affect construction operations.

Material Planning and Activity Scheduling Integration :

Four of the responses to question 8 (see Table 4-04) showed that no integration took place. Two of the respondents noted that their material plans were tied to the schedules. This question drew several comments from the respondents.

	1	3	4	40	52	74	133

NMCS							

Question 8. Was a material resource plan that tied materials to the schedule developed for the deployment?							

-YES			X	X			
-NO	X				X	X	X

Question 9. If so, was the material resource plan related directly to (segregated by) construction activities ?							

-YES							
-NO							

Table 4-04 : Questions 8 & 9 Results

NMCB 3 included the following statement with his "yes" answer:

"Level III activities. This is a key concept of project control and is a common mistake many battalions make. Such as, scheduling drywall installation at month 3 when metal studs won't arrive until month 4. This makes for for an unrealistic schedule. Control of this problem is particularly paramount at the 45 day Ops review when % tasking is assigned by CBPAC/CBLANT. The danger is that the S-3 may commit to reaching a certain % without realizing its impossible."

NMCB 4 annotated its "yes" answer with the statement,

"We had plan, but there was no system that popped up a red flag when there was a problem".

NMCB 62 answered "no" to the question and included the note,

"It was a cross-check item. Critical items were considered only".

NMCB 74 also answered "no" to the question with the note,

"Major hit during ORI".
(ORI is Operational Readiness Inspection and its purpose is to determine the level of readiness to deploy of the battalion.)

Three "yes" answers were received to question 9 (see Table 4-04). A positive answer indicated that the material resource plan was related to detailed activities on the network schedule. This situation would be the preferred method in that the foundation for it is already laid with the CAS sheets.

Material Group Contributing to Material Constraints :

The answers indicated that the vast majority of material problems were associated with CONUS procured materials (see Table 4-05). The materials with typically long lead times (doors & windows, electrical items, HVAC

equipment) were identified with material constraints. The materials noted as contributing to material constraints were also the materials where the correct size or type was required for the specific application. For instance, electrical finish items or plumbing and piping are not as readily interchangeable between projects as drywall or lumber would be. Generally, the correct size pipe or correct electrical panel box is an absolute requirement to construction progress.

From the responses to question 14 (see Table 4-05), HVAC equipment was noted by four battalions as being the number 1 material group with the greatest material constraints. Electrical items, both finish and rough, were

	1	3	4	40	52	74	100

Question 14. From your battalion experiences, which material group has created the greatest material constraints :							
(RATE THE TOP THREE (1, 2, 3) GROUPS CREATING PROBLEMS)							

-LUMBER							
-DOORS/WINDOWS	2		3			1	
-FINISH ELECTRICAL				3	2	3	
-ROUGH ELECTRICAL		2	1		2		
-FINISH PLUMBING				2			3
-ROUGH PLUMBING			2				
-DRYWALL/INTERIOR FINISHES							
-REINFORCING STEEL							
-PAINTS							2
-PRE ENGINEERED BUILDING COMPONENTS			3			3	
-PIPE						2	
-PIPE FITTINGS	1				2	2	
-CONCRETE	2						
-ASPHALT	3						
-HVAC EQUIPMENT		1		1			1
-OTHER						1*	

* Long lead electrical-transformers, etc. Long lead mechanical-HVAC"

Table 4-05 : Question 14 Results

----- What three materials groups would you most recommend tracking : -----		
NMCB 1 :		
1. Heavy timber	2. HVAC equipment	3. Doors & windows
NMCB 3 :		
1. HVAC equipment	2. Electrical gear i.e. transformers	
NMCB 4 :		
1. Rough electrical	2. Finish electrical	3. Rough plumbing
NMCB 40 :		
1. HVAC	2. Plumbing	3. Electrical
NMCB 62 :	Annotated "I would not track it this way; I would track critical items that affect project accomplishment. What is on the critical path ?"	
NMCB 74 :		
1. Doors & windows	2. Pipe fittings	3. Finish electrical
NMCB 133 :		
1. HVAC	2. Electrical	3. Mechanical

Figure 4-07 : Question 15 Results

noted as contributing to material constraints. Doors and windows, typically special sizes for each project, were also noted by three of the six respondents as contributing to material constraints.

Interest in Development of Integrated Material Resource Plan :

-----	-----						
NMCB	1	3	4	40	62	74	133
-----	-----						
Question 16. Would development of a material resource plan that tracked material by detail (level III) activities be of use in battalion operations ?							

