

# *EVALUATION OF MILITARY BASE CLOSURE ALTERNATIVES*

by

Gregory A. Hogan

Thesis submitted to the faculty of Virginia Polytechnic Institute and State University  
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE  
IN SYSTEMS ENGINEERING

Approved:

---

Dr. William G. Sullivan, Chairman

---

Dr. George Ioannou

---

Mr. V. Stephen Carberry

February 1997  
Blacksburg, Virginia

Key words and Phrases: Privatization, Relocation, Military Base Closure,  
BCRC Recommendations, DoD Outsourcing

# ***EVALUATION OF MILITARY BASE CLOSURE ALTERNATIVES***

by

Gregory A. Hogan

Dr. William G. Sullivan, Chairman  
Industrial & Systems Engineering Department

## **Abstract**

This project defines a decision support system developed to permit the user to perform a cost - benefit analysis for any military installation cited for closure, relocation, or privatization. The procedure recognizes both the economic costs and strategic benefits of a feasible solution. Though the cost estimates for a particular study may vary in magnitude, the economic portion of the model must focus on the net savings to the tax payer. Detailed cost estimates for each alternative have been developed at a level so that sensitivity analysis can be performed on any of the input parameters. Individual cost elements have been summed to yield the net cost increase / decrease to the United States tax payer. The resultant cost figures were converted to an economic score. The paper also describes a effective method to evaluate the benefits derived from implementing various alternatives. By incorporating a group participative process using multivoting and the Dunn-Rankin technique, the values resulting from benefits have yielded a benefits score. The Brown-Gibson model, which considers both subjective and objective measures, was used to depict the combination of economic and benefit scores to provide an overall cost - benefit score. A graphical illustration of the cost - benefit tradeoffs serves as a useful tool in assessing the risk associated with a decision.

The results of the analysis have supported the Department of the Navy's decision to privatize the Naval Air Warfare Center Aircraft Division, Indianapolis, IN. The Department of Defense is considering alternatives for many military installations, this process will facilitate those decisions.

## Table of Contents

---

|   | <u>page</u> |
|---|-------------|
| I. Introduction   |             |
| Background .....  | 1           |
| Problem Statement .....   | 3           |
| Project Scope .....   | 4           |
| Limitations .....   | 5           |
| II. Approach to the Analysis  |             |
| step 1 - Statement of system objectives. ....   | 7           |
| step 2 - Determination and definition of feasible alternatives. ....  | 11          |
| step 3 - Development of cost estimates for each alternative. ....   | 14          |
| step 4 - Development of a break-even analysis which represents the net cost increase / decrease to the Federal Government. .... | 27          |
| step 5 - Determination of the benefits of each alternative. ....  | 30          |
| step 6 - Weighting the importance of the benefits. ....   | 32          |
| step 7 - Calculation and discussion of the results. ....  | 34          |
| step 8 - Conduct sensitivity analysis. ....   | 36          |
| III. Conclusions and recommendations for future study .....   | 38          |
| IV. Appendices  |             |
| A - Glossary of Terms .....   | 39          |
| B - Decision Support Model Calculations .....   | 44          |
| C - Detailed Cost Estimates .....   | 46          |
| D - References .....  | 48          |

## List of Illustrations

---

|   | <u>page</u> |
|---|-------------|
| Figure 1 - NAWC Indianapolis Characteristics .....                      | 8           |
| Figure 2 - Status Quo Plan .....  | 11          |
| Figure 3 - Relocation Plan .....  | 12          |
| Figure 4 - Privatization in Place .....                                 | 13          |
| Figure 5 - Work Breakdown Structure .....                               | 15          |
| Figure 6 - NSWC Crane Overhead Projections .....                        | 17          |
| Figure 7 - Relocation Facilities & Equipment Baseline .....             | 20          |
| Figure 8 - Relocation Personnel Assumptions .....                       | 24          |
| Figure 9 - Privatization Personnel Assumptions .....                    | 25          |
| Figure 10 - Break Even Analysis .....                                   | 28          |
| Figure 11 - Cost and Benefits for each Alternative .....                | 35          |
| Figure 12 - Sensitivity Analysis, Accelerated Transition Schedule ..... | 36          |

## List of Tables

---

|  | <u>page</u> |
|--|-------------|
| Table 1 - Alternative Cost Comparison .....            | 15          |
| Table 2 - Recurring Workload .....                     | 16          |
| Table 3 - Break-even Analysis Results .....            | 29          |
| Table 4 - Value Scores for Benefits E & F .....        | 31          |
| Table 5 - Qualitative Benefits Value Scores .....      | 31          |
| Table 6 - Paired Comparison Matrix .....               | 33          |
| Table 7 - Summary Dunn-Rankin Matrix .....             | 33          |
| Table 8 - Resultant Scores for BCRC Alternatives ..... | 34          |

## I. Introduction - Background

---

The post cold-war era, combined with the growing urgency to reduce the Federal budget deficit, has compelled the United States to reduce and realign its military forces. In response, Congress enacted the Defense Base Closure and Realignment Act of 1990 (public law 101-510). Signed by President George Bush on 5 November 1990, the Act established an independent Defense Base Closure and Realignment Commission (DBCRC). The commission was established “to provide a fair process that will result in the timely closure and realignment of military installations inside the United States”. The commission was authorized to meet in calendar years 1991, 1993, and 1995. The authority of the commission expired on 31 December 1995.

The commission had taken the approach that the base closure process was not a budget cutting exercise, but a method to reduce the excess defense infrastructure in a way as to improve military readiness and ensure the most efficient expenditure of tax payer dollars. The commission’s challenge was to develop a list of base closures and realignments (relocations) that permits the Department of Defense (DoD) to preserve the force levels required for national security.

The results from the 1995 Commission recommended the closure or realignment of 132 military installations in the United States. The one-time implementation cost of these actions was estimated at \$3.5 billion. It is anticipated that the DoD would recoup \$1.6 billion annually from the base closures / realignments.

Concerned over the negative impact base closures would have on the local economy, the DoD established the Office of Economic Adjustment (OEA) to help communities affected by base closure. The OEA’s principal objective was to maintain economic stability in the communities. Over 150,000 new jobs have been created through the partnership of the OEA and local authorities.

As a means to alleviate the economic and social impact from base closure, many local communities proposed a public-private partnership as an alternative use of the facilities. The alternative became known as *privatization in place*. With the impetus of Vice President Gore's "reinvention of Government," and the support from the Secretary of Defense, communities have proposed privatization in place as an option to complete base closure or relocation. The privatization in place option is defined below.

- A private sector company is selected to operate and maintain the existing Government facility.
- The Government would contract for the desired products and services from the private company.
- All non-mission essential Government assets would become the possession of the private company after an initial lease period. Mission essential equipment would remain as Government owned property.
- The existing Government workforce would be entitled to the right of first refusal for private sector jobs.

The BCRC Commission has accepted privatization in place as a viable option to closure / realignment for many DoD installations. Each of the military services (i.e., Air Force, Army, and Navy) have been directed to implement the most cost effective solution.

## Problem Statement

---

In 1995 the Secretary of Defense embraced the idea of privatization in place and recommended that the BCRC consider privatization in place prior to implementing base closures or realignments. The challenge to the Department of Defense is to determine the fate of those installations which may be closed or relocated according to the BCRC Commission recommendation. On a case by case basis, each facility that has been deemed by the BCRC commission as a privatization candidate must be separately evaluated with respect to the cost and benefits of each feasible alternative.

Since 1995, the military services have identified a number of Defense bases suitable to be privatized. Because privatization of an installation has a negative financial impact on a facility projected to receive additional work under BCRC relocation, some state Senators have sponsored the General Accounting Office (GAO) to review privatization plans. In one particular report, the GAO stated, “privatization in place at Louisville depot has not been justified”.<sup>1</sup> This and similar conclusions from other studies have prompted intense scrutiny of the process whereby the decision to privatize was made.

In order to minimize political inquisition of the decision process, the Department of Defense must develop a defensible decision support tool for senior officials which consolidates the costs and benefits of implementing a BCRC option. The options considered are listed below.

- Status Quo - continued operation of the military installation.
- Relocation of the military installation to other military sites.
- Privatization in place of the military installation.

---

<sup>1</sup> United States General Accounting Office, *GAO / NSIAD-96-202*.

## Project Scope

---

The project focuses on the potential solutions which could arise from BCRC review of a Department of Defense military installation. The primary objective of the paper is to provide a decision support tool for DoD senior decision makers which summarizes the cost and benefits associated with any BCRC alternative. This decision support system (DSS) will illustrate the combination of objective and subjective attributes about a potential solution. To illustrate the effectiveness of the decision support system, a beta test has been developed using the data from the Naval Air Warfare Center Aircraft Division, Indianapolis, IN (NAWC-ADI). NAWC-ADI signed a privatization contract with Hughes Technical Services Company on 25 September 1996.

The process used to develop the decision support system was a function of many different tools from the Systems Engineering process.

1. The Brown-Gibson model<sup>2</sup> was used to illustrate the combination of objective (economic) measures and subjective (benefits) measures. A model developed for evaluating investments in manufacturing local area networks also provided insight into the analysis.<sup>3</sup>
2. Economic Analysis tools
  - Break-even analysis was conducted to determine the points of indifference among the feasible alternatives.
  - Savings - Investment Ratio was calculated to provide another data point in the decision making process.

---

<sup>2</sup> Canada and Sullivan, *Economic and Multiattribute Evaluation of Advanced Manufacturing Systems*, Prentice Hall, 1989. pp. 232-7.

<sup>3</sup> Sullivan and Liggett, *A Decision Support System for Evaluating Investments in Manufacturing Local Area Networks*, American Society of Mechanical Engineers, 1988. pp. 151-7.

- Net present value or present worth calculations were made from detailed cost estimates. These values were used to calculate the economic score of each alternative.
3. Cost estimating relationships (CERs) were developed from the cost driving parameters of each alternative. The CERs formed the backbone of the cost estimates for the alternatives.
  4. Regression analysis was used to forecast recurring workload at each Navy activity. Overhead rates at each activity were calculated according to a regression of previous actual data.

## **Limitations**

---

*Due to the proprietary nature of private contractor labor and overhead rates, the actual rates have not been disclosed. Corporate trade secrets have not been disclosed in order to protect the rights of the contractors.*

## **II. Approach to the Analysis**

---

The backbone of the Decision Support System is the Brown-Gibson model, developed in 1972. The model is capable of illustrating the combination of economic (cost) and non-economic (benefits) factors. In order to ensure the most appropriate BCRC recommendation to implement, the decision making process must take into account the long term costs and strategic goals (benefits) to the Department of Defense. In this exercise, the goals are those of the Department of the Navy. A one-sided decision made solely on the cost of the alternatives would overlook many of the benefits that are critical to the successful implementation of a BCRC alternative.

Eight discrete steps were performed during the analysis.

1. Statement of system objectives.
2. Determination and definition of feasible alternatives.
3. Development of cost estimates for each alternative.
4. Development of a break-even analysis which represents the net cost increase / decrease to the Federal Government.
5. Determination of the benefits of each alternative.
6. Weighting the importance of the benefits.
7. Calculation and discussion of the results.
8. Conduct sensitivity analysis.

The following pages describe the proposed process to perform each of the steps mentioned above.

*step 1. Statement of system objectives*

---

A goal of the Base Closure and Realignment Commission (BCRC) process was to improve military readiness through the most efficient closure or relocation of military bases. Privatization in place has been offered as an option to base relocation that will minimize the economic distress created when jobs are relocated (i.e., realigned) out of local communities.

The General Accounting Office (GAO) concluded, in a April 1996 report <sup>4</sup>, that Defense bases within the United States have 45% excess capacity. Minimizing excess capacity decreases the cost of doing business because fixed costs (e.g., facility and maintenance costs) are spread over a larger allocation base. By combining the Government work with military installations that produce like products or combining the work at these military bases with like products in commercial (non-Federal Government) industry, operating expense can be reduced without jeopardizing military readiness.

