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Mobile Deployable Bases and Ports: A Study for Interim Requirements

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MOBILE DEPLOYABLE BASES AND PORTS:

A Study for Interim Requirements

by

William Glenn Moore

Major paper submitted in partial fulfillment
of the requirements for the degree of
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MASTER OF MARINE AFFAIRS

Major Paper of

William Glenn Moore

Approved: _____

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University of Rhode Island
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ABSTRACT

Logistics is an age old problem that has been the key to the greatest victories and defeats in history. Maritime support of wartime land campaigns as well as conflicts at sea, has been the answer to that problem even as far back in history as the ancient Greek Empire. Throughout the ages however the lesson that seems to be learned and relearned, the hard way, is that of logistic support.

Today the United States is faced with what, to some seems to be an overwhelming problem in logistic support overseas, particularly in the maritime transportation and support arena. The U.S. flag merchant fleet is in no position to support even a medium sized conflict overseas. At the same time, our "peacetime" logistic security is continually threatened by the ebb and flow of other "friendly" nations' political attitudes.

One option is the development of deployable mobile base and port structures. In many ways less expensive than permanent overseas basing facilities, mobile bases/ports could be a solution to some of the current maritime logistics woes of the U.S. By providing an alternative to fixed sea/air bases, the above two problems could be diminished. In addition, mobile overseas base facilities could provide military commanders with new strategic and tactical options during a crisis or conflict. They could give new meaning to the term "disaster relief" or even one day provide new economic options for entire nations.

The technology for giant mobile ocean bases exists, but the capability to efficiently produce and use such facilities are still fifteen to twenty years away. In the interim, there is still a need for a mobile base capability. Use of existing offshore construction and mining operations equipment such as various drilling platform designs, giant support barges and floating port construction methods can fill the gap.

There is historic and up to date data on the use of such designs for a multitude of purposes, including those stated above. An analysis of currently available equipment and capabilities can aid in making a choice, but as always cost effectiveness is a major factor in the decision. In this case however, there are high stakes in political costs as well as capital costs.

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CHAPTER I

INTRODUCTION

Purpose

The purpose of this study is to investigate and evaluate some of the alternatives to traditional port construction methods. Currently, the United States (U.S.) is faced with the possible closure of overseas military installations which are vital to its national defense and the security of its allies. Of particular concern in this examination are naval bases and marine terminals which are vital to the logistic support of conflicts in theaters outside the range of direct support from the U.S.

Discussion

There is a great deal to consider in the planning for a maritime/naval base of operations. Besides the physical considerations of location and size, there is also a need to consider the services which are unique to a military establishment. To incorporate all facets of operations into a single unit is a challenge even when there is a large land area to use.

The problem is, however that the land and space is not very often available. This is usually due to the

simple fact that the place best suited to build a base belongs to some other nation. Development of a port within your own territory affords the ability to purchase the land outright. This is not true elsewhere.

The search for oil and gas has moved from the land to points further and further out to sea. This quest has brought about new technologies for exploration, drilling and transportation. It is with these technological developments that the options for developing more versatile and efficient port facilities around the world exist. These facilities will be more secure from the political winds which presently threaten to close existing bases resulting in the loss of millions of dollars invested in their construction. In addition, they will also provide an extra measure of rapid deployment in the case of a natural disaster or hostilities cropping up around the world.

Decisions must be made, however. As the nation's attention turns toward controlling the budget deficit, the costs of any endeavor are of paramount concern. Since in theory, costs are cut by mass production; which one of the methods currently available for base or port construction will be the most versatile and efficient?

The methods under discussion at various levels of government and military organizations center upon three basic offshore platforms as a basis for mobile/deployable

port facilities and military bases. The first is based on the semi-submersible type of drilling platform. The second involves the use of the "jack-up" style of offshore platform. The third design centers around large floating pier structures. This includes the use of giant barges, which are used for servicing offshore operations, pontoon type pier structures and the increasingly popular use of advanced cement technology in the construction of floating piers.

Hypothesis

Recent Department of Defense studies have looked in detail at the possible alternatives to fixed bases overseas. There are a number of organizations providing the technical data for the future of mobile bases. The common denominator in these investigations is that some sort of floating facility is always an option.

It is hypothesized that the offshore service barge or floating pier design can provide the versatility and efficiency required for the purpose of building a mobile base. It is also the least expensive alternative, making it the choice for a large scale effort to build both "permanent" bases overseas and highly mobile, rapid deployment/crisis operations bases.

In support of this hypothesis, a history of the problem and options are first explored, highlighting the

general advantages of the mobile, modular base/port over the fixed traditional facility. Additionally, the engineering concepts of construction for each are also briefly outlined. Comparisons of the three alternative methods of construction are then made, with emphasis on the near term availability and versatility. This is used to make a judgment on which type/style can be most readily available for deployment and provide the most options for operations.

The basic information for this study has been collected from interviews, reports and briefings provided from three basic sources: the Naval Civil Engineering Laboratory, Port Hueneme, California; the David Taylor research Center, Bethesda, Maryland; and the Naval War College, Newport, Rhode Island. Other supporting data and current information has been obtained from various marine related periodicals as well as port and marine engineering reference books. The author has also relied upon personal expertise and knowledge of strategic sealift, operational logistics and naval operations to make a critical evaluation of the options available.

CHAPTER II

U.S. OVERSEAS BASES

Situation

Currently, the United States operates approximately seven hundred bases in thirty seven countries around the world (Figure 1). About one-third of these bases are very small and are of little importance within the scope of this discussion. Of the total, about 500 bases are located in West Germany or the United Kingdom. While most of these should be considered important, they are not at risk of being lost. Of what remains, there exists a number of very important bases located in nineteen other countries, where they may be considered "at risk" of being lost for use at any time (Table 1). U.S. bases in Spain, Greece and the Philippines for example, are under pressure on a regular basis from the host nations' governments. Threats to close bases or reduce basing rights in these and other countries, are the result of either anti-American sentiment, both outside and within the nation's government, or the use of these threats as a hammer against the U.S. to accomplish some political end. Radical changes in a nations leadership quite often results in one or both of the above problems.

FIGURE 1

U.S. Overseas Base Concentrations
(BDM, 1988)

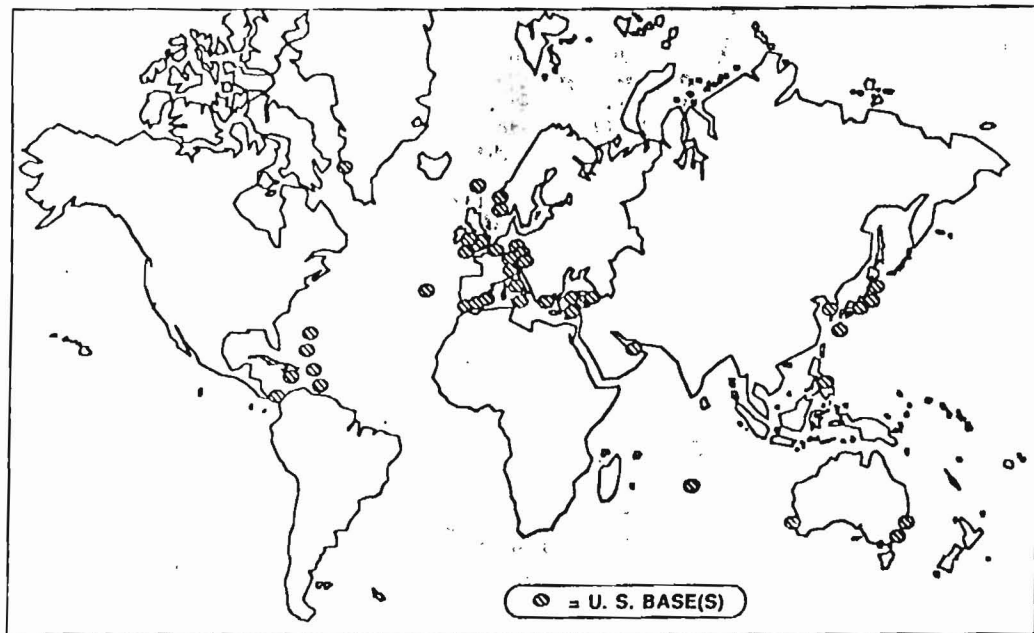


TABLE 1
Countries Considered At Risk for
U.S. Overseas Bases
(BDM, 1988)