-YES		X	X	X	X	X	*
-NO							
* LIMITED							

Table 4-06 : Question 16 Results

The respondents all replied that such development would be of use (see Table 4-06). Many of the answers were annotated with suggestions and comments for such development. NMCB 1 annotated the answer with the statement, "If COMCBLANT or COMCBPAC provided activities". This suggestion is taken to mean that the activities should be standardized throughout the NCF. NMCB 3's answer was annotated with, "Does this mean tracking material on a time line? If so, it may be helpful but you must always consider what activity is in progress. Long lead items should be ordered when identified. The uncertain delivery schedules cause problems later, but adjustments may be made." Material should be basically ordered well enough in advance of the construction execution to allow for procurement and shipping. NMCB 4 hit on a critical element of material resource planning and possibly the primary reason why currently established procedures are internally adjusted. The following note was made, " But it must have a simple way to be updated and simply show input on activities i.e. crew leaders have got to be able to understand it." Simple to use, update and understand, and the development will have a chance for success. NMCB 40 annotated its answer with, "What we need to concentrate on are items procured in the states. From that we need to look at long lead items such as HVAC equipment and specialty items...". This response provides reinforcement that the long lead items merit a greater share of attention during the material planning phase.

CHAPTER 5 : CONCLUSIONS AND RECOMMENDATIONS

GENERAL OBSERVATIONS

Having reviewed the completion reports for seven battalion construction deployments, reviewed the operating directives and instructions for the battalions, and surveyed the Operations Officers responsible for the construction efforts of seven of the nine active battalions, several observations about Naval Mobile Construction Battalion material resource planning became readily apparent. Like any other construction operation, material availability and utilization attracted a lot of attention and "guidance".

Four facts dominated the investigation. Those being :

- 1) Construction operations undertaken by United States Naval Mobile Construction Battalions are best characterized as small project construction.
- 2) Material resource planning for NMCB construction operations is of particular importance because of the character of the construction.
- 3) The requirement for solid material resource planning is understood within the Naval Construction Force as evidenced in the policy and procedures directives.
- 4) Well established, coordinated, and integrated material planning is not being satisfactorily employed in the NMCBs as evidenced by the responses of the battalion Operations Officers.

CONSTRUCTION CHARACTERISTICS

NMCB construction operations were shown in chapter 3 to be typical "small project" operations. The operations characterized as :

- consisting of a large number of projects, 20 to 50 for a six month deployment;
- projects typically of short durations, 1 week to several months;

- projects employing crew sizes of less than thirty personnel, many times only four or five workers;
- projects generally consisting of only a few paths of execution on the network schedule; a critical path and one alternative path not being uncommon.
- construction being accomplished at relatively remote overseas sites with long logistics pipelines;
- many times the construction occurring in operational environments.

Each of the noted characteristics places demands on the construction material resource plan. The apparent simplicity in size and duration may at first appear to ease the construction management burden, but the opposite is true:

"To those involved with small projects, resource management may seem like a lot of extra work to do something which could be done intuitively. However, it is on the small project that resource management is, by far, the most critical since small projects have very little alternative work that can be done when a lack of labor or materials stops progress. "(20)

The NCF policy of procuring construction materials in the continental United States for utilization at overseas sites establishes a long "logistics pipeline", both physically and organizationally. The vast majority of Seabee battalion construction projects are executed at distant overseas deployment sites. The relative remoteness of the sites to the sources of project material contributes to the physical length of the logistics pipeline. The logisitcs pipeline is also long from the organizational standpoint because construction materials are procured, supplied and shipped in accordance with Navy-wide policies and directives imposed by the Chief of Naval Operations through the Navy Supply Corps. Construction materials

cannot be bought directly from the shelves of hardware stores or local suppliers without going through the Navy supply system.

Projects undertaken in operational environments must be executed in the most expeditious manner. Projects of this nature can only be undertaken with a committed availability of construction materials so as not to cause undue delay or hindrance to facilities receiving the construction effort.

Material resources, however, are the questionable resources; the resource with less certainty of being available when required. Material resources, therefore, must receive that much more attention during planning and execution. Battalion planners must establish the necessary material resource plan to confidently and comprehensively support the battalion labor resource plan, the Deployment Execution Plan.

