LINKING PROCUREMENT DOLLARS TO AN ALTERNATIVE FORCE STRUCTURES' COMBAT CAPABILITY USING RESPONSE SURFACE METHODOLOGY

THESIS

James B. Grier, Major, USAF

AFIT/GOA/ENS/97M-07

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THESIS

Presented to the Faculty of the Graduate School of Engineering

of the Air force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Operations Research

James B. Grier, B.G.S.

Major, USAF

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ABSTRACT

A General Officer Steering Group, chaired by HQ USAF/XOM tasked action to develop and implement evaluation and analysis support to 'lead turn" the Program Objective Memorandum (POM) and Joint Warfare Capability Assessment (JWCA) process. This evaluation process should be designed to supply measures of the "health" of the Air Force program in light of the Defense Planning Guidance (DPG) and the Chairman's Program Assessment (CPA).

The Air Force needs to be able to quickly evaluate various alternative force structures with regards to it's combat capability, measured in terms of theater level campaign objectives (CO). HQ USAF/XOM tasked HQ USAF/XPY to develop a "quick turn" tool to perform iterative "exercises", allowing for comparison of alternative force structures within 24 to 48 hours.

Using Factor Analysis and Response Surface Methodology, this thesis successfully developed a "quick turn" tool designed to capture the cost and capabilities of alternative force structures, linking dollars spent to campaign level measures of outcome.

LINKING PROCUREMENT DOLLARS TO AN ALTERNATIVE FORCE STRUCTURES' COMBAT CAPABILITY USING RESPONSE SURFACE METHODOLOGY

1. INTRODUCTION

1.1 Background

While the operations tempo through out the world continues to increase for the U.S. Armed Forces, the Department of Defense (DoD) budget continues to shrink. In addition, efforts to balance the budget deficit may result in further downsizing of the military. How the United States Air Force (USAF) meets these challenges is a major focus of senior leadership.

A General Officer Steering Group, chaired by HQ USAF/XOM tasked action to develop and implement evaluation and analysis support to "lead turn" the Program Objective Memorandum (POM) and Joint Warfare Capability Assessment (JWCA) process. This evaluation process should be designed to supply measures of the "health" of the Air Force program in light of the Defense Planning Guidance (DPG) and the Chairman's Program Assessment (CPA) (Griggs, 1996).

1.1.1. Planning, Programming, and Budgeting System (PPBS)

The PPBS is the DoD Resources Management System controlled by the Secretary of Defense (SecDef) and used to establish, maintain, and revise the Future Years Defense Plan (FYDP) and the DoD portion of the President's budget. Secretary of Defense McNamara implemented the PPBS concept to provide a clearer relationship between defense plans and defense dollars (ACSC Vol.5, 1991: 20-9,21)

As the name implies, there are three major phases of the PPBS: Planning, Programming, and Budgeting phases.

1.1.1.1 Planning Phase

The objective of the planning phase is to identify the threat to U.S. national security, develop the strategy necessary to meet national objectives, and determine the forces required to carry out the strategy. One of the key results of this phase is a planning document entitled the Defense Planning guidance (DPG). The DPG furnishes the SecDef's planning guidance and fiscal constraints to the military department for developing their program. Issuance of the DPG to the services in October marks the end of the planning phase (ACSC Vol. 5, 1991: 20-22).

1.1.1.2. Programming Phase

The purpose of the programming phase is to structure resources (e.g. forces and personnel) by mission to achieve the objectives established in the DPG. The process of determining forces and personnel for given programs involves the preparation of alternative force structures called "exercises". The proper number of forces, munitions, training and support must be determined to ensure proposed programs support and conform to the SecDef's guidance. Successive iterations of the exercises continue until the service arrives at its final position as reflected in the Program Objective Memorandum (POM).

The POM proposes total program requirements for the next six years and includes rational for planned changes from the current approved FYDP baseline within the fiscal year. The POM also contains an assessment of the risk associated with current proposed forces and support programs. The services usually complete their POMs by the middle of May and submit them simultaneously to the Office of the Secretary of Defense (OSD) and the Chairman of the Joint Chiefs of Staff (CJCS)

The Chairman's Program Assessment (CPA) provides the CJCS's assessment of the composite POM to assist the SecDef in making decisions on the defense program. The CJCS provides his "big picture" views on the balance and capabilities of the aggregate force represented by all the POMs. The end result of the programming phase is the Program Decision Memorandum (PDM) which is the SecDefs approval of service and defense agency *programs (POMs) as modified by specific decisions (ACSC Vol. 5, 1991: 20-24)*

1.1.1.3. Budgeting Phase

The final phase is the Budgeting phase. Based on the POM and PDM, the services prepare and forward to OSD their Budget Estimate Submission (BES). Once the SecDef is satisfied with the BES, he then submits the final defense budget to the Office of Management and Budget (OMB) for inclusion in the President's budget. From there, the budget becomes a part of the Appropriations Bill to be passed by the U.S. Congress. The Appropriations and Armed Services Committees from both the House and Senate must approve the budget before it reaches the House and Senate floor respectively for a final vote (ACSC Vol. 5, 1991, 20-25).

1.1.2. PPBS Impact to USAF/XPY

Clearly, there are a number of "wickets" the USAF PPBS must pass through: CSAF, CJCS, SecDef, the President, and finally Congress. Opinions differ, and in light of current and future budget cuts many "what if" questions are asked. The result is *constant revision of the PPBS* on the part of HQ USAF/XPY.

To compound the problem further, the PPBS process described above is for a single biennial cycle. Unfortunately, they do not evolve in isolation. Several cycles progress simultaneously. At any given point in time, four fiscal programs are being managed. For example, while the current FY96 budget is being executed, the FY97 budget is being defended on Capital Hill, the FY98 budget is being submitted to OMB, and the FY99 budget is in the planning phase (ACSC Vol. 5; 20-27). The Air Staff makes many of its budget decisions involving force structure based on the recommendations from panels comprised of experts from each major functional area. The time available to develop these recommendation can be as little as 15 minutes in extreme cases, which precludes conducting extensive analysis. The result is "back of the envelope" or "gut instinct" recommendations.

1.2 Problem Statement

The Air Force needs to be able to quickly evaluate various alternative force structures with regards to its combat capability as measured in terms of theater level campaign objectives (CO). HQ USAF/XOM has tasked HQ USAF/XPY to develop a "quick turn" tool to perform iterative "exercises", allowing for comparison of alternative force structures within 24 to 48 hours. *This thesis will examine methods to capture the cost and capabilities of alternative force structures, linking dollars spent to campaign level measures of outcome.*

1.3 Scope

USAF/XPY directed that THUNDER, a theater level combat model, be used in developing this quick turn tool. The database used by the simulation was a Southwest Asia (SWA) scenario developed by HQ ASC/XR personnel for the express purpose of this thesis. All USAF assets were used in a joint context with U.S. Navy (USN) aviation, while other coalition forces were excluded from the model. In order to keep this thesis effort UNCLASSIFIED, notional data was used for probability of kill (pk), aircraft utilization (UTE) rates, sortie generation, aircraft performance, etc.; hence, the focus must remain on the methodology and not the quantitative results.

1.4 Limitations

The number of THUNDER data files modified to establish a single design point, and the associated time required to do so, given manpower and time limitation, clearly impacted the type of experimental designs considered. Additionally, a single UltraSPARC workstation was available to conduct simulations, also influencing the selection of experimental designs used in this thesis.

1.5 Thesis Overview

Chapter II is a literature review of relevant OR techniques and methodologies needed to develop this thesis. Chapter III begins by outlining the desired objectives, followed by a chronological progression of the methods used, and the decision logic associated with each step. Chapter IV provides the analysis results and Chapter V provides conclusions and recommendations.

Appendix B lists the THUNDER files modified during this thesis. Appendix D outlines the Campaign Objectives identified by USAF/XPY. Appendix E includes the experimental designs used and Appendix F lists the THUNDER out metrics in tabular form. The multivariate results are located in Appendix G while the statistical results of this thesis are located in Appendix H and I.

2. LITERATURE REVIEW

In this chapter we will review relevant literature on simulation, the combat model THUNDER, and OR methods and applications needed to develop this thesis.

2.1 Why Simulation?

A simulation is the imitation of the operation of a real-world process or system over time. The behavior of a system as it evolves over time is studied by developing a simulation model (Banks et al., 1995:3).

The purpose of most simulation is to develop an understanding of system behavior, with the goal of using that understanding to make decisions involving the system (Seila, 1992 : 190) . By changing simulation inputs and observing the resulting outputs, valuable insight may be obtained into which variables are most important and how variables interact (Banks, 1995 : 4). From this analysis, informed decisions can be made. However, the disadvantages must also be considered. Simulation can be very time consuming and expensive, with the results obtained possibly difficult to interpret.

2.2 THUNDER Overview

2.2.1. Introduction

THUNDER is a theater-level warfare simulation model. It is a two-sided, stochastic computer simulation of conventional air, land and naval warfare, which is used to evaluate force structure, Cost and Operational Effective Analysis (COEA), strategic and tactical development, war-gaming, and senior staff training.

Thunder is written in SIMSCRIPT II.5, and is used by a large number of U.S. and allied defense organizations and contractors. It is operational on various workstation platforms and on personal computer platforms under the WINDOWS NT operating system environment.

2.2.2 Statistical Implications

Because THUNDER is stochastic in nature, multiple runs are necessary to achieve desired levels of confidence in outputs. Acceptable levels of confidence in highly aggregate outputs are achieved by performing 10 to 30 replications. For a more complete discussion on model variability and sensitivity to input parameters within THUNDER see Webb (1994).

2.2.3 Air War

THUNDER simulates 22 different air missions and automatically generates Air Tasking Orders (ATOs), based on theater-level apportionment and targeting priorities. The air missions include (THUNDER Analyst's Manual, Vol 1, 1995: 23)

- Airborne Refueling (AAR)
- Airborne Early Warning (AEW)
- Air -to-Air Escort (AIRESC)
- Battlefield Air Interdiction (BAI)
- Barrier Combat Air Patrol (BARCAP)
- Close Air Support (CAS)
- Close-In Non-Lethal Air Defense Jamming (CJAM)
- Close-In Lethal Air Defense Suppression (CSUP)
- Defensive Counter-Air (DCA)
- Lethal Direct Air Defense Suppression (DSEAD)
- Escort Non-Lethal Air Defense Jamming (EJAM)
- Escort Lethal Air Defense Suppression (ESUP)
- Fighter Sweep (FSWP)
- High Value Asset Attack (HVAA)
- Long Range Air Interdiction (INT)
- Offensive Counter Air (OCA)
- Over FLOT Defensive Counter Air (ODCA)
- Reconnaissance (RECCE)
- Standoff Non-Lethal Air Defense Jamming (SJAM)
- Standoff Reconnaissance (SREC)
- Standoff Lethal Air Defense (SSUP)
- Strategic Target Interdiction (STI)

2.3 Multiple Regression

Regression analysis is a statistical technique that utilizes the relation between two or more quantitative variables so that one variable can be predicted from the other(s) (Neter et al., 1996 : 3). This methodology seeks to relate a *response*, or *output variable*, to the levels of a number of *predictors*, or input variables that affect it (Box & Draper, 1987 : 1).

This thesis will use multiple linear regression techniques to construct a response surface of a "combat index" derived from THUNDER output. There are a number of ways to determine the "goodness of fit" of a model. The primary methods used in this thesis are mean square error and coefficient of multiple determination.

2.3.1 Mean Square Error

The Mean Square Error (MS_E) is an estimate of the variance of the model. It is calculated by dividing the Sum of Squares of Error by the Degrees of Freedom (DF). The square root of MS_E is an estimate of the standard deviation of the error in the model. Therefore, the smaller the MS_E, the better.

2.3.2 Coefficient of Multiple Determination

The coefficient of multiple determination, $\mathbf{R}^2$, is defined as the measure of the amount of reduction in the variability of y obtained by using the regressor variables $x_1, x_2, \ldots\ldots, x_k$ in the model. It can be expressed as

$$R^2 = \frac{SS_R}{S_{yy}} = 1 - \frac{SS_E}{S_{yy}} \tag{2.1}$$

where SS_R is the sum of squares of residual, SS_E is the sum of squares of error, and S_{yy} is the total sum of squares. A large value of R^2 does not necessarily imply a good fit. Adding a variable to a model will *always* increase R^2, regardless of whether the variable added is statistically significant or not. Thus it is possible for models to have a large R^2, yet yield poor predictions of the estimated response. If we take into account the degrees of freedom, then the ***adjusted R²*** would be:

$$R^2_{adj} = 1 - \left[\frac{SS_E / (n-p)}{S_{yy} / (n-1)} \right] = 1 - \frac{(n-1)}{(n-p)}(1 - R^2) \tag{2.2}$$

where the R^2_{adj} statistic will not always increase as variables are added to the model. In fact, if unnecessary terms are added, the value of R^2_{adj} will often decrease (Banks et al., 1995 : 31).

2.3.3. Linear Regression Model

A multiple linear regression model with *k* independent variables (also referred to as regressor variables), would yield the following equation

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + ... \beta_k x_k + \varepsilon \tag{2.3}$$

where: y = response, or dependent variable

β_j = regression coefficients, j = {0,1,2,........,k}

x_j = regressor, or independent variable

ε = some random variable

This model describes a hyper plane in k-dimensional space of the regressor variables. The parameter β_i , represents the expected change in response **y** per unit change in x_i when all the remaining independent variables x_i ($i \neq j$), are held constant. (Myers & Montgomery, 1995 : 17). The most popular technique used to estimate the regression coefficient is called the method of least squares. The method of least squares chooses the β's so as to minimize the sum of squares of the error ε. The least squares normal equations can be written in matrix form as:

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \tag{2.4}$$

where **y** is an (n x 1) vector of the observations. **X** is an (n x p) matrix of the levels of the independent variables, $\boldsymbol{\beta}$ is a (p x 1) vector of the regression coefficients, and ε is an (n x 1) vector of random error. From this it can be shown that the least square estimator of $\boldsymbol{\beta}$, denoted **b**, is

$$\mathbf{b} = (\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T\mathbf{y} \tag{2.5}$$

2.4 Response Surface Methodology

Response Surface Methodology (RSM) compares a group of statistical techniques for empirical model building and model exploitation (Box & Draper, 1987 : 1). These techniques are very useful for developing, improving, and optimizing processes (Myers & Montgomery, 1995 : 1). The primary purpose for using RSM in this thesis is to map a response surface (e.g. overall combat capability index) over a particular region of interest (e.g. alternative force structures). From the regression results that follow, we can then determine which inputs variables were significant players on the battlefield.

A specially selected pattern of points chosen to investigate a response function relationship is called an *experimental design* (Box & Draper, 1987 : 17). Three designs were considered in this thesis: Fractional Factorial, Plackett-Burman and Mixture designs.

2.4.1 Factorial Designs

Factorial designs are widely used in experiments involving several factors where it is necessary to investigate the joint effects of the factors on a response variable. By joint factor effects, we typically mean main effects and their interaction. (Myers & Montgomery, 1995 : 79). Designs where the input variables can only take on a high or low value are called *2^k factorial designs,* since there are 2^k possible design levels (given k variables). This type design is very useful for identifying significant input variables early in the study, as well as fitting first-order response surfaces.

Since we have mentioned input variables that take either a high or low value, a discussion of *coded variables* is appropriate. If we are working with input variables that have different units of measure, analyzing results can be very difficult. However, by coding (or standardizing) the variables between -1 and +1, interpreting results of linear regression becomes more meaningful. Values for the estimator of the regression coefficient, **b** (see equation 2.5), show a relative magnitude of importance. For example, using coded variables, if $b_1 = 10$ and $b_2 = 40$, the input variable x_2 has 4 times greater impact on the response y than x_1. To code a variable

$$x_i = \frac{\xi_i - [\max(\xi_i) + \min(\xi_i)]/2}{[\max(\xi_i) - \min(\xi_i)]/2} \tag{2.6}$$

where ξ_i is the actual variable value.

Since input variables in a factorial design take on either a high or low value, the coded variables are simply -1 and +1 respectively. Adding center points to measure pure error gives a coded value of 0.

A factorial design involving k = 3 input variables would consist of $2^3 = 8$ possible combinations of input variable values:

Table 1. Factorial Design, 2^3

Run	X_1	X_2	X_3
1	1	1	1
2	1	1	-1
3	1	-1	1
4	1	-1	-1
5	-1	1	1
6	-1	1	-1
7	-1	-1	1
8	-1	-1	-1

However, as the number of factors in a 2^k factorial design increases, the number of runs required for a complete replicate of the design can rapidly outgrow the resources available (Myers & Montgomery, 1995: 134). Consider a design involving 10 input variables. A full factorial design would have 1024 design points, the majority of which are required to determine three-factor and higher interaction effects. If the experimenter can reasonably assume that certain high-order interactions are negligible, then information on the main effects and low-order interactions may be obtained by running only a fraction of the complete factorial design (Myers & Montgomery, 1995, 134). Two such designs, used as screening experiments, are the Fractional Factorial and Plackett-Burman designs.

2.4.1.1 Fractional Factorial Designs

One of the basic reasons for using a fractional factorial design is to take advantage of the Sparsity-of-Effect principle. When there are several variables, the system is *likely* to be driven primarily by some of the main effects and low-order interactions (Myers & Montgomery, 1995: 134). The general form of the fractional factorial design is

$$2^{k-p} \tag{2.7}$$

where k is the number of input variables and p is the number of independent design generators. A full theoretical development of the construction, and alias relationships of a fractional factorial design is beyond the scope of this review (see Myers and Montgomery, 1995). However, one very important concept to understand when selecting a fractional factorial design is *resolution.*

When it becomes impossible to distinguish the individual contributions of two effects to a response, we say the effects are confounded, or *aliased.* How the effects are aliased determines the resolution of a given design.

Resolution III Designs: No main effects are aliased (or confused) with any other main effect, but main effects are aliased with two-factor interactions and two-factor interactions may be aliased with each other.

Resolution IV Designs: No main effects are aliased with any other main effects or with any two-factor interactions, however, two-factor interactions are aliased with each other.

Resolution V Designs: No main effects are aliased with any other main effect or with any two- or three-factor interactions: Two-factor interactions are aliased with three-factor or higher interactions.

Resolution III designs are the minimum resolution needed to fit first-order models, and are denoted 2_{III}^{k-p}. A Resolution IV design is better for fitting first-order models since it allows us to check for two-factor interactions. Resolution V designs are useful for fitting second-order models, provided three-factor interactions or higher are not significant.

2.4.1.2 Plackett-Burman Designs

The Plackett-Burman design is a special case of a fractional factorial design. It is a Resolution III design used to determine the effects of k = N - 1 main effects in N runs, where N is a multiple of 4 and *not* a power of 2 (e.g. N = 12,20,28,36,...). (Myers and Montgomery, 1995;169)

2.4.2. Mixture Designs

In the designs discussed thus far, the levels chosen for input variables in the experimental design have been independent of each other. In contrast, a mixture design is a special type of response surface experiment in which the input variables are a component of a mixture, and the response is a function of the proportions of each variable (Dillion and Goldstein, 1984: 535) In equation form

$$\sum_{i=1}^{p} x_i = x_1 + x_2 + x_3 + \ldots x_p = 1 \tag{2.8}$$

In our case, the mixture is dependent on the amount of dollars available to procure additional aircraft and weapons. Hence, the summation of aircraft and weapon variables added to each lower bound , in terms of unit cost, must not exceed the total procurement budget. Therefore our design would be

$$\sum_{i=1}^{23} c_i x_i = c_1 x_1 + c_2 x_2 + c_3 x_3 + \ldots . c_{23} x_{23} = TotalBudget \tag{2.9}$$

where c_i is the unit cost of the aircraft or weapon and x_i is the number purchased.

2.5 Multivariate Analysis

Multivariate analysis is defined as the application of methods that deal with reasonably large numbers of measurements (i.e. variables) made on each object in one or more samples *simultaneously* (Dillion and Goldstein, 1984: 1-2). It is a collection of techniques and statistical methods designed to elicit information from data characterized by observations on many different variables. The choice of technique is dictated by the objective of the study or endeavor. Reasonable objectives include (1) Data Reduction, (2) Sorting and Grouping, (3) Investigating Dependence, (4) Prediction, and (5) Hypothesis Testing (Johnson, 1982: 4). Two multivariate techniques which are applicable for this research are: Principle Component Analysis (PCA) and Factor Analysis (FA).

2.5.1 Principle Component Analysis (PCA)

A principle component analysis is concerned with explaining the variance-covariance structure through a few *linear* combinations of the original variables. Its general objectives are (1) data reduction, and (2) interpretation. Although *p* components are required to reproduce the total system variability, often much of this variability can be accounted for by a small number, *k*, of the principle components. The *k* principle components can then replace the initial *p* variables, and the original data set, consisting of *n* measurements of p variables, is reduced to *n* measurements on *k* principle components (Johnson, 1982: 3).

The nature of the data set will determine how the principle components are computed. If the unit of measurement is the same for all variables in the data set, then using a covariance matrix is appropriate. However, when the variables under consideration are measured in grossly different units, scale effects can influence the composition of the derived components. In such cases, the data are standardized and the correlation matrix is used (Dillion and Goldstein, 1984: 36).

The components are extracted from the sample covariance matrix, or sample correlation matrix, by determining the eigenvalues and eigenvectors from the matrix (Webb, 1994: 3.12). The components are ordered according to their eigenvalue (λ), from largest to smallest. To determine the percentage of variance explained by the component(s)

$$\text{Percent of variance} = \frac{\sum_{i=1}^{k} \lambda_i}{\sum_{i=1}^{p} \lambda_i} \tag{2.10}$$

There are two popular techniques used to determine the number of components, k, to retain; Kaiser's Criterion, and Cattell's Scree test.

Kaiser's criterion is the most widely used rule, retaining only those components corresponding to eigenvalues of the correlation matrix that are greater than unity (Tatsuoka, 1971:147) The rationale for Kaiser's rule is that each component selected should have a variance larger than any single variable.

Cattell's Scree test is a graphical method, plotting the entire set of p eigenvalues against their ordinal number. Such a plot shows a steep initial descent, followed by a nearly straight line with gradual downward slope, known as a scree line (Tatsuoka, 1971: 147). Cattell's test calls for using those components that form the "cliff" and discarding those components that form the "rubble" at the foot of the cliff. One limitation of this method is that sometimes the "break" between cliff and rubble is not distinguishable.

2.5.2 Factor Analysis

Factor Analysis (FA) attempts to simplify complex and diverse relationships that exist among a set of observed variables by uncovering common dimensions or factors that link together the seemingly unrelated variables (Dillion and Goldstein, 1984: 53). This multivariate method has as its aim the explanation of relationships among several difficult-to-interpret, correlated variables in terms of a few conceptually meaningful, *independent factors* (Kleinbaum and Kupper, 1978: 376). The big difference between FA and PCA is

(1) FA uses *common variance* between variables versus,

(2) PCA , which uses *total variance.*

One advantage of FA is the ability to rotate the factors to get a cleaner breakout of loadings. The most popular method of rotation is the varimax rotation, which attempts to maximize variation of squared factor loadings within a factor (Dillion and Goldstein, 1984: 91).