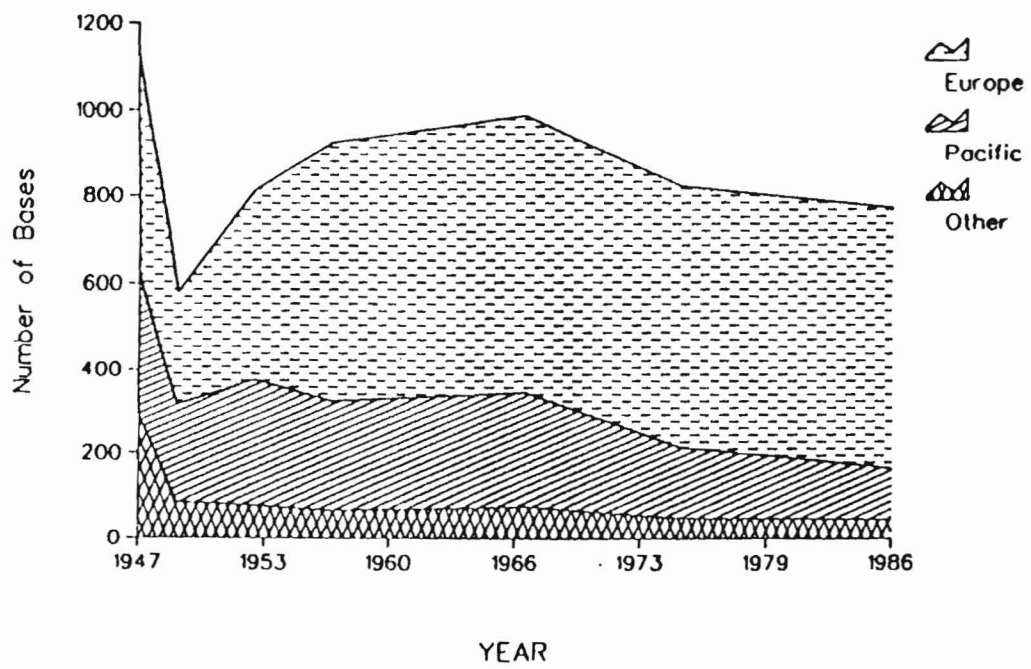
| | |
|------------------|-------------------|
| Antigua | Philippines |
| Ascension Island | Portugal (Azores) |
| Bahamas | Seychelles |
| Bahrain | South Africa |
| Bermuda | Spain |
| Greece | Thailand |
| Johnston Island | Turkey |
| Midway | Virgin Islands |
| New Zealand | Wake Island |
| Panama | |

This dilemma is nothing new. The numbers of U.S. advance bases around the world has been declining steadily since the end of the Second World War (Figure 2). Although the NATO related bases in Europe (mostly northern Europe) have been holding steady, facilities located in the Pacific region and other more remote areas (South America and the Indian Ocean for example) have suffered badly. Recently it has been in these areas that the crises have been occurring, leaving the U.S., and other friendly nations in a position to provide support only in a very expensive and inefficient manner.

The Persian Gulf War was the most obvious example of this situation (Figure 3). Food, fuel, ammunition and other supplies had to be shuttled long distances directly from the U.S. in order to support the U.S. naval presence in the area. The closest U.S. Base in the area is at Diego Garcia, thousands of miles away. So for repairs a ship had either take long periods of time off station to get to that base, or very large sums of money had to be spent to temporarily use very limited berthing facilities closer to the operating area. In the case of regular resupply, food, fuel and ammunition was shuttled from Diego Garcia and the Philippines to the operations area. This was because there was no place nearby where large amounts of these items (especially explosive materials) could be staged from. The ships providing this shuttle service had to operate on

FIGURE 2

Number of U.S. Overseas Bases
by Region: 1947 - 1986
(BDM, 1988)



irregular schedules at very rapid speeds. This required use of a great deal of fuel at great cost.

The provision of effective lines of communication and logistics is dependent on the use of the sea lanes. If, however, there is no port to use either because one does not exist or one has been restricted in its use, then an alternative must be found to open those lines.

The Costs

The cost of establishing a naval/maritime port facility is getting more difficult to determine. The permit and fixed costs are no longer the only categories to be considered. There is also the risk that must be figured into the cost equation.

The political risks are very hard to establish. Would the access to a particular piece of real estate be worth having to deal with a third world dictator? What would be the implications of cooperating with a nation which is not on friendly terms with other allies? These are questions that must somehow be answered.

The risk of base loss is also of great importance. U.S. facilities in Viet Nam were totally lost to the enemy. The naval/air base at Cam Ranh Bay had a large amount of capital invested in it, but there was no way to retrieve the fixed base superstructure. Today it serves not only as a Vietnamese base, but as the forward

deployment location for the Soviet Pacific Fleet.

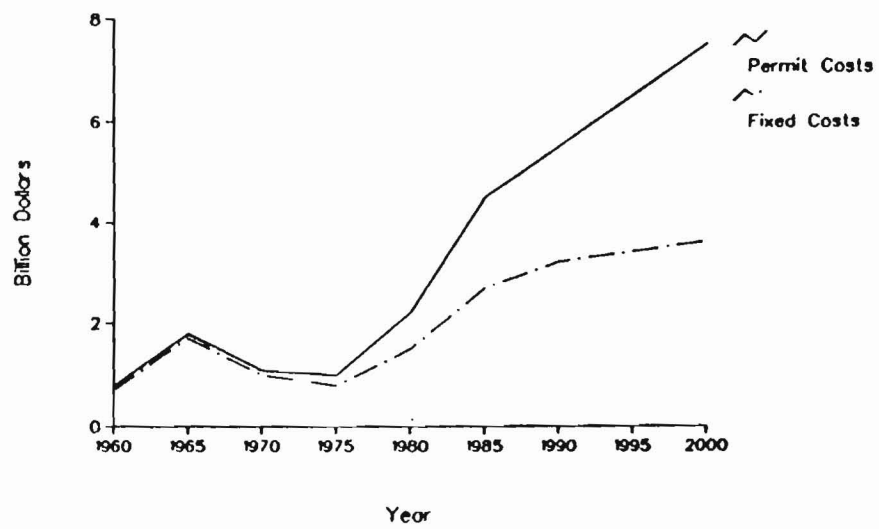
Then there is the price on the quality of life. Providing the services and support to the personnel who work at the facility, military and others, also costs more as the standards demanded by society are met. This is true even without considering the dependents who might be accompanying base staff/work force. Security also figures prominently here. Due to increasing pressure of terrorism around the world, the United States spends ever increasing amounts on personnel and physical security.

In combination with the sometimes extremely high permit costs, which may be exacted by the "host" nation, the construction and procurement costs required to build and establish a new port or naval base are extremely high (Figure 4). Although the simple answer to the loss of a base might be to just replace it elsewhere, the physical movement of a fixed base is impossible and the costs and investments lost by rebuilding on a regular basis should be considered totally unacceptable.

Port Development

In order to adequately discuss alternatives to a fixed base/port facility, it is important to understand how it got there in the first place. A military marine base has a great deal in common with a commercial marine terminal. Both share a great number common operations, but

FIGURE 4
U.S. Overseas Basing Costs
(BDM, 1988)



the purpose in their existence are very different.

The traditional definition of a seaport is as a "terminal and an area within which ships are loaded with and/or discharged of cargo..." (Branch, 1986). This basic concept, although still valid, has expanded in its scope. Today the seaport, more appropriately referred to as an ocean terminal, exists as a link in the overall trade chain. This point in the chain has four basic roles: 1) provision of shelter from the elements; 2) cargo and passenger handling; 3) support services for ships; and 4) a base for industrial development (Branch, 1986).

There is a direct correlation of the first three items above in relation to the roles of a military marine base. The fourth, a base for industrial development, has no direct correlation. The many roles of a base will be discussed further later. At this point it is important to note that the purpose, location and functions of a military base is not related directly to industrial growth. Industries related to the workings of ships and their support may develop around the base, but that is not the driving force in its development.

Further, the choice of location for each has many parallels as well. Political influences, costs, climate, and range of facilities available are all common factors to be considered. Of course the access to sea lines of communication is important to each as well, but for vastly

different reasons. A commercial port seeks to exploit those trade routes, and a military marine base seeks to provide protection.

Developers of each seek to locate near land and air transportation links. This again is for diverse reasons. The commercial facility seeks to become a major link in the trade chain. The base will hopefully become a link in a line of defense which includes military aviation, as well as ground and naval forces.

Finally, the similarities in operational efficiency in U.S. ports and military bases are driven by opposite poles of port management. Both seek economic answers to such considerations such as port layout, equipment purchase and even labor costs are a concern to the management of each. The driving forces which seek those economies are not the same. Traditional control of ports in the U.S. has been through private enterprise. Governmental controls do not exist at a federal level. There are some associated federal regulations which have an influence on port operations, but the port depends on business to survive. That business is attracted by efficient and relatively inexpensive services provided. The military base facility is solely run by elements of the federal government. Marketing the facility's capabilities to attract users is not a concern. Efficiency is considered an important element in readiness and cost

effectiveness is required by the public, which finances the entire operation.

In the final analysis however, costs are the key difference in the development of each facility. For a commercial endeavor to survive, the costs of operation must be outweighed by the return or profit. The profit is measured in currency. The profit gained by the effective function of a military base is measured in perhaps less tangible, although probably more important, scales. For this reason the two are not considered compatible (Hedden, 1967). There are a number of ports around the world, developed commercially, which are used by the military. In most cases, this dual use is simply as vessel berthing space or for supply purposes. Military occupancy may tie up berthing, transit shed or warehouse space. Other buildings may be required for use as barracks for security force or other personnel. If this space is not required for the normal operation of the port, it may not be a problem, but most ports are planned with operational peaks in mind. When the military occupancy interferes with that, it inhibits the overall function and development of the port. At the same time, a congested harbor and shore services are not conducive to military readiness. Separation of planning and development becomes a necessity for both.