IMPORTANCE OF MATERIAL RESOURCE PLAN

"Resource planning is based on the inarguable premise that work cannot be accomplished without four essential resources necessary to accomplish the given scope of work : materials, people, equipment, and time." (20) Battalion OPS Officers work with relatively fixed labor, equipment and time. Material cannot be truly considered a known commodity until the material is delivered to the project site. The nature of the construction and the logistics pipeline combine to make project material the most highly variable of the construction resources and also the resource over which

the battalion exerts the least control. The importance of the material resource plan to the success of U. S. Naval Mobile Construction Battalion construction operations cannot be overemphasized.

IMPORTANCE EMPHASIZED IN DIRECTIVE

Material resource planning is not foreign to Naval Construction Force project management thinking. As shown in chapter 4, the importance of such planning is frequently expressed in the instructions and publications that guide NMCB construction efforts. These references clearly emphasize the importance of material resource plans and the need for integrating those plans to the network schedule. Battalion OPS Officers responsible for the actual construction operations of the NMCBs also expressed their understanding of the importance of material resource planning, but they also indicated that actual planning does not reflect adequate emphasis on construction materials. Project materials were noted as creating the greatest constraints on operations.

Instructions such as the "Operations Officer Handbook" and the two Seabee command instructions on project management, COMCBLANTINST 10370.1 and COMCBPAC 5200.1, lay down the foundation for battalion material resource planning. While the NCF instructions provide a solid foundation for battalion material resource planning, the instructions do not specifically outline and define the elements of the plan. The elements for the material resource

plan presented in Chapter 4 were compiled by the author by reviewing the pertinent NCF instructions and publications. This plan, however, cannot be found in any specific location in the references. It was collectively composed from the information contained in all of the sources reviewed and from experience. This collection of elements, nevertheless, contains the ingredients for a superior material resource plan; one which could easily be integrated with the network schedule.

PARTIAL APPLICATION BY THE NMCBS

The responses to the Operations Officer questionnaire survey indicated that the battalions are conducting only partial material resource planning for tasked construction as outlined by the guidance. In responding to a question about the existence of a material resource plan that tied materials to the schedule, five of the seven OPS Officers responded that no plan existed. In spite of the guidance expressing the importance of material planning and, most probably, with the OPS Officers' understanding that material constraints would be their number one concern, many of the battalions are deploying with less than adequate material resource plans. In the cover letter returned with the questionnaire, the Ops Officer for NMCB 74 stated, "We preach tying materials to level III but I did not personally check and it did not happen on last deployment. Crew leaders are supposed to do this in our battalion."

This discussion is not to imply that the battalions are

deploying with out any thought to material requirements. Battalions are clearly identifying material requirements and taking steps to track material status. Material requirements are identified on Material Takeoffs and Bills of Material. There are also attempts to integrate scheduling and material by identifying material associated with specific construction activities. This tracking is done on the Construction Activity Summary Sheets; however, the consistency by which this tracking is accomplished is in question. Material status tracking and updating is accomplished with the two regimental material reports, the Project Status Report and the Project Control Report. These basic elements form the core of the material resource plan and are employed by the NMCBs for the majority of tasked construction. Nevertheless, the questionnaire responses indicate that the elements are not being brought together into a responsive material resource plan by most of the battalions. Consistent battalion level directive appears to be lacking for the material resource plan.

MATERIAL RESOURCE PLAN AS A STAND-ALONE ENTITY

The third objective of this work was to suggest improvements to the Material Resource Plans of NMCBs. There are some areas in the application of planning procedures that have been identified during this research as requiring further attention. It is in the search for improvement in the application of resource planning procedures that the suggestions to follow are made. The importance of the

Naval construction battalion material resource plan to the successful execution of construction tasking has been previously demonstrated. Because of this importance, the Material Resource Plan must receive an increased measure of the attention and effort from battalion planners. Developing the material resource plan should receive, as a minimum, the same level of attention and effort as is directed to the development of the Deployment Execution Plan.

Definition of the Material Resource Plan:

Definition of the Material Resource Plan is a significant contribution to the success of the plan. Defining the limits of the plan, listing the functions of the plan, and outlining the elements that go to make up the plan contribute to the effectiveness of the plan in accomplishing construction tasking. Battalion construction personnel must readily know what the Material Resource Plan consists of and what it is designed to accomplish. At present, battalion planning personnel are familiar with the various elements of resource planning such as the MTO and the BM, the PCR and the PSR, and CAS sheets. However, the consolidation of these elements into a distinct Material Resource Plan is not being fully implemented. From the results of the research it appears that each battalion has its own idea of what planning for the material resources consists of. Unlike the Deployment Execution Plan, the battalion labor resource plan, the Material Resource Plan is

not an entity in itself.