2.6 Metamodels

A metamodel is a statistical model of the response from a simulation model. In other words, it is a model of a model (Kleijnen, 1987; 147). The simulation community has used metamodels to study the behavior of computer simulation for over twenty-five years. The most popular techniques have been based on parametric polynomial response surface approximations (Barton, 1994; 235).

> *Thinking of the simulation logic and action as being a transformation of inputs into outputs, the notion arises that a simulation is just a function, albeit a complicated one. But it might be possible to approximate what the simulation does with a function, particularly when there are a large number of input variables and it takes a long time to run the simulation. A common practice is to fit a regression model to the simulation model, with the dependent variables being the simulation output and the independent variables being the input parameters for the simulation (Kelton, 1994; 67).*

2.6.1 Developing a Metamodel

Donohue addresses a number of important issues unique to experimentation in a simulation environment. His statistical approach to the design and analysis of experiments include the following steps (Donohue, 1994; 200):

1. State the problem requiring experimentation and state the objective of the study (e.g.; prediction, optimization, sensitivity analysis).
2. Choose the *factors* (controllable input variables).
3. Select the *response* variable (output variables).
4. Determine the *operability region* (range of values for each factor within which the system can operate).
5. Specify the *region of interest* (a subregion of the operability region with which you want to perform the current experiment).
6. Choose a statistical model (e.g.; ANOVA, regression, spatial correlation).
7. Select a criteria for choosing an experimental design (e.g.; minimize generalized variance, minimize mean squared error).
8. Choose an appropriate experimental design class (e.g.; factorial, Latin square, central composite).
9. Select the levels of the factors for each *design point* (experimental run).
10. Perform the experiments and collect data.
11. Analyze and summarize the data; check for adequacy of the statistical model.
12. Draw inferences and conclusions.

Furthermore, there are a number of tactical and strategic experimental design issues to consider:

Tactical Issues

- whether to perform a terminating or steady-state simulation,
- estimating the distributions of stochastic model components,
- selecting the initial conditions or the duration of the warm-up period,
- choosing the final conditions such as run time or number of events completed, and
- deciding on an appropriate balance between run length and the number of replications (or batches).

Strategic Issues

- choosing a method for the assignment of random number streams to design points, and
- deciding whether to use an appropriate variance reduction technique.

2.6.2 Experimental Design Selection

Two level experimental designs are of importance for a number of reasons: (1) they can indicate major trends and so determine a promising direction for further experimentation; (2) they form the basis for two-level fractional factorial designs; (3) these designs and the corresponding fractional designs may be used as a building block for more complex problems; and (4) the interpretation of the result is easy (Lin et al., 1994; 845). In large scale computer simulation models it is often necessary to perform a screening experiment to reduce the number of factors to be examined in subsequent analysis. A very popular 2 level screening design is the Plackett-Burman design. It is a Resolution III design that can identify the significant main effects in a minimum number of runs (Van Groenendaal et al., 1994; 1435). Webb and Bauer successfully used a Plackett-Burman design to reduce the number of input variables in THUNDER (Webb and Bauer, 1994; 311).

Numerous textbooks outline the advantages of using fractional factorial designs to minimize the number of simulation runs while capturing main and second-order interaction effects. Several include Naylor (1969), Law and Kelton (1991), Box and Draper (1987), and Myers & Montgomery (1995).

2.6.3 Variance Reduction Techniques

One objective of variance reductions is to reduce the amount of noise, ε (see equation 2.4), in the simulation output.

> *Such variance-reduction techniques often proceed by exploiting your ability to control the random-number generator driving the simulation, and re-use random numbers to induce helpful correlations that reduce the noise in the output. Whatever differences in performance you observe are due to system differences (alternate force structures in this case) rather than to "environmental" differences . This strategy, known as common random numbers, is often used by starting the runs for all alternatives with the same random-number streams and seeds (Kelton, 1994; 66)*

Recent research has focused on the estimation of the vector parameter, $\boldsymbol{\beta}$, in simulation linear metamodels of 2^k design. By minimizing the variation of $\boldsymbol{\beta}$, the approximating function, **Y** (see equation 2.4), becomes less sensitive to the random noise ε (Barton, 1994; 238). See Song and Su (1996, 511-519) for a more detailed discussion. For other sophisticated variance-reduction techniques, refer to Fishman (1978), Law and Kelton (1991), and Nelson (1992).

3. METHODOLOGY

Chapter III begins by outlining the desired objectives, followed by a chronological progression of the methods used, and the decision logic associated with each step.

3.1 Objectives

To successfully build a "quick turn" tool which meets the requirements specified by USAF/XOM, we must accomplish the following:

1. develop Measures of Outcome (MOO), based on THUNDER metrics, that accurately represent or measure each of the theater level Campaign Objective (CO);
2. using multivariate techniques, reduce the THUNDER output data set to a set of "factors" that closely represent the Campaign Objectives;
3. identify those input variables that are statistically significant in terms of their contribution to the outcome on the battlefield, by using Response Surface Methodology (RSM);
4. using multiple linear regression techniques, develop a *response surface* that quickly estimates an alternative force structure's combat capability, constrained by budgetary requirements.

To accomplish these four objectives, the following progression will be used.

3.1.1. Develop Measures of Outcome (MOO)

- Identify major goals of theater commanders (i.e. Campaign Objectives) to be measured.

- Identify the Operational Objectives (OO) and Operational Tasks (OT) required to obtain the Campaign Objectives.
- Identify the metrics that are measured in THUNDER which closely represent the OOs and OTs that USAF/XPY has outlined.

3.1.2. Multivariate Analysis

- Perform factor analysis to reduce the number of output variables to a set of factors that closely represent the Campaign Objectives.
- Take a linear combination of the factor scores to obtain an overall combat index for each alternative force structure.

3.1.3 Identify Significant Input Variables

- Using a Plackett-Burman screening design, reduce the number of input variables based on their statistical significance.
- Use a level IV Fractional Factorial design to identify significant main and second order interaction effects.

3.1.4 Develop a Response Surface

- Perform multiple regression to obtain a mathematical equation, or response surface, that represents our combat index in n-factor space.

Figure 1 is a flow diagram of the methodology described above to obtain the metamodel. Once the variables were identified and a model selected and run, the output data was collected in matrix form, where Factor Analysis was performed. From these factors, indices are derived and used as the dependent response in stepwise linear regression. The resulting response surface then becomes the objective function in a linear program, where the constraints link dollars to combat capability in terms of the Campaign level measures identified by USAF/XPY. The significant variables from the Plackett-Burman design can be identified and the process repeated for the fractional factorial design.

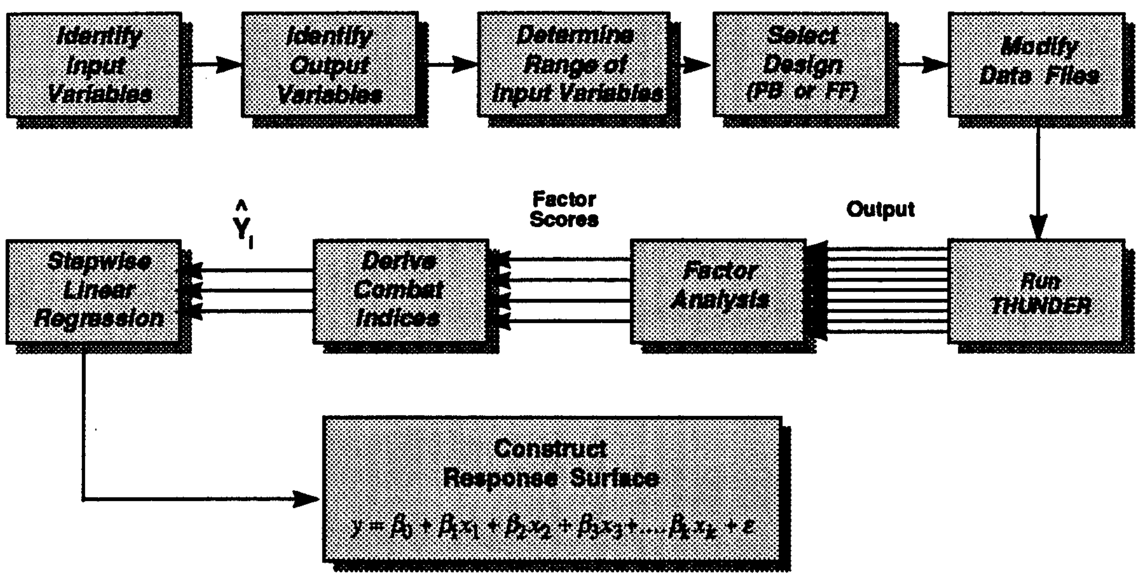

Figure 1. Methodology of Thesis Effort

3.2 Input / Output Variables

Recall from Chapter I, the scenario used to develop this metamodel was based on a Major Regional Conflict (MRC) in Southwest Asia (SWA). The UNCLASSIFIED database was representative of a "real world" database with respect to the number and type of aircraft and munitions modeled. However, the target array was very limited in scope. Consequently, the 34 output metrics (i.e. number of tanks destroyed, number of

Red Air-to-Air losses, etc.) directly impacted which campaign objectives could be measured. For a detailed description of both the input variables and output metrics, see Appendix A.

3.2.1 Input Variables

In most practical experiments, the decision maker can select the appropriate levels of independent variables, based on historical data and experience. The historical approach was used in this thesis to establish the lower bound of each aircraft variable. The number of squadrons was representative of the actual number that deployed and fought in the Persian Gulf War. With few exceptions a typical squadron was assigned 24 primary aircraft (PAA) (e.g. F-16s at Incirlik, EF-111s, F117s, JSTARS, and AWACS). For a complete breakout of PAA, refer to the ***squadron.dat*** file in Appendix B. To establish the upper bound, the following assumption was made: the greatest single increase of PAA approved by Congress in a given year would be a 50 percent increase.

To establish the lower bound on munitions available in theater, the following steps were taken. All aircraft input variables were set at the lower bound and the THUNDER default values set for the number of weapons in a squadron aircraft service kit (see ***acserv.dat***, Appendix B). The simulation was run 30 times and the average number of munitions expended was obtained (see ***muntexp.dat***, Appendix B). The lower bound for each munition variable was then set at 80 percent of this average number expended. The same logic was used (i.e. 50 percent Congressional increase) to establish the upper bound. Center point values, used to measure pure error, were calculated for each variable as well. Table 2 lists the lower, center, and upper values for all 23 variables.

Table 2. Input Variable Levels

Aircraft	Lower	Center	Upper	Munitions	Lower	Center	Upper
F-15C	120	150	180	AIM-120	4,250	5,312	6,375
F-15E	48	60	72	AIM-9	6,600	7,500	8,400
F-16	228	282	336	20 MM	3,250	4,062	4,875
A-10	144	180	216	MK-82	87,275	109,094	130,912
F-111	96	120	144	AGM-65	8,707	10,883	13,060
EF-111	18	21	24	ARM-88	567	708	850
F-4G	72	90	108	B-DELAY	375	468	562
F117	12	15	18	B-LETHAL	1,644	2,060	2,476
Tomahawk	120	150	180	CBU-87	1,300	1,631	1,962
JSTAR	6	9	12	CBU-97	23,895	28,373	32,852
AWACS	12	15	18	LGB	2,930	3,632	4,335
				GPS LGB	60	75	90

THUNDER allows for the modeling of pre-positioned munitions and intra-theater re-supply. This feature was disabled (see ***ab.dat*** and ***critres.dat***, Appendix B). All munitions were in place at the commencement of hostilities.

Given the number of input variables, modifying the ***squadron.dat*** and ***acserv.dat*** files for each design point would have been extremely tedious and time consuming. Therefore, UNIX shell scripts were written, for both center point and upper bound values of each input variable, and used to overwrite lower bound values. For several examples see Appendix C.

3.2.2 OUTPUT VARIABLES

The Air and Space Power Validation Group (ASPVG), HQ USAF, performed a detailed evaluation of THUNDER (Ver 6.3), in 1995 (ASPVG, 1995). The evaluation identifies the Operational Objectives (OO), and Operational Tasks (OT) that THUNDER is capable of measuring with regards to Campaign Objectives (CO) (given a classified database). Below are the nine Campaign Objectives USAF/XPY wanted evaluated with regards to each alternative force structure.

- CO # 1: Halt Invading Armies
- CO # 2: Marshall and Sustain In-Theater Assets
- CO # 3: Evict halted Armies from Friendly Territory
- CO # 4: Gain and Maintain Air Superiority
- CO # 5: Gain and Maintain Sea Control
- CO # 6: Gain and Maintain Space Control
- CO # 7: Gain and Maintain Information Dominance
- CO # 8: Deny Possession and use of Weapons of Mass Destruction (WMD)
- CO # 9: Suppress National Capacity to Wage War

Appendix D provides a detailed breakdown of all nine COs, to include the Operational Objectives (OO), and Operational Tasks (OT), associated with each CO, and their metrics. Most of the metrics needed to evaluated the COs are available in CLASSIFIED Databases. However, the UNCLASSIFIED Database used in this thesis had limitations on the number of metrics available. Table 3 reflects the capability to measure COs using THUNDER:

Table 3. Ability to Measure Campaign Objectives

Database	Satisfactory	Marginal	Unsatisfactory
CLASSIFIED	1 3 4 5, 8, 9	2 7 6	
UNCLASSIFIED	1 3 4	7 8 9	2, 5, 6

Even so, enough output was available to demonstrate the methodology, using an UNCLASSIFIED Database. This thesis will attempt to measure COs 1,3,4,7,8,and 9.

3.3 Experimental Design Selection

In selecting the experimental designs, two objectives were kept in mind: (1) reducing the number of input variables based on their statistical significance; and (2) analyzing main and second order interaction effects.

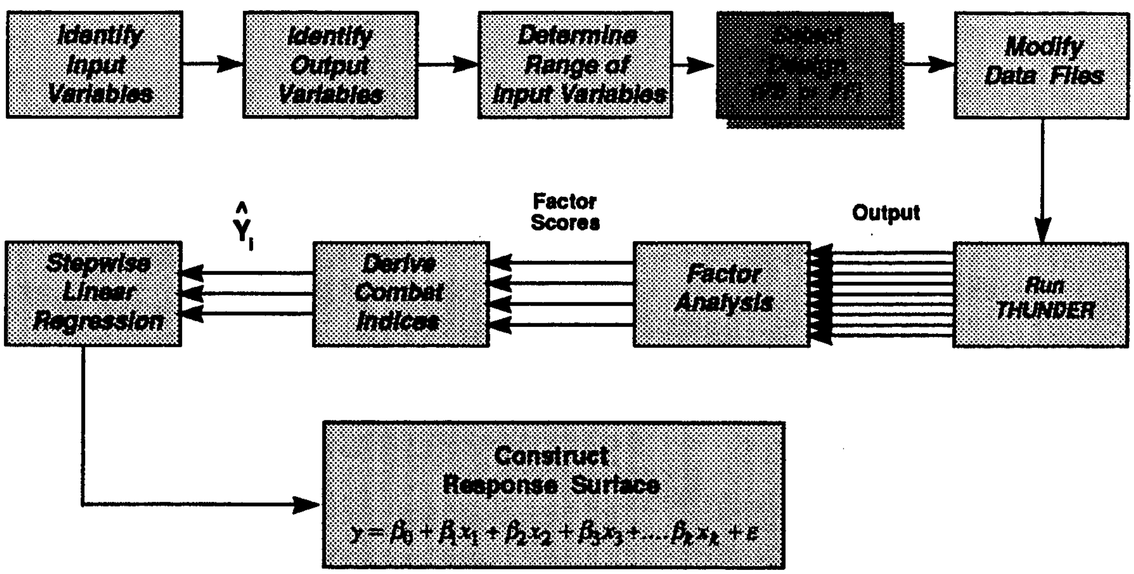

Figure 2. Selecting Experimental Design

To reduce the number of variables, a Resolution III Plackett-Burman design was selected (see Appendix E). Two center point runs were added to allow for better measurement of pure error within the model. Thirty replications were performed at each design point, and the aggregate (i.e. average) number of each output variable "killed or destroyed" was calculated. An additional 30 replications were performed with a different random seed value, and the output aggregated for a second independent observation.

In this thesis effort, a senior decision maker wanted to know if a synergistic effect existed among a set of input variables. A 2_{IV}^{4-1} fractional factorial design was used to measure these main effects and second order interactions (see Appendix E). Again, center point observations were added. Third order and higher interaction effects were considered negligible. For example, the four-factor interaction of an F15C (air superiority fighter), JSTARS (a ground surveillance aircraft), LGB (laser guided bomb) and MK82 (unguided bomb) is not likely to be a major contributor to the outcome of the war, since neither the F15C or JSTARS aircraft drop bombs, and the aircraft do not interact directly in combat. However, consider the two-factor interaction of the A10 ground attack aircraft and the AGM-65 Maverick missile, designed specifically for killing armored vehicles. Since the AGM-65 missile is the A10 pilots' weapons of choice when it comes to killing armored vehicles, determining if a synergistic effect exists is important, especially if you are the theater commander responsible for bringing the right "mix" of weapons to the war.

3.4 Multivariate Techniques

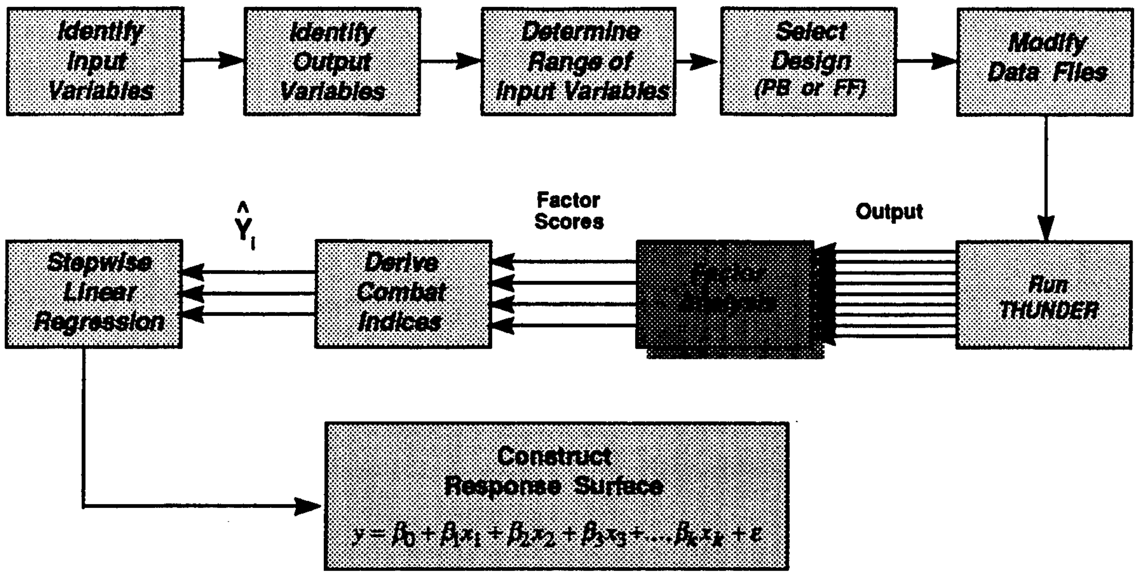

Figure 3. Factor Analysis

The THUNDER output was converted to matrix form for each "aggregate observation" (see Output, Appendix F). A factor analysis was performed (with varimax rotation) on the first set of observations. Multiple iterations were performed to determine which number of factors best represented the underlying relationships among the output variables. The set of factors that most closely represented the COs was selected and named (see Appendix G).

3.5 Derivation of Combat Indices

Recall from above, indices are derived and used as the dependent response in stepwise linear regression. The resulting response surface then becomes the objective function in a linear program, where the constraints link dollars to combat capability of alternative force structures in terms of campaign objectives identified by USAF/XPY.

Matrix multiplication was performed using the second aggregate observation and the factor matrix:

$$\begin{bmatrix} \textbf{THUNDER} \\ \textbf{OUTPUT:} \\ \textbf{2nd Aggregate} \\ \textbf{Observation} \\ \textbf{(26 x 34)} \end{bmatrix} \begin{bmatrix} \textbf{Factor} \\ \textbf{Matrix} \\ \textbf{(34 x 7)} \end{bmatrix} = \begin{bmatrix} \textbf{Indicies} \\ \textbf{Matrix} \\ \textbf{(26 x 7)} \end{bmatrix} \tag{3.1}$$

deriving a set of indices for each Campaign Objective of the following form:

	HALT	OCA	EVICT	AIR SUP	C3	AIR SUP	INTER
Run 1	$Y_{1,1}$	$Y_{2,1}$	$Y_{3,1}$	.	.	.	$Y_{7,1}$
Run 2	$Y_{1,2}$	$Y_{2,2}$	$Y_{3,2}$	.	.	.	$Y_{7,2}$
Run 3	$Y_{1,3}$	$Y_{2,3}$	$Y_{3,3}$	.	.	.	$Y_{7,3}$
	.	.	.	.			.
	.	.	.		.		.
	.	.	.			.	.
Run 26	$Y_{1,26}$	$Y_{2,26}$	$Y_{3,26}$	.	.	.	$Y_{7,26}$

Figure 4. Indices In Matrix Form

For example, $\mathbf{Y_{1,1}}$ is an index score that represents Run 1's ability to Halt Invading Armies (CO #1). To represent the overall combat capability of a given force structure, an equally weighted linear combination of the indices was calculated for each design point:

$$\textit{Total Combat Index}_{\,i} = \hat{Y}_i = Y_{1,i} + Y_{2,i} + Y_{3,i} + Y_{4,i} + Y_{5,i} + Y_{6,i} + Y_{7,i} \tag{3.2}$$

3.6 Constructing Response Surfaces

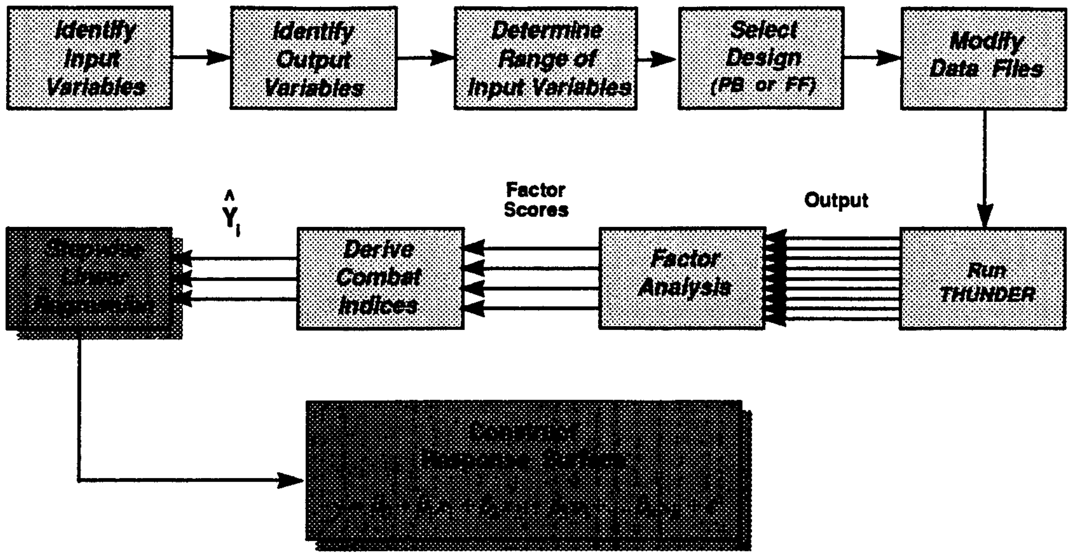

Figure 5. Constructing Response Surface

Stepwise linear regression was performed using each of the indices as the dependent variable (Y) to create response surfaces for each campaign objective. The regression results for the total combat index were analyzed to determine which input variables were the most significant (i.e. greatest contributors) on the battlefield. Each response surface can be used as an objective function, bound by fiscal constraints.