*Beta Test - Naval Air Warfare Center Aircraft Division, Indianapolis, IN.*

---

The 1995 Base Closure and Realignment Commission (BCRC) concluded the Naval Air Warfare Center, Indianapolis, IN (NAWC-ADI) be closed. The initial recommendation was to relocate portions of NAWC-ADI to other Navy installations and convey excess equipment to the city of Indianapolis. The results from process steps 1-5 were used as the sole basis for the Department of the Navy's conclusion to privatize the facility. Steps 6-8 were performed to provide further defense for the decision.

Figure 1 illustrates some characteristics of the NAWC Indianapolis facility.

---

<sup>4</sup> United States General Accounting Office, *GAO/T-NSIAD-96-146*.

## NAWC INDIANAPOLIS

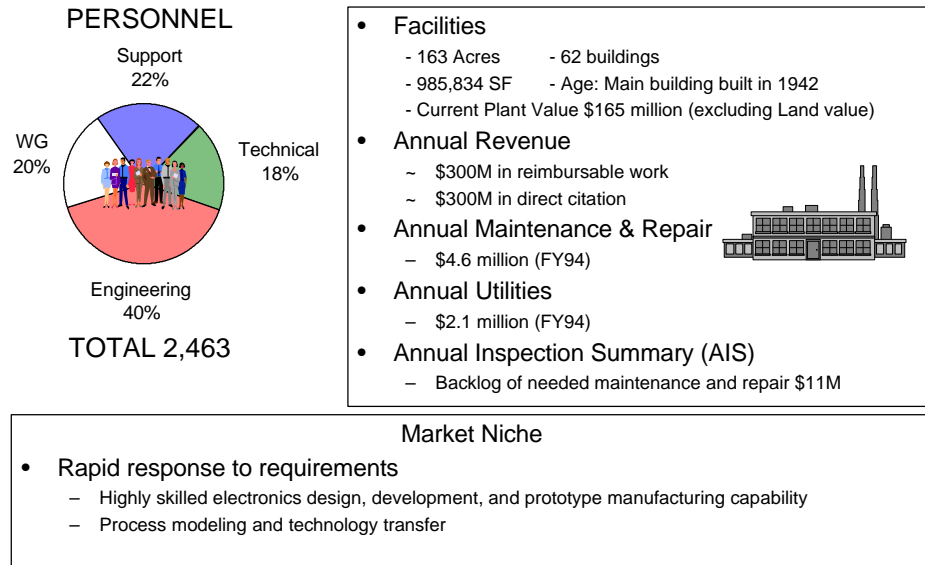


Figure 1 - NAWC Indianapolis Characteristics.

The City of Indianapolis, concerned over the negative impact that the NAWC-ADI closure may have on the local community, proposed a public-private partnership as an alternative reuse of the facility prior to final approval of the recommendation to close and relocate. The privatization in place alternative would also meet DoD infrastructure and manpower down-sizing goals. The BCRC adopted this approach as a viable alternative and provided the Navy the latitude to implement the Relocation or the Privatization alternative. The official BCRC language read as follows:

“Transfer workload, equipment and facilities to the private sector or local jurisdiction as appropriate if the private sector can accommodate the workload on site; or relocate necessary functions along with the necessary personnel, equipment and support to other naval technical activities, primarily the Naval Surface Warfare Center (NSWC), Crane, Indiana; the Naval Air Warfare Center Aircraft Division (NAWC-AD), Patuxent River,

Maryland; and the Naval Air Warfare Center Weapons Division (NAWC-WD), China Lake, California.”<sup>5</sup>

The Department of the Navy, in particular, had stated specific goals for NAWC-ADI which must be realized through the BCRC process. These goals were recognized in the decision process.

**Goals of Relocation..**

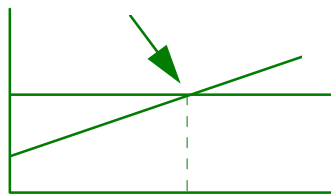
- *Reduce infrastructure and improve military readiness*
- *Reduce costs paid by the customers for products and services*

**Support Privatization in place as a feasible alternative to relocation if..** <sup>6</sup>

- *It is cost effective and provides responsive service to the Navy’s needs.*
- *An effective business relationship can be created with the private entity.*
- *There is an orderly transition to minimize program impacts.*
- *There is convincing evidence that the potential exists for a successful, self-sufficient enterprise.*

These goals form the questions which the decision support system will answer. In addition, the DSS will also consider the following.

- What are the break-even points for comparison of alternatives?



---

<sup>5</sup> Base Closure and Realignment Commission 1995 Language, *Official BCRC Commission Recommendation*.

<sup>6</sup> Naval Air Warfare Center Aircraft Division, Indianapolis, IN; *Sources Sought NAWC-Indianapolis Privatization*, 1996.

→ What is the sensitivity of the analysis to the transition schedule for the Relocation plan?

Concurrent with the development of the Analysis, the Indianapolis Local Reuse Authority (LRA) conducted a full and open competition to determine a private corporation most suitable to manage and operate the NAWC facility, if privatization in place was the preferred alternative. Seven proposals were initially received and through the evaluation process the LRA selected four offers. In May, the LRA selected Hughes Technical Services Company (HTSC) as the successful offer. At that time the Navy was permitted to conduct discussions with Hughes to facilitate completion of the analysis. The contracts team also entered into negotiations with Hughes. The Navy intended to execute a contract (one base year plus four option years) with Hughes beginning in FY97. After the base contract year, a decision to privatize could be revisited, and the relocation option could be initiated. At the end of the fifth year, the private company will be competing for business in the open market.

*step 2. Determination and definition of feasible alternatives*

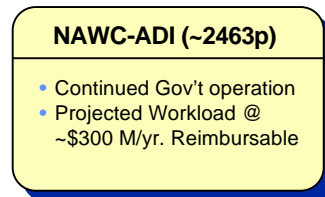
---

In every BCRC scenario, there are four potential outcomes; (1) status quo - continue operation of the military installation without impact from the BCRC process, (2) closure of a military installation with the relocation of the operations to a compatible facility, (3) privatize the military installation in place while subsidizing excess capacity with commercial work, and (4) complete closure of a military installation with a cease of operations. The decision support system considers outcomes 1-3, outcome 4 (complete base closure) would be determined by the BCRC Commission if there was no need to continue base operations, i.e., no mission deficiency.

The analysis considered the options presented on the following pages.

**1. Status Quo - continue operation of NAWC-ADI without impact from BCRC.** Note, the status quo alternative was not a feasible alternative for NAWC-ADI. It was used only as a basis for comparison.

- Perform workload at the Government facility.
- Retain current federal workforce.
- Maintain facilities and equipment.



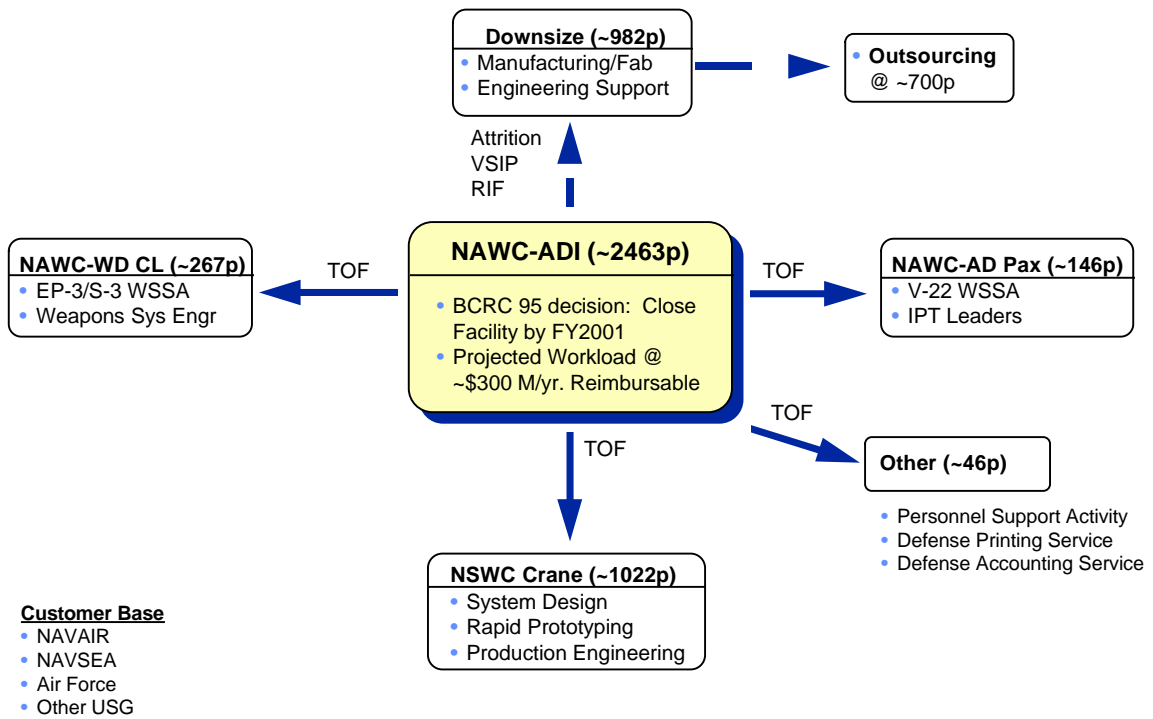
**Customer Base**

- NAVAIR
- NAVSEA
- Air Force
- Other USG

Figure 2 - Status Quo Plan.

**2. Relocate people, equipment, and processes to another military installation.**

- Transfer workload and personnel to other Navy sites.
- Move mission essential equipment to other Navy sites.
- Convey facility and excess equipment to the LRA.

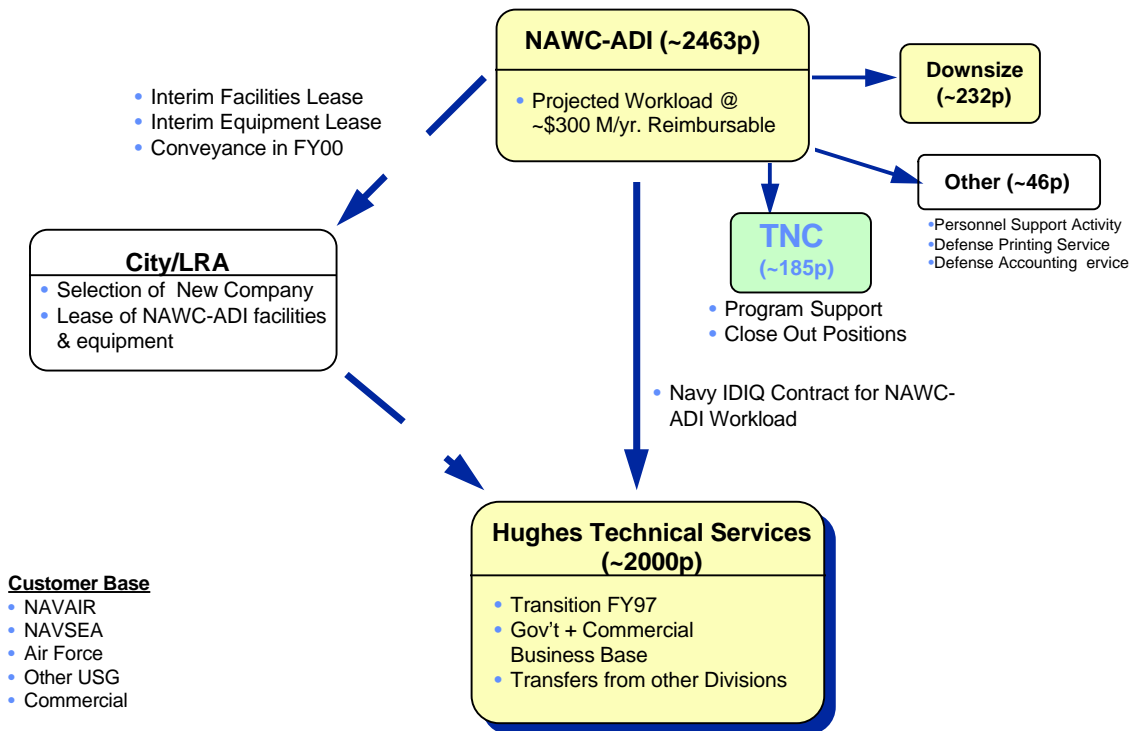


The Relocation plan was updated from the original FY95 BCRC plan based on current NAWC-ADI personnel figures.