Functions of the Material Resource Plan:

The first, and foremost, step in defining a battalion Material Resource Plan is to clearly identify the functions of the plan. What the plan is to accomplish must be spelled out before the elements of the plan can be brought together into an operating program. A NMCB Material Resource Plan must carry out five functions ; they are :

1. Identify project material resources required.
2. Relate material resources to specific construction activities for which the materials are required.
3. Schedule material resources; level the resources with the construction network.
4. Track material status from identification through utilization.
5. Identify the impact on operations of material delays, shortages, etc.

Naval Mobile Construction Battalion material resource planning presently fulfills the functions of identification of requirements, integration of the requirements with construction activities, and tracking the procurement/shipping status. Completion of battalion Material Takeoffs and regimental Bills of Material clearly identify material requirements, and there are varied attempts to relate those requirements to specific activities by using CAS sheets; the consistency with which this occurs may be of some question. Bi-weekly regimental project material status reports allow the battalions to track project material status from identification through receipt at the deployment site.

NMCBs do not typically carry through on the identification and integration and fully develop a resource schedule, function 3. A resource schedule is a logical result of identifying the resources and relating them to specific activities, but, it involves a great deal of effort and requires constant and continual updating in order to be of any use. Such a resource schedule would help identify constraints while they could still be resolved in spite of the logistics pipeline. The resource schedule would be immeasurably helpful in determining alternative courses of action in the event of unavoidable material delays.

In developing the battalion Material Resource Plan, the battalion Operations and planning personnel must take some important actions with regard to the plan. The Operations Officer must recognize the importance to the successful execution of construction tasking of a sound Material Resource Plan, and this importance must be emphasized to the battalion planners and construction crews. Therefore, the OPS Officer's first major action must be to accord the Material Resource Plan the same attention that he accords the Deployment Execution Plan. This action can be easily accomplished if the OPS Officer defines the Material Resource Plan to himself and to his personnel. Each battalion Operations department should develop its concepts for the Material Resource Plan so as to carry out the five functions listed above. Operations must clearly define the battalion plan to all personnel involved with battalion

tasking and material support. This definition can be accomplished in a battalion construction management manual or instruction. Wherever it is defined, it must clearly be stated that it is the "Material Resource Plan", and it should stand alone as an entity contributing to successful execution of tasking. The battalion Operations department, the battalion MLO, and the battalion construction managers and supervisors must be able to comfortably talk about the Material Resource Plan and each know exactly what they are talking about.

Level of Detail for the Plan:

The most influential decision about the Material Resource Plan that the battalion must make concerns the level of detail that the plan goes into. Obviously, all material resource requirements must be initially identified for procurement and shipment. However, the battalion may decide not to develop a resource schedule for all material resources, and instead, may decide only to develop a schedule for those material resources critical to the level II schedule of each project, material for critical path activities, or for materials that are known to require a long time in the logistics pipeline, long lead CONUS items. This narrowing of attention allows the Material Resource Plan to concentrate attention on those items with the greatest possibility of adversely effecting construction operations.

Material on Site:

Another consideration important to the implementation of a realistic, useable Material Resource Plan is the knowledge of material resources already on site prior to the battalion deployment. Completion of the battalion tasking is based on the execution of tasking beginning immediately upon arrival of the battalion main body after the camp turnover. In order for the battalion to begin tasking, the critical materials for the projects scheduled first must be available on site. The battalion must know this information early in the homeport planning period in order to develop a realistic level I schedule. The battalion can easily improve its situation in this concern by identifying and assigning the battalion MLO Officer and MLO chief going into the homeport period, and allowing them to track material status from the start of the homeport. The MLO Officer and the chief must become fully knowledgeable about the status of required materials long before the battalion deploys. This consideration is supported by the results reported by those Ops Officers who said that MLO personnel were on the job early in the homeport period and fewer problems were experienced.

SUGGESTED FUTURE RESEARCH

This work has been of a base level; formulated to determine if the planning of project material resources was a serious concern for Seabee construction management. This study indicates that construction material resource planning is of the utmost importance in NMCB operations and worthy of continual improvement.