The entire process was repeated using a 2_{IV}^{4-1} fractional factorial design to identify the main effects and some second-order. The resultant expression from multiple linear regression

$$\hat{Y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots\ldots\ldots + \beta_{23} x_{23} \qquad (3.3)$$

can be used as an objective function in a linear programming problem.

This feasible region (in 23-dimensional space), expressed in the form of equation (3.3), can then be constrained by the total procurement dollars available in a given year

$$c_1x_1 + c_2x_2 + c_3x_3 + \ldots\ldots + c_{23}x_{23} \leq \text{Total Procurement \$ for FY} \tag{3.4}$$

where c_i is the unit fly-away cost in current year dollars, and x_i is the number of units purchased in that FY. The coefficient of cost for each type aircraft and weapons system in the USAF inventory is published annually in AFI 65-503, Table 10-1, and 11-1(see Appendix J). Additional constraints, such as operational and maintenance costs for each weapons system, and the maximum number of aircraft that can be produced in a one year period of time, can also be modeled.

4. RESULTS

This chapter takes a detailed look at the results of Factor Analysis (FA) and Stepwise Linear Regression for both the Plackett-Burman (PB) and 2_{IV}^{4-1} Fractional Factorial designs. While the results from the PB design provide excellent insight, the statistical results from the 2_{IV}^{4-1} design were less useful.

4.1 Plackett-Burman Design

The THUNDER output metrics for the Plackett-Burman design are located in Appendix E. These results reflect the aggregate values for each output variable over 30 replications of a fifteen day war.

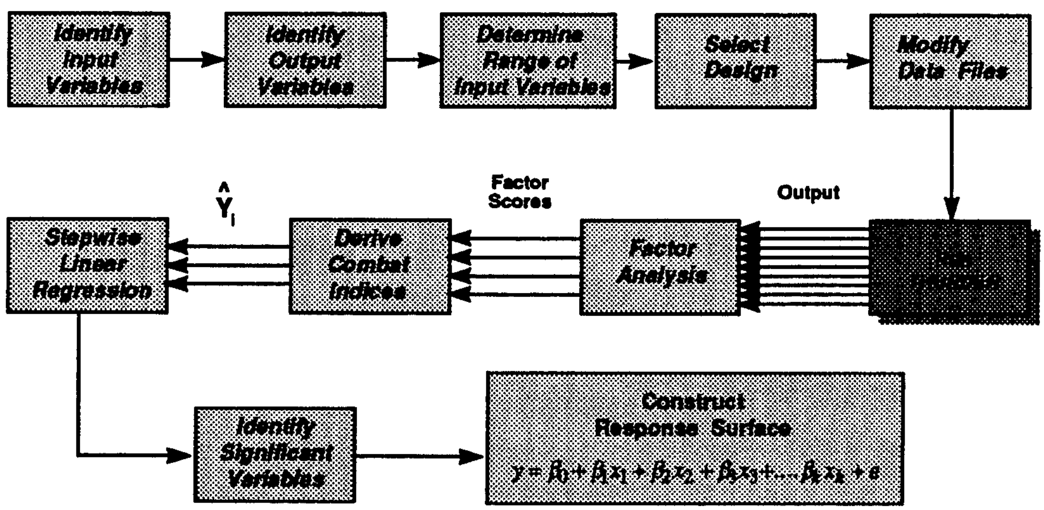

Figure 6. THUNDER Output

For example, the average number of tanks destroyed while Blue forces are on the defensive for Observation 1, Run 1 was 9774 (see Appendix F).

4.1.1 Factor Analysis Results

Once the output data was obtained, Factor Analysis (FA) was performed to identify underlying relationships in an effort to reduce the number of output variables to

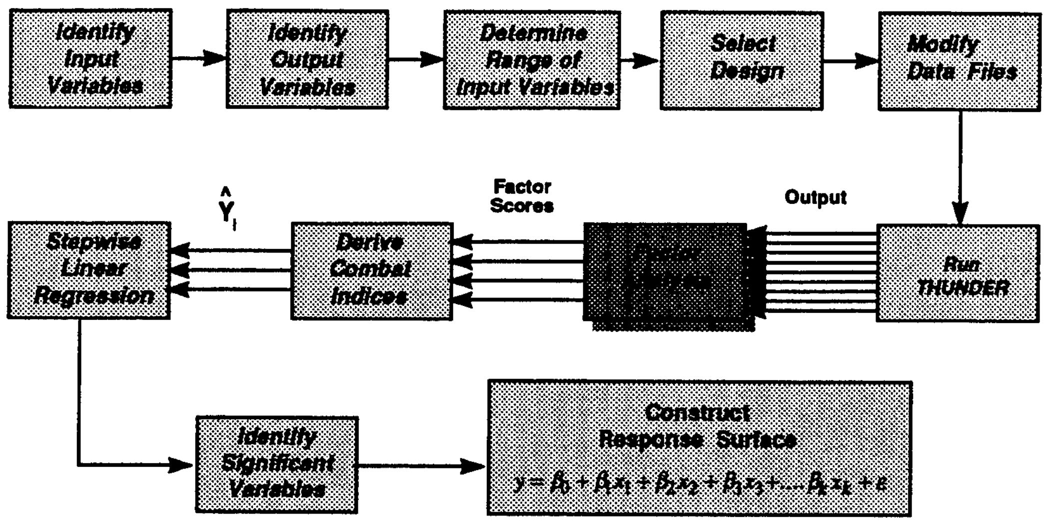

Figure 7. Factor Analysis

a set of "factors" that closely represent the Campaign Objectives identified by USAF/XPY. The output data for Observation 1 was arranged in matrix format and FA performed using the correlation matrix with varimax rotation (see Appendix G). Calculating seven factors resulted in six distinct, definable factor loadings (two of the loadings measured Air Superiority). These six factors could be easily defined in terms of the Campaign Objectives (CO) outlined by USAF/XPY and ASPVG:

- CO 1: Halt Invading Armies (Halt)
- CO 3: Evict Invading Armies (Evict)
- CO 4: Gain and Maintain Air Superiority (Air Sup)
- CO 7: Gain and Maintain Information Dominance (C3)
- CO 8: Deny Possession and use of Weapons of Mass Destruction (OCA)
- CO 9: Suppress National Capacity to Wage War (Interdiction)

4.1.1.1 Halt Invading Armies Factor

Recall from previous discussion in Chapter 3 that metrics were identified to measure each CO by means of Operational Objectives (OO) and Operational Tasks (OT) (see Appendix D). The associated metrics that were measurable in this UNCLASSIFIED database for Halting Invading Armies (CO 1) included

- Number of Tanks killed
- Number of APCs killed
- Time to stop Red advancement
- Distance FLOT moved
- Number of Rail Bridges destroyed
- Number of Transshipment Points destroyed
- Number of Logistics sites destroyed
- Number of Bridges destroyed
- Number of Artillery killed (Self-propelled (SP), Towed, and Multiple Launch Rocket System (MLRS))

When FA was performed on the output data, the third factor "Halt" (see Appendix G) loaded significantly on the THUNDER output metrics listed in Table 4.

Table 4. Significant Factor Loadings (Halt)

THUNDER Output Metric	Loading
Tanks(d)	.96
APC(d)	.96
Inf(d)	.95
Arty(d)	.42
ADTels	.64

This set of loadings is clearly representative of the metrics needed to measure CO 1, hence, the factor (i.e. new variable) was named *Halt.*

4.1.1.2 **Evict Invading Armies Factor**

Similarly, the metrics identified to measure Evict Invading Armies (CO 3) include

- Tanks killed in defensive positions
- APCs killed in defensive positions
- Number of Infantry killed in defensive positions
- Number of Rail Bridges destroyed
- Number of Transshipment points destroyed while offensive
- Number of Logistics sites destroyed
- Number of Bridges destroyed
- Number of Artillery killed (SP, Towed, and MLRS)

The first "factor" (see Appendix G) loaded significantly on the THUNDER output metrics listed in Table 5.

Table 5. Significant Factor Loadings (Evict)

THUNDER Output Metric	Loadings
Tanks(o)	.86
APCs(o)	.90
Inf(o)	.72
Arty(o)	.96
Halt(days)	.94
ADTels	.69
ADRadar	.53

The first four loadings in Table 5 are clearly representative of the metrics needed to measure CO 3. Furthermore, it can be argued that suppressing enemy air defenses directly impacts our ability to evict invading forces with airpower. Pilots engaged in CAS missions can better concentrate on destroying ground forces in a "low threat" environment. Therefore, this new variable was named *Evict.*

4.1.1.3 Gain and Maintain Air Superiority Factor (AirSup)

The metrics identified to measure CO 4 (Gain and Maintain Air Superiority) include

- RED aircraft lost due to BLUE air
- Total number of BLUE aircraft destroyed on the ground
- Number of RED aircraft destroyed in the open
- Number of TELS killed
- Number of ACQ radars killed
- Number of Fire Control radars killed
- Total number of BLUE aircraft lost to enemy surface-to-air threats

The fourth and sixth factors (see Appendix G) loaded on air superiority metrics; therefore, a linear combination was formed to represent the factor. Table 6 reflects the significant loadings for the combined factor.

Table 6. Significant Factor Loadings (AirSup)

THUNDER Output Metric	Loadings
RedAALosses	.86
RedSALosses	.78
RedAGLosses	.68
ACinOpen	.66
BlueAALosses	.90
BlueSALosses	.80
BlueAGLosses	.50
ADRadars	.60

Again, clearly these represent the metrics identified above for measuring CO 4; hence, the new variable was named AirSup.

4.1.1.4 Gain and Maintain Information Dominance Factor (C3)

The metrics identified in Appendix D to measure the OOs and OTs for CO 7 include

- Percent of Command Bunkers destroyed
- Number of C3 Antennas killed
- Number of C3 Vans killed
- Number of Mainstay aircraft killed

The significant loadings from the fifth factor (see Appendix G) are listed in Table 7.

Table 7. Significant Factor Loadings (C3)

THUNDER Output Metric	Loadings
CmdBunkers	.46
C3Ant	.83
C3Van	.87
TmpRdBrid	.56
TSPT	.60

These outputs are representative of the metrics identified above for measuring CO 7; hence, the new factor was named C3.

4.1.1.5 Deny Possession and Use of WMD Factor (OCA)

The metrics available in the UNCLASSIFIED database to measure CO 8 include (see Appendix G)

- Percent of WMD storage facilities destroyed
- RED aircraft lost due to BLUE air
- Number of RED aircraft shot down
- Number of BLUE aircraft destroyed on the ground
- Percent of RED airfields operable
- Number of RED aircraft killed in open
- Percent of RED support facilities destroyed by BLUE air
- Percent of RED FARPs destroyed by BLUE air

The significant loadings associated with the second factor (see Appendix G) are listed in Table 8.

Table 8. Significant Factor Loadings (OCA)

THUNDER Output Metric	Loadings
Runways	.84
ABAmmo(H)	.91
ABMaint(S)	.91
ABSpares(S)	.87
RedSALosses	.41
RedAGLosses	.31
NBCFacil	.34

Once again, these clearly represent the metrics identified above for measuring CO 8; therefore, the new variable was named OCA.

4.1.1.6 Suppress National Capacity to Wage War Factor (Interdict)

The last CO identified as being measurable with the THUNDER output obtained from the PB design is Suppress National Capacity to Wage War (CO 9). The metrics needed to measure this CO include (see Appendix D)

- Number of Transshipment points killed
- Number of C2 nodes killed
- Number of Bridges destroyed
- Number of Defense related plants destroyed

The significant loadings found in the seventh factor (see Appendix G) are listed in Table 9.

Table 9. Significant Factor Loadings (Interdiction)

THUNDER Output Metric	Loadings
TSPT	.56
CmdBunker	.68
Mainstay	.68
StoneBldg	.62
NBCFacil	.80

The Mainstay aircraft and command bunker do represent C2 capability while the stone building and NBC facility represent defense related plants. Therefore, these metrics represent the ability to suppress national capacity to wage war, and was named Interdiction for brevity purposes.

4.1.1.7 Summary

The results of Factor Analysis using THUNDER output from the Plackett-Burman experimental design were excellent. The underlying relationships were easily identified, successfully reducing the number of output variables from 34 to six. More importantly, these six newly derived output "factors" *clearly* represent six of the Campaign Objectives identified by HQ USAF/XPY:

- Halt Invading Armies
- Evict Invading Armies
- Gain and Maintain Air Superiority
- Gain and Maintain Information Dominance
- Deny Possession and use of Weapons of Mass Destruction
- Suppress National Capacity to Wage War

4.1.2 Constructing Combat Indices

Once the results of FA were obtained, the next step was to create combat indices for each of the new output factors (see Figure 8). These indices served as the

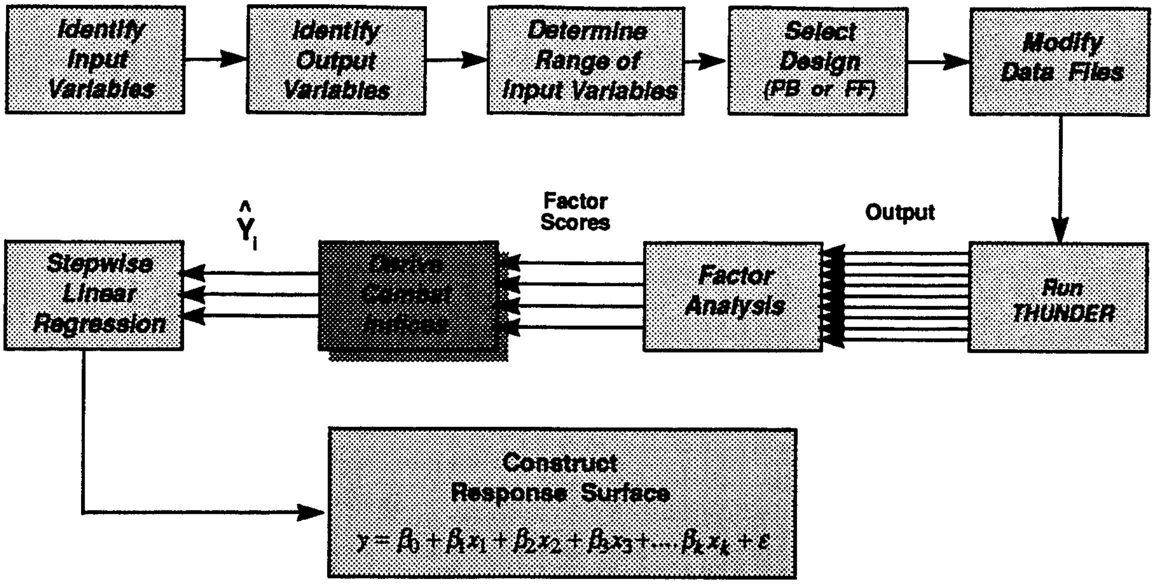

Figure 8. Derive Combat Indices

dependent variable in stepwise linear regression. Equation 3.1 was used to obtain these indices

$$\begin{bmatrix} \text{THUNDER} \\ \text{OUTPUT:} \\ \text{2nd Aggregate} \\ \text{Observation} \\ (26 \times 34) \end{bmatrix} \begin{bmatrix} \text{Factor} \\ \text{Matrix} \\ (34 \times 7) \end{bmatrix} = \begin{bmatrix} \text{Indicies} \\ \text{Matrix} \\ (26 \times 7) \end{bmatrix} \qquad (3.1)$$

Matrix multiplication of the data obtained from the second aggregate observation (i.e. independent observation) and the newly derived set of factors resulted in the index scores listed in Table 10 (the two air superiority indices were combined to simplify the table , e.g. 26 x 6 matrix). The Total Combat Index (TCI) is simply an equally weighted linear combination of the six individual indices (see equation 3.2).

Table 10. Combat Indices

	Halt	Evict	Air Sup	C3	OCA	Interdict	Response
Run 1	27326.6	26237.6	10454.5	5875.3	1344.5	2282.6	73521.2
Run 2	22092.6	21506.5	8741.2	4867.6	1180.4	1723.4	60111.6
Run 3	24369.7	26852.8	10208.4	5447.5	1440.9	2250.1	70569.5
Run 4	28419.9	20755.1	8924.9	5199.9	826.4	1833.8	65960.0
Run 5	25555.6	24918.6	9623.2	5260.6	1172.8	2144.7	68675.5
Run 6	23549.1	26547.7	9936.6	5258.0	1328.5	2254.3	68874.2
Run 7	21863.5	20693.9	8118.6	4500.8	1001.2	1787.8	57965.9
Run 8	21912.7	21295.5	8381.8	4661.9	1052.9	1809.0	59113.9
Run 9	21970.4	22013.3	8550.2	4691.9	1137.9	1766.1	60129.8
Run 10	24026.4	18797.5	8401.8	4823.4	876.2	1560.7	58486.1
Run 11	23893.6	19023.7	8180.4	4630.4	876.0	1516.7	58120.8
Run 12	28276.2	20180.6	8800.2	5191.4	806.6	1835.2	65090.3
Run 13	23762.7	19803.9	8575.1	4880.8	940.0	1617.6	59580.2
Run 14	26224.2	25253.8	9897.0	5448.8	1167.7	2230.2	70221.5
Run 15	24037.2	19354.9	8413.6	4754.9	926.0	1545.2	59031.9
Run 16	19878.4	22725.8	8546.1	4544.8	1286.9	1762.0	58744.1
Run 17	23886.3	26984.8	10254.9	5505.2	1368.3	2245.1	70244.7
Run 18	26911.8	22301.0	9243.2	5264.8	931.5	2000.1	66652.3
Run 19	23708.5	18865.7	8325.1	4747.2	957.0	1563.0	58166.4
Run 20	23280.9	17605.4	8025.8	4630.6	829.0	1535.7	55907.3
Run 21	28152.0	19755.2	8715.5	5136.4	746.9	1820.7	64326.6
Run 22	26071.4	25610.2	10091.9	5593.2	1267.6	2132.5	70766.7
Run 23	23154.1	21855.6	8722.6	4905.4	1099.8	1917.1	61654.6
Run 24	24977.1	28259.5	10737.6	5810.8	1552.4	2374.5	73711.8
Run 25	24063.1	18163.4	7434.9	4265.6	664.8	1717.8	56309.8
Run 26	23370.4	20384.1	7927.9	4387.7	832.4	1861.0	58763.5

4.1.3 Stepwise Linear Regression Results

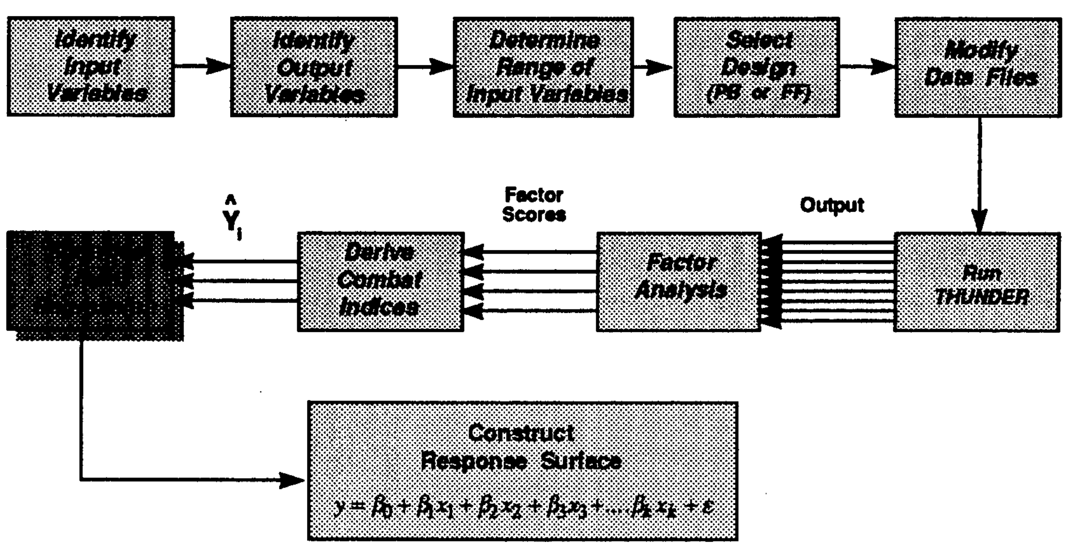

Figure 9. Stepwise Linear Reqression

Once the individual and TCIs are calculated, the next step in developing the quick turn tool is stepwise linear regression (see Figure 9). Stepwise linear regression was performed using each of the individual indices, including the TCI, as the dependent variables (see Table 10). The independent variables were the coded input variables of the Plackett-Burman design (see Appendix E).

Outstanding results were obtained for each of the indices used from Table 10. Table 11 provides a summary of the results. The R^2_{adj} (i.e. percent of variance explained) ranged from 50 percent for OCA and AirSup to 91 percent for the Total Combat index regression equation.