Figure 3 - Relocation Plan.

### 3. Privatization in place of NAWC-ADI.

- Convey/transfer facility to the local reuse authority (LRA).
- Contract for workload.
- Provide mission essential equipment as GFE/GFP.
- Transfer personnel to the private enterprise.



The Privatization alternative is based on inputs received from Hughes Technical Services Company and current NAWC-ADI personnel figures.

Figure 4 - Privatization in Place.

### *Step 3. Development of cost estimates for each alternative*

---

The non-recurring and recurring labor costs were segregated by a work breakdown structure (WBS)<sup>7</sup> similar to OMB Circular A-76<sup>8</sup> guidelines. OMB Cir A-76 provides guidance for conducting DoD outsourcing studies; however, BCRC actions are not required to adhere to these guidelines. Figure 5 illustrates the WBS used in the analysis. The methods used to develop the cost estimates are described on the subsequent pages. The detailed supporting data for each WBS element contains proprietary data and has not been included as an appendix.<sup>9</sup> In general, the following methods were used to derive the costs of each alternative.

- Regression of historical data [labor projections, rates]
- Analogous system cost estimating relationships [material]
- Published cost estimating relationships [Personnel, Other Costs]
- Grass roots cost estimating [Facilities, Environment]

The WBS elements were identified as either recurring or non-recurring costs. A WBS dictionary can be found in Appendix A. A side by side comparison of the recurring costs for each alternative to perform the NAWC-ADI workload for the five year contract period (FY97-01) is illustrated in Table 1. These figures are a subset of the total savings to the Federal Government. A break-even analysis was performed to capture the net cost impact to the Federal Government, see step 4.

---

<sup>7</sup> Department of Defense, *Work Breakdown Structures for Defense Material Items, MIL-STD 881B*, 25 March 1993.

<sup>8</sup> Office of Management and Budget, *OMB Circular No. A-76 - Revised Supplemental Handbook*, March 1996.

<sup>9</sup> Naval Air Systems Command, Cost Department, *NAWC-ADI Cost/Benefit Analysis Supporting Data*, September 1996.

Table 1.  
Alternative Cost Comparison

|                                   | Status Quo    | Relocation    | Privatization |
|-----------------------------------|---------------|---------------|---------------|
| <b>Total Program Cost (TY\$M)</b> | 1428.0        | 1585.3        | 1384.2        |
| <i>Recurring Cost (5 years)</i>   | <i>1428.0</i> | <i>1342.6</i> | <i>1254.1</i> |
| <i>Non-recurring Cost</i>         | <i>0.0</i>    | <i>242.7</i>  | <i>130.1</i>  |
| 1.0 Labor                         | 1022.4        | 859.0         | 881.0         |
| 2.0 Material                      | 381.5         | 457.9         | 357.7         |
| 3.0 Facilities                    | 0.0           | 57.8          | 0.4           |
| 4.0 Environment                   | 0.0           | 52.8          | 52.0          |
| 5.0 Personnel                     | 24.1          | 122.3         | 82.3          |
| 6.0 Other Cost                    | 0.0           | 35.5          | 10.6          |

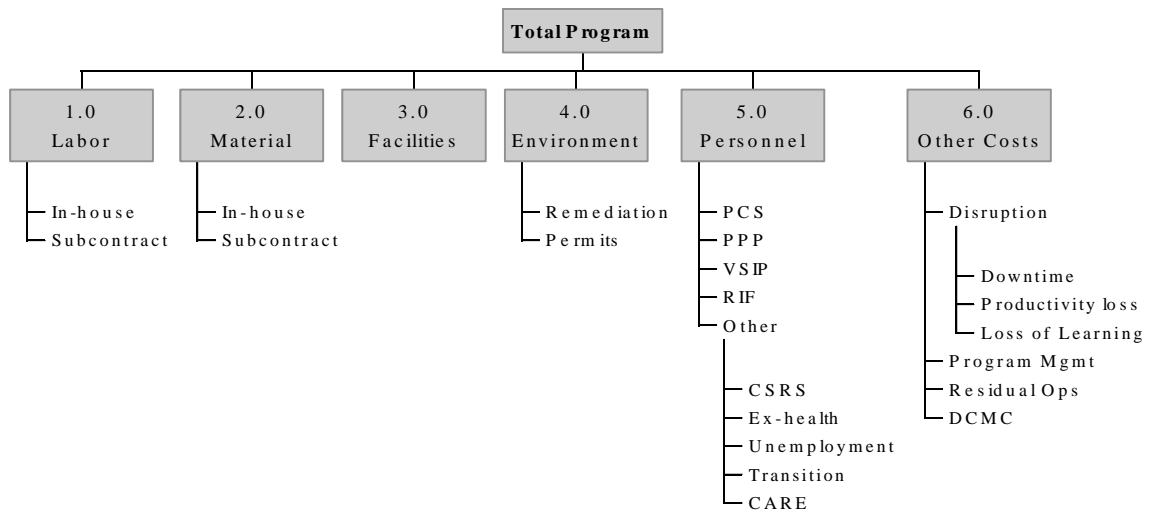


Figure 5 - Work Breakdown Structure

**- Detailed Cost Estimates -**

WBS element 1.0 Labor

|  | <b>Status Quo</b> | <b>Relocation</b> | <b>Privatization</b> |
|--|-------------------|-------------------|----------------------|
| <b>5 year recurring labor cost (TY\$M)</b> | 1022.4            | 859.0             | 881.0                |

Status Quo Labor Cost

The recurring labor cost estimate for the NAWC-ADI facility assuming no impact from BCRC was derived by multiplying the forecasted workload by the NAWC-ADI stabilized composite billing rate. Stabilized rates include direct labor, indirect overhead, and material overhead functions. The forecasted workload (customer demand) was assumed to be the same for each alternative, see table 2.

Table 2.

Recurring Workload

|  | <b>FY97</b> | <b>FY98</b> | <b>FY99</b> | <b>FY00</b> | <b>FY01</b> |
|--|-------------|-------------|-------------|-------------|-------------|
| <b>Customer Demand (direct work years)</b> | 1890        | 1778        | 1602        | 1652        | 1671        |

Relocation Labor Cost

The relocation recurring labor cost to perform the projected workload has been segregated by in-house and subcontract. The in-house portion of labor is split, according to the transition schedule, among the Navy activities (i.e., NAWC-ADI, NAWC-AD Patuxent River, NAWC-WD China Lake and NSWC Crane). Labor cost was derived by multiplying the direct labor hours to be performed at each site by the site composite rates. The site composite rates were forecasted to include the relocating workload. All direct and indirect rate projections were reviewed and compared against FY94-96 actual rates using multiple variable linear regression. Figure 6 is a tool used to illustrate NSWC Crane productive overhead and general & administrative costs as a function of forecasted workload. Intuitively, overhead percentage should be inversely proportional to labor base, the graph indicates that very point. Subcontract labor was calculated by subtracting the full time equivalents at each site from the total labor demand.

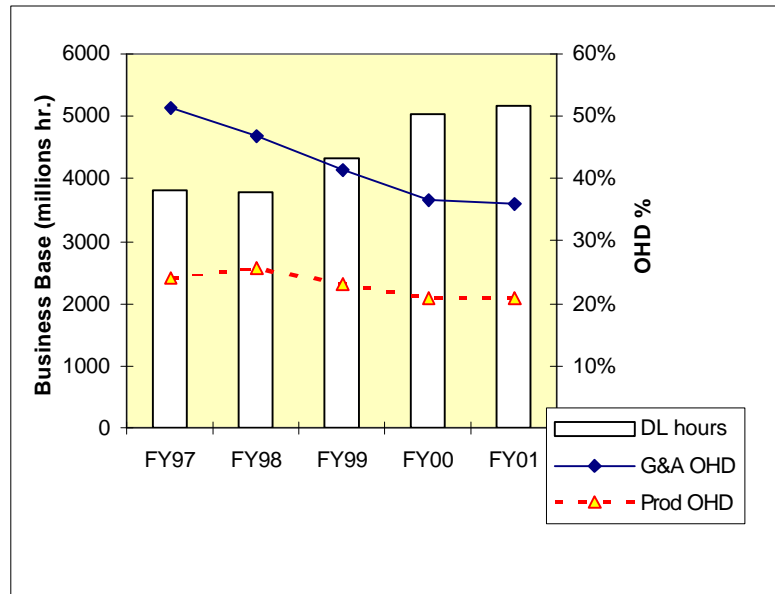


Figure 6 - NSWCrane Overhead Projections.

### Privatization Labor Cost

The recurring labor cost to perform the projected privatization workload has been segregated by in-house and subcontract. Labor cost was derived by multiplying the projected direct labor hours (adjusted for differences between NAWC and Hughes accounting systems) by the fully burdened rates. The analysis was based on the fixed-price level of effort rates submitted by Hughes (17 Aug. 1996). Subcontract labor was calculated by multiplying the Hughes proposed subcontracted labor by an industry average subcontract rate.

The accounting system proposed by Hughes was substantially different than the accounting systems in use at each of the Navy activities. Prior to computation of direct and indirect labor cost, the following cost elements were thoroughly defined.

- Classification of direct/indirect functions
- Projection of direct labor plus fringe benefits, including attrition. Hughes proposed a comparable benefits package to the Federal employee benefits.

- Material burden pool. Hughes created a separate material overhead pool. Navy activities capture material handling costs through Productive Overhead and G&A expenses.
- Indirect staffing (Engineering and Manufacturing OHD). Hughes created separate Engineering and Manufacturing cost centers. The Navy activities allocate those costs to a Productive Overhead pool.
- Subcontract Labor. Hughes proposed to burden subcontract labor with G&A and profit.
- Profit. Hughes proposed to generate a profit whereas the Government activities charge only cost.

***Realism Assessment of Hughes Proposed Overhead Rates.***

Conversations with the Defense Contract Audit Agency (DCAA) have supported the calculation of a realistic rate forecast for Hughes. Consequently, a realism estimate was provided to the decision makers (refer to figure 10). Hughes proposed to eliminate approximately 277 indirect positions. The resultant rates appeared unachievable and an adjustment was made to increase the indirect full time equivalents (FTE) to levels commensurate with other Hughes divisions and historical NAWC-ADI data. This realism adjustment increased the Hughes proposed rate by ~\$1.00 per hour in fiscal years (FY) 1997 to 2006.

The transitional Navy contingent (TNC) <sup>note</sup> is a unique sub-element of labor costs to Privatization. This is the cost incurred by the Navy for a group of approximately 185 Navy personnel assigned to perform inherently Government functions and close out NAWC-ADI processes. Program Support positions within the TNC relocate to NAWC-AD, Patuxent River beginning in FY98. Labor cost for the TNC are derived by multiplying the TNC direct labor hours by the NAWC-AD stabilized rate.

---

<sup>note</sup> The number of positions assigned to the TNC at completion of the analysis was 185. The number of TNC positions has since been reduced; however, there is minimal impact to the cost for Privatization.