Alternative Definition

In order to develop a set of alternatives to fixed bases/port facilities to choose from, the functionality of a base must be established. Although this study is centering on maritime oriented support, the general categories of base functions will be applied (Table 2). These functions may at first appear to be strictly military in nature, but it must be noted that the term "national defense" does not always directly translate to the term "military". A commercial maritime port will incorporate all but one of these functions as well.

Perhaps the most outstanding functions are the three Cs: Command, Control, and Communications. These functions are the key to the integration of all other functions. Administration of information, equipment and personnel is also a coordinating function. Operations and Logistics involve planning, staging, employment, deployment and support for the base itself, as well as the supported mission. Life support includes security, utilities and quality of life. Political functions are not always easy to determine or to implement, but some come naturally. This includes symbolic presence, representational duties, support to the host nation, public affairs, and cover for other activities. Miscellaneous functions might include research or disaster relief.

The one function that is perhaps most military

TABLE 2

Base Functions
(ADTECH, 1987)

| | |
|----------------------------|------------------------------|
| <u>Command</u> | <u>Logistics</u> |
| <u>Control</u> | Planning |
| <u>Communications</u> | Staging |
| <u>Administration</u> | - Warehousing |
| | - Assembly |
| | - Material Handling |
| | - Transport |
| <u>Operations</u> | Supply (All Classes) |
| Planning | Maintenance (Drydocks/Shops) |
| Staging | Transportation |
| Deployment | Housing |
| Employment | Utilities |
| Sustainment | Host Nation Support |
| Training | Medicine |
| Engineering | - Care |
| Construction | - Evacuation |
| Special Operations | - Supply |
| Psychological Operations | Construction |
| | Security Assistance |
| | Embassy Support |
| <u>Intelligence</u> | <u>Life Support</u> |
| Collection | Security |
| Control | Utilities |
| Analysis | Hotel |
| Production | Logistics |
| Dissemination | Quality of Life |
| Surveillance | |
| Liaison Operations | |
| Cover | <u>Miscellaneous</u> |
| Weather | Research and Development |
| <u>Political</u> | Test and Evaluation |
| Symbolic Presence | Requirements/Needs |
| Advisory Duties | Generation |
| International Negotiations | Disaster Relief |
| Representational Duties | |
| Public Affairs | |
| Support to Host Nation | |
| Cover for Other Activities | |

oriented is Intelligence. Although weather data collection is one sub-function, the collection, control, analysis, production and dissemination of various types of intelligence gathered through surveillance and liaison operations, is the raw purpose of a base's Intelligence functions.

In order to incorporate all of these functions into one package, the base facilities must be extensive. This obviously requires sufficient acreage to incorporate the appropriate superstructure. The need for access to the sea is the unique requirement for the naval/maritime base. This increases the monumental costs of a base establishment further still. The insurmountable obstacle of dealing with these costs while continuing to provide the functions necessary is at the least, difficult. If one add the risk of losing that huge investment, it might be difficult to generate the interest in starting such a project.

The risk can be significantly reduced by making the port mobile. Unfortunately, mobility has its own costs. Until recently such costs, brought on by the trade off of durability for for mobility, have been difficult to deal with. Since the Second World War, however, there has been a giant leap in the technology of stable ocean platforms, resulting from the search of hydrocarbons beneath the ocean bottom. Additionally, modular construction

techniques, initially developed during the war, have also advanced in leaps and bounds. Finally, the development of marine vehicles capable of lifting and/or moving extremely large and heavy cargoes (such as the modular ocean platforms indicated above), completes the list of advancements which can overcome most of mobility/durability trade off costs. Of course, not every option can attain the maximum degree of performance in all categories of consideration, but a nominal degree of efficiency is probable.

CHAPTER III

MOBILE BASES

History

There are perhaps countless examples of offshore facilities (floating or otherwise) all around the world. Giant floating oil production rigs are commonplace in the North Sea and the Gulf of Mexico. As time goes on, technological advances in anchoring capabilities and station keeping propulsion systems allow for these huge facilities to operate in deeper and deeper water. The Persian Gulf as well as the Gulf of Mexico are littered with an assortment of free standing oil production rigs as well. A variety of methods have been used to position them. Either floated out on barges or on self-contained buoyant floats, they rest on the sea floor and rise ten to twenty meters above the surface. These oil production platforms provide long-term platforms for large scale industrial projects.

In most cases, these examples illustrate only a limited amount of the rapidly growing technology that exists to assemble a fully functional mobile base/port facility. The knowledge gained from the operation of these many examples will provide a starting point for the

development of some very flexible, multi-purpose, mobile base construction projects.

The current growth of offshore facilities is not new and certainly did not pop up out of nowhere. On the other hand, the very recent growth in marine construction technology certainly accounts for the dramatic increase in the size and scope of the facilities currently in operation.

In the case of mobile support of military operations, World War II provides the backdrop for the initial development of offshore, mobile bases. Throughout the war in the Pacific Ocean, the "Island Hopping" campaign required a dynamic logistics and maintenance/repair infrastructure. Otherwise allied naval forces would have faced the threat of extended lines of communication being cut. Underway replenishment of warships helped the effort, but floating bases consisting of barges, modular preconstructed piers and highly specialized ships (i.e. repair and hospital ships) provided the replenishment ships a base of operations close to the battle zone. This conglomeration of support capability was usually maintained inside an island harbor or atoll lagoon to provide protection from the elements.

In the Atlantic and European theaters, invasion plans called for the ability to move large quantities of supplies over the beach-head after the initial assault.

With no port facilities to use in the assault area, alternatives had to be found. The "Mulberry" was one of those ideas. A pier facility that could be floated across the English Channel to the Normandy beach-head, it would be anchored in place by self-contained steel pilings. One of them was lost in a violent storm just a few days after the Normandy landings, but another still stands today as a monument to the conflict.

The "Mulberry" concept is the basis behind the Army's Delong Piers, of today. Floated into place, they provide a temporary pier facility in a crisis situation. During the Viet Nam War, the Navy used barges and support ships anchored together as bases for riverine and coastal patrol boats. Support ships would move to the site of operations far away from base logistics and maintenance support.

More recently, during the "Tanker War" in the Persian Gulf, the U.S. Navy used large offshore construction support barges as a base of operations. Modified with prefabricated shelters, armor plating, landing platforms and other equipment, this base was used to counter mining, small boat, and other operations by Iranian naval forces. Moving the location of this floating base on an irregular basis, countered the targeting of land based missiles (Miller, 1989).

The Falklands/Malvinas conflict recently set the stage for perhaps the most ambitious project of its kind

to date. In a matter of five months, a completely self-contained base/port facility was constructed at Port Stanley. The barge based structure (Flexiport) provides a cost effective way to support the requirement for an alert military posture (Tsinker,1987).

Besides offshore oil and gas operations, there are also several other large non-military oriented port facilities around the world. Some of these structures are not new and all are examples of more long-term facilities.

Until recently, the world's largest and perhaps the oldest floating dock was the passenger wharf in Liverpool, England. It was built in 1874 and was about 756 meters in length and over 24 meters wide. Flotation was provided by a number of steel pontoons. This was replaced in 1977 by a new concrete floating pier, due to high operational and maintenance costs. The new structure was 350 meters long and 19 meters in width. Each of the six concrete pontoons, joined together to form the pier, were constructed in Dublin in only 35 days (Tsinker,1987).

In Tilbury, England, another ferry/cargo pier, similar to the original Liverpool wharf is still in operation. Slightly newer and smaller this facility handles ocean going cargo ships as well as passenger/vehicle ferries.

The Soviet Union also uses steel and concrete floating pontoon piers for the Dnieper River ferry services. This provides a structure flexible enough to

withstand the onslaught of river, tidal and ice forces.

In Valdez, Alaska, floating pier facilities were the answer to many problems. Steep sloped harbor bottom contours made fixed piers impractical and potentially dangerous. On one side of the bay is Berth One of the oil loading port. The 118 meter long, steel loading pier is supported by 13 double-shelled buoyancy tanks. The pier is used to load supertankers up to 125,000 dead weight tons (dwt) (Tsinker,1987).

Across the bay, or rather in it, lies the Valdez container terminal. The storage area is mostly land fill, but the pier and working area is of the floating concrete design. The 213 meter long, 30 meter wide structure was transported over 2500 miles in just two sections. The wharf is not only capable of handling large container ships and barges, but it also supports a 40-ton container crane as well. The facility regularly accommodates Lo/Lo and Ro/Ro operations (Tsinker,1987).

There are other examples of floating facilities in Iquitos and Pucallpa, Peru, as well, and in Brazil a pulp processing plant with its own port facility was built offshore recently. On the recreation front, a complete resort hotel was built on a barge and towed to the Great Barrier Reef off of Australia for patrons interested in underwater excursions for relaxation. Back in the oil industry, the Louisiana Offshore Oil Port facility (LOOP)

was completed in 1978. Designed to moor and offload supertankers away from shore, LOOP is an outstanding example of deepwater anchoring technology. All in all, an impressive list of very successful operations.

Mobility

Mobility appears to be the solution to all the problems. Political restrictions such as limitation of basing rights, constantly changing political climates and expensive forward basing of troops, are reduced in level of concern. High investment costs are reduced through modular preconstruction methods. Actual construction time is also reduced, especially at the base site. There will be reduced need for site preparations such as channel dredging, foundations or land grading. Once considered nonrecoverable assets, pier facilities, landing pads and buildings can now be moved to new or more desirable locations.