Table 11. Stepwise Linear Regression Results

Index	Adj R^2	Response Surface
Halt	.9527	$Y = 24412.82 + 263.93X_{F15E} + 234.54X_{F111} + 1672.46X_{A10} + 233.55X_{EF111} - 654.18X_{F117} - 181.84X_{AWACS} - 293.28X_{JSTARS} + 500.48X_{AIM120} + 298.55X_{AIM9} + 656.23X_{MK82} - 306.12X_{ARM88} - 430.68X_{DELAY} + 296.72X_{CBU97} + 364.66X_{LGB} + 232.79X_{GPS}$
Evict	.7336	$Y = 22144.03 + 576.01X_{F16} + 2088.13X_{A10} + 1042.72X_{F117} + 520.02X_{TOM} - 496.47X_{AIM120} - 646.88X_{MK82} + 554.38X_{AGM65} + 648.13X_{ARM88} + 748.66X_{DELAY} - 661.47X_{CBU97} - 458.18X_{LGB} - 508.84X_{GPS}$
AirSup	.5077	$Y = 7215.75 + 138.51X_{F15C} + 192.17X_{F16} + 527.75X_{A10} + 168.84X_{F117} - 140.37X_{MK82} + 196.70X_{DELAY}$
C3	.6617	$Y = 5010.90 + 120.98X_{F16} + 63.75X_{F15E} + 347.99X_{A10}$
OCA	.5070	$Y = 1062.06 + 45.98X_{F16} + 74.62X_{A10} + 97.91X_{F117} + 43.13X_{TOM} - 50.37X_{AIM120} - 69.11X_{MK82} + 41.03X_{AGM65} + 53.08X_{ARM88} + 67.82X_{DELAY} - 57.19X_{CBU97} - 43.79X_{LGB} - 46.87_{XGPS}$
Interdict	.8972	$Y = 1887.92 + 29.19X_{F15C} + 56.20X_{F16} - 29.62X_{F111} + 220.81X_{A10} + 96.42X_{F117} + 23.80X_{JSTARS} + 31.43X_{TOM} - 22.00X_{MK82} + 21.75X_{AGM65} + 42.72X_{ARM88} + 36.90X_{DELAY} - 43.95X_{CBU97} - 32.45X_{LGB} - 28.59X_{GPS}$
TOTAL	.9090	$Y = 62020.34 + 566.15X_{F15C} + 989.35X_{F16} + 706.15X_{F15E} + 4931.75X_{A10} + 774.70X_{F117} + 649.00X_{TOM} + 771.50X_{AGM65} + 584.18X_{ARM88} + 659.49X_{DELAY} - 583.31X_{CBU97} - 497.09X_{GPS}$

For a more complete statistical analysis of the results of stepwise regression , including the step history and an input variable's contribution to R^2_{adj} , see Appendix H. Least squares regression was then performed with just those variables identified during stepwise regression. Figure 10 shows the Response v. Predicted Response plot for the TCI.

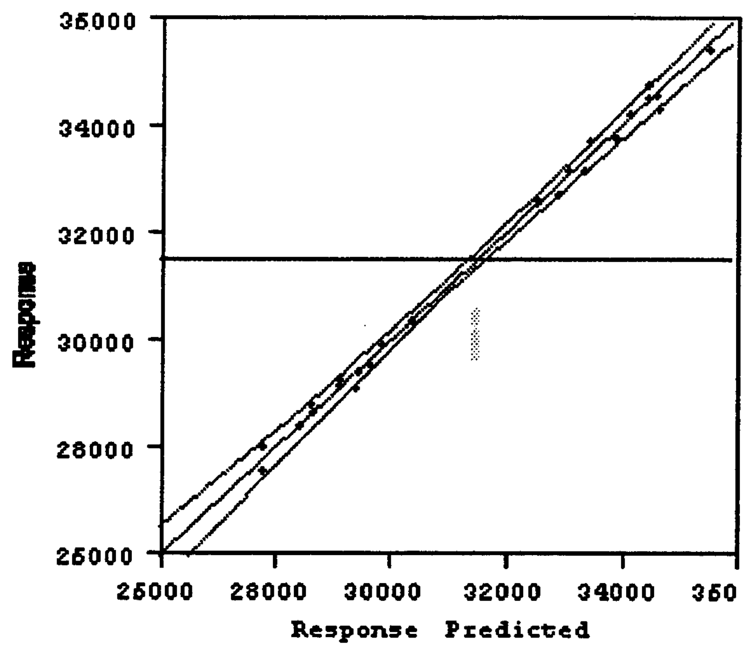

Figure 10. Response vs. Predicted Response (Total Combat Index)

The two outer lines in Figure 10 represent a 95 percent confidence interval, while the center line is the linear approximation of the predicted response value. All of the predicted response values fell within the 95 percent confidence interval, representing an outstanding fit. The Residual vs. Predicted Response plot is shown in Figure 11, which indicates no residual patterns, thus another indicator of a good fit. Plots of Response vs. Predicted Response as well as Residual vs. Predicted Response for each of the individual indices can be found in Appendix I. In all cases the residual plots indicated normal distribution of error.

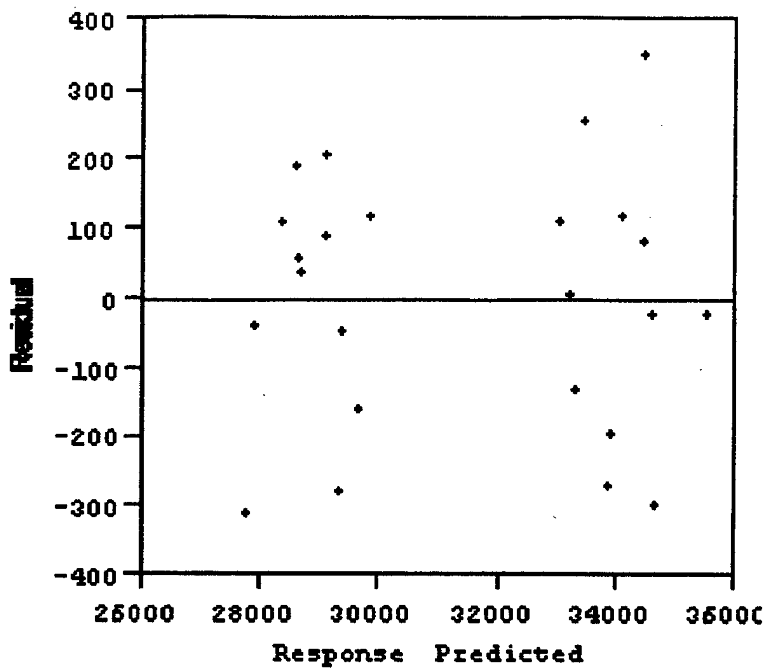

Figure 11. Residual vs. Predicted Response

4.2 2_{IV}^{4-1} Fractional Factorial (FF) Design

The first step in constructing the fractional factorial design was to determine the input variables to focus on. We could have used the significant variables identified in the PB results. However, a senior decision maker was interested in finding out if there existed a synergistic effect among the following input variables: *A10 , F15E, MK 82 and AGM65.*

4.2.1 **Fractional Factorial Design (FF)**

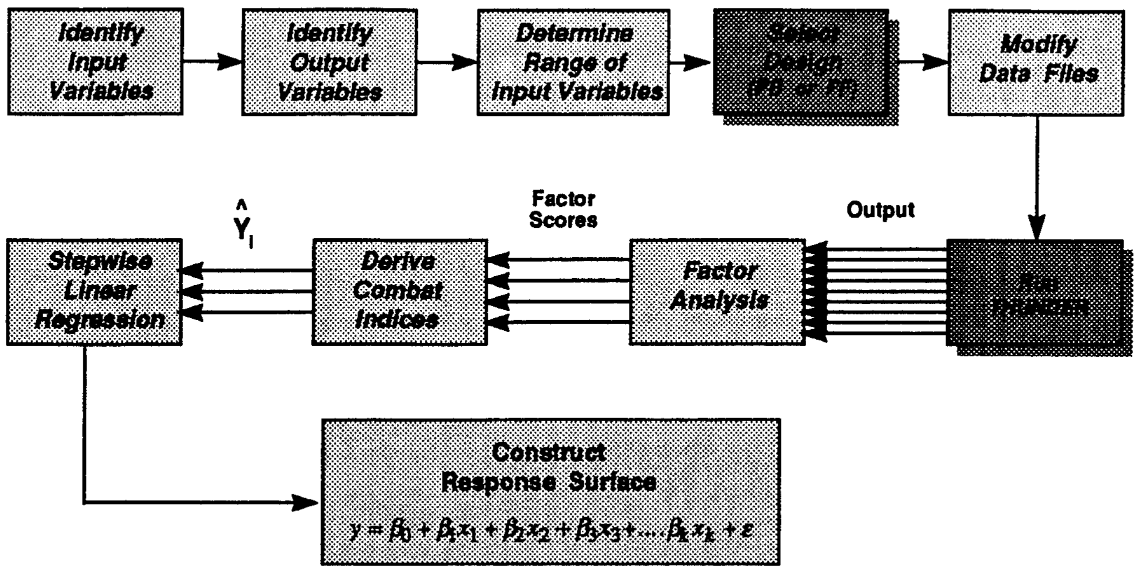

Figure 12. FF Design Selection

A 2_{IV}^{4-1} design was selected to model the main and some second-order interaction terms (see Appendix E). With two center point runs added to measure pure error, a total of 10 design points were constructed. The same range of values were used for the four variables. Two independent observations of thirty replications each were collected, just as with the PB design (see Appendix F).

4.2.2 Factor Analysis Results

The same methodology outlined in 4.1.1 was used to obtain factor scores for the fractional factorial design. The output data for Observation 1 was arranged in matrix format and FA performed using the correlation matrix with varimax rotation (see Appendix G).

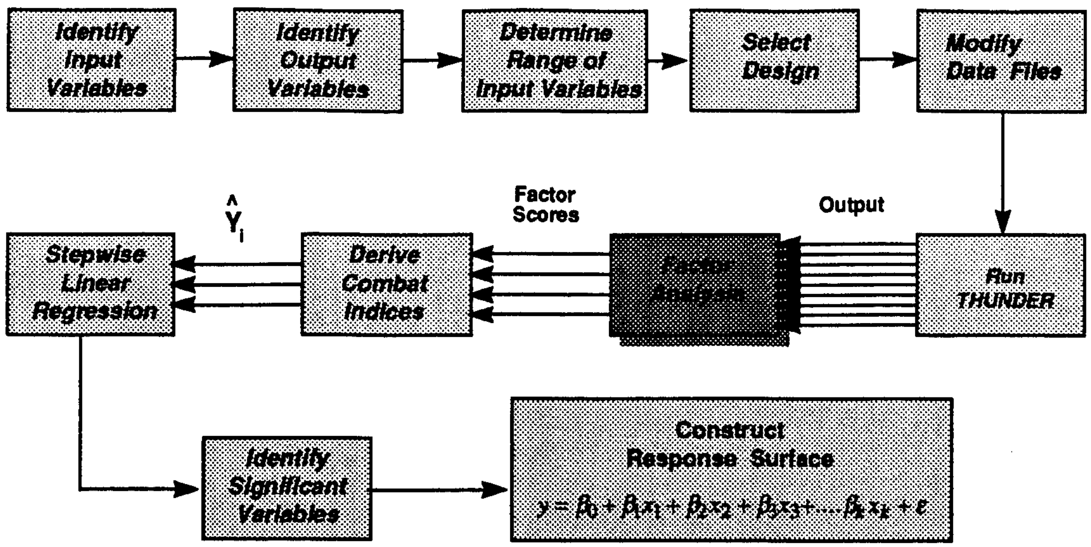

Figure 13. Factor Analysis (FF Design)

This time calculating seven factors resulted in 5 distinct indices (see Appendix G):

- CO 1: Halt Invading Armies (Halt)
- CO 3: Evict Invading Armies (Evict)
- CO 4: Gain and Maintain Air Superiority (Air Sup)
- CO 7: Gain and Maintain Information Dominance (C3)
- CO 8: Deny Possession and use of Weapons of Mass Destruction (Interdiction)

Three of the 7 factors loadings related to Air Superiority. Again, a linear combination of the indices formed the Total Combat Index.

4.2.2.1 Halt Invading Armies Factor

Table 12. Significant Factor Loadings (Halt)

THUNDER Output Metrics	Loadings
Tanks(d)	.97
APCs(d)	.98
Inf(d)	.95
Arty(d)	.97
Halt(dist)	.84
Push	.69
ADTel	.92
ADRadar	.91

When FA was performed on the FF output data, the first "factor" (see Appendix G) loaded significantly on the THUNDER output metrics listed in Table 12 above. Using the same criteria as with the PB design, this factor clearly represents CO1, Halting Invading Armies.

4.2.2.2 Evict Invading Armies Factor

Table 13. Significant Factor Loadings (Evict)

THUNDER Output Metrics	Loadings
Tanks(o)	.51
APC(o)	.83
Inf(o)	.70
Arty(o)	.69
Halt(days)	.89
Restore(days)	.83

The third factor (see Appendix G) loaded significantly on the output metrics listed in Table 13 above. These variables clearly define CO 3, Evict Invading Armies.

4.2.2.3 Gain and Maintain Air Superiority Factor

Table 14. Significant Factor Loadings (Air Sup)

THUNDER Output Metrics	Loadings
RedAALosses	.73
RedSALosses	.68
RedAGLosses	.85
BlueAALosses	.63
BlueSALosses	.77
BlueAGLosses	.90
Runways	.75
ACinOpen	.66
ABMaint(S)	.81
ABSpares(S)	.94
CmdBunker	.74
Mainstay	.83
Helo	.92

The second, fourth, and seventh factors (see Appendix G) loaded on air superiority metrics; therefore, a linear combination was formed to represent the factor. Table 14 reflects the significant loadings for the combined factor. These represent the metrics identified above for measuring CO 4; hence, the new variable was named AirSup.

4.2.2.4 Gain and Maintain Information Dominance (C3)

The fifth factor (see Appendix G) clearly loaded on metrics used to measure CO 7, Gain and Maintain Information Dominance; hence, the new variable was named C3.

Table 15. Significant Factor Loadings (C3)

THUNDER Output Metrics	Loadings
C3Ant	.85
C3Van	.91

4.2.2.5 Suppress National Capacity to Wage War Factor

The sixth factor was somewhat difficult to interpret. Only four output variables loaded significantly with this factor: Push, TmpRdBrid, ABAmmo(H), and StoneBldg. Two of these metrics are used to define CO 9: Ability to Suppress National Capacity to Wage War.

Table 16. Significant Factor Loadings (Interdiction)

THUNDER Output Metrics	Loadings
Push	.63
TmpRdBrid	.69
ABAmmo(H)	.82
StoneBldg	.85

4.2.3 Deriving Combat Indices

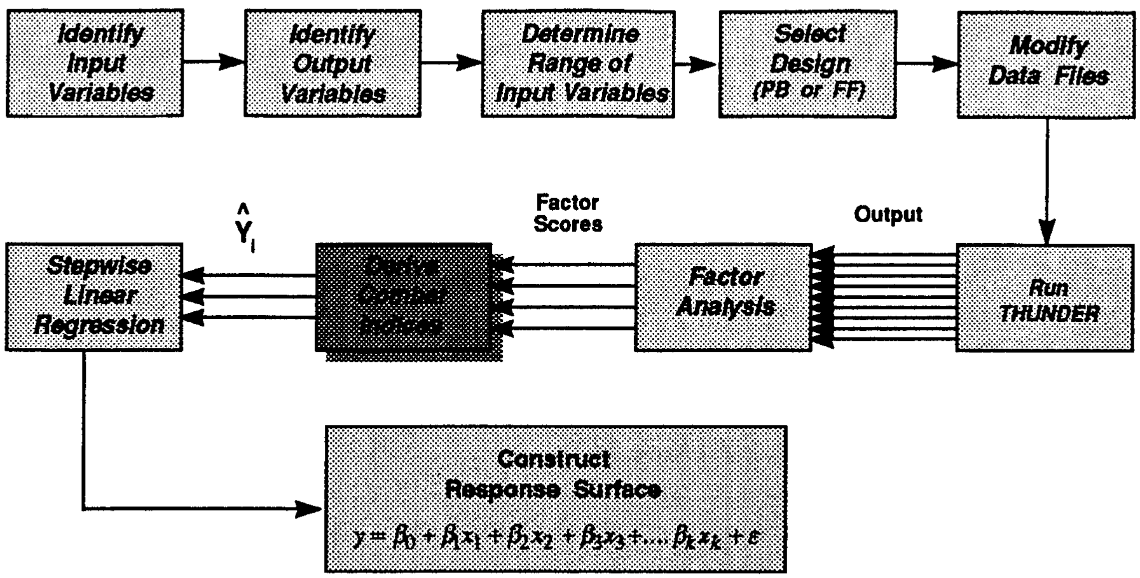

Figure 14. Derive Combat Indices

The same procedures as outlined in section 4.1.2 above were used to obtain the combat indices listed in Table 17.

Table 17. Combat Indices (FF)

	Halt	Evict	Air Sup	C3	Interdict	Total
Run 1	24807.6	13503.9	3228.6	786.2	6294.2	48620.3
Run 2	23627.7	12750.0	3285.6	743.0	5981.7	46388.0
Run 3	24358.4	12607.9	3340.4	699.7	5937.4	46943.9
Run 4	24302.9	12865.5	3391.4	730.5	6049.8	47340.2
Run 5	27851.4	14628.9	3573.8	859.9	6857.1	53771.0
Run 6	29938.8	13753.6	4236.9	931.2	6818.1	55678.6
Run 7	27605.4	14586.2	3611.7	824.2	6823.2	53450.7
Run 8	29687.1	13586.9	4252.3	868.2	6703.2	55097.7
Run 9	24668.1	10759.9	3681.9	795.4	5507.5	45412.8
Run 10	27371.3	13214.7	3834.9	831.4	6424.5	51676.8

4.2.4 Stepwise Linear Regression

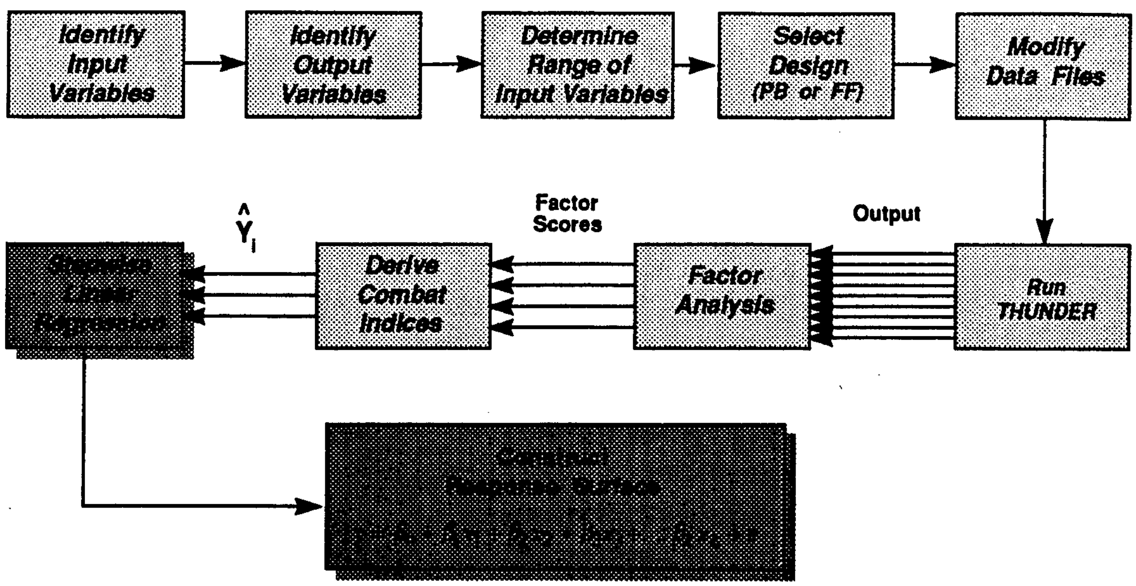

Figure 15. Stepwise Linear Regression

In order to perform stepwise linear regression for the fractional factorial design, new variables were defined.

Main Effects

- x_1 = A10
- x_2 = F15E
- x_3 = AGM65
- x_4 = MK82

Second Order Interaction Effects

- x_5 = A10*AGM65
- X_6 = A10*MK82
- X_7 = F15E*AGM65
- X_8 = F15E*MK82
- X_9 = A10*F15E
- X_{10} = AGM65*MK82

Detailed results of the stepwise linear regression for the fractional factorial design can be found in Appendix H. A summary of the results and associated response surface is listed in Table 18 below. While the adjusted R^2 value for Evict was disappointing, the remaining values explained anywhere from 50 percent (Interdiction) to 94 percent (C3) of the variance within THUNDER.

Table 18. Stepwise Linear Regression Results

Index	Adj R^2	Response Surface
Halt	.8655	$Y = 26421.80 + 2248.13X_{A10} + 366.88X_{AGM65} + 675.63X_{A10 \cdot AGM65}$
Evict	.1697	$Y = 13225.90 + 603.50X_{A10}$
Air Sup	.7020	$Y = 9544.90 + 498.13X_{A10} + 356.13X_{AGM65}$
C3	.9488	$Y = -806.90 - 65.38X_{A10} + 24.63X_{F15E} - 12.88X_{AGM65} + 12.63X_{MK82} - 15.88X_{A10 \cdot AGM65}$
Interdiction	.5012	$Y = 6339.50 + 367.25X_{A10}$
TOTAL	.6674	$Y = 54725.20 + 3651.63X_{A10}$

Furthermore, the Response vs. Predicted Response plot (see Figure 16) and Residual vs. Predict Response (see Figure 17) also support the claim that the total combat response surface is a good linear approximation and the residuals are normally distributed. Plots for all of the response surfaces are located in Appendix I.

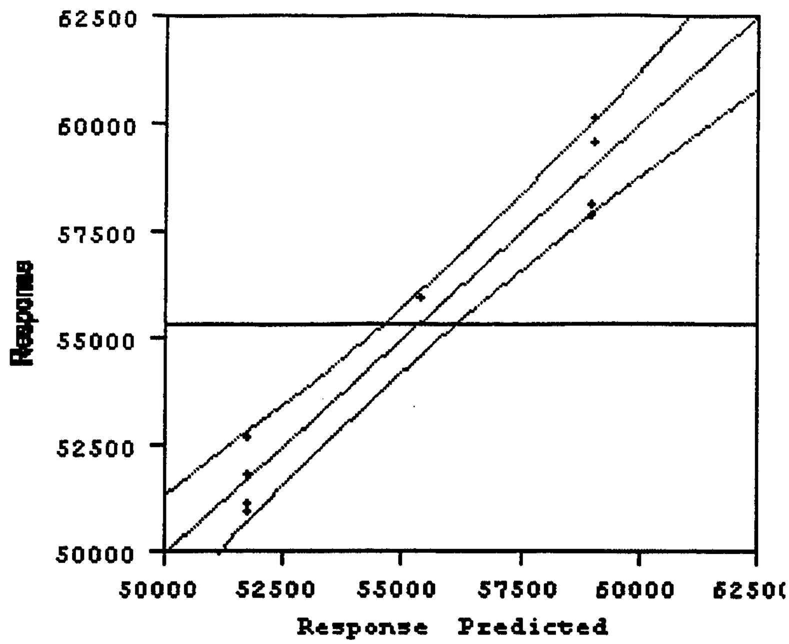

Figure 16. Response vs. Predicted Response (Total)

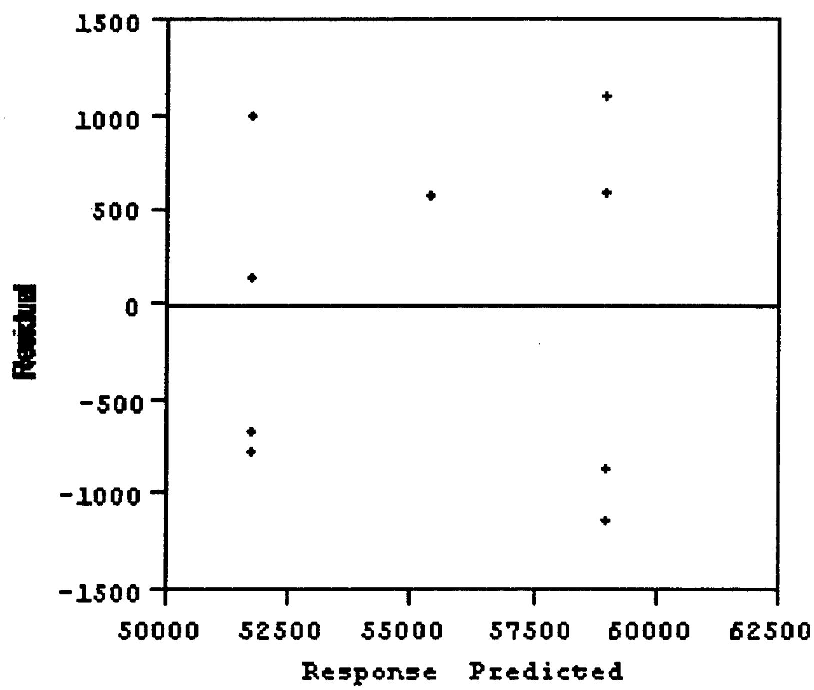

Figure 17. Residual vs. Predicted Response (Total)

4.3 Analysis of Results

The following four variables were significant in the PB design at the 95 percent confidence interval: A10, F16, F117, and AGM65. By examining the magnitudes of the parameter estimates, as well as the Sums of Squares, the A10 was clearly *the dominant input variable* when all 23 variables were considered. Furthermore, the A10 was the only contributing input variable common among all PB metamodels. The fractional factorial design was able to identify some synergistic effects between the A10 and AGM65 maverick missile. Surprisingly, no other second-order effects were observed to be significant statistically.