WBS element 2.0 Material

|  | <b>Status Quo</b> | <b>Relocation</b> | <b>Privatization</b> |
|--|-------------------|-------------------|----------------------|
| <b>recurring material cost (TY\$M)</b> | 381.5             | 457.9             | 357.7                |

Status Quo Material Cost

Material cost is defined as the consumable direct material that can be charged directly to a given product. It is a recurring cost that consists of two main sub-elements: in-house and subcontract material. Material estimates exclude the direct citation of end items. The material cost was calculated by applying a historical cost estimating relationship to the workload at the facility.

$$\text{eqn (1) : Material } \$ (\text{FY97}) = \$17.68 * \text{direct labor hours (in-house + subcontract)}$$

Relocation Material Cost

The in-house material cost is based on historical NAWC-ADI data. Material costs were calculated for each Navy site by applying equation 1 to the workload that will be transferred from NAWC-ADI. The material charge for subcontract labor is considered part of the material cost. Material overhead cost is captured in the fully burdened labor rates for each Navy activity.

Privatization Material Cost

Material cost for privatization is defined as the consumable direct material that can be charged to a specific delivery order. Material estimates exclude the direct citation of end items, this function will be performed by the inherently governmental program support positions. The analysis included a 7.5% decrement to the estimated material dollars because Hughes proposed to participate in the General Motors world-wide buying program. In accordance with Hughes accounting principles, material overhead, G&A, and profit were applied to direct material cost.

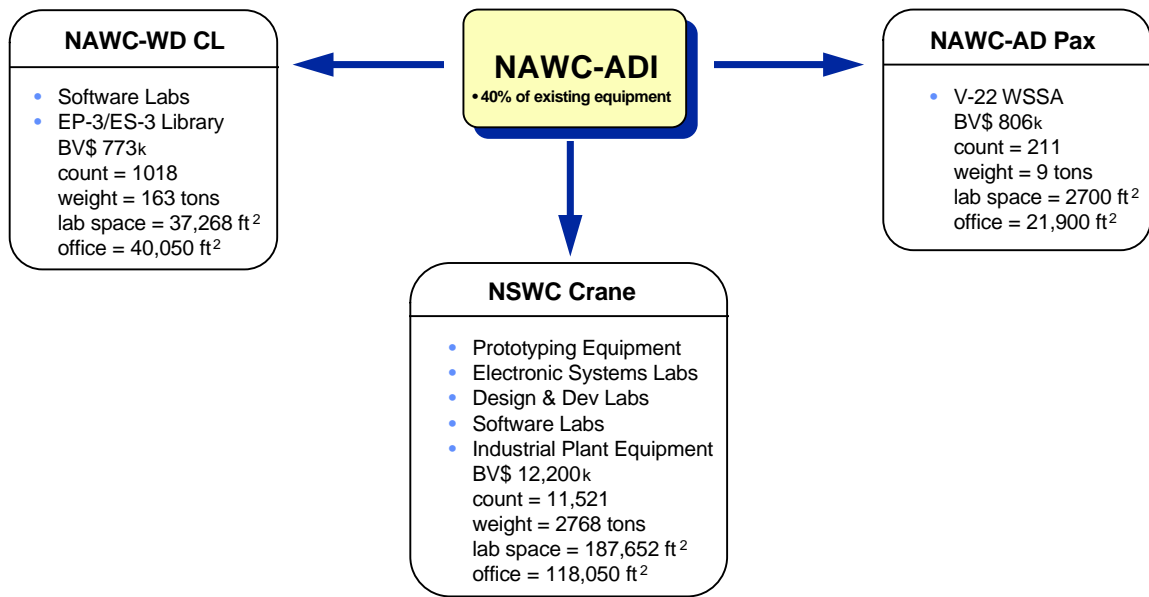
WBS element 3.0 Facilities <sup>10</sup>

|  | Status Quo | Relocation | Privatization |
|--|------------|------------|---------------|
| <b>non-recurring facilities cost (TY\$M)</b> | 0.0        | 57.8       | 0.4           |

There is no non-recurring facilities cost for the Status Quo or Privatization alternatives. Maintenance costs are included in the productive overhead pool. The \$.4M estimate for Privatization is for excess equipment disposal.

Relocation Facilities Cost

The facilities cost reflects the non-recurring cost required to move assets (software labs, test equipment, offices, etc.) and any other hardware necessary to support the work being transferred from NAWC-ADI to the other Navy sites. NAWC Indianapolis provided equipment listings and quantifiable attributes (e.g., weight, square footage, book value, etc.) for each major group of equipment relocating to the receiving activities (see figure 7).



• Facilities and all remaining equipment will be available for reuse by the City of Indianapolis

Figure 7 - Relocation Facilities & Equipment Baseline.

<sup>10</sup> Naval Air Warfare Center Aircraft Division - Indianapolis, IN; BCRC95 - Lab/Facility Move Cost Estimate. March 1996.

NAWC Indianapolis industrial engineers performed a study on 32 of the labs scheduled to relocate. The detailed study was translated into a cost estimate for facility transition.

WBS element 4.0 Environment

|   | <b>Status Quo</b> | <b>Relocation</b> | <b>Privatization</b> |
|---|-------------------|-------------------|----------------------|
| <b>non-recurring environment cost (TY\$M)</b> | 0.0               | 52.8              | 52.0                 |

Relocation and Privatization Environment Cost

The environmental cost is a non-recurring cost incurred by the Navy to clean up any hazardous materials that may have contaminated the NAWC-ADI site, to conduct environmental re-mediation, to ensure the facility is EPA code compliant, and to transfer permits. This cost is supported by an estimate performed by the Naval Facilities Engineering Command (NAVFAC) and is based on a recent environmental baseline study of the NAWC-ADI facility to assess the existence of hazardous type materials that are handled at this site and outline the extent of any required re-mediation. The environmental re-mediation effort is essentially the same for Relocation and Privatization (i.e., the facility must be clean prior to conveyance to the city/LRA). The NAWC facility is scheduled to be conveyed to the city/LRA in FY01, and environmental operations are assumed to cease at that point.

WBS element 5.0 Personnel

|   | <b>Status Quo</b> | <b>Relocation</b> | <b>Privatization</b> |
|---|-------------------|-------------------|----------------------|
| <b>non-recurring personnel cost (TY\$M)</b> | 0.0               | 96.6              | 67.1                 |
| <b>recurring CSRS cost (TY\$M)</b>          | 24.1              | 25.7              | 15.2                 |

Status Quo Personnel Cost

The recurring cost is for continued unfunded Civil Service Retirement System (CSRS) pension benefits for ~1000 employees. This cost was estimated at 11% of the average employee salary. The 11% figure represents the unfunded portion of the Government contribution to pension benefits.

Relocation Personnel Cost

The non-recurring and recurring personnel costs associated with the implementation of the Relocation are comprised of the following eight elements:

1. Relocation cost - the reimbursable costs for employee permanent change of station (PCS) moving expenses. Estimated at \$35,000 per person based on maximum allowable values for real-estate expenses, temporary quarters, storage, and mileage.
2. Voluntary Separation Incentive Program (VSIP) - incentive paid to employees to voluntarily terminate employment with the Federal Government. Allowable up to \$25,000 per person.
3. Reduction In Force (RIF) - cost incurred for the severance paid to employees whose jobs have been terminated and no longer work for the Federal Government. Calculated at \$26,700 per person by a mathematical algorithm which accounts for employee age and years of Government service.
4. Civil Service Retirement System (CSRS) - unfunded recurring benefits paid to retiring employees under CSRS plus a non-recurring payment from DBOF to reimburse the CSRS pension fund once an employee is severed. Unfunded liability was estimated at 11% of average employee salary, non-recurring cost was estimated at 9% of average employee salary.

5. Extended Health Benefits - cost incurred to extend health benefits for up to 12 months for employees who have been displaced from their jobs. The cost was estimated at \$200 per month for 12 months of benefits for each employee.
6. Civilian Assistance and Re-Employment Program (CARE) - a civilian personnel program whereby an employer can obtain up to \$10,000 per displaced federal employee for retraining necessary for a job in the private sector. The personnel selected for retraining must meet certain employment conditions and eligibility requirements.
7. Unemployment - costs paid based on the number of personnel displaced from their jobs. Unemployment costs were estimated at \$217 per week (state of Indiana unemployment rate) for 26 weeks.
8. Career Transition Training - training for employees who transfer to new jobs within the government. Training costs were calculated to be \$2500 per person.

Figure 8 defines the assumptions used to derive personnel costs. The estimated number of employees at NAWC-ADI at the beginning of FY97 equals 2463, of which, 1481 would be offered a transfer of function (TOF) to one of the receiving activities and 982 positions would be eliminated. 883 of the 1481 positions offered a TOF would subsequently decline and be terminated via VSIP or RIF. A NAWC-ADI employee survey (Oct. '96) was used to project the number of people accepting/declining the TOF. The employees holding the 982 positions chosen to be eliminated would either be terminated via VSIP or RIF, or the employees can apply for the Priority Placement Program (PPP). The CARE program applies to those employees declining the TOF and those whose positions are eliminated, who do not apply for PPP and are not retirement eligible.

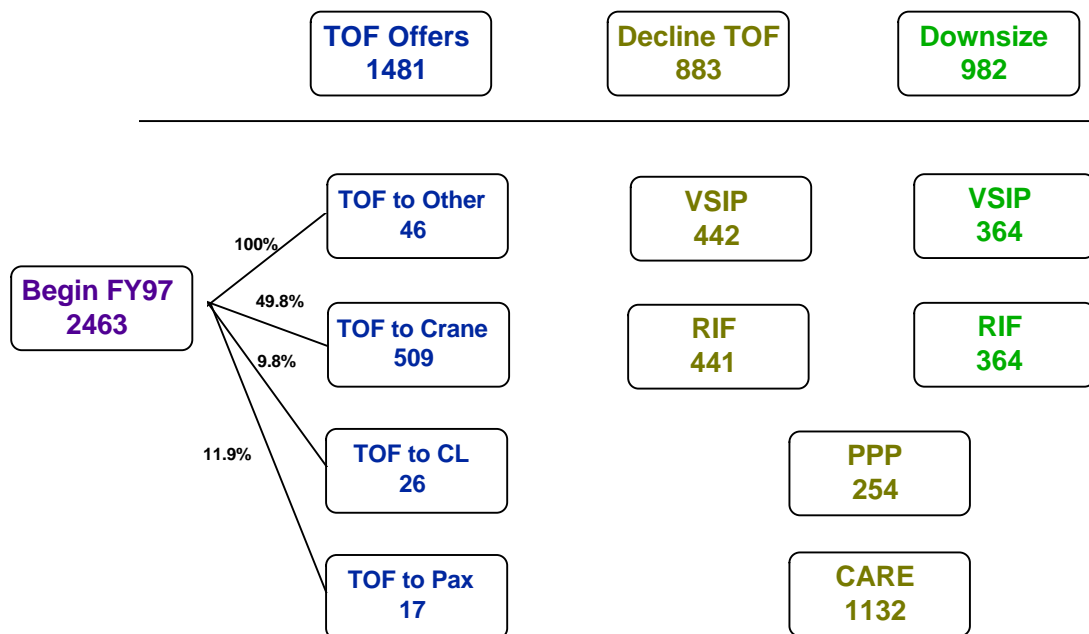


Figure 8 - Relocation Personnel Assumptions.

Privatization Personnel Costs <sup>note</sup>

The Personnel costs for Privatization were calculated using the same methodology as the Relocation plan; however the personnel assumptions were quite different. Figure 9 defines the assumptions used to derive personnel costs. The estimated number of employees at NAWC-ADI at the beginning of FY97 equals 2463. Of the 2463 people, approximately 185 positions will transfer to the TNC and 254 people will apply for Priority Placement (PPP). The remaining balance will be separated (and consequently receive severance pay if not retirement annuity eligible), of which Hughes will hire approximately 2000 of the current employees.