One critical area for continued research is in the development of the NCF Material Resource Planning capability of the SAMM System.

Additional research should be conducted into identifying those specific materials that have historically been hindering construction operations. Developing the listing of specific materials or material groupings that have traditionally been causing delayed operations would give battalion planners a database of information upon which to base early Material Resource Planning decisions. This research could also help to identify procurement/shipment times for specific items to specific deployment sites.

An extremely important project for additional research would be the development and testing of a model battalion Material Resource Plan incorporating the SAMM system with the current material resource planning elements. This model could be tested and monitored for one battalion over two to three deployment cycles. Data could be closely collected pertaining to the status of construction, status of construction materials throughout the period, material delays, procurement/shipment times and the comments of the personnel using the plan.

SUMMATION

This project was undertaken to determine the importance of sound, consistent material resource planning to the successful construction operations of United States Naval Mobile Construction Battalions. Material related delays and constraints are common to most construction efforts, and, as has been shown, the construction operations of NMCBs are particularly demanding on the efficient utilization of project materials. The overall character of the operations requires a determined Material Resource Plan for successful completion of tasked construction. The critical nature of the construction was found to be expressed in policy directives for the battalions and the basic elements for such a plan are in place. NMCB material resource planning is not lacking for procedures or the proper elements. Appropriate procedures are sufficient in the NCF to guide each battalion in developing sound, consistent Material Resource Plans from deployment to deployment. Instead, the deficiency lay with the application of the elements, more specifically, in the lack of consolidation of the elements into a firm, stand-alone plan of action for material resources. Battalion emphasis need not be on developing new or different forms for the material resource plan, but should be on forming the existing elements into a committed and distinct plan that carries out the five functions stated previously.

REFERENCES

1. Barrie, D.S. and Paulson, B.C. Professional Construction Management, 2nd ed. New York: McGraw-Hill, 1984.
2. Brasfield, Charles W. Jr. "SAMM: Computers for the Seabees". Navy Civil Engineer, Fall 1986, pp.24-25.
3. Halpin, Daniel W. Financial & Cost Concepts for Construction Management. New York: John Wiley & Sons, 1985.
4. Kern, Dale R., ed. Engineering and Construction Projects: The Emerging Management Roles. New York: American Society of Civil Engineers, 1982.
5. King, J.R., ed. Improving Productivity. New York: American Society of Civil Engineers, 1983.
6. Neil, James M. Construction Cost Estimating for Project Control. Englewoods Cliffs, New Jersey: Prentice-Hall, Inc., 1982.
7. Nunnally, S.W. Construction Methods and Management. Englewoods Cliffs, New Jersey: Prentice-Hall, Inc., 1980.
8. Spruill, Victor F. and Popescu, Calin, ed. Current Practices in Cost Estimating and Cost Control. New York: American Society of Civil Engineers, 1983.
9. Stock, Molly. A Practical Guide to Graduate Research. New York: McGraw-Hill, 1985.
10. U.S. Navy Department. Construction Battalion Operations. Student Guide. Naval School, Civil Engineer Corps Officers, Port Hueneme, CA, 1982.
11. U.S. Navy Department. Construction Project Management. COMCBPACINST 5200.1. Pearl Harbor, HI, 1982.
12. U.S. Navy Department. Construction Programming, Planning, Material Support, and Cost Control. COMCBLANTINST 10370.1. Washington, 1982.

REFERENCES (continued)

13. U.S. Navy Department. Deployment Completion Reports.
 U.S. Naval Mobile Construction Battalion SEVENTY-FOUR.
 Diego Garcia, November 1977- July 1978.
 U.S. Naval Mobile Construction Battalion ONE.
 Diego Garcia, March 1981- November 1981.
 U.S. Naval Mobile Construction Battalion ONE THREE
 THREE
 Rota, March 1982- September 1982.
 U.S. Naval Mobile Construction Battalion ONE.
 Rota, September 1983- April 1984.
 U.S. Naval Mobile Construction Battalion SEVENTY-FOUR.
 Guam, January 1979- September 1979.
 U.S. Naval Mobile Construction Battalion THREE.
 Guam, April 1984- December 1984.
 U.S. Naval Mobile Construction Battalion ONE.
 Okinawa, December 1984- June 1985.
14. U.S. Navy Department. Military Training. Student
 Guide. Naval School, Civil Engineer Corps Officers,
 Port Hueneme, CA, 1982.
15. U.S. Navy Department. Naval Construction Force Lessons
 Learned Manual. NAVFAC P-399. Washington, 1972.
16. U.S. Navy Department. Naval Construction Force Manual.
 NAVFAC P-315. Washington, 1985.
17. U.S. Navy Department. Operations Officer Handbook.
 COMCBPAC/COMCBLANTINST 5200.2. Washington, 1977.
18. U.S. Navy Department. SEABEE Construction Management.
 Student Guide. Naval School, Civil Engineer Corps
 Officers, Port Hueneme, CA, 1983.
19. U.S. Navy Department. SEABEE Planner's and Estimator's
 Handbook. NAVFAC P-405. Washington, 1983.
20. Westney, Richard E. Managing the Engineering and
 Construction of Small Projects. New York: Marcel
 Dekker, Inc., 1985.