Dominance of the A10 in both the PB and FF designs can be explained in part by the scenario developed by ASC/XR. Greater than 75 percent of the targets in the data base created by ASC/XR were located in the first 40 miles of enemy territory. They consisted mostly of CAS and BAI targets (i.e. Tanks, APCs, Mobile SAM, bridges, etc.). This, along with the nature of the terrain in SWA, greatly influenced the dominance of the A10 aircraft, well suited for the desert environment. The same holds for the AGM65 maverick missile.

The number of OCA and strategic targets loaded in the data base was limited, down playing the importance for precision guided weapons delivery. The lack of importance of air-to-air assets can be attributed to the abilities of the Iraqi Air Force. During the Persian Gulf War, the Iraqi Air Force was literally non existent after the first 24 hours of hostilities. Therefore, the absence of significant air-to-air input variables in the indices is consistent with military judgment and combat experience.

Given the results obtained from both metamodels, the Plackett-Burman design was clearly the best choice for linking procurement dollars to combat capability as measured in terms of Campaign Objectives . Using the TCI, the PB design explained

90.9 percent of the variance, modeling all 23 input variables, while the fractional factorial design captured 66 percent of the variance and was limited in scope.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

As a result of this thesis effort, a methodology for constructing a "quick turn" tool capable of relating procurement dollars to combat capability was successfully developed. THUNDER input variables were selected along with their range of values.

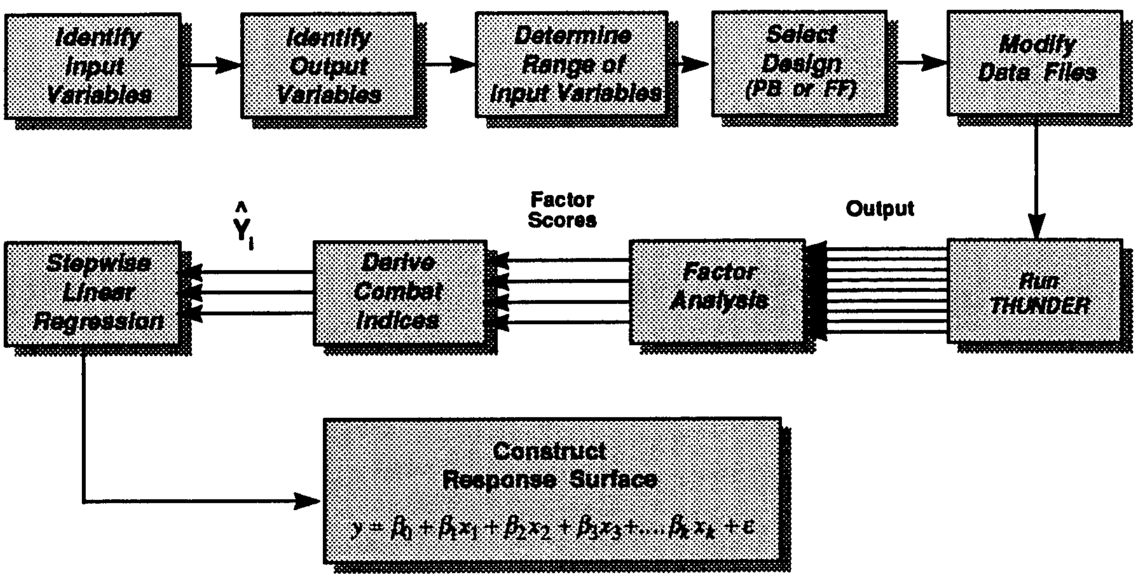

Figure 18. Methodology Overview

Output metrics were identified to measure Campaign Objectives as outlined by HQ USAF/XPY and the ASPVG. Constructing a Plackett-Burman Resolution III experimental design enabled us to successfully reduce the number of input variables from 23 to 4, and identifing the significant variables. Furthermore, the synergistic effects of a set of input variables, selected by a senior decision maker, were identified using a 2_{IV}^{4-1} fractional factorial design.

A significant accomplishment was the ability to identify underlying relationships between output variables using Factor Analysis. These relationships were expressed by factors that clearly represented the combat capability of each alternative force structure in terms of the Campaign Objectives outlined by HQ USAF/XPY.

Response Surface Methodology, using the total combat indices generated from Factor Analysis, provided a first order linear metamodel that accounted for 90.9 percent of the variation within the model THUNDER. Using these response surfaces in a computer spreadsheet, comparisons between alternative force structures in terms of campaign objective can be made in a matter of minutes. Figure 16 is a notional example of how this "quick turn" tool could generate graphical representations of current and future combat capability. Here the left most column represents the current, or baseline, force structure. Future years are expressed in terms of a percentage of our current capability.

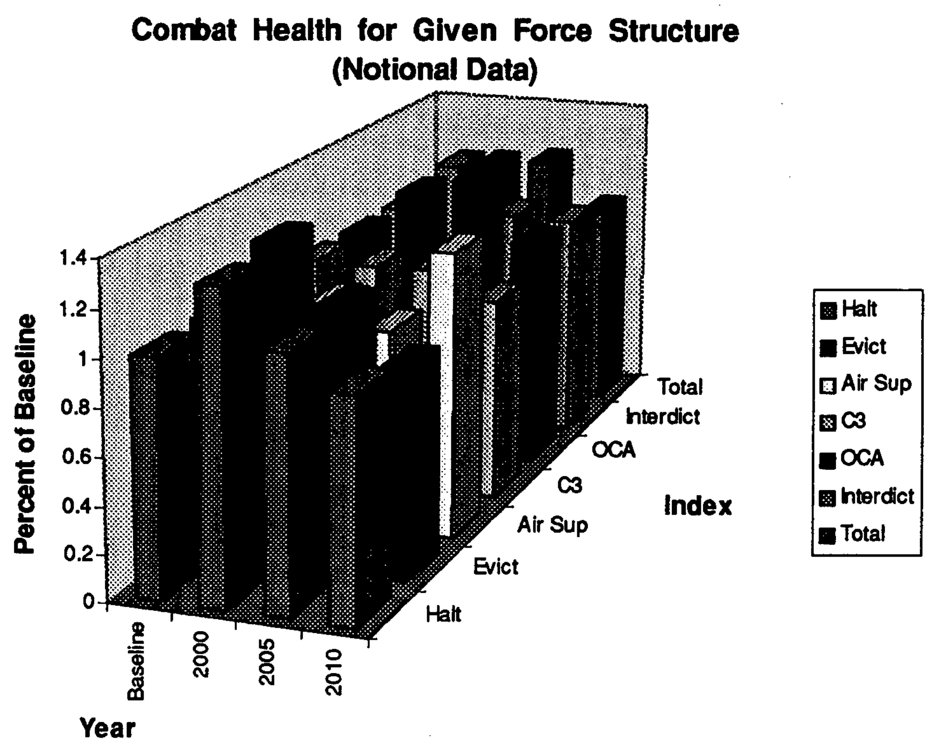

Figure 19. Projected Combat Health through 2015 (Notional)

Additionally, these response surfaces can be used as an objective function in a integer programming problem. As stated before, we are interested in determining how to spend our procurement dollars in order to get the "biggest bang for our buck" on the battle field. We can use the response surface derived from the total combat index as our objective function. We then bound the feasible region by identifying a number of fiscal, production, and "political" constraints. These constraints might include

- Procurement dollars available,
- Operation & Maintenance dollars available,
- Production limitations for each weapons system,
- Treaty limits on number of aircraft types,
- Integer values for input variables.

However, In order to use the regression results (i.e. equations) listed in Table 11 and Table 18, a transformation must be performed. These regression equations were derived using coded input variables (i.e. -1 to 1) to gain insight into the significance of each variable based on the magnitude of their respective parameter estimate. The simplest approach is to transform the regression equations back into uncoded form by using values listed in Table 2 as the independent variables in stepwise linear regression.

The resulting integer programming problem would then have the form

Obj Funct: $$Y = 14799.04 + 18.87X_{F15C} + 18.32X_{F16} + 58.85X_{F15E} + 136.99X_{A10} + 258.23X_{F117} + 21.63X_{TOM} + 0.35X_{AGM65} + 4.13X_{ARM88} + 7.07X_{DELAY} - 0.13X_{CBU97} - 33.17X_{GPS}$$

Subject to:
$$\sum_i C_i X_i \leq \text{Total Procurement Budget}$$
$$\sum_i O_i X_i \leq \text{Operational Budget}$$
$$\sum_i M_i X_i \leq \text{Maintenance Budget}$$
$$\sum_i X_i \leq \text{Treaty Limits}$$
$$X_i \leq \text{Production Limitation}_i$$
$$X_i \in (\text{INTEGER}) \ \forall i \quad i = 1,2,\ldots\ldots,n$$

where C_i is the unit cost, O_i is the operational costs, and M_i is the maintenance cost for each type aircraft or munition. These fiscal constraints are the key to linking dollars to combat capability as measured by Campaign Objectives.

However, solving this problem in integer form may take an enormous amount of time to find a solution (if one can be found). However, if we relax the integer constraint and solve the problem as a linear programming problem, a solution can be found quickly. By rounding each of the input variable solutions down to the next nearest integer value, we can very closely approximate the optimal integer solution.

5.2 Lessons Learned

The importance of using shell scripts (or some other front end application) to modify THUNDER data files can not be overstated. Given the number of input variables, and the nature of THUNDER data files, modifying the files for each design point by hand would have been too time consuming for a team of analysts. The time spent writing scripts was an order of magnitude less than would have been required to modify each file by hand.

Prior to the start of this thesis, the author had very little simulation experience, and no previous experience running THUNDER. Air Force Studies and Analysis (USAF/SAA) officially owns the model. CACI is the civilian defense contractor who maintains and provides version updates of THUNDER on behalf of USAF/SAA. Attending the week long training seminar offered by CACI would be extremely beneficial for anyone interested in furthering this study. An important capability of THUNDER was not discovered until very late in the research. As stated in Chapter III, the output data was an aggregated result of 30 replications. This is the standard format provided by THUNDER when using the ***ttrep*** function. However, through a series of advanced commands, the data from each individual replication could have been extracted in the same format as the aggregated report. This would have been a much better approach to use from a statistical perspective, allowing for greater degrees of freedom. Unfortunately, the data from the Plackett-Burman design was deleted in order to make enough disk space available to run the fractional factorial design. Had this data been backed up to a tape drive or CD-rom, the individual replications could have been recovered.

The time required to run one replication of THUNDER using a CLASSIFIED database is approximately 45 minutes to an hour, assuming a 30 day scenario. The computational capability of an organization will greatly influence which experimental designs are feasible. Had a CLASSIFIED database been used for this thesis effort, the time to collect THUNDER output data would have taken 90+ days of continuous CPU time. Therefore, parallel processing capability should be seriously considered for any organization interested in using this metamodel approach.

5.3 Recommendation for Further Study

While the results of this thesis effort are insightful and provide a beginning reference point for USAF/XPY, additional study should be accomplished in the following areas.

5.3.1 Database

An UNCLASSIFIED data base was used to develop this metamodel. A similar effort should be made using a CLASSIFIED database to ensure feasibility. Furthermore, there are a significant number of input variables used in this thesis that have been recently removed, or reduced in numbers, from the USAF inventory. For example, all F-111 Varks, EF-111 Ravens, and F-4G Wild Weasels airframes have been "mothballed," and the number of A-10s have been dramatically cut since the Persian Gulf War. A database that incorporates many of the newer weapons systems, such as the B-1, B-2, and F-22, should be used to validate this metamodel approach. Efforts have been made in recent months to integrate THUNDER with a mobility model called GAMMs. Constructing a metamodel that captures the mobility impact on theater level combat would be of great interest.

The CLASSIFIED database would also provide a significant increase in available THUNDER output metrics. This would clearly have an impact on the multivariate analysis results. Determining the underlying relationships between output variables is essential to constructing a metamodel that can measure theater level outcomes. Deriving factors that *clearly* represent these campaign objectives may become difficult with the increased number of output variables.

5.3.2 Advanced Topics

In this thesis, a linear combination of indices was used to compute the overall combat index for each alternative force structure. Future research could consider ways of weighting the indices. One possible approach could use the eigenvalues (λ) associated with each factor.

The second area of interest is the use of variance reduction techniques to more accurately model the stochastic nature of the parameter estimates (β). This technique could greatly improve the fidelity of the metamodel constructed.

Appendix A

The following is a list of definitions for the independent variables modeled in the scenario.

Aircraft

F-15C: Primary air superiority fighter for the USAF, with all weather ,by day or night capability, able to engage Beyond Visual Range (BVR).

F-15E: Dual role F15 variant, capable of long range deep interdiction, day or night, in adverse weather while retaining air-to-air capabilities of the F-15C

F-16: Multi-role ground attack and air superiority fighter, by day or night, and in adverse weather condition. BVR capable.

F-111: Swing wing tactical fighter bomber, capable of deep interdiction and precision guided weapons delivery, by day or night, and adverse wx.

EF-111: Non-Lethal electronic warfare aircraft, designed to provide tactical jamming of EW, GCI, and surface-to-air acquisition radars, day or night, in adverse weather conditions.

F-4G: Lethal Suppression of Enemy Air Defense systems.

A10: USAF's primary ground attack aircraft, designed specifically for the Close Air Support (CAS) mission.

F117: Precision attack aircraft with stealth elements, optimized for radar energy dispersion and low IR emissions.

AWACS: Airborne Early warning and control aircraft. Detect and orchestrate intercept of enemy aircraft.

JSTARS: Long range radar reconnaissance aircraft. Detect stationary and moving objects, such as trucks and armored vehicles.

TOMAHAWK: Long range, inertial-guided, cruise missile. Modeled as a "one-way" aircraft in THUNDER.

Munitions

AIM-120:	AMRAAM Missile. An all weather, all aspect, active radar-guided air-to-air missile.
AIM-9:	Sindwinder Missile. An all aspect, short range IR guided air-to-air missile.
20MM:	GE M61A1 Vulcan, multi-barrel Gatling type cannon for air-to-air and air-to-ground attacks.
MK-82:	500 lb, free-fall general purpose bomb.
AGM-65:	Maverick Missile. Short- and medium range TV-, IIR- and laser guided, air to surface missile. Designed for use against tanks and hardened targets.
ARM-88:	Harm Missile. Medium-range, anti-radar, air-to-surface missile. Designed for use against frequency agile radar emitter.
CBU-87:	Multi-purpose cluster bomb, which opens prior to impact, releasing 202 anti-tank and -personnel bomblets that have a shaped warhead for improved penetration.
CBU-97:	Similar to CBU-87, but carries 10 specially developed sub-munitions, which in turn house 4 "smart" anti-armor warheads that use IR sensors to detect armored targets.
B-DELAY:	Approximates CBU-89. Anti-tank and area denial cluster bomb. Airborne delivered anti-tank and -personnel mine field.
B-LETHAL:	Generic cluster munition. Similar to CBU-58/71. Releases baseball size anti-armor and anti- personnel bomblets. Fragmentation type sub-munition.
LGB:	Laser guided nose assembly and steerable tail fin assembly bolted on to a general purpose bomb for precision attack.
GPS:	Approximation of GBU 29/30 JDAM munition. A mk-84 (2000lb bomb) guided by an inertial navigation unit housed in the tail assembly, and augmented with a GPS satellite receiver.

THUNDER Output Metrics

Tank(d)	Number of Red tanks destroyed while Blue forces are on the defensive.
Tank(o)	Number of Red tanks destroyed while Blue forces are on the offensive.
APC(d)	Number of Red Armored Personnel Carriers (APC) destroyed while Blue forces are on the defensive.
APC(o)	Number of Red Armored Personnel Carriers (APC) destroyed while Blue forces are on the offensive.
Inf(d)	Number of Red Infantrymen Killed while Blue forces are on the defensive.
Inf(o)	Number of Red Infantrymen Killed while Blue forces are on the offensive.
Arty(d)	Number of Red Artillery pieces destroyed while Blue forces are on the defensive.
Arty(o)	Number of Red Artillery pieces destroyed while Blue forces are on the offensive.
Halt(days)	Number of days to halt Red advancement.
Halt(dist)	Distance in Km to halt Red advancement.
Restore(days)	Number of days to restore original border, from the start of hostilities.
Push	Distance Blue forces moved into Red territory.
TmpRdBrid	Temporary Road Bridge.
TSPT	Transshipment Point. Port or Logistics site.
RedAALosses	Number of Red aircraft shot down by Blue aircraft.
RedSALosses	Number of Red aircraft shot down by Blue SAMs and AAA.
RedAGLosses	Number of Red aircraft destroyed by Blue forces while sitting on the ground.
BlueAALosses	Number of Blue aircraft shot down by Red aircraft.

BlueSALosses	Number of Blue aircraft shot down by Red SAMs and AAA.
BlueAGLosses	Number of Blue aircraft destroyed by Red forces while sitting on the ground.
Runways	Number of Red runways destroyed.
ACinOpen	Number of Red Aircraft destroyed on the ground while in the open.
ABAmmo(H)	Number of Red Hardened Air Base Ammo storage sites destroyed
ABMaint(S)	Number of Red Soft Air Base Maintenance facilities destroyed.
ABSpares(S)	Number of Red Soft Air Base Spares facilities destroyed
C3Ant	Number of Red C3 communications antennas destroyed.
C3Van	Number of Red C3 control vehicles destroyed.
ADTel	Number of Red Air Defense TELs destroyed.
ADRadar	Number of Red Air Defense Radar Control Vans destroyed.
CmdBunker	Number of Red Command Bunkers destroyed.
Mainstay	Number of Mainstay aircraft destroyed.
Helo	Number of Red Helicopters destroyed on the ground.
StoneBldg	Number of Red stone buildings destroyed.
NBCFacil	Number of Red NBC facilities destroyed

Appendix B

The following are the THUNDER data files modified to establish the two-level factorial designs. The values highlighted reflect the values for each input variable at the lower bound. These are the values overwritten by the shell scripts.