<sup>note</sup> Personnel cost estimate does not include CSRS pension indexing as proposed under section 1616 of the National Defense Authorization Act.

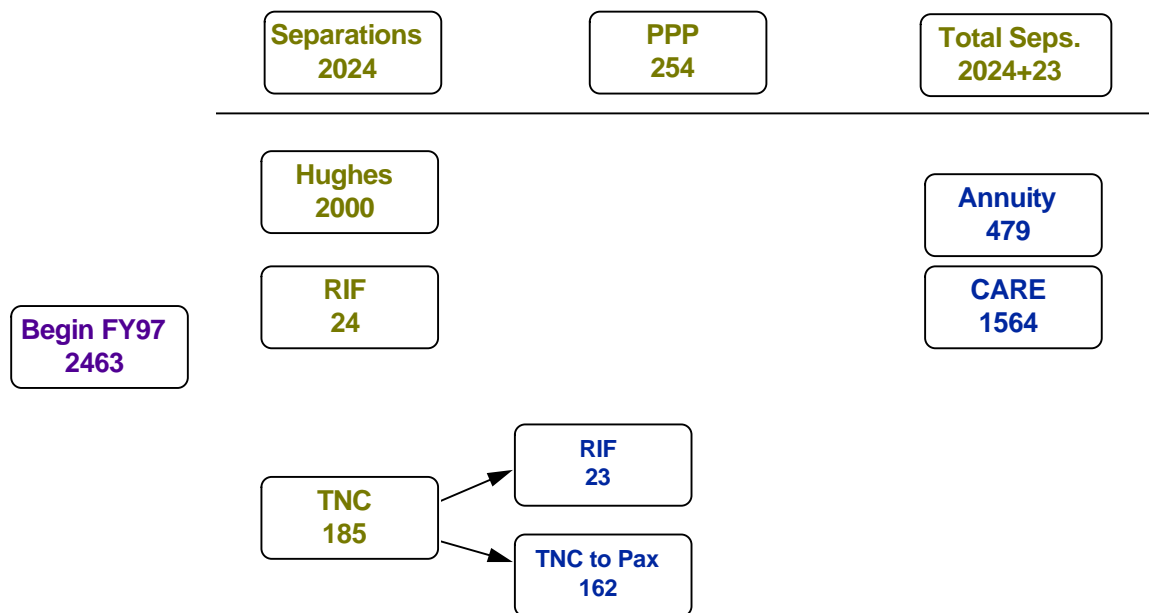


Figure 9 - Privatization Personnel Assumptions.

WBS 6.0 Other Costs

|   | Status Quo | Relocation | Privatization |
|---|------------|------------|---------------|
| <b>non-recurring other cost (TY\$M)</b> | 0.0        | 35.5       | 10.6          |

Relocation Other Costs

The other cost category includes elements which did not fall into any of the previous WBS categories; they are disruption, program management, and residual operations. Disruption cost is the most significant portion of “other cost” and it is comprised of three lower level WBS elements:

1. Downtime - inability to perform direct labor hours as a result of equipment tear-down and assembly, transportation, and calibration. Downtime was estimated as a function of the workdays lost during equipment downtime.

2. Productivity loss - loss in productivity as a result of office relocation. Assumed to be concurrent with downtime. Productivity loss was estimated at two weeks for each employee accepting a transfer of function.
3. Loss of learning - loss in organizational learning as a result of displacing an experienced workforce. Loss of learning was estimated as a function of downtime and the percentage of skilled workforce estimated to move to the receiving activities.

Program Management functions are required to transition workload, personnel and equipment to the receiving activities. This element consisted of a core transition team at NAWC-ADI and three transition managers at each of the receiving activities. The residual operations function is to prepare the facility for turnover to NAVFAC in FY00/01.

#### Privatization Other Costs

The “other cost” category for Privatization includes two lower level WBS elements: Disruption and the Defense Contracts Management Command (DCMC) costs. Disruption costs for Privatization are very small in comparison to the Relocation plan because the existing workforce will be retained and the equipment will not be relocated. There is a potential for disruption to result from environmental re-mediation efforts (i.e., asbestos containment, hazardous material cleanup); however, NAVFAC has proposed to work with HTSC to perform environmental re-mediation in a non-disruptive manner. The DCMC estimate is the recurring cost for ~20 on-site personnel to administer the Privatization contract and perform quality assurance operations.

*step 4. Development of a Break-even analysis*

---

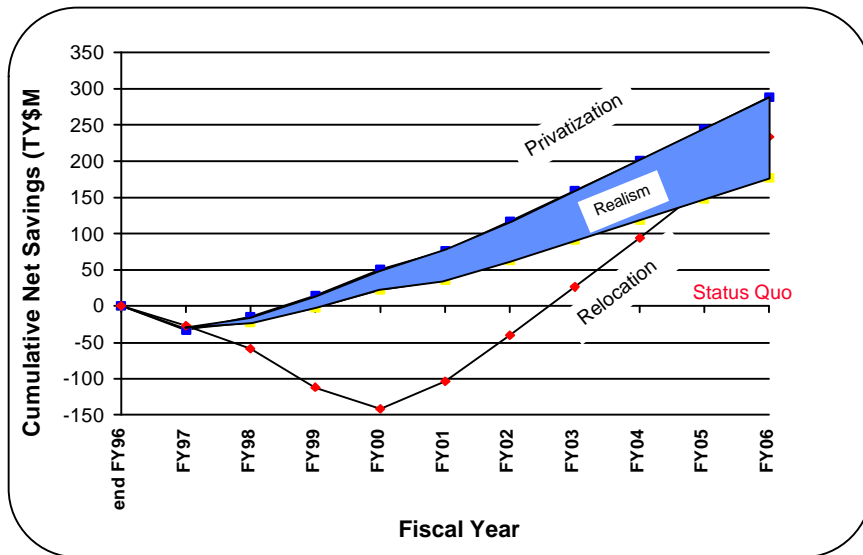
The recurring and non-recurring costs derived in step 3 do not alone constitute the net increase / decrease in tax payer dollars needed to implement either alternative. In this context, the analysis must consider the net cost to the Federal Government. A break-even analysis was conducted to determine the cumulative net savings which may result from either alternative. Below are the ground rules and assumptions which bound the break-even analysis.

1. Cumulative Net Savings represent the cumulative increase/decrease in cost relative to the Status Quo alternative, incurred by the Federal Government; these costs are measured by:
  - Non-recurring investment required to implement either alternative.
  - Recurring costs to perform contracted work.
  - Federal tax revenue generated from the tax paying private entity.
  - CSRS pension savings once federal employees terminate Government service.
2. Relocation savings applies to all customers of NAWC-AD, NAWC-WD, and NSWC.
3. Privatization savings applies to entire NAWC-AD customer base plus Government cost-type contracts within Hughes Technical Services Company.
4. The net present value (NPV) and savings-investment ratio calculations were based on a 7% discount rate, the Sept. 1997 ten year T-bill rate.
5. Customer demand (workload) was assumed to be the same for each alternative.
6. OSD inflation indices for O&MN and OPN (dated February 1996) were used to forecast out year labor rates and personnel costs. NAVAIR calendar year aircraft electronics hardware escalation indices were used to forecast material costs.
7. The analysis assumed that NAWC-ADI was on schedule for all work in process.
8. The analysis was performed in real dollars (TY\$).

A summary of the quantitative results of the analysis can be seen graphically from figure 10. Relocation and Privatization were compared to the Status Quo (baseline alternative). All savings

and economic measures were derived by comparing Relocation and Privatization to the Status Quo alternative. Cumulative net savings was calculated by adding the recurring savings to be realized by customers plus any other savings (i.e., federal tax savings, federal retirement pension savings) minus the non-recurring investment cost to implement the alternative.

Graphically, it can be seen that both privatization and relocation will cost the Federal Government more than the status quo in the near term. This is a direct result of the large up front investment required to implement either alternative. Both alternatives will yield a positive return on the investment within a 10 year study period.



Net Savings = Recurring Savings - Non Recurring Cost

Figure 10 - Break Even Analysis.

Table 3 depicts the results of the break-even analysis for each alternative over the 10 year study period. NPV\$ was used to calculate an objective economic score for each alternative (see step 7). The savings-investment ratio (SIR) was calculated according to equation 2. The SIR favors the privatization alternative for the study period. A SIR of greater than 1.0 is often considered a wise investment within the Government.

$$eqn (2) : NPV(cost\ savings) / NPV(investment\ cost)$$

Table 3. Break-even Analysis Results

|  | <b>Status Quo</b> | <b>Relocation</b> | <b>Privatization</b> |
|--|-------------------|-------------------|----------------------|
| <b>Discount rate</b>                   | 7%                | 7%                | 7%                   |
| <b>Life of study</b>                   | 10 yr.            | 10 yr.            | 10 yr.               |
| <b>Non-recurring investment (TY\$)</b> | \$0               | \$243 M           | \$130 M              |
| <b>Annualized Cost Savings (TY\$)</b>  |                   | \$18.0 M          | \$23.0 M             |
| <b>Break-even point</b>                |                   | FY03              | FY99                 |
| <b>10 year Net Present Value</b>       | -                 | <b>\$102 M</b>    | <b>\$179 M</b>       |
| <b>Savings-investment ratio</b>        | -                 | .50               | 1.40                 |

It is important to note that the anticipated privatization savings are based upon the assumption that the projected NAWC-ADI workload, excluding inherently governmental work, will transition to the privatized operation. Any significant changes to the workload volume will proportionally impact the anticipated savings.

*step 5. Determination of Benefits of each alternative*

---

The benefits of each alternative were determined through discussions with senior officials within the Navy. In order to ensure a consensus of stakeholder interest, the evaluation team was comprised of individuals from each impacted military installation and the private company, Hughes. By first providing each subject the goals of the BCRC process, which are outlined in step 1, a free-form brainstorming session yielded a list of approximately 20 “benefits”. Because a few of the benefits were dependent upon one another, the subjects established working definitions for each benefit. The list was now down to 15 benefits. The multivoting technique<sup>11</sup> was used to reduce the list of benefits to a manageable number. Once the final list was determined, desired levels of performance for the quantifiable benefits were established. The resultant benefits are listed below:

- A. Maintain continuity of Integrated Product Teams (IPTs).
- B. Minimize program disruption.
- C. Establish partnerships with industry and academia.
- D. Reinforce synergy of weapons / platform support.
- E. Transfer of jobs to the private sector (desirable level > 500 people).
- F. Reduction in labor rates paid by customers (desirable > 10% decrease).

The last two benefits identified were quantifiable in nature. Because these benefits are measured in different units, a common unit of measure was developed. A value score was assigned based on the anticipated performance of each alternative. Min. value = 0 and max. value = 100. The sum of the scores from the alternatives were then normalized to a score of 100. Table 4 shows the results.

---

<sup>11</sup> Department of the Navy TQL Office, *Handbook for Basic Process Improvement*, 1992, p. 34.

Table 4.

Value Scores for Benefits E & F.

|                              | <b>Status Quo</b> | <b>Relocation</b> | <b>score</b> | <b>Privatization</b> | <b>score</b> |
|------------------------------|-------------------|-------------------|--------------|----------------------|--------------|
| <b>E. Transfer of jobs</b>   | 0                 | 728               | 32           | 1564                 | 68           |
| <b>F. Reduction in rates</b> | -                 | -10%              | 40           | -15%                 | 60           |

The next step in the evaluation process was to calibrate a score for the non-quantifiable benefits (benefits A-D). Each of the subjects was asked to subjectively estimate the effectiveness of each alternative relative to a particular benefit. The scoring system used was min. effectiveness = 0 and max. effectiveness = 5. The resultant scores were multiplied by a factor of 20 to yield a maximum score of 100 for any particular benefit. There was not any significant variation in the individual scores provided by the team members. Table 5 illustrates the average scores for the team.