Interviews

21. Neil, Benjamin D., LCDR, Director Military Readiness,
 Naval School Civil Engineer Officers School, United
 States Navy, Telephone interview by Robert M. Carr, 19
 February 1987.

APPENDIX A :
OPERATIONS OFFICER
QUESTIONNAIRE SURVEY RESPONSES

COMPOSITE RESULTS: NMCB OPERATIONS OFFICER QUESTIONNAIRE

1. To which deployment site did your battalion last deploy ?

GUAM	ROTA
PUERTO RICO	SIGONELLA
OKINAWA	

2. Were material delays and shortages prevalent during deployment construction operations ?

YES : 5 NO : 2

3. How would you characterize those material problems :
(Check one)

NUISANCE	: 0
CONCERN TO S-3	: 2
CONCERN TO S-3 HOWEVER PROBLEMS HANDLED INHOUSE	: 3
ENOUGH TO CAUSE TASKING CHANGES	: 3

4. Which period of deployment seemed to have the most problems with material nonavailability :

(Check one)

FIRST 45 DAYS	: 0
FIRST HALF OF DEPLOYMENT	: 3
SECOND HALF OF DEPLOYMENT	: 2
FINAL 45 DAYS	: 2

5. Other than tracking material via the "Project Status Report" or the "Project Control Report", was a system for tracking material status developed within the battalion ?

YES : 4 NO : 3

6. If so, was the material segregated by :
(Check one)

PROJECT	: 2
PROJECT MASTER ACTIVITY	: 0
PROJECT DETAIL ACTIVITY	: 1
SOME OTHER IDENTITY	: 1

7. In the Operations Department which material was tracked ?

ALL PROJECT MATERIAL	: 0
ITEMS CRITICAL TO THE SCHEDULE	: 4
MATERIAL PRESENTLY DELAYING OPERATIONS	: 3
OTHER	: 1

8. Was a material resource plan that tied materials to the schedule developed for the deployment?

YES : 2 NO : 5

COMPOSITE RESULTS: NMCB OPERATIONS OFFICER QUESTIONNAIRE

14. From your battalion experiences, which material group has created the greatest material constraints :

(RATE THE TOP THREE (1 , 2 , 3) GROUPS CREATING PROBLEMS)

	NMCB	1	3	4	40	62	74	133
LUMBER								
DOORS/WINDOWS		2		3				1
FINISH ELECTRICAL					3			3
ROUGH ELECTRICAL			2	1				
FINISH PLUMBING					2			3
ROUGH PLUMBING				2				
DRYWALL/INTERIOR FINISHES								
REINFORCING STEEL								
OTHER								
PAINTS								2
PRE ENGINEERED BUILDING COMPONENTS			3					
PIPE								
PIPE FITTINGS		1					2	
CONCRETE		2						
ASPHALT		3						
HVAC EQUIPMENT			1		1			1

15. What three materials groups would you most recommend tracking :

NMCB	1	3	4	40	62	74	133
1. TIMBER		HVAC	ROUGH	HVAC	NO	DOORS/	HVAC
			ELEC		LISTING	WINDOWS	
2. HVAC		ELEC	FINISH	PLUMB		PIPE	ELEC
			ELEC			FITTINGS	
3. DOORS/			ROUGH	ELEC		FINISH	MECH
WINDOWS			PLUMB			ELEC	

16. Would development of a material resource plan that tracked materia by detail (level III) activities by of use in battalion operation ?

YES : 6

NO : 0

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