Flexibility

Offshore bases of any kind must be flexible. There must also be an ability to adapt a mobile facility to changes in its employment. Moving a base of operations as part of an advance plan or as an unplanned contingency involves the possibility of relocating to a considerably different area. Therefore, flexibility is the key to

mobility. This is not to say some facilities can be assembled for an arctic climate and perhaps others for more tropical areas. What is important is that a basic design that is in use in one place can be used in other places as well.

Also, not every location in the world is a potential site for an offshore base/port facility. On the other hand, a review of the various facilities now in operation indicate that a larger portion of the world's shorelines are potential port sites. The grade of the harbor bottom or the availability of level ground for efficient aviation operations may no longer need to be a cause for concern.

Construction

In all cases, the majority of construction for a mobile base can be done at a location other than the base/port site. This has many benefits.

Since the construction might be done at home, there could be a tremendous benefit to the U.S. shipbuilding industry, which is in need of a boost. This leads to investing money in the domestic economy and not possibly losing it. Even not considering the aspect of investment recovery, this is a very positive side effect.

Although the construction of most offshore facilities currently occurs outside of the U.S., the technology and methodology for the construction is readily available in

this country. The purchase of already constructed structures for the purpose of modification to base/port modules can further decrease costs. The recent slump in oil and gas production around the world has left such useful structures sitting idly, awaiting use.

Having construction occur outside of the U.S. is still an efficient option. Since the building of a fixed port can end up being slaved to the host nation's capabilities, competitive methods are limited. Finding the most economical construction yard opens the door to further cost reduction and increase in quality.

If the host nation has no capability to support port construction, then expensive transportation of raw materials and labor to the site must be used. A mobile base/port facility would require only a limited amount of logistics support during installation.

Transportation

Currently, this kind of mobility can only be accomplished via marine transport. Only movement over the seas can provide the transport of the massive modular units that are required. This capability exists now in the form of free floating modular units and super/ultra-heavy lift vessels (barges and ships). The ability to move a complete basing facility and have it operational in a matter of a few months not only exists on paper, but it

has been accomplished.

More specifically it should be noted that the need to move large modular units from point to point also arose from offshore oil and gas requirements. The huge drilling/operations platforms sometimes had to be moved to opposite sides of the globe.

Initially, these structures were towed from point to point, while free floating. Costs began to rise dramatically as the distances grew longer. This was due to the additional structural support that was required to protect the units from the elements and insurance costs that are always much higher for tug and tow transportation (MAR, 1987 #1).

The revolution began with the semi-submersible barge and moved on to semi-submersible ships. These vessels lift the unit out of the water, and welded brackets secure the structure to the deck. Sizable reductions in insurance and construction costs are obtained. In addition, transportation time is slashed. A job that might take 90 days to accomplish by towing is cut to a little more than 30 days by using a semi-submersible heavy lift ship. Cargoes towering over 100 meters into the air and/or extending twice the width of the transporting vessel can be moved in this fashion both inexpensively and efficiently (MAR, 1987 #1).

There are 18 of these ships currently in operation in the free world with the capability to support transportation of offshore base/port facility modules (Table 3). These ships, in addition to numerous heavy lift barges have the potential to provide a mode of transportation for larger permanent facilities and "rapid deployment" of prepositioned contingency facilities. The ability to locate a port facility on short notice, in a remote area of the world to support a disaster relief effort or an amphibious assault multiplies the chances of success for both (Harris, 1973).

TABLE 3

CHARACTERISTICS OF SEMI-SUBMERSIBLE SHIPS:

By Operator, Flag and Number of Units
(MAR, 1987 #1)

| SHIP NAME | DIM(ft) LOA/Beam | DRAFT(ft) Trns/Sub | DECK SUB(ft) | SPEED (kts) | CARGO CAP(kt) |
|--------------|---------------------|-----------------------|-----------------|----------------|------------------|
|--------------|---------------------|-----------------------|-----------------|----------------|------------------|

OPERATOR: American Automar (Flag: U.S.) 1 unit

| | | | | | |
|-----------------------|---------|-------|----|----|------|
| American Cormorant | 738/135 | 34/65 | 26 | 16 | 47.0 |
|-----------------------|---------|-------|----|----|------|

OPERATOR: Dock Express (Flag: NL) 4 units

| | | | | | |
|----------------------------|--------|-------|----|----|------|
| Dock Express #s 10 - 12 | 505/89 | 29/39 | 16 | 16 | 12.8 |
| Dock Express # 20 | 556/90 | 29/39 | 16 | 15 | 14.1 |

OPERATOR: Dyvi (Flag: NO) 4 units

| | | | | | |
|--------------------------|---------|-------|----|----|------|
| Swan/Swift/ Teal/Tern | 593/106 | 32/68 | 24 | 16 | 24.5 |
|--------------------------|---------|-------|----|----|------|

OPERATOR: I.T.C. (Flag: NO) 1 unit

| | | | | | |
|------------------|---------|-------|----|----|------|
| Sibig Venture | 728/138 | 31/64 | 23 | 15 | 43.1 |
|------------------|---------|-------|----|----|------|

OPERATOR: Wijsmuller (Flag: NL) 8 units

| | | | | | |
|---------------------------|---------|-------|----|----|------|
| Super Servant #s 1,3,4 | 456/105 | 21/48 | 19 | 15 | 13.9 |
| Super Servant #s 5 & 6 | 465/105 | 20/48 | 19 | 15 | 13.1 |
| Mighty Servant 1 | 525/132 | 31/65 | 26 | 15 | 21.2 |
| Mighty Servant 2 | 553/132 | 31/65 | 26 | 15 | 22.8 |
| Mighty Servant 3 | 591/132 | 31/65 | 26 | 15 | 24.3 |

Notes: DIM - Dimensions (kts) - Knots
 LOA - Length Overall (kt) - kilotons
 Trns - in transit configuration (ft) - feet
 Sub - in submerged configuration
 SPEED - Maximum Speed
 DECK - Cargo Deck Depth

CHAPTER IV

OPTIONS FOR MOBILE BASES

Overview

Current strategic planning recognizes the need for mobile support bases for future conflicts. There are numerous recommendations for the eventual design of mobile ocean bases that provide a complete spectrum of support facilities. This includes stable ocean platforms capable of fixed wing aircraft operations as well as maritime facilities (Figures 5 through 7). The goal is to have an operational capability at this level by the year 2010 or beyond (Lin, 1973). This study will not, in any way try to deal with this effort. The capability to accomplish this is well documented and its actual outcome depends on the political winds within the U.S. rather than in the regions of concern.

The concern herein is to look at the situation as it now stands and how to deal with the short-term problem of basing rights. With this in mind, there are three basic design options for a mobile overseas base/port program to be considered. These are: 1) the semi-submersible offshore platform; 2) the "jack-up rig" platform; and 3) the barge/floating pier design. Although there may be other designs,

FIGURE 5

Mobile Ocean Basing System Concept (MOBS)
(BDM, 1988)

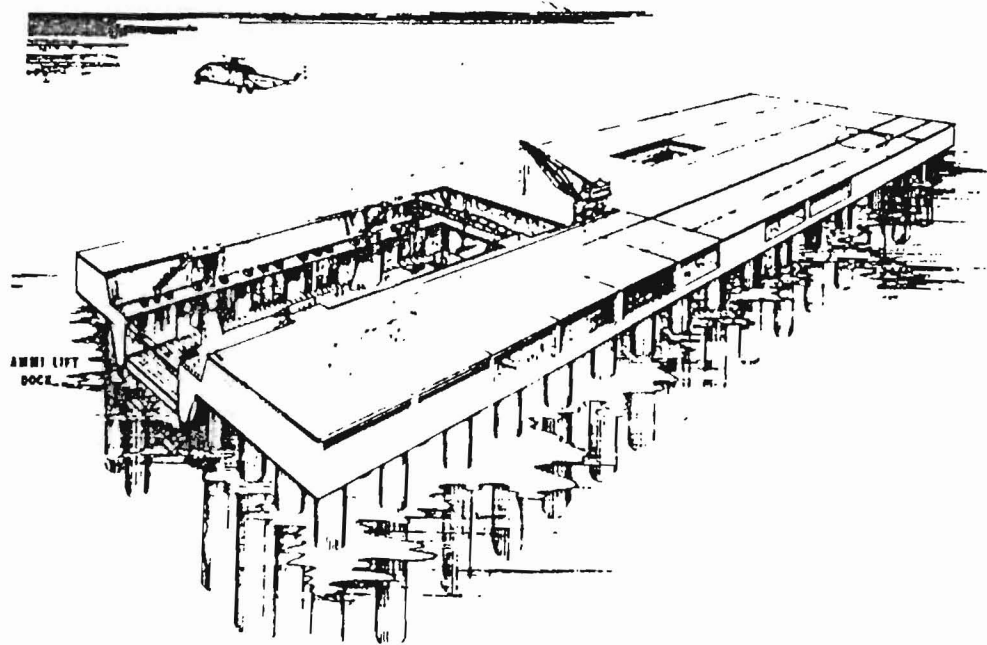


FIGURE 6
Mobile Operational Large Island Base (MOLI)
(BDM, 1988)