Table 5. Qualitative Benefit Value Scores.

|   | <b>Status Quo</b> | <b>Relocation</b> | <b>Privatization</b> |
|---|-------------------|-------------------|----------------------|
| <b>A. Maintain continuity of IPTs</b>             | 90                | 74                | 84                   |
| <b>B. Minimize program disruption</b>             | 100               | 30                | 72                   |
| <b>C. Partnerships w/ industry &amp; academia</b> | 50                | 50                | 90                   |
| <b>D. Synergy of weapons / platform support</b>   | 55                | 92                | 55                   |

*step 6. Weighting the importance of the Benefits*

---

According to the Brown-Gibson procedure, the relative weightings of each of the benefits had to be determined. A number of different formula weightings exist for this type of exercise. The intermediate goal was to pick a method which could be easily explained to senior officials without diminishing the integrity of the analysis.

The study examined the following methods: rank sum weights<sup>12</sup>, rank reciprocal weights<sup>13</sup>, analytic hierarchy process (AHP)<sup>14</sup>, and the Dunn-Rankin<sup>15</sup> procedure. The first two methods can easily be explained; however, they are far less credible because there is not a reasonable check for consistency. At first, it appeared the AHP model would be most applicable to the problem; however, there was difficulty explaining the matrix calculations to senior management. The Dunn-Rankin technique offered the best solution for establishing weighting factors with ratio scaled properties. This technique assumes independence among the benefits. The definitions of the benefits were carefully defined in the previous step to eliminate any dependence among them. Transitivity, logical inconsistency, was studied and found not to be a factor in the analysis. An example of transitivity can be explained by the following: if  $A > B > C$ , then  $C \text{ not } > A$ .

The Dunn-Rankin method uses a size  $m \times m$  matrix ( $m$  is the number of benefits) of paired comparisons. Table 6 will facilitate the discussion. Each column benefit is compared against each row benefit. An integer value of one indicates the column benefit is more important than the row benefit. Integer value zero indicates the row benefit is perceived to be more important. A tie in the sum total for the benefits indicates transitivity. Table 7 shows the cumulative matrices from each of the test subjects which was used to calculate the normalized benefit weights. The individual matrices are provided in Appendix B.

---

<sup>12</sup> Canada and Sullivan, *Economic and Multiattribute Evaluation of Advanced Manufacturing Systems* Prentice Hall, 1989. pp. 226-28.

<sup>13</sup> Canada and Sullivan. pp. 226-28.

<sup>14</sup> Canada and Sullivan. pp. 259-84, 448-52.

<sup>15</sup> Dunn-Rankin, P, and King, F J.; *Multiple Comparison in a Simplified Method of Scaling*, Educational and Psychological Measurement, 1969, pp. 318-29.

Table 6. Paired Comparison Matrix

| Benefit | A | B | C | D | E | F |
|---------|---|---|---|---|---|---|
| A       | - | 1 | 0 | 0 | 0 | 1 |
| B       | 0 | - | 0 | 0 | 0 | 1 |
| C       | 1 | 1 | - | 1 | 1 | 1 |
| D       | 1 | 1 | 0 | - | 1 | 1 |
| E       | 1 | 1 | 0 | 0 | - | 1 |
| F       | 0 | 0 | 0 | 0 | 0 | - |
| sum     | 3 | 4 | 0 | 1 | 2 | 5 |

Table 7. Summary Dunn-Rankin Matrix

| Benefit              | A  | B  | C | D | E | F  |
|----------------------|----|----|---|---|---|----|
| A                    |    | 6  | 0 | 0 | 1 | 3  |
| B                    | 0  |    | 0 | 0 | 0 | 1  |
| C                    | 6  | 6  |   | 4 | 2 | 4  |
| D                    | 6  | 6  | 2 |   | 2 | 6  |
| E                    | 5  | 6  | 4 | 4 |   | 6  |
| F                    | 3  | 5  | 2 | 0 | 0 |    |
| <i>n</i>             | 6  |    |   |   |   |    |
| <i>R<sub>i</sub></i> | 20 | 29 | 8 | 8 | 5 | 20 |

The Dunn-Rankin technique requires a number of intermediate calculations prior to the computation of the normalized benefit weight. The formulae below have been applied to the results from table 7 to perform these calculations. Appendix B contains the results for each benefit.

eqn (3): Rank sum,  $R_{min} = n$ ;

eqn (4):  $R_{max} = mn$ ;

eqn (5):  $R_{avg} = n(m+1)/2$

eqn (6): Standard deviation expected value,  $s = ((mn(m+1))^{(1/2)})/12$

eqn (7): Normalized ratio,  $Z_i = (R_i - R_{avg})/s$

eqn (8): Weight of each benefit,  $W_i = [(Z_i + Z_{min}) \times 100]/(Z_{max} + Z_{min})$

eqn (9): *Normalize benefit weight,  $N(W_i) = W_i/Sum(W_i)$*

*step 7. Calculation and Discussion of the results*

---

The normalized weightings that were developed in the previous step are shown in table 8. A value score for each benefit was obtained by multiplying the normalized weight for each benefit by the corresponding value score (from table 4 and table 5).

The economic (cost savings) scores were derived by normalizing (based on a total score of 100) the net present value savings for each alternative. The values from table 3 were used in the calculation. Note that since Relocation and Privatization were compared to the Status Quo when calculating savings, there is a zero net present value amount for the Status Quo alternative.

Table 8. Resultant Scores for BCRC Alternatives

|   | <b>Normalized Weight</b> | <b>Status Quo Score</b> | <b>Relocation Score</b> | <b>Privatization Score</b> |
|---|--------------------------|-------------------------|-------------------------|----------------------------|
| <b>A. Maintain continuity of IPTs</b>             | .22                      | 90                      | 74                      | 84                         |
| <b>B. Minimize program disruption</b>             | .32                      | 100                     | 30                      | 72                         |
| <b>C. Partnerships w/ industry &amp; academia</b> | .09                      | 50                      | 50                      | 90                         |
| <b>D. Synergy of weapons / platform support</b>   | .09                      | 55                      | 92                      | 55                         |
| <b>E. Transfer of jobs to the private sector</b>  | .06                      | -                       | 32                      | 68                         |
| <b>F. Reduction in rates</b>                      | .22                      | -                       | 40                      | 60                         |
| <b>Benefits Score</b>                             |                          | 61.6                    | 49.4                    | 71.9                       |
| <b>Economic (cost savings) Score</b>              |                          | 0.0                     | 36.3                    | 63.7                       |

The benefits and economic scores for each alternative were plotted using a Microsoft Excel 5.0 model (see figure 11). The horizontal axis (x axis) is the relative importance of cost to

benefits. Because there is commonly a disagreement about the relative importance of cost and benefits, the illustration provides the decision maker a range of importance from which one alternative may exceed another. The right most region in the graph indicates that economic factors are dominant over subjective benefits, whereas the left hand region indicates that benefits are more important than economic considerations. This format allows the decision maker to conduct a trade-off analysis between the alternatives. The following formula was used to develop the overall cost-benefit score.

*eqn (10): cost - benefit score<sub>alt a</sub> = x (economic score) + (1 - x)(benefits score),*  
*where x is the relative importance of cost to benefits (x axis on the graph)*

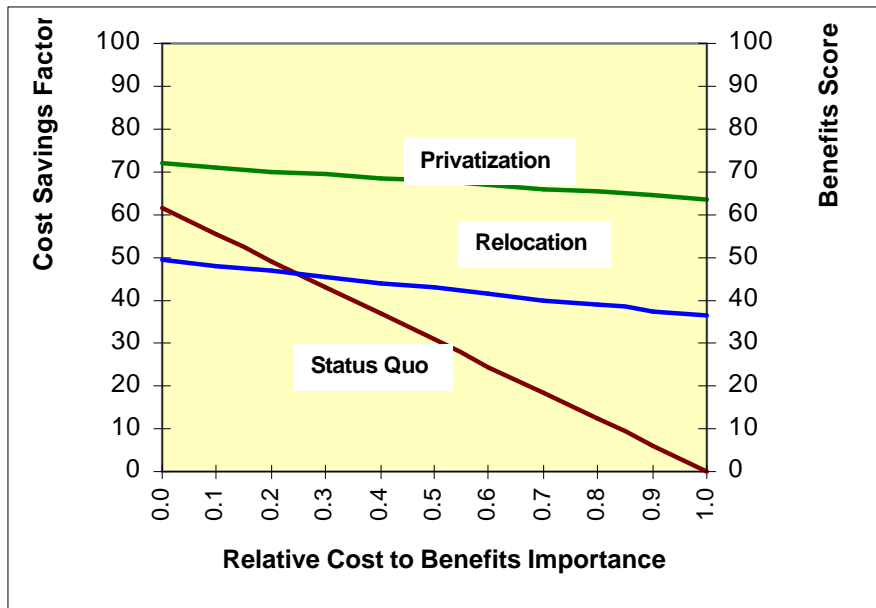


Figure 11 - Cost and Benefits for each Alternative.

The analysis suggests that the privatization alternative is more cost effective to the Federal Government. These results are consistent with the savings-investment ratio.

If privatization were not an option for NAWC-ADI, the decision maker may determine that relocation is more cost effective than the status quo when cost was considered at least 25% ( $x > .25$ ) as important as the strategic benefits.

step 8. Conduct sensitivity analysis

---

Throughout discussions with each of the receiving activities under the Relocation plan, it became apparent the transition schedule could be accelerated to yield a more cost effective Relocation option. It appeared the accelerated schedule could be realized if adequate BCRC funding was available for implementation. The accelerated schedule assumed that all work could be transferred to the receiving Navy activities within 3 years, the original plan would take 5 years to implement. The accelerated schedule also assumed that NSWC Louisville is privatized in FY97. An accelerated transition schedule would cause the “knee” in the Relocation curve (see figure 10) to begin in FY99 as opposed to FY01 and then continue at the same slope. This would result in a net present value savings of \$192M for Relocation. Sensitivity analysis was conducted to determine the impact the transition schedule has on the overall analysis. Figure 12 illustrates the results. Sensitivity analysis is defined as the magnitude in change of the analysis when one or more variables are changed to reflect possible outcomes.

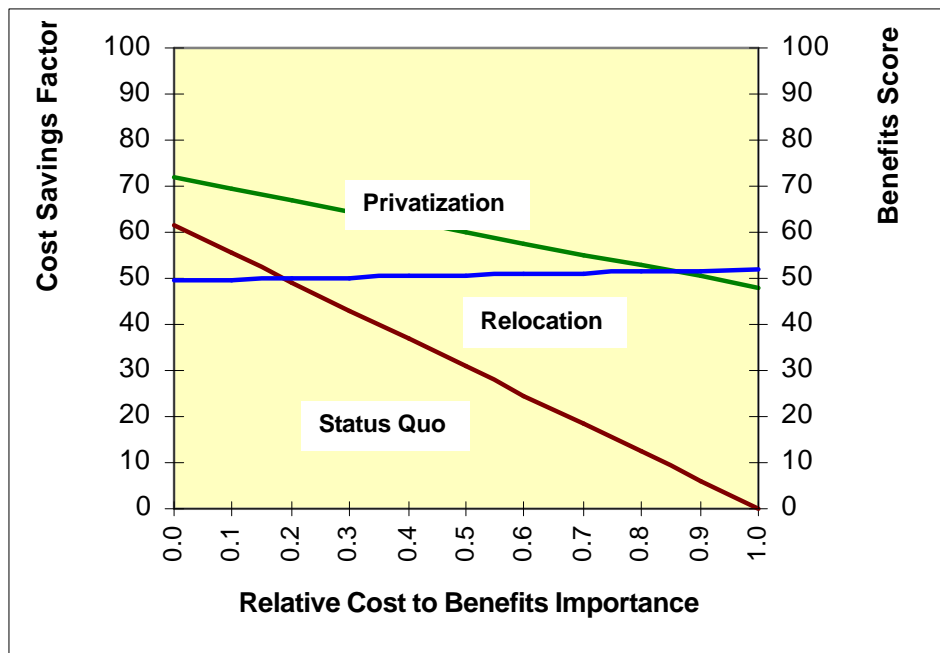


Figure 12 - Sensitivity Analysis (Transition Schedule)

The results of the sensitivity analysis also suggest that privatization is the preferred alternative for cost to benefits importance values  $x < .85$ . When the decision is made solely on the basis of cost, there is a marginal economic benefit of the relocation option. Once again, the status quo alternative will never exceed the cost effectiveness of the other alternatives. The sensitivity analysis also provides further justification of the decision to privatize NAWC-ADI.