squadron.dat

```
SQUADRONS.305

NUMBER.OF.MISSION.CLASSES:    10
 AIR.SUPERIORITY
 DEEP.STRIKE
 GROUND.SUPPORT
 JAMMER
 MULTI.ROLE
 RECCE
 WEASEL
 AWACS
 TOMAHAWK
 JSTARS

NUMBER.OF.SORTIE.PROFILES: 23
 1010 "A-10"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             4.00             5.00
  END.PROFILE
 1099 "TOMAHAWK"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             1.00             1.00
  END.PROFILE
 1016 "F-16"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             3.60             4.50
       6.00             2.50             3.50
  END.PROFILE
 1004 "F-4G"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             2.50             3.00
       6.00             1.50             2.00
  END.PROFILE
 1011 "F-111"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             2.00             2.50
       6.00             1.20             1.50
  END.PROFILE
 1015 "F-15C"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             3.00             3.50
       6.00             2.20             2.50
  END.PROFILE
 1215 "F-15E"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             3.00             3.50
       6.00             2.20             2.50
  END.PROFILE
 1017 "F-117A"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             3.00             3.50
       6.00             2.20             2.50
  END.PROFILE
 1052 "B-52"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             1.00             1.00
  END.PROFILE
 1008 "AV-8B"
  DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
       1.00             4.00             5.00
       6.00             3.00             4.00
  END.PROFILE
```

```
1018 "F/A-18"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             3.60              4.00
      6.00             2.50              3.50
 END.PROFILE
1006 "A-6E"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             2.20              2.50
      6.00             1.20              1.50
 END.PROFILE
1026 "EA-6B"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             2.00              2.50
      6.00             1.20              1.50
 END.PROFILE
1007 "A-7E"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             2.00              2.50
      6.00             1.20              1.50
 END.PROFILE
1014 "F-14"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             3.00              3.50
      6.00             2.20              2.50
 END.PROFILE
1003 "AWACS_E-3"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00              .67              1.50
 END.PROFILE
1098 "JSTARS_E-8"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00              .67              1.50
 END.PROFILE
2023 "MIG-23"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             3.00              3.00
 END.PROFILE
2001 "MIRAGE_F-1"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             4.00              4.00
 END.PROFILE
2021 "MIG-21"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             3.00              3.00
 END.PROFILE
2029 "MIG-29"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             4.00              4.00
 END.PROFILE
2025 "SU-25"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00             2.20              2.20
 END.PROFILE
2006 "MAINSTAY"
 DAY.IN.THEATER..AUTH.QTY.SORT/DAY..AC.MAX.SORT/DAY
      1.00              .67              1.50
 END.PROFILE

NUMBER.OF.SQUADRONS:     105
@ NAVAL AOB SOURCE:
@ "CONDUCT OF PERSIAN GULF WAR" FINAL REPORT TO CONGRESS (UNCLASSIFIED SOURCE)
@ PAGE 110
@
@ RED SEA BATTLE FORCE
@ USS KENNEDY
11401 "F-14_KENNEDY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1101        1014        20         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1014       1015         1014         1014        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
   100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
```

```
  END.ORDERS

10701 "A-7E_KENNEDY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1        1101            1007         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1014        1015           1007          1007          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0     70    100    100    100     70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     70      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

10601 "A-6E_KENNEDY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1        1101            1006         13          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1014        1015           1006          1006          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0     70    100    100    100     70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     70      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

10261 "EA-6B_KENNEDY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1        1101            1026          5          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1014        1015           1026          1026          JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0      0      0      0      0      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0      0      0      0    100    100    100      0      0      0      0    100
  ORDERS
  END.ORDERS

19901 "TOMAHAWK_KENNEDY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1        1101            1099         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1014        1015           1099          1099          TOMAHAWK
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    0      0      0      0      0      0     100    10     10     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

@ USS SARATOGA
11402 "F-14_SARATOGA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1        1101            1014         12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1015        1014           1014          1014          AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100    100    100    100    100    100    100    100    100    100    100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
   100      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
     2.0 ARRIVE
  END.ORDERS

11801 "F/A-18_SARATOGA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1        1101            1018         12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1015     1014              1018       1018          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100    100    100    100    100    100    100    100    100    100    100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    100    100    100      0      0      0      0      0      0      0    100
  ORDERS
```

```
    2.0 ARRIVE
  END.ORDERS

10602 "A-6E_SARATOGA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1101         1006        10          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1015      1014        1006        1006        GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     70   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     70    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    2.0 ARRIVE
  END.ORDERS

10262 "EA-6B_SARATOGA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1101         1026         4          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1015      1014        1026        1026        JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0    100   100   100    0     0     0     0   100
  ORDERS
    2.0 ARRIVE
  END.ORDERS

19902 "TOMAHAWK_SARATOGA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1101         1099        24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1015      1014        1099        1099        TOMAHAWK
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0    100    10    10    90    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    2.0 ARRIVE
  END.ORDERS

@ PERSIAN GULF BATTLE FORCE
@ USS AMERICA
11403 "F-14_AMERICA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1014        12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1019      1017        1014        1014        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    7.0 ARRIVE
  END.ORDERS

11802 "F/A-18_AMERICA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1018        12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1019   1017         1018      1018        MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100   100   100   100    0     0     0     0     0     0     0   100
  ORDERS
    7.0 ARRIVE
  END.ORDERS

10603 "A-6E_AMERICA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1006        10          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
```

```
    1019       1017        1006        1006        GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     70   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    70     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    7.0 ARRIVE
  END.ORDERS

10263 "EA-6B_AMERICA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1026         4         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1019       1017        1026        1026        JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0   100   100   100     0     0     0     0   100
  ORDERS
    7.0 ARRIVE
  END.ORDERS

19903 "TOMAHAWK_AMERICA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1099         24        0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1019       1017        1099        1099        TOMAHAWK
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0    100    10    10    90    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    7.0 ARRIVE
  END.ORDERS

@ USS MIDWAY
11803 "F/A-18_MIDWAY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1018        12         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1016   1010         1018     1018        MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100   100   100   100    0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

10604 "A-6E_MIDWAY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1006        10         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1016       1010        1006        1006        GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     70   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    70     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

10264 "EA-6B_MIDWAY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1102         1026         4         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1016       1017        1026        1026        JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0   100   100   100     0     0     0     0   100
  ORDERS
  END.ORDERS

19904 "TOMAHAWK_MIDWAY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
```

```
  1       1102          1099          24          0
MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
  1016       1017          1099         1099          TOMAHAWK
..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
   0     0     0     0     0     0    100    10    10    90    90
.DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
  100    0     0     0     0     0     0     0     0     0     0   100
ORDERS
END.ORDERS

@ USS RANGER

11404 "F-14_RANGER"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1014          12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1017       1016          1014         1014          AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
  END.ORDERS

10605 "A-6E_RANGER"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1006          10          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1017       1016          1006         1006          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     70   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     70    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
  END.ORDERS

10265 "EA-6B_RANGER"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1026          4           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1017       1016          1026         1026          JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0    100   100   100    0     0     0     0   100
  ORDERS
    4.0 ARRIVE
  END.ORDERS

19905 "TOMAHAWK_RANGER"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1099          24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1017       1016          1099         1099          TOMAHAWK
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0    100    10    10    90    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
  END.ORDERS

@ USS ROOSEVELT
11405 "F-14_ROOSEVELT"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1014          12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1018       1010          1014         1014          AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0     0     0     0     0     0     0     0     0     0   100
```

```
  ORDERS
    5.0 ARRIVE
  END.ORDERS

11804 "F/A-18_ROOSEVELT"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1018        12         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1016    1010           1018      1018          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100   100   100   100     0     0     0     0     0     0     0   100
  ORDERS
    5.0 ARRIVE
  END.ORDERS

10606 "A-6E_ROOSEVELT"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1006        10         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1018       1010        1006        1006        GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0    70   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     70    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    5.0 ARRIVE
  END.ORDERS

10266 "EA-6B_ROOSEVELT"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1026         4         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1018       1010        1026        1026          JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0   100   100   100     0     0     0     0   100
  ORDERS
    5.0 ARRIVE
  END.ORDERS

19906 "TOMAHAWK_ROOSEVELT"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1102          1099        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1018       1010        1099        1099          TOMAHAWK
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    0     0     0     0     0     0   100    10    10    90    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100   0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    5.0 ARRIVE
  END.ORDERS

@ US AOB --LAND BASED FIXED WING
@ CONDUCT OF PERSIAN GULF WAR - FINAL REPORT TO CONGRESS PAGE 106
@ RAF FAIRFORD
15201 "B-52_FAIRFORD"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1200          1052        22         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1001       1002        1052        1052          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0   100    90   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

@ MORON
15202 "B-52_MORON"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
```

```
    1       1200          1052         22         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1002       1001         1052         1052         GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0   100    90   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

@ INCIRLIK
11601   "F-16_INCIRLIK"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1200          1016         36         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1003       1011         1016         1016         MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0    70    70    70    70    70    50   100   100   100    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

11501 "F-15C_INCIRLIK"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1200          1015         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1003       1002         1015         1015        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

11101 "F-111_INCIRLIK"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1200          1011         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1003       1002         1011         1011        DEEP.STRIKE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0    90    10    10    90   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     90     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

10401   "F-4G_INCIRLIK"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1200          1004         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1003       1002         1004         1004           WEASEL
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0    10    10    10    90    10
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    70    70    90     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

@ TABUK
11502 "F-15C_TABUK"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1       1200          1015         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1004       1003         1015         1015        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0   100   100   100   100   100     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    2.0 ARRIVE
  END.ORDERS

@ KING ABDUL AZIZ NAVAL BASE
```

```
10801 "AV-8B_KING_AZIZ"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1008         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1005      1006         1008         1008         GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

10802 "AV-8B_KING_AZIZ"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1008         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1005      1006         1008         1008         GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    2.0 ARRIVE
    2.0 MERGE 10801
  END.ORDERS

10803 "AV-8B_KING_AZIZ"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1008         12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1005      1006         1008         1008         GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    3.0 ARRIVE
    3.0 MERGE 10801
  END.ORDERS

10804 "AV-8B_KING_AZIZ"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1008         12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1005      1006         1008         1008         GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
    4.0 MERGE 10801
  END.ORDERS

@ KING FAHD
11001 "A10_KING_FAHD1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1010         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1006      1009         1010         1010         GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     50     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

11002 "A10_KING_FAHD2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1010         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1006      1009         1010         1010         GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100   100    70
```

```
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     50     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    2.0 ARRIVE
    2.0 MERGE 11001
  END.ORDERS

11003 "A10_KING_FAHD3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1010         24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1006       1009          1010          1010          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     50     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    3.0 ARRIVE
    3.0 MERGE 11001
  END.ORDERS

11004 "A10_KING_FAHD4"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1010         24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1006       1009          1010          1010          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     50     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
    4.0 MERGE 11001
  END.ORDERS

11005 "A10_KING_FAHD5"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1010         24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1006       1009          1010          1010          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     50     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    5.0 ARRIVE
    5.0 MERGE 11001
  END.ORDERS

11006 "A10_KING_FAHD6"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1010         24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1006       1009          1010          1010          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0   100   100   100    70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     50     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    6.0 ARRIVE
    6.0 MERGE 11001
  END.ORDERS

@ AL-KHARJ
11503 "F-15C_AL-KHARJ"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1015         24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1007       1008          1015          1015          AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
```

```
   3.0 ARRIVE
  END.ORDERS

12151 "F-15E_AL-KHARJ1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   1       1200         1215          24        0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   1007       1008          1215          1215         DEEP.STRIKE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0   100    10    10    90   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    90     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

12152 "F-15E_AL-KHARJ2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   1       1200         1215          24        0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   1007       1008          1215          1215         DEEP.STRIKE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0   100    10    10    90   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    90     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
   2.0 ARRIVE
   2.0 MERGE 12151
  END.ORDERS

11602  "F-16A_AL-KHARJ"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   1       1200         1016          24        0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   1007       1008          1016          1016         MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
   100    70    70    70    70    70    50   100   100   100    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
   100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
   2.0 ARRIVE
  END.ORDERS

11603  "F-16A_AL-KHARJ"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   1       1200         1016          24        0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   1007       1008          1016          1016         MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
   100    70    70    70    70    70    50   100   100   100    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
   100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
   3.0 ARRIVE
   3.0 MERGE 11602
  END.ORDERS

@ AT-TAIF
12111  "EF-111_AT-TAIF"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   1     1200         1211          18        0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   1008       1011          1211          1011         JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0   100   100   100     0     0     0     0   100
  ORDERS
  END.ORDERS

11102 "F-111_AT-TAIF1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   1       1200         1011          24        0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   1008       1011          1011          1011         DEEP.STRIKE
```

```
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0      0     0     0     0     0    90    10    10    90   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    90      0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    2.0 ARRIVE
  END.ORDERS

11103 "F-111_AT-TAIF2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1011         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1008      1011        1011        1011        DEEP.STRIKE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0      0     0     0     0     0    90    10    10    90   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    90      0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    3.0 ARRIVE
    3.0 MERGE 11102
  END.ORDERS


11104 "F-111_AT-TAIF3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1011         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1008      1011        1011        1011        DEEP.STRIKE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0      0     0     0     0     0    90    10    10    90   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    90      0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
    4.0 MERGE 11102
  END.ORDERS

@ DHAHRAN
11504 "F-15C_DHAHRAN1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1015         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1009      1011        1015        1015        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    70    100   100   100   100   100     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
  END.ORDERS

11505 "F-15C_DHAHRAN2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1015         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1009      1011        1015        1015        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    70    100   100   100   100   100     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    5.0 ARRIVE
    5.0 MERGE 11504
  END.ORDERS

@ SHAIKH_ISA
11805 "F/A-18_SHAIKH_ISA1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1018         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1010    1011          1018       1018       MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100   100   100   100   100   100   100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
```

```
    100    100    100    100      0      0      0      0      0      0      0   100
  ORDERS
  END.ORDERS

11806 "F/A-18_SHAIKH_ISA2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1018         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1010    1011           1018       1018         MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100    100    100    100    100    100    100    100    100    100    100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    100    100    100      0      0      0      0      0      0      0   100
  ORDERS
    2.0 ARRIVE
@   2.0 MERGE 11805
  END.ORDERS

11807 "F/A-18_SHAIKH_ISA3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1018         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1010    1011           1018       1018         MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100    100    100    100    100    100    100    100    100    100    100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    100    100    100      0      0      0      0      0      0      0   100
  ORDERS
    3.0 ARRIVE
    3.0 MERGE 11805
  END.ORDERS

11808 "F/A-18_SHAIKH_ISA4"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1018         12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1010    1011           1018       1018         MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100    100    100    100    100    100    100    100    100    100    100
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    100    100    100      0      0      0      0      0      0      0   100
  ORDERS
    4.0 ARRIVE
    4.0 MERGE 11805
  END.ORDERS

10607 "A-6E_SHAIKH_ISA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103         1006        12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1010        1011         1006         1006          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0     70    100    100    100     70
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     70      0      0      0      0      0      0      0      0      0      0   100
  ORDERS
  END.ORDERS

10402  "F-4G_SHAIKH_ISA1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1004         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1010        1011         1004          1004          WEASEL
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0     10     10     10     90     10
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     70     70     90      0      0      0      0      0      0      0   100
  ORDERS
  END.ORDERS

10403  "F-4G_SHAIKH_ISA2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1004         24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
```

```
    1010       1011          1004          1004           WEASEL
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0    10    10    10    90    10
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100    70    70    90     0     0     0     0     0     0     0   100
  ORDERS
    2.0 ARRIVE
@   2.0 MERGE 10402
  END.ORDERS

10267 "EA-6B_SHAIKH_ISA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1103          1026        12         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1018       1011          1026          1026          JAMMER
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0     0     0   100   100   100     0     0     0     0   100
  ORDERS
  END.ORDERS

@ DOHA
11604  "F-16_DOHA"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1016        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1011       1013          1016          1016          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     70    70    70    70    70    70    50   100   100   100    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    4.0 ARRIVE
  END.ORDERS


@ AL-MINHAD
11605  "F-16_AL-MINHAD1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1016        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1012       1013          1016          1016          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0    70    70    70    70    70    50   100   100   100    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    5.0 ARRIVE
  END.ORDERS

11606  "F-16_AL-MINHAD2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1016        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1012       1013          1016          1016          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0    70    70    70    70    70    50   100   100   100    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    6.0 ARRIVE
    6.0 MERGE 11605
  END.ORDERS

11607  "F-16_AL-MINHAD3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200          1016        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1012       1013          1016          1016          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0    70    70    70    70    70    50   100   100   100    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0     0     0     0     0     0     0     0     0     0   100
```

```
  ORDERS
    7.0 ARRIVE
    7.0 MERGE 11605
  END.ORDERS

@ AL-DHAFRA
11608  "F-16_AL-DHAFRA1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1016          24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1013       1012          1016          1016          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     70     70     70     70     70     50    100    100    100     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    4.0 ARRIVE
  END.ORDERS

11609  "F-16_AL-DHAFRA2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1016          24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1013       1012          1016          1016          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     70     70     70     70     70     50    100    100    100     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    5.0 ARRIVE
    5.0 MERGE 11608
  END.ORDERS

11610  "F-16_AL-DHAFRA3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1016          24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1013       1012          1016          1016          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     70     70     70     70     70     50    100    100    100     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    6.0 ARRIVE
    6.0 MERGE 11608
  END.ORDERS

@ NOTE: QUANTITY OF F-117 AIRCRAFT AND BEDDOWN LOCATION ARE ARBITRARY
11701 "F-117A_RIYADH"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1017          12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1020       1029          1017          1017          DEEP.STRIKE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0      0      0      0      0      0    100      0      0     95     95
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    100     0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    3.0 ARRIVE
  END.ORDERS

10301 "AWACS"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200         1003          12          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1029       1020          1003          1003          AWACS
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0     0      0      0      0      0      0      0      0      0      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0     0      0      0      0      0      0      0      0    100      0    100
  ORDERS
  END.ORDERS

10981 "JSTARS"
```

```
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    1      1200        1098         6          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    1029      1020         1098        1098         JSTARS
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0   100     0     0   100
  ORDERS
  END.ORDERS

@ RED
@ UNCLASSIFIED SOURCE:  "STORM OVER IRAQ" BY HALLION
@  750 FIGHTER AIRCRAFT OVER 20 AIRBASES
@  ALL 5 FIGHTER TYPES IN THIS DATABASE ARE UTILIZED
@  BEDDOWN IS PURELY ARBITRARY
@
@  750 AIRCRAFT/ 24 AIRCRAFT PER SQUADRON = 31.25 SQUADRONS
@  THUS, 6.25 SQUADRONS OF EACH TYPE OF AIRCRAFT
22901 "MIG29 1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2029        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2006      2007         2029        2029        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

22902 "MIG29 2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2029        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2007      2006         2029        2029        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

22903 "MIG29 3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2029        24         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2008      2007         2029        2029        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

22904 "MIG29 4"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2029        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2008      2007         2029        2029        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    100   100   100   100   100     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
    1.0  MERGE 22903
  END.ORDERS

22905 "MIG29 5"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2029        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2006      2007         2029        2029        AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
```

```
   100   100   100   100   100     0     0     0     0     0     0
 .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
ORDERS
  1.0  MERGE 22901
END.ORDERS

22906 "MIG29 6"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   2       2101           2029       25          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   2007       2006          2029          2029       AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
   100   100   100   100   100     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
   1.0  MERGE 22902
  END.ORDERS

22101 "MIG21 1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   2       2101           2021       24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   2013       2028          2021          2021       AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    90     0     0    90    90    90     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

22102 "MIG21 2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   2       2101           2021       24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   2028       2013          2021          2021       AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    90     0     0    90    90    90     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

22103 "MIG21 3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   2       2101           2021       24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   2031       2013          2021          2021       AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    90     0     0    90    90    90     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

22104 "MIG21 4"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   2       2101           2021       25          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   2013       2028         2021          2021       AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    90     0     0    90    90    90     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
   1.0 MERGE 22101
  END.ORDERS

22105 "MIG21 5"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
   2       2101           2021       25          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
   2028       2013          2021          2021       AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
```

```
    90      0      0     90     90     90      0      0      0      0      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    1.0 MERGE 22102
  END.ORDERS

22106 "MIG21 6"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2021        25           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2031       2013         2021          2021          AIR.SUPERIORITY
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    90      0      0     90     90     90      0      0      0      0      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    1.0 MERGE 22103
  END.ORDERS

20101 "MIRAGE F1 1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2001        24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2028       2003         2001          2001          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    70     70      0     70     70      0     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

20102 "MIRAGE F1 2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2001        24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2011       2004         2001          2001          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    70     70      0     70     70      0     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

20103 "MIRAGE F1 3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2001        24           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2003       2004         2001          2001          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    70     70      0     70     70      0     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

20104 "MIRAGE F1 4"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2001        25           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2011       2004         2001          2001          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    70     70      0     70     70      0     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    1.0 MERGE 20102
  END.ORDERS

20105 "MIRAGE F1 5"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101          2001        25           0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2003       2004         2001          2001          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
```

```
     70     70      0     70     70      0     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
     1.0 MERGE 20103
  END.ORDERS

20106 "MIRAGE F1 6"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2       2101          2001          25          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2004       2003        2001          2001          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     70     70      0     70     70      0     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22501 "SU25 1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2       2101          2025          24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2028       2027        2025          2025          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0      0    100    100    100      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22502 "SU25 2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2       2101          2025          24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2026       2028        2025          2025          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0      0    100    100    100      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22503 "SU25 3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2       2101          2025          24          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2027       2028        2025          2025          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0      0    100    100    100      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22504 "SU25 4"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2       2101          2025          25          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2028       2026        2025          2025          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0      0    100    100    100      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
      0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22505 "SU25 5"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2       2101          2025          25          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2026       2028        2025          2025          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
      0      0      0      0      0      0      0    100    100    100      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
```

```
    0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    1.0 MERGE 22502
  END.ORDERS

22506 "SU25 6"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2025        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2027      2028          2025          2025          GROUND.SUPPORT
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    0      0      0      0      0      0      0    100    100    100      0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    1.0 MERGE 22503
  END.ORDERS

22301 "MIG23 1"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2023        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2005      2004          2023          2023          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    10     0      0     10     10     10     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22302 "MIG23 2"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2023        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2004      2005          2023          2023          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    10     0      0     10     10     10     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22303 "MIG23 3"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2023        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2030      2005          2023          2023          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    10     0      0     10     10     10     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
  END.ORDERS

22304 "MIG23 4"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2023        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2030      2005          2023          2023          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    10     0      0     10     10     10     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
    0      0      0      0      0      0      0      0      0      0      0    100
  ORDERS
    1.0 MERGE 22303
  END.ORDERS

22305 "MIG23 5"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2023        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2009      2005          2023          2023          MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
    10     0      0     10     10     10     90     90     90     90     90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
```

```
     0     0     0     0     0     0     0     0     0     0     0   100
   ORDERS
   END.ORDERS

22306 "MIG23 6"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2023        25         0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2026       2004        2023        2023        MULTI.ROLE
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     10     0     0    10    10    10    90    90    90    90    90
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0     0     0   100
  ORDERS
  END.ORDERS

20000 "MAINSTAY"
  SIDE..SUP.CMD.ID..TYPE.AC.ID..AUTH.QTY..AR.PRIORITY
    2      2101         2006        2          0
  MOB.ID..DISP.AB.ID..SERV.KIT.ID..SORT.PROF.ID..MISSION.CLASS
    2014       2013        2006        2006        AWACS
  ..DCA..ODCA..HVAA..BARC..FSWP..EAIR...STI...CAS...BAI...INT...OCA
     0     0     0     0     0     0     0     0     0     0     0
  .DSED..SSUP..CSUP..ESUP..SJAM..CJAM..EJAM..RECC..SREC...AEW...AAR..RESV
     0     0     0     0     0     0     0     0     0   100     0   100
  ORDERS
  END.ORDERS
```