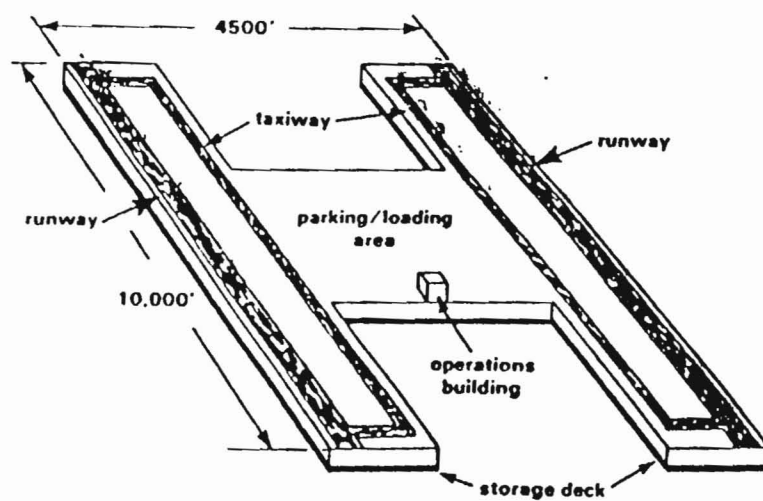
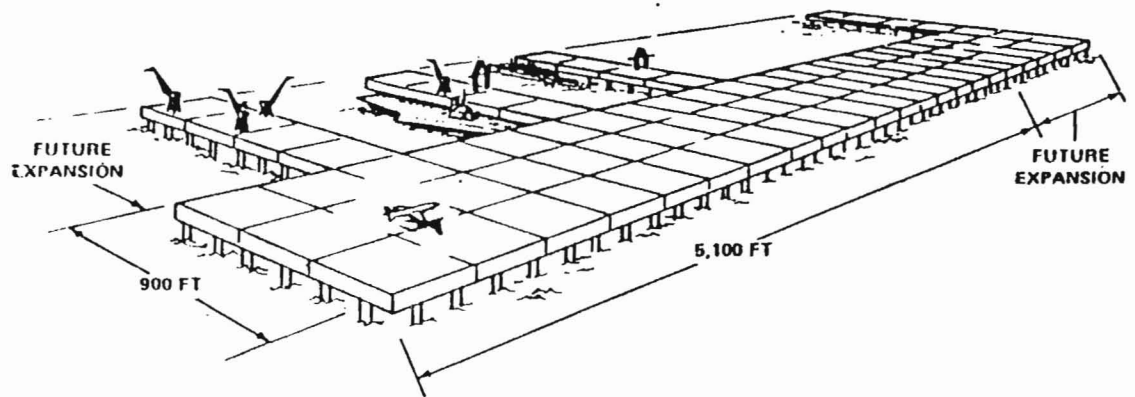


FIGURE 7

Stable Ocean Platform
(Lin, 1973)

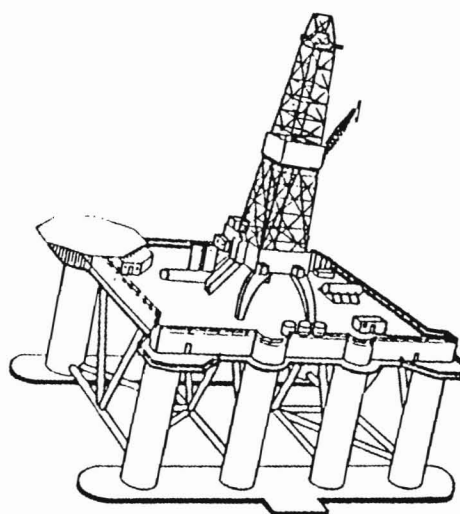


they are all basically variations or combinations of the above listed structures. More advanced designs have to be considered for the long-term, but are not available now for rapid development and deployment. The efficiency of these three basic designs is of concern here. All three are proven to be capable of supporting large scale mobile facilities. A comparison of these designs provides the basis for selecting an "off the shelf" design to modify as required and deploy rapidly. The selected design could be available for immediate use as both a long-term base of operations and port facility, and as a temporary support base for contingency operations, both civilian and military. Furthermore there must also be a solid ability to sustain this role until the ocean basing project can fully assume the responsibility for these missions. This could result in a 20 to 30 year life expectancy.

Semi-submersible Platforms

The semi-submersible platform (Figure 8) is a popular design for the exploration for oil and gas beneath the ocean floor. It provides a stable platform in deep water through the use of large ballast tanks in the bottom. When partially filled, these tanks provide the buoyancy to maintain the work platform well above the surface waves. At the same time, the ballast tanks "float" far enough below the surface to not be affected by the relatively

FIGURE 8
Semi-submersible Platform
(Rona, 1988)



chaotic motion at and just below the surface (Rona, 1988).

Larger platforms can support the drilling operation by housing dozens of workers and support personnel. Literally a floating town, all the essentials are provided for. A helicopter platform provides for the primary physical link to the outside world, but ferries and work boats are also able to moor.

Maintaining position is accomplished through the use of lines moored to the ocean bottom or by some sort of station keeping systems that uses propellers or water jets to maneuver the platform in place. Anchoring provides the only limit to the depth of the water where this structure may operate (BDM, 1988).

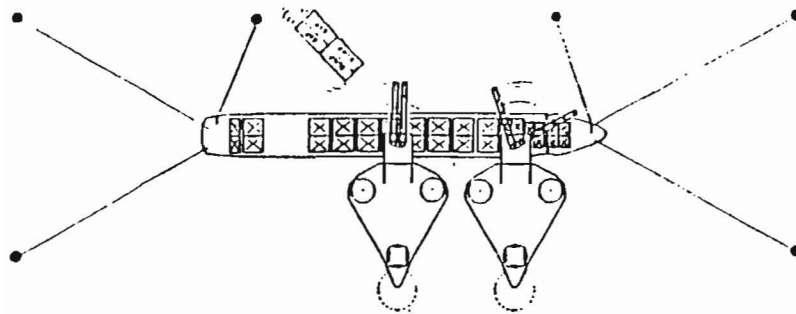
Jack-up Rig

The jack-up platform (Figure 9) provides the same capability to support the drilling operation. This structure is held above the surface of the ocean by legs (usually 3). This of course limits the depth of water in which a particular platform might be able to stand.

After being floated out to its site, the legs, until now rising hundreds of meters into the air, are cranked down until they touch the ocean floor. The platform is lifted out of the water by continued cranking of the legs providing a very stable working platform.

FIGURE 9

Jack-up Rigs Port Facility
(BDM, 1988)



Since the jack-up rig is free standing there is no requirement to keep it in place. An anchoring system may be employed for safety reasons however, but this will not actually affect the location of the platform beyond the limit of the legs (BDM, 1988).

Barges/Floating Piers

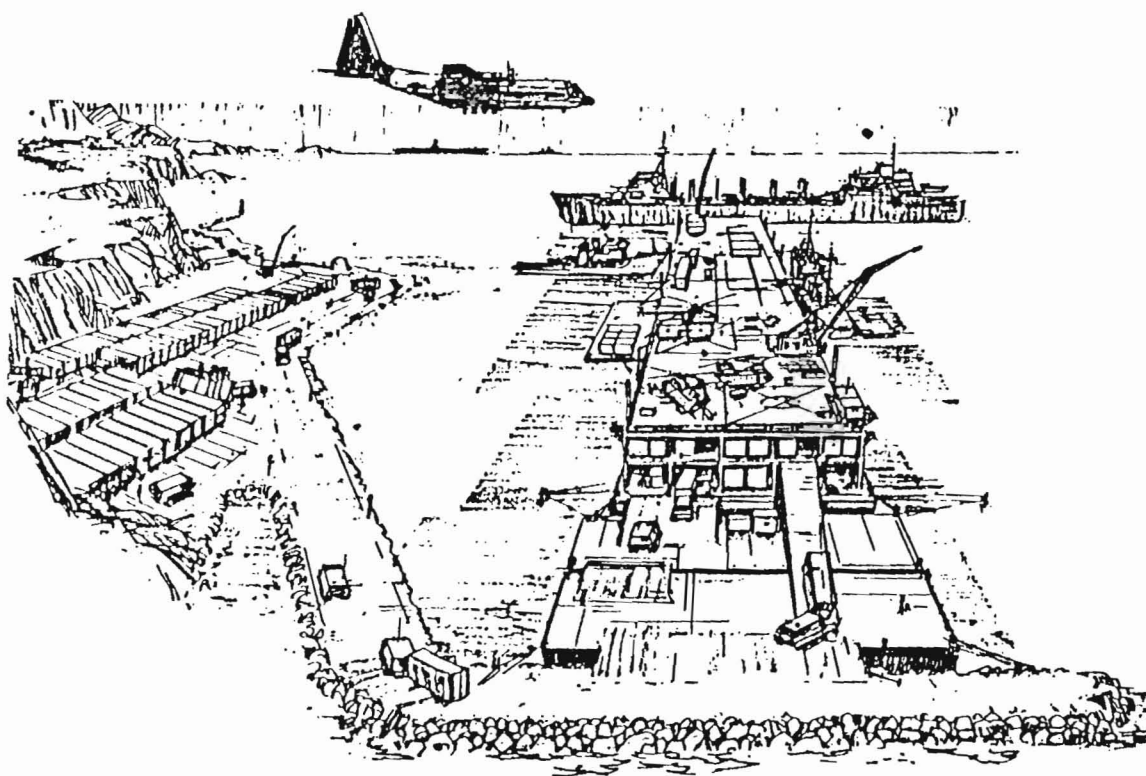
Use of a barge or a specifically constructed floating pier structure (Figure 10) for an operation is the third option. Very large offshore work barges are designed to transport and support heavy equipment to be used in offshore projects. Specifically constructed to withstand the harsh conditions on the open sea, the offshore work barge floats on top of the water. Due to its massive size and bulk, it provides a semi-stable work platform, even in rough weather.