## V. Conclusions and Recommendations for Future Study

---

The analysis concludes that the privatization alternative is overwhelmingly more cost effective to the Federal Government. From an economic standpoint, privatization will save the Federal Government a net present value of \$77M (\$179M - \$102M) over the 10 year study period. These results are consistent with the savings-investment ratio which indicated that privatization is a wiser investment. Sensitivity analysis conducted on the largest cost driver in the analysis, transition schedule, also proved that privatization is dominant over relocation when the decision is not made solely on the basis of cost. Privatization is also more beneficial to the goals of the Department of the Navy and the welfare of the impacted Federal employees. The aggregate benefits scores give privatization an advantage over relocation.

The Department of the Navy was correct in awarding a privatization contract for the work at the Naval Air Warfare Center Aircraft Division, Indianapolis, IN.

A Micro-Soft Excel 5.0 model was developed to calculate the inputs to the Brown-Gibson procedure. The model accepts the cost estimates (or any economic measure preferred by the user) from each alternative and develops a normalized economic score. The benefits page in the model uses the Dunn-Rankin technique to calculate the normalized weightings for a list of benefits. The resultant cost and benefit scores are automatically plotted for purposes of analysis. The model can be easily adapted to handle more alternatives and additional benefits. Sensitivity analysis can be performed by linking cost estimating relationships to the model.

### Future Study

The procedure developed herein can be adapted to cover all military base closure decisions. Though the specific input parameters may vary, the architecture of the analysis is flexible to any BCRC study. In addition, the process provides a framework for determining make or buy decisions within an organization.

# Appendix A

## Glossary of Terms & WBS Dictionary

### ACRONYMS

|          |  |
|----------|--|
| BCRC     | BASE CLOSURE AND REALIGNMENT COMMISSION                      |
| CARE     | CIVILIAN ASSISTANCE AND RE-EMPLOYMENT PROGRAM                |
| CERs     | COST ESTIMATING RELATIONSHIPS                                |
| CSRS     | CIVIL SERVICE RETIREMENT SYSTEM                              |
| DCMC     | DEFENSE CONTRACT MANAGEMENT COMMAND                          |
| DoD      | DEPARTMENT OF DEFENSE  |
| DoN      | DEPARTMENT OF THE NAVY                                       |
| ID/IQ    | INDEFINITE DELIVERY/INDEFINITE QUANTITY                      |
| NAWC-AD  | NAVAL AIR WARFARE CENTER - AIRCRAFT DIVISION                 |
| NAWC-ADI | NAVAL AIR WARFARE CENTER - AIRCRAFT DIVISION<br>INDIANAPOLIS |
| NAWC-WD  | NAVAL AIR WARFARE CENTER - WEAPONS DIVISION                  |
| OMB      | OFFICE OF MANAGEMENT AND BUDGET'S                            |
| O&MN     | OPERATION AND MAINTENANCE NAVY                               |
| OPN      | OTHER PROCUREMENT NAVY                                       |
| OSD      | OFFICE OF SECRETARY OF DEFENSE                               |
| PPP      | PRIORITY PLACEMENT PROGRAM                                   |
| REC      | RECURRING  |
| RIF      | REDUCTION IN FORCE   |
| TNC      | TRANSITIONAL NAVY CONTINGENT                                 |
| VSIP     | VOLUNTARY SEPARATION INCENTIVE PROGRAM                       |
| WBS      | WORK BREAKOUT STRUCTURE                                      |

## WORK BREAKDOWN STRUCTURE DICTIONARY <sup>16</sup>

### 1.0 Labor

This element refers to the recurring labor cost to perform the projected workload. For the Relocation plan, this cost is a product of the direct labor hours (transferring from NAWC-ADI to each site) and the site composite rates. The composite rates include direct labor, fringe, G&A, and production overhead.

For the Privatization Plan, labor cost is comprised of:

- ⌚ Pre-Privatization labor: defined as the labor incurred by on-site government personnel at the NAWC-AD rate for the three month period (Oct. through Dec. 1997) before the start of the ID/IQ contract.
- ⌚ Hughes labor: defined as the transferring labor from NAWC-ADI to Hughes. Hughes composite rate includes direct labor, fringe, G&A, production overhead, profit, and cost of money (CoM).
- ⌚ TNC labor: defined as the labor incurred by the TNC personnel located at Indianapolis during the nine month period from Jan through Sept. 1998.
- ⌚ Post-TNC labor: defined as the labor incurred by the TNC personnel for the period from Oct. 1998 to the end of the ID/IQ contract at Patuxent River.

### 2.0 Material

This element refers to the recurring cost of consumable/direct type material that can be charged directly to a given product. This cost can include such things as engineering material, tooling material, and purchased equipment.

### 3.0 Facilities

This element refers to the non-recurring cost required to move assets (software labs, test equipment, offices, etc.) and any other hardware necessary to support the work being transferred from NAWC-ADI to the other Navy sites. This element includes:

- ⌚ Collateral Equipment: refers to the purchase and installation of miscellaneous furniture e.g., cabinets, conference room furniture, partitions, etc.

---

<sup>16</sup> Department of Defense, *Work Breakdown Structures for Defense Material Items, MIL-STD 881B 25* March 1993.

- ① Facility Rehab: refers to the construction or/and repair of an existing building, e.g., construction of walls; painting; demolition, etc.
- ① Establish labs: includes the Relocation of all avionics computers and test equipment; building racks and cables for the EP-3E and EP-3 hot benches; and Relocation of V-22 avionics, racks and cables.
- ① Communication/Information Systems: includes the telephone systems as well as network infrastructure and file servers.
- ① Transportation of Things: includes the costs for equipment disassembly, reassembly, marking, documenting, preparing for shipment, moving to the receiving site, reconnecting utilities to equipment, and recalibration of equipment.
- ① Equipment disposal.

#### 4.0 Environment

This element refers to the non-recurring cost incurred by the Navy to: clean up any hazardous materials at the NAWC-ADI site; conduct environmental remediation; ensure the facility is EPA code compliant; transfer permits, etc.

##### Environment Cleanup/Removal:

- ① Preliminary assessment of site(s) that may pose hazards to public health or the environment. Such assessment typically includes information on the source, nature, extent, and magnitude of actual and potential hazardous substance.
- ① On site sampling and analysis to determine actual contamination and action needed.
- ① Remedial investigation including risk determination.
- ① Feasibility study of remedial action option(s) (e.g., removal, etc.)
- ① Remedial design plans for remedial action option(s).
- ① Implementation of selected remedial option(s).
- ① Interim remedial actions taken at any time during the cleanup process (e.g., public health protection; control of contaminant releases to the environment, etc.)
- ① Remedial action(s) in operation and functioning properly (action(s) may be needed for extended time period(s)).

##### Permit Transfer:

There are several categories of permits, each category defines operating requirements and various provisions that are specific to the permitting need. Types of hazardous waste permits include:

- ① Treatment, Storage, and Disposal Permits

- ① Research, Development, and Demonstration Permits
- ① Post-Closure Permits
- ① Emergency Permits
- ① Permit-by-Rule
- ① Trial Burn and Land Treatment Demonstration Permits

## 5.0 Personnel

Personnel is a non-recurring cost. This element includes:

A. Relocation PCS:

This element refers to the reimbursement of employees permanent change of station (PCS) moving expenses. The costs associated with this element include: Temporary Quarters Subsistence Expenses (TQSE) per diem 2 months, storage of household goods, transportation of household goods, Personal Own Vehicle (POV) mileage allowance, per diem moving @ 350 mi/day, average cost for house hunting, sale of current and purchase of new residence.

B. Voluntary Separation Incentive Program (VSIP):

This element refers to the incentive paid to employees to voluntarily terminate employment with the Federal Government.

C. Reduction In Force (RIF):

This element refers to the severance paid to employees whose jobs have been terminated and will no longer work for the Federal Government.

D. Civil Service Retirement System (CSRS):

This element refers to the benefits paid to retiring employees under the CSRS retirement system. The non-recurring CSRS element is a one time repayment of the CSRS by DBOF for severed employees.

E. Extended Health Benefits:

This element refers to the temporary continuation of health benefits for up to 12 months to government employees who have been displaced from their jobs.

F. Civilian Assistance and Re-Employment Program (CARE):

This element refers to a civilian personnel program whereby Hughes can obtain up to \$10k/person for retraining NAWC-ADI personnel who transition to Hughes. The personnel selected for retraining must meet certain employment conditions and eligibility requirements.

G. Unemployment:

This element refers to the cost paid to employees who are displaced from their jobs

H. Career Transition Training: employees who transfer to new jobs within the government.

#### 6.0 Other Cost

##### Disruption:

- ① Downtime: refers to the inability to perform direct labor functions as a result of equipment downtime (i.e., lab teardown and assembly, transportation, and calibration).
- ① Productivity loss: refers to the temporary loss in productivity as a result of office Relocation.
- ① Loss of learning: refers to the loss in organizational effort due to the displacement of experienced personnel.
- ① Program Management under the Relocation plan is defined as the functions that are required to transition workload, personnel and equipment to the receiving activities.
- ① Residual Operations under the Relocation plan is defined as the preparation of facility for turnover to NAVFAC in FY01.
- ① DCMC under the Privatization Plan refers to the government personnel responsible for the overall on-site management of government contractual operations.

# Appendix B

## Decision Support Model Calculations

Ratio-Scaled Weighting using Dunn-Rankin Matrix

|   | A | B | C | D | E | F |   | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1 | 0 | 0 | 0 | 0 | 1 | A | 1 | 0 | 0 | 0 | 0 | 0 |
| B | 0 | 1 | 0 | 0 | 0 | 1 | B | 0 | 1 | 0 | 0 | 0 | 0 |
| C | 1 | 1 | 1 | 1 | 1 | 1 | C | 1 | 1 | 1 | 1 | 0 | 1 |
| D | 1 | 1 | 0 | 1 | 1 | 1 | D | 1 | 1 | 0 | 1 | 0 | 1 |
| E | 1 | 1 | 0 | 0 | 1 | 1 | E | 1 | 1 | 1 | 1 | 1 | 1 |
| F | 0 | 0 | 0 | 0 | 0 | 1 | F | 1 | 1 | 0 | 0 | 0 | 1 |
|   | 3 | 4 | 0 | 1 | 2 | 5 |   | 4 | 5 | 1 | 2 | 0 | 3 |
| A | B | C | D | E | F |   | A | B | C | D | E | F |   |
| A | 1 | 0 | 0 | 1 | 1 | A | 1 | 0 | 0 | 0 | 0 | 0 |   |
| B | 0 | 1 | 0 | 0 | 0 | B | 0 | 1 | 0 | 0 | 0 | 0 |   |
| C | 1 | 1 | 1 | 1 | 1 | C | 1 | 1 | 1 | 0 | 0 | 0 |   |
| D | 1 | 1 | 0 | 1 | 1 | D | 1 | 1 | 1 | 1 | 0 | 1 |   |
| E | 0 | 1 | 0 | 0 | 1 | E | 1 | 1 | 1 | 1 | 1 | 1 |   |
| F | 0 | 1 | 0 | 0 | 0 | F | 1 | 1 | 1 | 0 | 0 | 1 |   |
|   | 2 | 5 | 0 | 1 | 3 | 4 |   | 4 | 5 | 3 | 1 | 0 | 2 |
| A | B | C | D | E | F |   | A | B | C | D | E | F |   |
| A | 1 | 0 | 0 | 0 | 1 | A | 1 | 0 | 0 | 0 | 0 | 0 |   |
| B | 0 | 1 | 0 | 0 | 0 | B | 0 | 1 | 0 | 0 | 0 | 0 |   |
| C | 1 | 1 | 1 | 0 | 1 | C | 1 | 1 | 1 | 0 | 0 | 0 |   |
| D | 1 | 1 | 0 | 0 | 1 | D | 1 | 1 | 1 | 1 | 0 | 1 |   |
| E | 1 | 1 | 1 | 1 | 1 | E | 1 | 1 | 1 | 1 | 1 | 1 |   |
| F | 0 | 1 | 0 | 0 | 0 | F | 1 | 1 | 1 | 0 | 0 | 1 |   |
|   | 3 | 5 | 1 | 2 | 0 | 4 |   | 4 | 5 | 3 | 1 | 0 | 2 |