acserv.dat

```
SERVICE.KITS.304

BLUE.PCT.NONCRITICAL.MUNT.AT.DB   99
 RED.PCT.NONCRITICAL.MUNT.AT.DB   99
BLUE.PCT.AIRCRAFT.THAT.DISPERSE   99
 RED.PCT.AIRCRAFT.THAT.DISPERSE   99

NUMBER.OF.SERVICE.KITS: 24

 1010 "A-10 KIT"
  SIDE..NUM.AC
    1     24
  MUNITIONS..ID..NUM
     1103     100
     1105      12
     1106     390
     1107      10
     1109      10
     1110      10
     1111      10
     1112    2700
  REPAIR.RESOURCES..ID..NUM
        1      17
        2      12
        3       7
  INT.LEVEL.MAINTENANCE.FACS
  END.KIT

 1099 "TOMAHAWK KIT"
  SIDE..NUM.AC
    1     50
  MUNITIONS..ID..NUM
     1105     140
  REPAIR.RESOURCES..ID..NUM
        1      17
        2      12
        3       7
  INT.LEVEL.MAINTENANCE.FACS
  END.KIT

1016 "F-16 KIT"
  SIDE..NUM.AC
    1     24
```

```
 MUNITIONS..ID..NUM
    1102     100
    1103     200
    1104     100
    1105    2400
    1106     266
    1107      10
    1108    1000
    1109      10
    1110      32
    1111      10
    1112     250
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1004 "F-4G KIT"
 SIDE..NUM.AC
   1      24
 MUNITIONS..ID..NUM
    1107      54
    1108    2000
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1011 "F-111 KIT"
 SIDE..NUM.AC
   1      24
 MUNITIONS..ID..NUM
    1105    2350
    1108     500
    1109      10
    1110     275
    1111      10
    1112      75
    1113     175
    1114      10
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1015 "F-15C KIT"
 SIDE..NUM.AC
   1      24
 MUNITIONS..ID..NUM
    1102     200
    1103     200
    1104     100
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1215 "F-15E KIT"
 SIDE..NUM.AC
   1      24
 MUNITIONS..ID..NUM
    1102     100
    1103     200
    1104     100
    1105     930
    1108    1000
```

```
    1109     10
    1110     10
    1111     10
    1112     10
    1113    845
    1114     10
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1017 "F-117 KIT"
 SIDE..NUM.AC
  1      12
 MUNITIONS..ID..NUM
    1113    530
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1052 "B-52 KIT"
 SIDE..NUM.AC
  1      22
 MUNITIONS..ID..NUM
    1105    288
    1111    465
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1008 "AV-8 KIT"
 SIDE..NUM.AC
  1      24
 MUNITIONS..ID..NUM
    1105   1000
    1106    290
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1018 "FA-18 KIT"
 SIDE..NUM.AC
  1      24
 MUNITIONS..ID..NUM
    1102    100
    1103    200
    1104    100
    1105   1500
    1106    160
    1107     10
    1108   1000
    1109     10
    1110     10
    1111     10
    1112    450
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1006 "A-6 KIT"
```

```
 SIDE..NUM.AC
   1     10
 MUNITIONS..ID..NUM
    1105   1500
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1026 "EA-6B KIT"
 SIDE..NUM.AC
   1     24
 MUNITIONS..ID..NUM
    1107      10
    1108   1000
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1007 "A-7 KIT"
 SIDE..NUM.AC
   1     24
 MUNITIONS..ID..NUM
    1105   3000
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1211 "EF-111 KIT"
 SIDE..NUM.AC
   1     24
 MUNITIONS..ID..NUM
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1014 "F-14 KIT"
 SIDE..NUM.AC
   1     12
 MUNITIONS..ID..NUM
    1102    200
    1103    100
    1104    100
    1105   1500
    1106     10
    1107     10
    1108   1000
    1109     10
    1110     10
    1111     10
    1112     10
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1003 "AWACS KIT"
 SIDE..NUM.AC
   1     24
 MUNITIONS..ID..NUM
 REPAIR.RESOURCES..ID..NUM
```

```
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

1098 "JSTARS KIT"
 SIDE..NUM.AC
   1      24
 MUNITIONS..ID..NUM
 REPAIR.RESOURCES..ID..NUM
       1      17
       2      12
       3       7
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

2023 "MIG-23 KIT"
 SIDE..NUM.AC
   2      24
 MUNITIONS..ID..NUM
    2201     500
    2202     500
    2204    2000
    2208     500
 REPAIR.RESOURCES..ID..NUM
       1      24
       2      12
       3       2
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

2001 "F-1 KIT"
 SIDE..NUM.AC
   2      24
 MUNITIONS..ID..NUM
    2202     500
    2203     500
    2204    1500
    2205    1500
    2206     500
    2207    1000
    2208    1000
 REPAIR.RESOURCES..ID..NUM
       1      24
       2      12
       3       2
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

2021 "MIG-21 KIT"
 SIDE..NUM.AC
   2      24
 MUNITIONS..ID..NUM
    2201     500
    2202     500
    2204    1500
 REPAIR.RESOURCES..ID..NUM
       1      24
       2      12
       3       2
 INT.LEVEL.MAINTENANCE.FACS
 END.KIT

2029 "MIG-29 KIT"
 SIDE..NUM.AC
   2      24
 MUNITIONS..ID..NUM
    2202    1000
    2203    1000
    2204    2500
    2205    2500
    2206     500
    2207    1000
    2208    1000
```

```
    2209   1000
    2210   1000
  REPAIR.RESOURCES..ID..NUM
        1      24
        2      12
        3       2
  INT.LEVEL.MAINTENANCE.FACS
  END.KIT

 2025 "SU-25 KIT"
  SIDE..NUM.AC
    2      24
  MUNITIONS..ID..NUM
    2204   1500
    2205   2000
    2211   2000
  REPAIR.RESOURCES..ID..NUM
        1      24
        2      12
        3       2
  INT.LEVEL.MAINTENANCE.FACS
  END.KIT

 2006 "MAINSTAY KIT"
  SIDE..NUM.AC
    2      4
  MUNITIONS..ID..NUM
  REPAIR.RESOURCES..ID..NUM
        1      4
        2      2
        3      2
  INT.LEVEL.MAINTENANCE.FACS
  END.KIT

END.SERVICE.KITS
```

Below is an example of the ***muntexp.sum*** file used to determine the low and high levels of munitions and the resultant apportionment for each aircraft type. This is an example and not the actual data used.

muntexp.sum

BLUE MUNITIONS EXPENDED
ALL EXPENDITURES

AIRCRAFT	MUNITION	MISSION	TARGET	EXPENDED
F-16	AMRAAM	BARCAP	AIRCRAFT	.3
F-16	AMRAAM	STI	AIRCRAFT	247.9
F-16	AMRAAM	INT	AIRCRAFT	19.9
F-16	AMRAAM	OCA	AIRCRAFT	21.9
F-16	AMRAAM	DSEAD	AIRCRAFT	1.9
F-15C	AMRAAM	DCA	AIRCRAFT	16.5
F-15C	AMRAAM	BARCAP	AIRCRAFT	325.1
F-15C	AMRAAM	FSWP	AIRCRAFT	78.0
F-15C	AMRAAM	STI	AIRCRAFT	121.6
F-15C	AMRAAM	INT	AIRCRAFT	9.1
F-15C	AMRAAM	OCA	AIRCRAFT	11.3
F-15C	AMRAAM	DSEAD	AIRCRAFT	2.5
F/A-18	AMRAAM	DCA	AIRCRAFT	2.5
F/A-18	AMRAAM	INT	AIRCRAFT	.5
F-14	AMRAAM	DCA	AIRCRAFT	90.2
F-14	AMRAAM	BARCAP	AIRCRAFT	120.2
F-14	AMRAAM	FSWP	AIRCRAFT	65.3
F-14	AMRAAM	INT	AIRCRAFT	11.4
F-14	AMRAAM	DSEAD	AIRCRAFT	1.2
F-16	AIM-9	BARCAP	AIRCRAFT	.3

F-16	AIM-9	STI	AIRCRAFT	247.9
F-16	AIM-9	INT	AIRCRAFT	19.9
F-16	AIM-9	OCA	AIRCRAFT	21.9
F-16	AIM-9	DSEAD	AIRCRAFT	1.9
F-4G	AIM-9	STI	AIRCRAFT	288.7
F-4G	AIM-9	BAI	AIRCRAFT	32.7
F-4G	AIM-9	INT	AIRCRAFT	145.7
F-4G	AIM-9	OCA	AIRCRAFT	21.7
F-4G	AIM-9	SSUP	AIRCRAFT	69.5
F-15C	AIM-9	DCA	AIRCRAFT	16.5
F-15C	AIM-9	BARCAP	AIRCRAFT	325.1
F-15C	AIM-9	FSWP	AIRCRAFT	78.0
F-15C	AIM-9	STI	AIRCRAFT	121.6
F-15C	AIM-9	INT	AIRCRAFT	9.1
F-15C	AIM-9	OCA	AIRCRAFT	11.3
F-15C	AIM-9	DSEAD	AIRCRAFT	2.5
F/A-18	AIM-9	DCA	AIRCRAFT	2.5
F/A-18	AIM-9	INT	AIRCRAFT	.5
F-14	AIM-9	DCA	AIRCRAFT	48.4
F-14	AIM-9	BARCAP	AIRCRAFT	104.5
F-14	AIM-9	FSWP	AIRCRAFT	48.1
F-14	AIM-9	INT	AIRCRAFT	7.6
F-14	AIM-9	DSEAD	AIRCRAFT	.8
F-4G	20MM CANNON	STI	AIRCRAFT	26.2
F-4G	20MM CANNON	BAI	AIRCRAFT	.7
F-4G	20MM CANNON	INT	AIRCRAFT	8.3
F-4G	20MM CANNON	OCA	AIRCRAFT	.6
F-4G	20MM CANNON	SSUP	AIRCRAFT	1.3
F-14	20MM CANNON	DCA	AIRCRAFT	1.8
F-14	20MM CANNON	BARCAP	AIRCRAFT	25.8
F-14	20MM CANNON	FSWP	AIRCRAFT	4.4
TOMAHAWK	MK-82	STI	STRAT TGT	276.0
TOMAHAWK	MK-82	INT	AD TEL	1.6
TOMAHAWK	MK-82	INT	SUPPLY TRN	149.4
TOMAHAWK	MK-82	INT	EQUIPMENT	133.0
TOMAHAWK	MK-82	OCA	RUNWAY	6.4
TOMAHAWK	MK-82	OCA	AIR MUNITION	2.4
TOMAHAWK	MK-82	DSEAD	AD TEL	122.4
F-16	MK-82	STI	STRAT TGT	10572.2
F-16	MK-82	BAI	EQUIPMENT	4106.2
F-16	MK-82	INT	AD TEL	1.2
F-16	MK-82	INT	SUPPLY TRN	2648.4
F-16	MK-82	INT	CHKPNT ARC	2196.6
F-16	MK-82	INT	ISSUE CAP	22.8
F-16	MK-82	INT	EQUIPMENT	1529.4
F-16	MK-82	DSEAD	AD TEL	1630.0
F-111	MK-82	INT	SUPPLY TRN	1802.4
F-111	MK-82	INT	CHKPNT ARC	608.8
F-111	MK-82	INT	EQUIPMENT	3.2
F-111	MK-82	DSEAD	AD TEL	8333.6
F-15E	MK-82	INT	SUPPLY TRN	324.8
F-15E	MK-82	INT	CHKPNT ARC	62.4
F-15E	MK-82	DSEAD	AD TEL	3317.6
B-52	MK-82	CAS	EQUIPMENT	24.0
B-52	MK-82	BAI	EQUIPMENT	436.8
AV-8B	MK-82	CAS	EQUIPMENT	225.6
AV-8B	MK-82	BAI	EQUIPMENT	5.2
F/A-18	MK-82	BAI	EQUIPMENT	11219.2
F/A-18	MK-82	INT	AD TEL	6.4
F/A-18	MK-82	INT	SUPPLY TRN	1016.4
F/A-18	MK-82	INT	CHKPNT ARC	1378.4
F/A-18	MK-82	INT	ISSUE CAP	12.8
F/A-18	MK-82	INT	EQUIPMENT	467.2
F/A-18	MK-82	DSEAD	AD TEL	7174.8
A-6E	MK-82	CAS	EQUIPMENT	5724.4
A-6E	MK-82	BAI	CHKPNT ARC	3.2
A-6E	MK-82	BAI	EQUIPMENT	7612.0
A-6E	MK-82	INT	AD TEL	1.6
A-6E	MK-82	INT	SUPPLY TRN	1039.2
A-6E	MK-82	INT	CHKPNT ARC	536.8
A-6E	MK-82	INT	EQUIPMENT	599.2
A-7E	MK-82	CAS	EQUIPMENT	2533.2
F-14	MK-82	INT	SUPPLY TRN	240.0
F-14	MK-82	INT	CHKPNT ARC	57.2
F-14	MK-82	INT	EQUIPMENT	89.6

F-14	MK-82	OCA	MAINTENANCE	60.8
F-14	MK-82	OCA	AIR MUNITION	29.6
F-14	MK-82	OCA	SPARES	2.4
A-10	AGM-65	BAI	EQUIPMENT	3236.5
F-16	AGM-65	BAI	EQUIPMENT	1368.3
F-16	AGM-65	INT	SUPPLY TRN	851.7
F-16	AGM-65	INT	EQUIPMENT	486.3
AV-8B	AGM-65	CAS	EQUIPMENT	2273.5
AV-8B	AGM-65	BAI	EQUIPMENT	459.6
F/A-18	AGM-65	BAI	EQUIPMENT	1869.9
F/A-18	AGM-65	INT	SUPPLY TRN	161.9
F/A-18	AGM-65	INT	EQUIPMENT	77.9
F-14	AGM-65	INT	SUPPLY TRN	39.5
F-14	AGM-65	INT	EQUIPMENT	14.9
F-16	ARM-88	STI	AD RADAR	20.1
F-16	ARM-88	INT	AD RADAR	.6
F-16	ARM-88	DSEAD	AD RADAR	20.6
F-4G	ARM-88	STI	AD RADAR	483.2
F-4G	ARM-88	BAI	AD RADAR	39.5
F-4G	ARM-88	INT	AD RADAR	39.6
F-4G	ARM-88	OCA	AD RADAR	51.4
F-4G	ARM-88	SSUP	AD RADAR	93.4
F/A-18	ARM-88	DSEAD	AD RADAR	75.3
F-14	ARM-88	INT	AD RADAR	.1
F-14	ARM-88	OCA	AD RADAR	.2
F-16	SPW-45	STI	AD RADAR	78.3
F-16	SPW-45	INT	AD RADAR	8.2
F-16	SPW-45	DSEAD	AD RADAR	122.8
F-4G	SPW-45	STI	AD RADAR	1160.5
F-4G	SPW-45	BAI	AD RADAR	538.9
F-4G	SPW-45	INT	AD RADAR	582.7
F-4G	SPW-45	OCA	AD RADAR	220.0
F-4G	SPW-45	SSUP	AD RADAR	151.7
F-111	SPW-45	DSEAD	AD RADAR	799.1
F-15E	SPW-45	DSEAD	AD RADAR	231.9
F/A-18	SPW-45	INT	AD RADAR	1.6
F/A-18	SPW-45	DSEAD	AD RADAR	588.7
F-14	SPW-45	INT	AD RADAR	.9
F-14	SPW-45	OCA	AD RADAR	.3
F-16	B-DELAY MINE	INT	CHKPNT ARC	.3
F/A-18	B-DELAY MINE	INT	CHKPNT ARC	.1
F-16	B-LETHAL MINE	INT	CHKPNT ARC	442.1
F-111	B-LETHAL MINE	OCA	RUNWAY	953.9
F-111	B-LETHAL MINE	OCA	AB AVAIL	943.9
F/A-18	B-LETHAL MINE	INT	CHKPNT ARC	5.5
A-10	CBU-87 CEM	BAI	EQUIPMENT	204.3
F-16	CBU-87 CEM	CAS	EQUIPMENT	.3
F-16	CBU-87 CEM	BAI	EQUIPMENT	104.3
F-16	CBU-87 CEM	INT	EQUIPMENT	48.5
B-52	CBU-87 CEM	CAS	EQUIPMENT	76.8
B-52	CBU-87 CEM	BAI	EQUIPMENT	3652.0
F/A-18	CBU-87 CEM	CAS	EQUIPMENT	14.1
F/A-18	CBU-87 CEM	BAI	EQUIPMENT	70.7
F/A-18	CBU-87 CEM	INT	EQUIPMENT	19.2
F-14	CBU-87 CEM	INT	EQUIPMENT	.3
A-10	CBU-97 SFW	CAS	EQUIPMENT	32939.6
A-10	CBU-97 SFW	BAI	EQUIPMENT	1812.2
F-16	CBU-97 SFW	CAS	EQUIPMENT	.8
F-16	CBU-97 SFW	BAI	EQUIPMENT	1382.0
F-16	CBU-97 SFW	INT	EQUIPMENT	4107.6
F-111	CBU-97 SFW	INT	EQUIPMENT	434.8
F-15E	CBU-97 SFW	INT	EQUIPMENT	6.8
F/A-18	CBU-97 SFW	CAS	EQUIPMENT	6032.8
F/A-18	CBU-97 SFW	BAI	EQUIPMENT	352.8
F/A-18	CBU-97 SFW	INT	EQUIPMENT	503.2
F-14	CBU-97 SFW	INT	EQUIPMENT	28.0
F-111	LGB GBU	STI	STRAT TGT	20.1
F-111	LGB GBU	INT	AD TEL	2.7
F-111	LGB GBU	INT	CHKPNT ARC	78.7
F-111	LGB GBU	INT	ISSUE CAP	1.1
F-111	LGB GBU	INT	TRANSHIP POINT	.5
F-111	LGB GBU	INT	EQUIPMENT	279.9
F-111	LGB GBU	OCA	MAINTENANCE	527.2
F-111	LGB GBU	OCA	AIR MUNITION	108.9
F-111	LGB GBU	OCA	SPARES	84.5

F-15E	LGB GBU	STI	STRAT TGT	3512.0
F-15E	LGB GBU	INT	AD TEL	.8
F-15E	LGB GBU	INT	EQUIPMENT	20.5
F-117A	LGB GBU	STI	STRAT TGT	644.1
F-117A	LGB GBU	INT	SUPPLY TRN	5.2
F-117A	LGB GBU	INT	CHKPNT ARC	2.7
F-117A	LGB GBU	INT	EQUIPMENT	10.5

BLUE MUNITIONS EXPENDED
SUMMARY

Days	AIM-7	AMRAAM	AIM-9	20MM CANNON
1.0000	0.	74.8	107.1	7.1
2.0000	0.	137.5	190.3	10.8
3.0000	0.	86.9	142.0	7.2
4.0000	0.	123.2	183.7	5.1
5.0000	0.	123.2	177.2	5.4
6.0000	0.	120.7	161.6	8.7
7.0000	0.	90.2	133.1	5.7
8.0000	0.	91.0	126.2	6.7
9.0000	0.	73.3	105.0	5.8
10.0000	0.	53.3	78.9	2.7
11.0000	0.	51.6	69.8	1.6
12.0000	0.	45.0	56.5	.6
13.0000	0.	33.4	40.4	.7
14.0000	0.	24.0	30.0	.5
15.0000	0.	19.2	25.0	.5
Totals	0.	1147.3	1626.8	69.0

BLUE MUNITIONS EXPENDED
SUMMARY

Days	MK-82	AGM-65	ARM-88	SPW-45
1.0000	3058.6	247.1	28.7	223.4
2.0000	4542.0	535.3	62.1	321.4
3.0000	5015.0	966.9	49.0	323.1
4.0000	5582.0	1157.6	54.6	345.5
5.0000	6496.2	1158.8	57.6	353.1
6.0000	5939.0	1207.8	64.7	339.1
7.0000	6571.8	1084.3	70.4	360.0
8.0000	6326.8	1040.0	61.2	328.1
9.0000	6306.2	965.3	52.3	302.2
10.0000	6238.8	799.7	49.3	276.2
11.0000	5507.0	563.3	57.6	264.7
12.0000	4869.2	443.1	61.5	275.4
13.0000	4399.8	337.9	52.5	264.9
14.0000	4024.2	216.0	54.8	260.0
15.0000	3470.2	117.1	47.4	248.6
Totals	78346.8	10840.0	823.9	4485.6

BLUE MUNITIONS EXPENDED
SUMMARY

Days	B-DELAY MINE	B-LETHAL MINE	CBU-87 CEM	CBU-97 SFW
1.0000	0.	125.5	561.6	918.8
2.0000	.3	204.1	576.0	1630.2
3.0000	0.	208.4	311.2	2484.2
4.0000	0.	194.0	238.7	3385.4
5.0000	0.	213.8	219.2	3934.8
6.0000	0.	185.3	227.2	4815.2
7.0000	0.	174.1	215.2	4655.8
8.0000	0.	156.1	209.1	3817.6
9.0000	0.	134.0	216.1	3405.8
10.0000	0.	143.6	217.3	3163.0
11.0000	.1	131.7	233.9	3064.8
12.0000	0.	112.1	222.0	3022.8
13.0000	0.	116.3	223.5	3020.0
14.0000	0.	120.3	239.2	3130.8

F-15E	LGB GBU	STI	STRAT TGT	3512.0
F-15E	LGB GBU	INT	AD TEL	.8
F-15E	LGB GBU	INT	EQUIPMENT	20.5
F-117A	LGB GBU	STI	STRAT TGT	644.1
F-117A	LGB GBU	INT	SUPPLY TRN	5.2
F-117A	LGB GBU	INT	CHKPNT ARC	2.7
F-117A	LGB GBU	INT	EQUIPMENT	10.5

BLUE MUNITIONS EXPENDED
SUMMARY

Days	AIM-7	AMRAAM	AIM-9	20MM CANNON
1.0000	0.	74.8	107.1	7.1
2.0000	0.	137.5	190.3	10.8
3.0000	0.	86.9	142.0	7.2
4.0000	0.	123.2	183.7	5.1
5.0000	0.	123.2	177.2	5.4
6.0000	0.	120.7	161.6	8.7
7.0000	0.	90.2	133.1	5.7
8.0000	0.	91.0	126.2	6.7
9.0000	0.	73.3	105.0	5.8
10.0000	0.	53.3	78.9	2.7
11.0000	0.	51.6	69.8	1.6
12.0000	0.	45.0	56.5	.6
13.0000	0.	33.4	40.4	.7
14.0000	0.	24.0	30.0	.5
15.0000	0.	19.2	25.0	.5
Totals	0.	1147.3	1626.8	69.0

BLUE MUNITIONS EXPENDED
SUMMARY

Days	MK-82	AGM-65	ARM-88	SPW-45
1.0000	3058.6	247.1	28.7	223.4
2.0000	4542.0	535.3	62.1	321.4
3.0000	5015.0	966.9	49.0	323.1
4.0000	5582.0	1157.6	54.6	345.5
5.0000	6496.2	1158.8	57.6	353.1
6.0000	5939.0	1207.8	64.7	339.1
7.0000	6571.8	1084.3	70.4	360.0
8.0000	6326.8	1040.0	61.2	328.1
9.0000	6306.2	965.3	52.3	302.2
10.0000	6238.8	799.7	49.3	276.2
11.0000	5507.0	563.3	57.6	264.7
12.0000	4869.2	443.1	61.5	275.4
13.0000	4399.8	337.9	52.5	264.9
14.0000	4024.2	216.0	54.8	260.0
15.0000	3470.2	117.1	47.4	248.6
Totals	78346.8	10840.0	823.9	4485.6

BLUE MUNITIONS EXPENDED
SUMMARY

Days	B-DELAY MINE	B-LETHAL MINE	CBU-87 CEM	CBU-97 SFW
1.0000	0.	125.5	561.6	918.8
2.0000	.3	204.1	576.0	1630.2
3.0000	0.	208.4	311.2	2484.2
4.0000	0.	194.0	238.7	3385.4
5.0000	0.	213.8	219.2	3934.8
6.0000	0.	185.3	227.2	4815.2
7.0000	0.	174.1	215.2	4655.8
8.0000	0.	156.1	209.1	3817.6
9.0000	0.	134.0	216.1	3405.8
10.0000	0.	143.6	217.3	3163.0
11.0000	.1	131.7	233.9	3064.8
12.0000	0.	112.1	222.0	3022.8
13.0000	0.	116.3	223.5	3020.0
14.0000	0.	120.3	239.2	3130.8

15.0000	0.	126.1	280.3	3151.4
Totals	.4	2345.3	4190.4	47600.6

BLUE MUNITIONS EXPENDED
SUMMARY

Days	LGB GBU	GPS ALL WX GBU	DECOY	Totals
1.0000	290.5	0.	0.	5643.2
2.0000	483.3	0.	0.	8693.3
3.0000	444.2	0.	0.	10038.1
4.0000	475.8	0.	0.	11745.6
5.0000	455.5	0.	0.	13194.8
6.0000	420.8	0.	0.	13490.1
7.0000	345.8	0.	0.	13706.3
8.0000	318.6	0.	0.	12481.4
9.0000	283.4	0.	0.	11849.3
10.0000	285.4	0.	0.	11308.2
11.0000	298.4	0.	0.	10244.4
12.0000	304.2	0.	0.	9412.3
13.0000	294.5	0.	0.	8783.8
14.0000	297.3	0.	0.	8397.2
15.0000	301.7	0.	0.	7787.5
Totals	5299.5	0.	0.	156775.7

The airbase data file that follows has all pre-positioned munitions removed for blue forces.

airbase.dat.