Floating piers can be assembled through the use of these barges as well as be specifically constructed to meet any need. The use of either or both of these designs provides a platform that can be both moored or anchored in place (Rona, 1988).

Barges of this type have been modified to do many jobs from transporting various cargoes to supporting a variety of projects. Since this work requires the movement of often very heavy loads through sometimes harsh environmental conditions, support of an operations base or

FIGURE 10

Barge/Floating Pier
(Lin, 1982)



port facility is well within the capability of these barges. Various types of floating piers are in use throughout the world today (see Chapter III - History), providing reliable and usually inexpensive port facilities everywhere they are employed. Both variations, used separately or together, can provide another accessible design for a mobile base.

CHAPTER V

LOGIC FOR ANALYSIS

Objective

The purpose of this analysis is to compare the three basic concepts described in Chapter IV, on the basis of three criteria. These are: mobility, flexibility and cost. Two scales were used to judge all factors. They are: 1) use as a long-term base/port, and 2) for a contingency operation.

Mobility is judged on transportability and availability on short notice. Transportability is simply the ease with which each design can be transported to the assembly site. Availability scoring reflects the ability of each design to be deployed and/or redeployed, as well as the expediency with which this may be accomplished.

Flexibility scoring is based on several subsets. These are: 1) location, 2) mission, 3) environmental, 4) supportability, and 5) overall physical capabilities. The primary consideration for location flexibility is the judgment of how many locations a particular design might be used. Mission flexibility is a function of how many different missions might be fully supported. Environmental considerations include the adaptability of a design for

use in an assortment of climatic regions. Supportability considerations factor in the options available to logistically support the base. Overall physical capabilities include consideration of the actual construction and/or modification efforts that may be required to build the design and/or update it for the requirements set upon it.

Cost factors considered are both the political and capital costs for the construction and use of each design. Political costs are a judgment of the effort required to make use of a the design as required (this includes: level of negotiation overseas and popular support at home) and the gains that might be accomplished once that design is in use. Capital costs include the consideration of all factors that influence the actual amount of money spent to construct/modify, transport, store and use the design.

Grading

All factors are "graded" on a scale of zero (0.0 - poor) to four point zero (4.0 - best). These scores are recorded on Table 4 at the end of Chapter VI. In addition to a factor by factor comparison of scores, the table also reflects an overall score for each design.

All scoring areas are not given equal consideration however. Mobility is the primary factor in this analysis. It is important to note that in order to overcome the

drawbacks of fixed port/base facilities, the alternative must be as mobile as possible. If the facility cannot be moved with relative ease, it is not capable of fulfilling the missions which may possibly arise.

Of secondary importance is the flexibility of the unit(s). The ability to adapt to any situation is vital to the success of a mobile facility. Less variation reduces the number of choices, which in turn reduces the complex analysis required for making a decision. This is an economy of time and effort.

The tertiary concern is the cost factor. Although political costs are considered as well as capital, it is important to note that when a crisis arises the costs become manageable. Crisis management negotiations are one of the most expedient of political concepts. There is always a quick way to solve a problem in ideology when lives are at stake. Additionally the financial burden is put on the "back burner" to be figured out at a later date.

For these reasons grading of each area of consideration are calculated in percentages of the overall grade. Mobility is assessed as 45 percent (45%) of the final score. Flexibility is assessed as 35 percent (35%), and Costs will be 20 percent (20%) of the overall grade.

Scenarios

Scores, although subjective, are not arbitrary. Judgment of each design is based on consideration of each factor in relation to four hypothetical scenarios which reflect the two scales of measurement discussed earlier, long-term use and contingency operation. These four scenarios, outlined below, reflect fictional future situations which are based on current events. They were created solely for the purpose of this study and are not based on any form of military plan or governmental strategy. They only provide for various situations that might occur and provide a use for a mobile base/port facility.

Scenario A

The political atmosphere in the Philippines has forced the government, up until recently supportive of U.S. base facilities, to severely limit U.S. basing rights. One of the primary facilities to be shut down will be the naval facilities at Subic Bay. Given one year to scale down the U.S. military operation there, a new or at least temporary repair and supply facility must be found for U.S. Seventh Fleet units.

One option has been offered by the government of Singapore. Harbor and administrative space would be provided on long-term lease basis for a period to be

negotiated. Although there is more than adequate facilities available, the up front terms of the deal indicate that this option will be very expensive. Finally, despite the stability and friendly nature of the present government, there is no guarantee how the U.S. presence will affect that view.

The second option is to construct a facility at Guam. This will be a massive project however, and under normal circumstances could take many years before a facility could be in even limited operation. This is due to the very limited repair and support superstructure currently in place there.

Scenario B

The U.S. has been offered basing rights in the south african nation of Namibia. That country's young government is trying to fend off the growing support for a foreign backed guerrilla group. It is believed that the presence of U.S. military in the country will solidify the government's position and that the hard currency from the base leases and the probable labor requirement will help bolster the economy.

The U.S. is anxious to take advantage of this offer in the expectation that the Namibian government's plan will succeed. Not only will this give the U.S. direct access to the South Atlantic, but it provides an opportun-

ity to offer a sampling of good will to the friendly nations in the area while putting pressure on the others trying to expand their influence through covert actions against their neighbors.

Scenario C

The "drug war" in Columbia has raged on. That nation's government, in an effort to escalate the pressure on the drug cartels has requested, among other military aid, direct U.S. Navy and Coast Guard support along the coast. This is expected to drastically reduce the flow of weapons to the cartel forces who have organized effective special forces type military units in the jungles.

The request for aid includes an offer of basing rights and support on a temporary basis. It is not thought however, that use of Columbian harbor/base facilities would be prudent. Besides the lack of sufficient facilities to support an effort in such scale, it is not believed that security there would be adequate since Columbian military units are believed to be well infiltrated by cartel informants and operatives.

Scenario D

A violent earthquake and resulting mud slides have devastated many cities and towns in South America. Hardest hit has been the nation of Peru. The government,

traditionally weak in the rural areas, has accepted an offer of U.S. relief aid in the crisis. Neighboring countries are busy responding to their own disaster relief projects and can provide no assistance to the Peruvian government.

The damage extends to the few seaside towns in the country, leaving virtually no place from which to stage the rescue effort. The remote villages perched upon the massive mountains or buried in the dense jungles make access via both the air and ground difficult.

COMPARATIVE ANALYSIS

CHAPTER VI

Analysis: Mobility

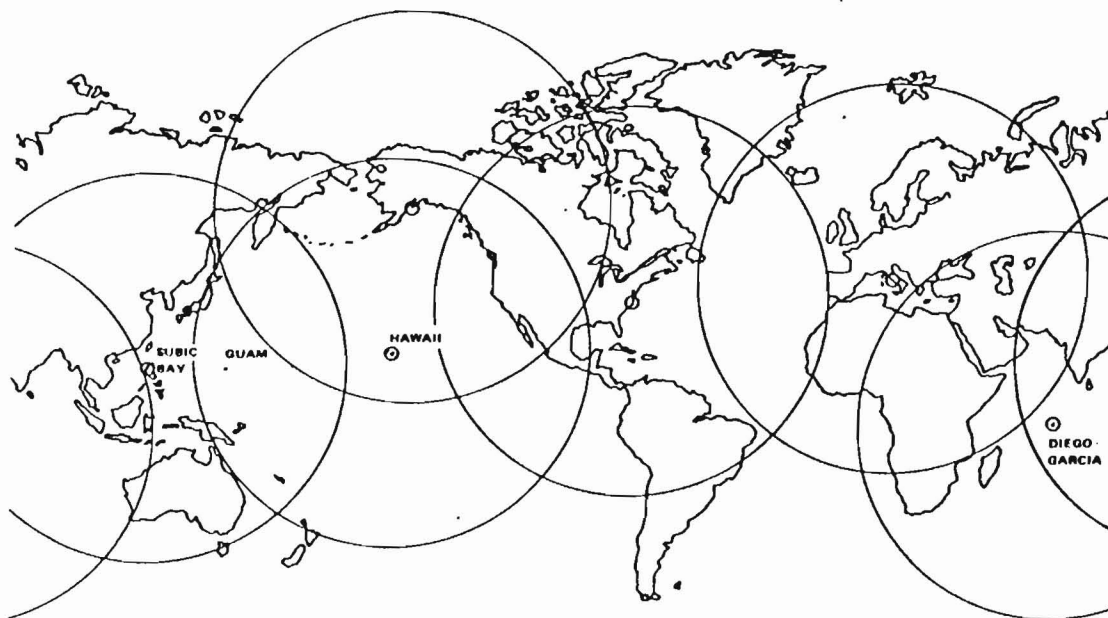
All three designs are capable of being transported as modules, in three ways. Each can be towed directly through the sea, towed on a barge across the sea or ferried across aboard a heavy lift ship. In the case of the ship or barge, the primary choice is use of a semi-submersible vessel. Towing directly through the sea is the least desirable of the three options (Figure 11). This is because of the risk of damage from heavy seas (this will also figure into the cost evaluation later).