| <b>Benefits</b>                               |   |                            |              |             |             |             |             |             |             |           |
|---|---|----------------------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------|
| A   | Maintain continuity of IPTs                   |                            |              |             |             |             |             |             |             |           |
| B   | Minimize program disruption                   |                            |              |             |             |             |             |             |             |           |
| C   | Establish partnerships with industry          |                            |              |             |             |             |             |             |             |           |
| D   | Reinforce synergy of weapons/platform support |                            |              |             |             |             |             |             |             |           |
| E   | Transfer of jobs to the private sector        |                            |              | 500         |             |             |             |             |             |           |
| F   | Reduction in rates paid by customers          |                            |              | 10%         |             |             |             |             |             |           |
|   | <b>committee, n =</b>                         |                            | <b>6</b>     |             |             |             |             |             |             |           |
|   | <b>benefits, m =</b>                          |                            | <b>6</b>     |             |             |             |             |             |             |           |
|   | <b>R min =</b>                                |                            | <b>6</b>     |             |             |             |             |             |             |           |
|   | <b>R max =</b>                                |                            | <b>36</b>    |             |             |             |             |             |             |           |
|   | <b>R avg =</b>                                |                            | <b>21</b>    |             |             |             |             |             |             |           |
|   | <b>Std dev, s =</b>                           |                            | <b>7.9</b>   |             |             |             |             |             |             |           |
|   |   |                            | min          | A           | B           | C           | D           | E           | F           | max       |
|   | <b>D-R sum</b>                                |                            |              | <b>20</b>   | <b>29</b>   | <b>8</b>    | <b>8</b>    | <b>5</b>    | <b>20</b>   |           |
|   | <b>+n</b>                                     |                            |              | <b>6</b>    | <b>6</b>    | <b>6</b>    | <b>6</b>    | <b>6</b>    | <b>6</b>    |           |
|   | <b>R<sub>i</sub></b>                          |                            | <b>6</b>     | <b>26</b>   | <b>35</b>   | <b>14</b>   | <b>14</b>   | <b>11</b>   | <b>26</b>   | <b>36</b> |
| Normalized Ratio, Z <sub>i</sub>              |   | -1.89                      | -1.89        | 0.63        | 1.76        | -0.88       | -0.88       | -1.26       | 0.63        | 1.89      |
| Zmax  |   | 1.89                       |              |             |             |             |             |             |             |           |
| Z <sub>i</sub> + [Zmin]                       |   |                            | 0.00         | 2.52        | 3.65        | 1.01        | 1.01        | 0.63        | 2.52        | 3.78      |
| Attribute Weight, W <sub>i</sub>              |   | 300.0                      | 0.0          | 66.7        | 96.7        | 26.7        | 26.7        | 16.7        | 66.7        | 100.0     |
| <b>Normalized weight, NOR (W<sub>i</sub>)</b> |   |                            | -            | <b>0.22</b> | <b>0.32</b> | <b>0.09</b> | <b>0.09</b> | <b>0.06</b> | <b>0.22</b> | -         |
|   |   |                            | Value scores |             |             |             |             |             |             |           |
|   |   | <b>NOR (W<sub>i</sub>)</b> | <b>SQ</b>    | <b>R</b>    | <b>P</b>    |             |             |             |             |           |
| A   |   | 0.22                       | 90           | 74          | 84          |             |             |             |             |           |
| B   |   | 0.32                       | 100          | 30          | 72          |             |             |             |             |           |
| C   |   | 0.09                       | 50           | 50          | 90          |             |             |             |             |           |
| D   |   | 0.09                       | 55           | 92          | 55          |             |             |             |             |           |
| E   |   | 0.06                       | 0            | 32          | 68          |             |             |             |             |           |
| F   |   | 0.22                       | 0            | 40          | 60          |             |             |             |             |           |
| <b>Benefits scores</b>                        |   |                            | <b>61.6</b>  | <b>49.4</b> | <b>71.9</b> |             |             |             |             |           |

# Appendix C

## Detailed Cost Estimates

### Relocation Plan

| WBS                               | TY97  | TY98  | TY99  | TY00  | TY01  | Total   |
|-----------------------------------|-------|-------|-------|-------|-------|---------|
| Total Program                     | 329.6 | 320.1 | 327.3 | 330.5 | 277.8 | 1,585.3 |
| Labor (in-house)                  | 211.3 | 196.1 | 167.8 | 142.8 | 141.1 | 859.0   |
| Material                          | 84.9  | 86.3  | 81.6  | 99.0  | 106.1 | 457.9   |
| In-house                          | 50.9  | 47.0  | 42.4  | 40.9  | 41.2  | 222.4   |
| Subcontract                       | 34.0  | 39.3  | 39.2  | 58.1  | 64.8  | 235.6   |
| Facilities                        | 12.0  | 15.4  | 18.7  | 11.7  | -     | 57.8    |
| Environment                       | 6.1   | 5.2   | 11.4  | 15.0  | 15.1  | 52.8    |
| Personnel                         | 13.6  | 14.8  | 36.9  | 42.9  | 14.0  | 122.3   |
| Relocation PCS                    | -     | 0.9   | 8.5   | 11.6  | 2.1   | 23.1    |
| PPP (Indy PCS)                    | 3.2   | 3.3   | 2.2   | 1.1   | 1.2   | 11.0    |
| VSIP                              | 1.7   | 1.8   | 6.7   | 8.0   | 1.9   | 20.1    |
| RIF                               | 1.7   | 1.9   | 7.1   | 8.6   | 2.2   | 21.5    |
| Other                             | 7.0   | 6.9   | 12.5  | 13.6  | 6.7   | 46.6    |
| CSRS                              | 6.1   | 5.8   | 5.9   | 5.7   | 4.7   | 28.1    |
| EXHEALTH                          | 0.0   | 0.0   | 0.1   | 0.1   | 0.0   | 0.2     |
| Unemployment                      | 0.8   | 0.7   | 1.2   | 1.0   | 0.8   | 4.5     |
| Career Transition<br>(retraining) | -     | 0.1   | 0.9   | 1.3   | 0.1   | 2.4     |
| CARE                              | 0.2   | 0.3   | 4.4   | 5.4   | 1.1   | 11.3    |
| Other Cost                        | 1.7   | 2.3   | 10.9  | 19.1  | 1.6   | 35.5    |
| Disruption                        | -     | 0.7   | 9.5   | 13.4  | 1.1   | 24.8    |
| Program Management                | 1.7   | 1.5   | 1.4   | 1.2   | 0.4   | 6.2     |
| Residual Operations               |       |       |       | 4.5   |       | 4.5     |

Costs by WBS element  
Cost in TY\$M

**Privatization Plan**

| WBS                            | TY97  | TY98  | TY99  | TY00  | TY01  | Total   |
|--------------------------------|-------|-------|-------|-------|-------|---------|
| Total Program                  | 339.3 | 282.7 | 241.6 | 254.1 | 266.6 | 1,384.2 |
| Labor (Hughes & TNC)           | 191.2 | 180.7 | 161.9 | 170.7 | 176.4 | 881.0   |
| Material                       | 79.5  | 71.0  | 65.7  | 69.4  | 72.1  | 357.7   |
| In-house                       | 58.2  | 56.0  | 50.4  | 52.9  | 54.3  | 271.9   |
| Subcontract                    | 21.3  | 15.0  | 15.3  | 16.5  | 17.8  | 85.9    |
| Facilities                     | 0.4   |       |       |       |       | 0.4     |
| Environment                    | 9.5   | 5.3   | 11.1  | 11.1  | 15.1  | 52.0    |
| Personnel                      | 55.9  | 23.3  | 1.0   | 1.0   | 1.1   | 82.3    |
| Relocation PCS                 | -     | 6.0   | -     | -     | -     | 6.0     |
| PPP (Indy PCS)                 | 10.6  | -     | -     | -     | -     | 10.6    |
| VSIP                           | -     | -     | -     | -     | -     | -       |
| RIF                            | 39.2  | 0.6   | -     | -     | -     | 39.8    |
| Other                          | 6.0   | 16.7  | 1.0   | 1.0   | 1.1   | 25.9    |
| CSRS                           | 5.4   | 1.0   | 1.0   | 1.0   | 1.1   | 9.5     |
| EXHEALTH                       | 0.5   | 0.0   | -     | -     | -     | 0.5     |
| Unemployment                   | 0.1   | -     | -     | -     | -     | 0.1     |
| Career Transition              | -     | -     | -     | -     | -     | -       |
| CARE                           | -     | 15.7  | -     | -     | -     | 15.7    |
| Other Cost                     | 2.8   | 2.3   | 1.8   | 1.9   | 1.9   | 10.6    |
| Disruption                     | 1.3   | 0.5   | -     | -     | -     | 1.8     |
| DCMC (recur)                   | 1.3   | 1.8   | 1.8   | 1.9   | 1.9   | 8.7     |
| DCMC pre-Privatization (recur) | 0.1   |       |       |       |       | 0.1     |

**Costs by WBS element  
Cost in TY\$M**

# Appendix D

## LIST OF REFERENCES

---

1. United States General Accounting Office, Report to Congressional Request, *GAO / NSIAD-96-202*.
2. Canada J.R. and Sullivan W.G., *Economic and Multiattribute Evaluation of Advanced Manufacturing Systems*, Prentice Hall, 1989. superceded by Canada J.R. and Sullivan W.G. and White J.A., *Capital Investment Analysis for Engineering Management*, Prentice Hall, 1996.
3. Sullivan W.G. and Liggett H.R., *A Decision Support System for Evaluating Investments in Manufacturing Local Area Networks*, American Society of Mechanical Engineers, 1988.
4. United States General Accounting Office, Report to Congressional Request, *GAO/T- NSIAD-96-146*.
5. Base Closure and Realignment Commission 1995 Language, *Official BCRC Commission recommendation*.
6. Department of Defense, *Work Breakdown Structures for Defense Material Items*, MIL-STD 881B, 25 March 1993.
7. Office of Management and Budget, *OMB Circular No. A-76 - Revised Supplemental Handbook*, March 1996.
8. Naval Air Systems Command, Cost Department, *NAWC-ADI Cost/Benefit Analysis Supporting Data*, September 1996.
9. Department of the Navy TQL Office, *Handbook for Basic Process Improvement*, 1992.
10. Dunn-Rankin, P, and King, F J.; *Multiple Comparison in a Simplified Method of Scaling*, Educational and Psychological Measurement, 1969.
11. Naval Air Warfare Center Aircraft Division, Indianapolis, IN; *Sources Sought NAWC-Indianapolis Privatization*, 1996.
12. Naval Air Warfare Center Aircraft Division - Indianapolis, IN; *BCRC95 - Lab/Facility Move Cost Estimate*. March 1996.