Within this option however, it is clear that use of the barge/floating pier design is much more desirable since these structures are in fact constructed to withstand the seas. The jack-up rig design is not intended for long haul towing. In this mode of transportation it is not very stable. The semi-submersible rig, although quite stable in its partially submerged state, is not efficient. This is due to the mass of the structure under the water, which puts a tremendous drag force on the towing vessel. In this condition, a very powerful tug must be used, decreasing the options of tow vessels available, and the

FIGURE 11

Deployment Flexibility:
Towing vs. Semi-submersible Ship
(MAR, 1986)

Transit Radius:
14 Days for Towing
8 Days for 16 Knot Capable Semi-submersible Ship



speed of the tow is dramatically reduced from an already slow pace. In the full float condition, the semi-submersible rig is only slightly more stable than the jack-up rig.

Transport aboard a semi-submersible barge or ship is the more efficient means (Figure 12). Here again however the considerations favor the barge/float pier design. All three designs when loaded in this manner overhangs the sides of the carrying vessel, sometimes by hundreds of feet. In the case of the jack-up and semi-submersible rigs however, the height above the deck adds to the stability problem during loading, transport and unloading.

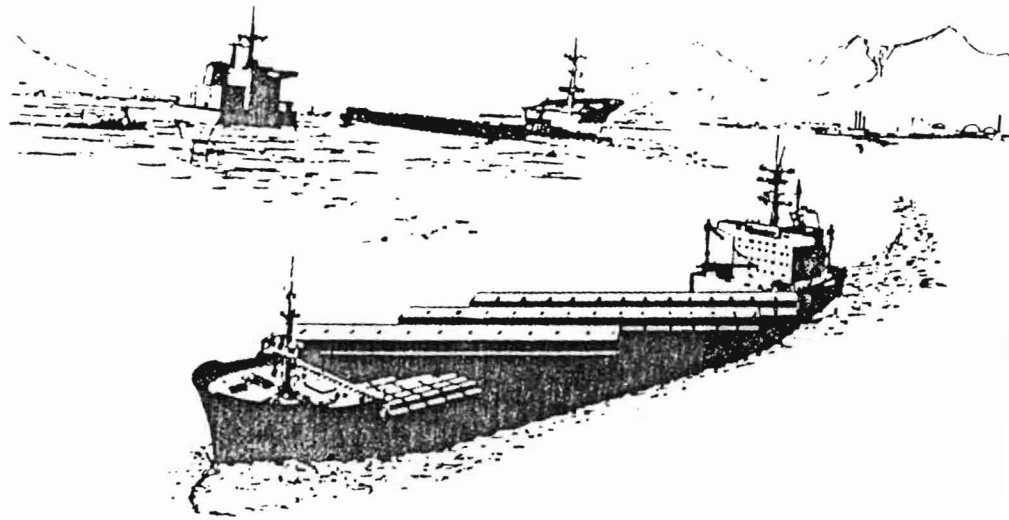
The semi-submersible vessel is inherently unstable during the transition from submerged to full float condition. This is most critical during loading, at the moment the deck breaks the surface. Due to the low center of gravity for the barge or pier, although not eliminated, this is less a problem (MAR, 1987 #1).

In all three design cases, however, the speed of the transportation can be most increased by use of the semi-submersible heavy lift ship. Its barge counterpart is restricted to a three or four knot speed compared to thirteen to fifteen knots.

The availability factor is highly influenced by the transportation options (which will also affect flexibility considerations later). With more transport options

FIGURE 12

Deployment Flexibility:
Semi-submersible Heavy Lift Ship
(MAR, 1987 #1)



available for its use, the barge/pier option has the maximum advantage. This is of most concern in the case of a contingency operation. Rapid availability is of prime concern here. If a nominal sized tug is all that can be obtained on short-notice transportation can begin immediately. The limited number of semi-submersible barges and even fewer similar ships (18 in the world at this time) may increase the the lead time for their use depending on the situation. It is only fair to note, however, that the tremendous increase in speed (thus reduction in transport time) of the semi-submersible ship could in fact overcome a lead time delay. In this case, again all three designs would be available.

Analysis: Flexibility

The most difficult distinction to make among the three designs is the one of "most" flexible. There is no way to truthfully say one design is not flexible. The purpose of this analysis is not to do that, but rather find a design that can provide the broadest spectrum of options.

It is quite obvious in studying the semi-submersible rig that it is not suited to very shallow water since the buoyancy tanks are well beneath the water's surface. On the other hand, the jack-up rig is quite well suited to relatively shallow water, but will not function in a deep

water area. In the case of the barge/pier option, since it floats, it can essentially be used in any depth of water. Because of relatively shallow draft it can be put into use right up to a shore line. The primary drawback is the susceptibility of the design to rough seas.

For a contingency operation, the scoring of all three is high. For long-term use however there is a slight advantage to the barge/pier concept. Given the planning and coordination that is required for such an undertaking as a major port of operations and the ability of the barge/pier construction to function close or up to the beach, there are many ways to reduce the risk of sea damage. The jack-up rig and semi-submersible designs would most likely require shore based construction of facilities to support them offshore. There is little chance of either having a direct physical link to shore. This would require separate piers or a helipad for that connectivity.

Finding a protected bay or inlet is a simple matter and if that is impossible, construction of a breakwater for sea defense is going to be required anyway. If there is no suitable location ashore to construct the support facilities for an offshore base, then these are useless options.

There are numerous missions that could be required of each design. The difference in ability of each to support those missions is not measurable. Therefore there can be

no standout in this factor.

Location of the base is integral in the ability to support it logistically. All three designs can be used for heliport operations and as pier for air and sea support. If there is no connectivity to the shore, however, the land link is lost (road and rail). This gives the barge/pier concept an advantage, especially for a long-term requirement.

The physical capabilities of all three designs are not considered from the engineering point of view. The ability technologically to efficiently construct each is a constant. It is however important to note that the major producers of all three currently are not located in the U.S. This now becomes a question of ease of construction (purchase of already existing structures for modification also entails a cost factor). Again the barge/pier design has a high margin of favorability. The semi-submersible rig design is much more detailed and require a great deal of more specialized expertise. This even more true for the "jack-up" rig design. This expertise and the capabilities that go with it are located overseas. Construction of barges and floating piers is much less complex and can be accomplished much more quickly if the need arises.

The complexity of jack-ups and semi-submersibles severely limits the flexibility of their use. This, in addition to the scoring edge of the barge/pier concept in

location, environment and supportability, gives it overall superiority for flexibility.

Analysis: Cost

The examination of the political costs is extremely subjective and can be interpreted over the long-term in a spectrum of analysis. Therefore it is acknowledged that there is room for considerable debate over the details of political thought on the subject. The analysis herein is an attempt to look at only the broadest aspects of the problem. Also, it is clear that the capital costs of any project funded by the public, is considered a part of the political costs. The separation of the two is not easy and each must be kept in mind while considering the other.

The semi-submersible design possesses a clear advantage in its ability for use with the least amount of political wrangling. It is capable of being used in a free floating mode, unencumbered by moorings or anchors. If a station-keeping propulsion system is used, the semi-submersible provides a stable base that can be operated outside of territorial waters. Continental shelf rights would have to be considered if any of the designs were to be anchored to the floor. As long as there were no perceived threat to a nation's Exclusive Economic Zone (EEZ), it would be a great advantage to have a base of operations off the coast. The advantage of reduced

political costs could be considered as counterbalanced by the enormous increase in financial support that would be required for such a system. The long-term use of the semi-submersible in this mode could become very expensive in terms of the energy requirements for such an endeavor.

All three designs have the great advantage of being mobile, and therefore provide the ability to recover the majority of investments. The leverage of this is in favor of the U.S. in any negotiation for the establishment of a base. The very existence of a mobile base capability also provides for similar leverage when faced with an unfriendly negotiation for a fixed base. Although the loss of the fixed base may be costly, the ability to shake off the absolute necessity for maintaining that fixed base gives the opposition more to think about. This is especially true if the threat of closure is not wholehearted.

The money side is very different however. The semi-submersible and jack-up designs are mechanically much more complicated. The cost of construction and/or purchase would obviously be much greater. The ability to construct these designs in this country also boosts these costs. The technical know-how is there, but as mentioned earlier, the infrastructure for construction is currently centered overseas. This would suggest an overseas purchase, as being the more economical route. This in itself poses a

political problem, assuming there is a desire to do the construction in the U.S. This provides jobs (a major item on the "American Agenda" at any time). U.S. construction also keeps the cash at home (this aids in the trade deficit problem). Finally, the lower overall cost and simplicity in the construction of a barge/float facility, make that an easier fiscal pill to swallow when the time comes for a budget minded Congress to approve funding.

The need to construct shore support facility when using an offshore design also adds to the costs. Once again, there is an opportunity to invest capital into at least a part of the facility that could be lost by the U.S. government. In any case, the ability to pack up and move the entire facility as easily as it was installed provides the best negotiating position and the least chance of loss. Moreover, the barge/floating pier design not only provides the best method for accomplishing this, but also has greater flexibility and transportability. Both of these traits will make it the preferred choice of the efficiency minded politician.

TABLE 4
COMPARATIVE ANALYSIS

| | <u>Semi-submersible</u> | <u>Jack-up</u> | <u>Barge/Float</u> |
|----------------------------------|-------------------------|----------------|--------------------|
| <u>Mobility</u> (45%): | 3.0 | 2.5 | 4.0 |
| Transportability | 3.0 | 2.0 | 4.0 |
| Availability | 3.0 | 3.0 | 4.0 |
| <u>Flexibility</u> (35%): | 2.6 | 2.6 | 3.0 |
| Location | 2.0 | 2.0 | 3.0 |
| Mission | 3.0 | 3.0 | 3.0 |
| Environmental | 3.0 | 2.0 | 2.0 |
| Supportability | 2.0 | 2.0 | 3.0 |
| Physical | 2.0 | 3.0 | 4.0 |
| <u>Cost</u> (20%): | 3.0 | 3.0 | 3.5 |
| Political | 4.0 | 3.0 | 3.0 |
| Capital | 2.0 | 3.0 | 4.0 |
| <u>Overall</u> (100%): | 2.9 | 2.6 | 3.6 |

CHAPTER VII

CONCLUSIONS

Summary

Long-term debate over the solution to the overseas basing dilemma is not desirable. Solutions to the problem are under development. Mobile ocean basing systems designs seem to be valid alternatives. Although the technology for these designs is available in theory, there is no capability at present to develop or deploy any of these alternatives in the near future.

Meanwhile, there are interim options available. Jack-up rigs, semisubmersible platforms and floating piers are all designs which are currently being used in various marine industries around the world. All three have proven to be capable of performing a wide variety of tasks in the harsh, often rapidly changing marine environment. This pointedly indicates that there is working technology currently available to assemble a very versatile mobile base/port capability in the U.S. in a matter of months.

The clear choice offered by current in use technology for mobile operations bases and port facilities is the use of large offshore support barges and/or specially designed floating pier designs (Figures 13 & 14). The advantages of

FIGURE 13

Temporary Floating Support Facility
(MAR, 1987 #2)

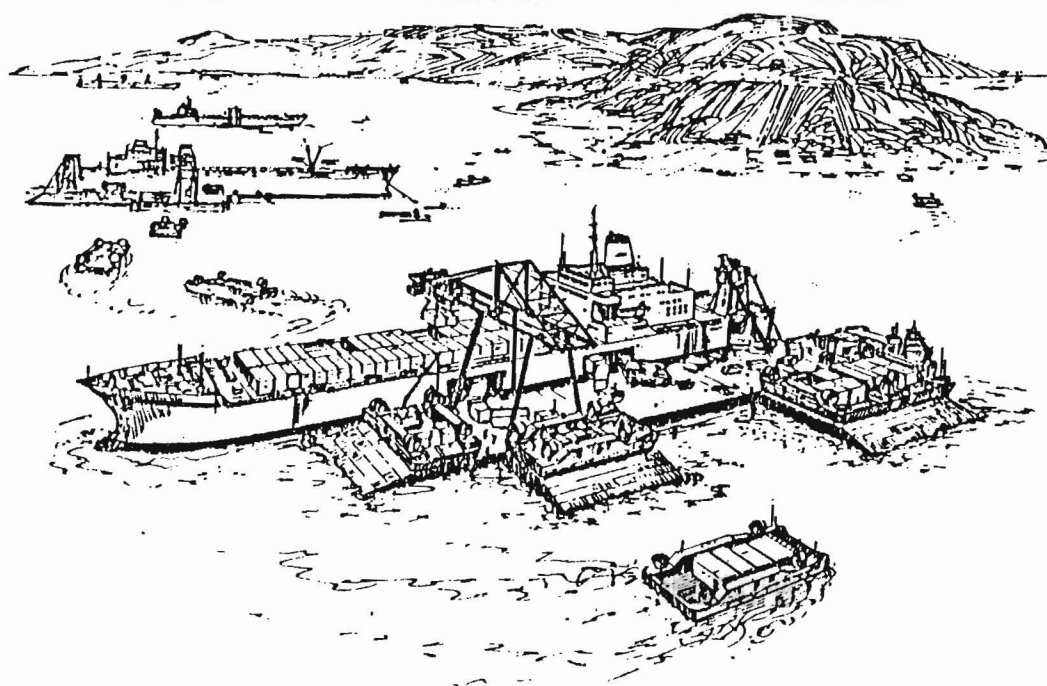
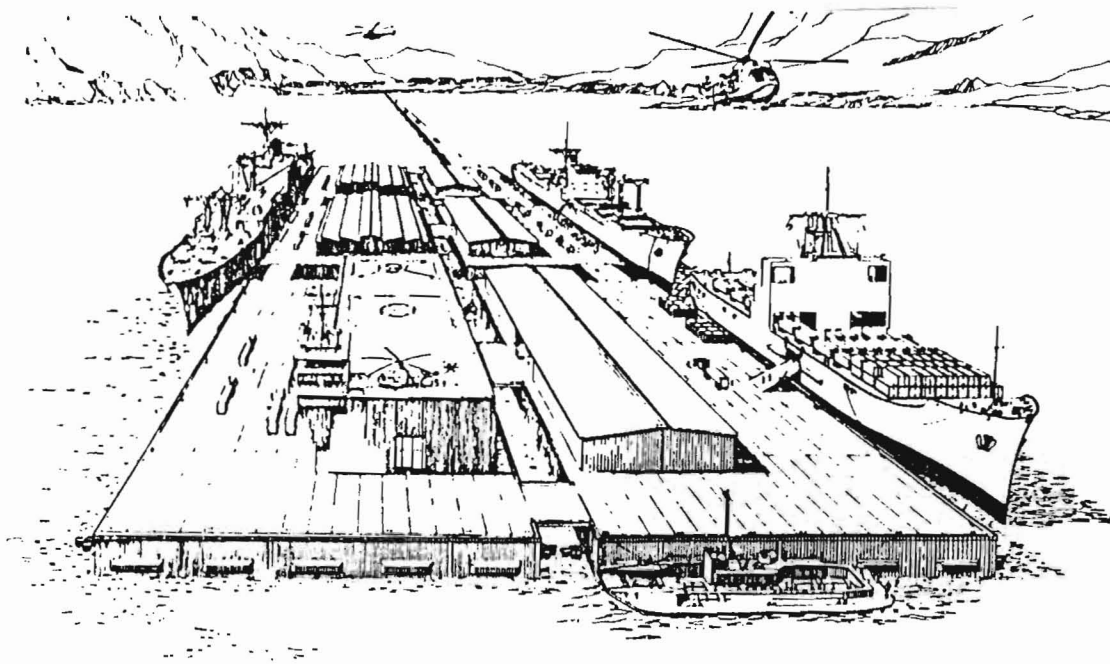


FIGURE 14

Long Term Advance Logistic Support Base
(Harris, 1973)



this design, in the areas of mobility, flexibility and cost, clearly support the given hypothesis.

In addition to the barge/floating pier design's long list of attributes, it has a rather long history of service as both a contingency base of operations in a crisis and as a versatile long-term port/base facility, as well. Its ability to fit into the most situations, in less time and with the least difficulty (politically, financially and physically) gives it the best chance of success in the current world environment. In the vast majority of conceivable scenarios a floating base or port facility will provide the superstructure required to support the mission, whatever it may be.

There as yet, is no real substitute for a fully capable fixed land base of operations. Although mobility has some definitive advantages, there are still many trade offs, including durability, which prevent a completely satisfactory one for one exchange. There is no doubt however, that under the less than desirable circumstances now facing the U.S., in its quest for forward support of its overseas interests, that an immediate mobile, deployable base/port capability is required. Until the more exotic designs can be put into production, use of a barge based or other floating pier design is the best choice.

Recommendations

It is imperative that an interim plan be developed for dealing with the overseas basing problem. All of the designs examined herein have already been studied as part of the long-term solution. Therefore, there is no need for additional technical or fiscal study. The need is for a plan to be drawn up using the existing data. Long-term base facilities admittedly require some planning before construction, but a plan which would detail the design, construction methods, and negotiation to be used in the event of need, will establish the foundation for the use of such structures in the future.

On the other hand, a series of offshore support barges should be constructed and/or purchased as soon as possible. These barges need to be modified for rapid deployment and use for contingency operations. These facilities must also be maintained in a ready status at various locations (in the U.S. or around the world) in the event a crisis might arise. This can be accomplished in less than two years, given government procurement processes and shipyard capabilities. Above all, the movement to incorporate this capability into the regular workings of the U.S. defense structure as soon as possible, is imperative.

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