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AIRBASE.303
NUMBER.OF.AIR.BASE.TAKEOFF.&.LANDING.ATTRITION.CLASSES:      3
  10001  "NO THREAT"
  10002  "LOW THREAT"
  10003  "HIGH THREAT"
END.AIR.BASE.TAKEOFF.&.LANDING.ATTRITION.CLASSES

NUMBER.OF.AIR.BASE.MINE.EFFECTS.CLASSES      4
   1901  "ONE AREA"
   1902  "TWO AREAS"
   1903  "THREE AREAS"
   1904  "MORE THAN THREE AREAS"
END.AIR.BASE.MINE.EFFECTS.CLASSES

BEGIN.AIRBASE.TGT.ELEMENT.REPAIR.FUNCTIONS
  10001  "Instant,  .15 percent repairable"
    MAX.REPAIRS          9999999
    PROB.REPAIRABLE          .15
    REPAIR.TIME.FN(HRS)    UNIF    0.0    0.0
  10002  "Instant"
    MAX.REPAIRS          9999999
    PROB.REPAIRABLE        1.0
    REPAIR.TIME.FN(HRS)    UNIF    0.0    0.0
  10003  "Exponential,  16.64 repair time"
    MAX.REPAIRS          9999999
    PROB.REPAIRABLE        1.0
    REPAIR.TIME.FN(HRS)    EXP  16.64    0.0
END.AIRBASE.TGT.ELEMENT.REPAIR.FUNCTIONS
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BEGIN.AIRBASE.TGT.SEPARATION.FUNCTIONS
  20001  "31 UNIFORM WITH RADIUS 707"
    TGT.X:Y.RATIO     1.0
    TGT.X.SEP.FN(M)   UNIF     318.3      318.3
    TGT.Y.SEP.FN(M)   UNIF     318.3      318.3
  20002  "1 UNIFORM WITH RADIUS 707"
    TGT.X:Y.RATIO     1.0
    TGT.X.SEP.FN(M)   UNIF    1772.2     1772.2
    TGT.Y.SEP.FN(M)   UNIF    1772.2     1772.2
  20003  "13 UNIFORM WITH RADIUS 447"
    TGT.X:Y.RATIO     1.0
    TGT.X.SEP.FN(M)   UNIF     310.8      310.8
    TGT.Y.SEP.FN(M)   UNIF     310.8      310.8
  20004  "116 UNIFORM WITH RADIUS 1358"
    TGT.X:Y.RATIO     1.0
    TGT.X.SEP.FN(M)   UNIF     316.1      316.1
    TGT.Y.SEP.FN(M)   UNIF     316.1      316.1
  20005  "46 UNIFORM WITH RADIUS 859"
    TGT.X:Y.RATIO     1.0
    TGT.X.SEP.FN(M)   UNIF     317.5      317.5
    TGT.Y.SEP.FN(M)   UNIF     317.5      317.5
END.AIRBASE.TGT.SEPARATION.FUNCTIONS

BEGIN.AIRCRAFT.IN.OPEN.TARGETS
  30001  "Aircraft in open #1"
    STD.TARGET.ID      10025
    TGT.SEPARATION.FN  20001
  30002  "Aircraft in open #2"
    STD.TARGET.ID      10025
    TGT.SEPARATION.FN  20004
END.AIRCRAFT.IN.OPEN.TARGETS

BEGIN.SHELTER.TARGETS
  40001  "Shelter #1"
    STD.TARGET.ID      10026
    TGT.SEPARATION.FN  20002
    BLUE.REPAIR.FN     10001
    RED.REPAIR.FN      10001
END.SHELTER.TARGETS

BEGIN.REVETMENT.TARGETS
END.REVETMENT.TARGETS

BEGIN.MAINTENANCE.TARGETS
  60001  "Maintenance facility #1"
    STD.TARGET.ID      10031
    TGT.SEPARATION.FN  20003
    BLUE.REPAIR.FN     10003
    RED.REPAIR.FN      10003
  60002  "Maintenance facility #2"
    STD.TARGET.ID      10031
    TGT.SEPARATION.FN  20005
    BLUE.REPAIR.FN     10003
    RED.REPAIR.FN      10003
END.MAINTENANCE.TARGETS

BEGIN.MUNITION.STORAGE.TARGETS
  70001  "Ammo storage facility #1"
    STD.TARGET.ID      10028
    TGT.SEPARATION.FN  20003
    BLUE.REPAIR.FN     10002
    RED.REPAIR.FN      10002
  70002  "Ammo storage facility #2"
    STD.TARGET.ID      10028
    TGT.SEPARATION.FN  20005
    BLUE.REPAIR.FN     10002
    RED.REPAIR.FN      10002
END.MUNITION.STORAGE.TARGETS

BEGIN.SPARES.STORAGE.TARGETS
  80001  "Spares storage facility #1"
    STD.TARGET.ID      10033
    TGT.SEPARATION.FN  20003
    BLUE.REPAIR.FN     10002
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    RED.REPAIR.FN      10002
  80002  "Spares storage facility #2"
    STD.TARGET.ID      10033
    TGT.SEPARATION.FN 20005
    BLUE.REPAIR.FN     10002
    RED.REPAIR.FN      10002
END.SPARES.STORAGE.TARGETS

BEGIN.POL.STORAGE.TARGETS
  90001  "POL storage facility #1"
    STD.TARGET.ID      10034
    TGT.SEPARATION.FN 20003
    BLUE.REPAIR.FN     10002
    RED.REPAIR.FN      10002
  90002  "POL storage facility #2"
    STD.TARGET.ID      10034
    TGT.SEPARATION.FN 20005
    BLUE.REPAIR.FN     10002
    RED.REPAIR.FN      10002
END.POL.STORAGE.TARGETS

NUMBER.OF.AIRBASES      83

@ AIRBASES NOT IN THEATER
ID.LIST...LATITUDE...LONGITUDE...AIR.CMD..FLYDIRECT..LOSABLE..NAME
   1001  52D46.0M-N  1D51.0M-W     1200       1          2       "RAF_FAIRFORD"
   1002  32D10.0M-N  5D36.9M-W     1200       1          2       "MORON_(SPAIN)"
   1003  37D00.1M-N 35D25.5M-E     1200       1          2       "INCIRLIK"
  SIDE..MINE.EFF.CLASS..MIN.CEILING(M)..MIN.VIS(M)..CRATER.CREWS..T&L.ATTR.CLASS
    1      1901             300              100           10              10001
  AD.SITES..TYPE.ID...QTY
  REPAIR.RESRCS..ID...QTY
                 1     2
                 2     1
                 3     1
  INT.LEVEL.MX.FACS
  AIR.MUNITIONS..ID..FULL.LOAD..ON.HAND
  RUNWAY..LENGTH(M)..WIDTH..MIN.WTH..CUTS.TO.CLOSE..TGT.ID
              2658      72       24        10        10024
              2743      73       25        10        10024
              3230      73       25        10        10024
  POL..CAPACITY..ON.HAND(STONS)
        30000          30000
  AC.IN.OPEN.TGTS..ID
             30001
  SHELTER.TGTS..ID..NUM.ELTS
             40001      75
  REVETMT.TGTS..ID..NUM.ELTS
  MX.TGTS.......ID..NUM.ELTS..FRAC.CAP
             60001       13        1.0
  AIR.MUNT.TGTS.ID..NUM.ELTS..FRAC.CAP
             70001       13        1.0
  SPARES.TGTS...ID..NUM.ELTS..FRAC.CAP
             80001       13        1.0
  POL.TGTS......ID..NUM.ELTS..FRAC.CAP
             90001       13        1.0
  END.AIRBASE
@ MAIN OPERATING BASES (BLUE)
ID.LIST...LATITUDE...LONGITUDE...AIR.CMD..FLYDIRECT..LOSABLE..NAME
   1004  28D22.3M-N  36D37.2M-E     1200       2          1        "TABUK"
   1005  26D56.4M-N  49D42.2M-E     1103       2          1        .
"KING_ABDUL_AZIZ_NAVAL_BASE"
   1006  26D28.2M-N  49D47.8M-E     1200       2          1        "KING_FAHD"
   1007  24D04.5M-N  47D26.6M-E     1200       2          1        "AL_KHARJ"
   1008  21D29.3M-N  40D32.6M-E     1200       2          1        "AT-TAIF"
   1009  26D15.8M-N  50D09.5M-E     1200       2          1        "DHAHRAN"
   1010  25D55.0M-N  50D35.0M-E     1103       2          1        "SHAIKH_ISA"
   1011  25D15.5M-N  51D33.9M-E     1200       2          1        "DOHA_INTL"
   1012  25D01.7M-N  55D22.2M-E     1200       2          1        "AL-MINHAD"
   1013  24D14.5M-N  54D33.1M-E     1200       2          1        "AL-DHAFRA"
  SIDE..MINE.EFF.CLASS..MIN.CEILING(M)..MIN.VIS(M)..CRATER.CREWS..T&L.ATTR.CLASS
    1      1901             300              100           10              10001
  AD.SITES..TYPE.ID...QTY
               1001      2
```

```
                  1002      1
   REPAIR.RESRCS..ID...QTY
                    1      2
                    2      1
                    3      1
   INT.LEVEL.MX.FACS
   AIR.MUNITIONS..ID..FULL.LOAD..ON.HAND
   RUNWAY..LENGTH(M)..WIDTH..MIN.WTH..CUTS.TO.CLOSE..TGT.ID
                  2658      72       24        10          10024
                  2743      73       25        10          10024
                  3230      73       25        10          10024
   POL..CAPACITY..ON.HAND(STONS)
          30000         30000
   AC.IN.OPEN.TGTS..ID
                 30001
   SHELTER.TGTS..ID..NUM.ELTS
                 40001      75
   REVETMT.TGTS..ID..NUM.ELTS
   MX.TGTS.......ID..NUM.ELTS..FRAC.CAP
                 60001      13          1.0
   AIR.MUNT.TGTS.ID..NUM.ELTS..FRAC.CAP
                 70001      13          1.0
   SPARES.TGTS...ID..NUM.ELTS..FRAC.CAP
                 80001      13          1.0
   POL.TGTS......ID..NUM.ELTS..FRAC.CAP
                 90001      13          1.0
   END.AIRBASE

@ CARRIER BATTLE GROUPS (CVGs) RED SEA BATTLE FORCE
ID.LIST...LATITUDE...LONGITUDE...AIR.CMD..FLYDIRECT..LOSABLE..NAME
    1014  26D47.6M-N  35D05.9M-E     1101       1          2        "CV67_KENNEDY"
    1015  25D33.8M-N  35D53.6M-E     1101       1          2        "CV60_SARATOGA"
   SIDE..MINE.EFF.CLASS..MIN.CEILING(M)..MIN.VIS(M)..CRATER.CREWS..T&L.ATTR.CLASS
     1     1902             90            1600              4              10001
   AD.SITES..TYPE.ID...QTY
                  1001      4
                  1002      4
   REPAIR.RESRCS..ID...QTY
                    1      2
                    2      1
                    3      1
   INT.LEVEL.MX.FACS
   AIR.MUNITIONS..ID..FULL.LOAD..ON.HAND
   RUNWAY..LENGTH(M)..WIDTH..MIN.WTH..CUTS.TO.CLOSE..TGT.ID
                  2745      45       20         6          10024
   POL..CAPACITY..ON.HAND(STONS)
          30000         30000
   AC.IN.OPEN.TGTS..ID
                 30002
   SHELTER.TGTS..ID..NUM.ELTS
   REVETMT.TGTS..ID..NUM.ELTS
   MX.TGTS.......ID..NUM.ELTS..FRAC.CAP
                 60002      46          1.0
   AIR.MUNT.TGTS.ID..NUM.ELTS..FRAC.CAP
                 70002      46          1.0
   SPARES.TGTS...ID..NUM.ELTS..FRAC.CAP
                 80002      46          1.0
   POL.TGTS......ID..NUM.ELTS..FRAC.CAP
                 90002      46          1.0
   END.AIRBASE

@ CARRIER BATTLE GROUPS (CVGs) PERSIAN GULF BATTLE FORCE
ID.LIST...LATITUDE...LONGITUDE...AIR.CMD..FLYDIRECT..LOSABLE..NAME
    1016  26D47.5M-N  52D19.4M-E     1102       2          1        "CV41_MIDWAY"
    1017  26D14.1M-N  52D18.3M-E     1102       2          1        "CV61_RANGER"
    1018  26D13.2M-N  52D52.9M-E     1102       2          1        "CV71_ROOSEVELT"
    1019  27D13.6M-N  50D47.8M-E     1102       2          1        "CV66_AMERICA"
   SIDE..MINE.EFF.CLASS..MIN.CEILING(M)..MIN.VIS(M)..CRATER.CREWS..T&L.ATTR.CLASS
     1     1902             90            1600              4              10001
   AD.SITES..TYPE.ID...QTY
                  1001      4
                  1002      4
   REPAIR.RESRCS..ID...QTY
                    1      2
```

```
                    2      1
                    3      1
      INT.LEVEL.MX.FACS
      AIR.MUNITIONS..ID..FULL.LOAD..ON.HAND
      RUNWAY..LENGTH(M)..WIDTH..MIN.WTH..CUTS.TO.CLOSE..TGT.ID
                  2745      45        20         6         10024
      POL..CAPACITY..ON.HAND(STONS)
             30000            30000
      AC.IN.OPEN.TGTS..ID
                30002
      SHELTER.TGTS..ID..NUM.ELTS
      REVETMT.TGTS..ID..NUM.ELTS
      MX.TGTS.......ID..NUM.ELTS..FRAC.CAP
                60002        46          1.0
      AIR.MUNT.TGTS.ID..NUM.ELTS..FRAC.CAP
                70002        46          1.0
      SPARES.TGTS...ID..NUM.ELTS..FRAC.CAP
                80002        46          1.0
      POL.TGTS......ID..NUM.ELTS..FRAC.CAP
                90002        46          1.0
      END.AIRBASE
    @ SECONDARY OR DISPERSAL AIRBASES (BLUE)
    ID.LIST...LATITUDE...LONGITUDE...AIR.CMD..FLYDIRECT..LOSABLE..NAME
       1020  24D42.6M-N  46D43.7M-E     1200       2          1         "RIYADH"
       1021  21D30.0M-N  39D13.0M-E     1200       2          1         "JIDDAH"
       1022  24D33.0M-N  39D41.0M-E     1200       2          1         "MEDINA"
       1023  29D47.3M-N  40D06.2M-E     1200       2          1         "AL_JAWF"
       1025  28D20.0M-N  46D07.0M-E     1200       2          1         "AL_QAYSUMAN"
       1027  25D15.1M-N  55D21.9M-E     1200       2          1         "DUBAI"
       1028  27D53.8M-N  45D31.6M-E     1200       2          1         "KING_KHALID_MIL_CITY"
       1029  26D16.1M-N  50D38.0M-E     1200       2          1         "BAHRAIN_INTL"
       1030  25D17.1M-N  49D29.1M-E     1200       2          1         "AL_AHSA"
       1031  24D57.7M-N  46D42.5M-E     1200       2          1         "KING_KHALID_INTL"
       1032  25D09.8M-N  46D33.0M-E     1200       2          1         "THUMAMAH"
       1033  27D57.0M-N  45D34.0M-E     1200       2          1         "HAFR_AL_BATIN"
       1034  26D18.1M-N  43D46.2M-E     1200       2          1         "GASSIM"
       1035  28D05.3M-N  48D36.6M-E     1200       2          1         "RAS_MISHAB"
       1036  27D26.5M-N  41D41.2M-E     1200       2          1         "HAIL"
       1037  24D08.6M-N  38D03.8M-E     1200       2          1         "YENBO"
       1038  26D11.9M-N  36D28.5M-E     1200       2          1         "WEJH"
       1039  28D22.3M-N  36D37.5M-E     1200       2          1         "KING_FAISAL_AB"
       1040  28D53.0M-N  36D10.0M-E     1200       2          1         "AL_BIR"
       1042  31D24.8M-N  37D16.6M-E     1200       2          1         "GURIAT"
       1043  16D54.3M-N  42D34.9M-E     1200       2          1         "GIZAN"
       1044  17D25.0M-N  47D05.0M-E     1200       2          1         "SHARURAH"
       1045  18D14.3M-N  42D49.3M-E     1200       2          1         "ABHA"
       1046  18D12.9M-N  42D47.4M-E     1200       2          1         "KHAMIS_MUSHAIT"
       1047  19D58.8M-N  42D37.6M-E     1200       2          1         "BISHA"
       1048  20D27.8M-N  45D37.2M-E     1200       2          1         "SULAYEL"
       1049  29D21.0M-N  47D32.0M-E     1200       2          1         "ALI_AL_SALEM"
       1050  29D13.7M-N  47D58.6M-E     1200       2          1         "KUWAIT_INTL"
       1051  28D56.0M-N  47D48.0M-E     1200       2          1         "AHMED_AL_JABER"
      SIDE..MINE.EFF.CLASS..MIN.CEILING(M)..MIN.VIS(M)..CRATER.CREWS..T&L.ATTR.CLASS
        1       1901           300             100            10              10001
      AD.SITES..TYPE.ID...QTY
      REPAIR.RESRCS..ID...QTY
                      1      2
                      2      1
                      3      1
      INT.LEVEL.MX.FACS
      AIR.MUNITIONS..ID..FULL.LOAD..ON.HAND
      RUNWAY..LENGTH(M)..WIDTH..MIN.WTH..CUTS.TO.CLOSE..TGT.ID
                  2658      72        24        10         10024
                  2743      73        25        10         10024
                  3230      73        25        10         10024
      POL..CAPACITY..ON.HAND(STONS)
             30000            30000
      AC.IN.OPEN.TGTS..ID
                30001
      SHELTER.TGTS..ID..NUM.ELTS
                40001        75
      REVETMT.TGTS..ID..NUM.ELTS
      MX.TGTS.......ID..NUM.ELTS..FRAC.CAP
                60001        13          1.0
```

```
AIR.MUNT.TGTS.ID..NUM.ELTS..FRAC.CAP
            70001       13          1.0
SPARES.TGTS...ID..NUM.ELTS..FRAC.CAP
            80001       13          1.0
POL.TGTS......ID..NUM.ELTS..FRAC.CAP
            90001       13          1.0
END.AIRBASE


@ RED MAIN OPERATING BASES
ID.LIST...LATITUDE...LONGITUDE...AIR.CMD..FLYDIRECT..LOSABLE..NAME
   2001  30D32.0M-N  46D35.0M-E    2101      2          1       "JALIBAH_SE"
   2002  30D32.7M-N  47D39.9M-E    2101      2          1       "BASRAH_WEST"
   2003  32D54.0M-N  44D38.0M-E    2101      2          1       "SHAYKA_MAZHAR"
   2004  33D15.0M-N  44D14.0M-E    2101      2          1       "BAGHDAD_INTL"
   2005  33D17.0M-N  44D30.0M-E    2101      2          1       "BAGHDAD_RASHEED"
   2006  33D57.0M-N  44D22.0M-E    2101      2          1       "BALAD_SE"
   2007  33D47.0M-N  42D27.0M-E    2101      2          1       "AL_ASAD"
   2008  33D21.0M-N  40D36.0M-E    2101      2          1       "H2"
   2009  32D56.0M-N  39D46.0M-E    2101      2          1       "H3"
   2010  33D05.0M-N  39D36.0M-E    2101      2          1       "H3_NW"
   2011  32D46.0M-N  39D37.0M-E    2101      2          1       "H3_SW"
   2012  32D52.0M-N  39D20.0M-E    2101      2          1       "H3_HWY"
   2013  33D20.0M-N  43D36.0M-E    2101      2          1       "AL_TAQADDUM"
   2014  34D36.0M-N  43D47.0M-E    2101      2          1       "TIKRIT_EAST"
   2015  34D33.0M-N  43D41.0M-E    2101      2          1       "TIKRIT_SOUTH"
   2016  34D55.0M-N  43D24.0M-E    2101      2          1       "K2"
   2017  35D28.0M-N  44D21.0M-E    2101      2          1       "KIRKUK"
   2018  36D18.0M-N  43D09.0M-E    2101      2          1       "MOSUL"
   2020  35D46.0M-N  43D07.0M-E    2101      2          1       "QAYYARAH"
  SIDE..MINE.EFF.CLASS..MIN.CEILING(M)..MIN.VIS(M)..CRATER.CREWS..T&L.ATTR.CLASS
    2      1901           300              100           3             10001
  AD.SITES..TYPE.ID...QTY
              2003      1
              2004      1
              2002      1
  REPAIR.RESRCS..ID...QTY
                 1      2
                 2      1
                 3      1
  INT.LEVEL.MX.FACS
  AIR.MUNITIONS..ID..FULL.LOAD..ON.HAND
              2202     500        500
              2203     500        500
              2208     500        500
  RUNWAY..LENGTH(M)..WIDTH..MIN.WTH..CUTS.TO.CLOSE..TGT.ID
              3353     73        25        10          10024
              3658     67        25        10          10024
  POL..CAPACITY..ON.HAND(STONS)
        30000          30000
  AC.IN.OPEN.TGTS..ID
             30001
  SHELTER.TGTS..ID..NUM.ELTS
             40001     100
  REVETMT.TGTS..ID..NUM.ELTS
  MX.TGTS.......ID..NUM.ELTS..FRAC.CAP
             60001      50          1.0
  AIR.MUNT.TGTS.ID..NUM.ELTS..FRAC.CAP
             70001      50          1.0
  SPARES.TGTS...ID..NUM.ELTS..FRAC.CAP
             80001      50          1.0
  POL.TGTS......ID..NUM.ELTS..FRAC.CAP
             90001      50          1.0
  END.AIRBASE
@ RED DISPERSAL AIRBASES
ID.LIST...LATITUDE...LONGITUDE...AIR.CMD..FLYDIRECT..LOSABLE..NAME
   2021  30D08.0M-N  47D40.0M-E    2101      2          1       "SAFWAN"
   2022  30D22.0M-N  47D06.0M-E    2101      2          1       "AR_RUMAYLAH_SW"
   2023  30D14.0M-N  47D27.0M-E    2101      2          1       "AL_MUFRASH"
   2024  30D55.0M-N  46D06.0M-E    2101      2          1       "TALLID"
   2025  31D27.0M-N  47D17.0M-E    2101      2          1       "QALAT_SALIH"
   2026  31D49.0M-N  47D05.0M-E    2101      2          1       "AMARA_NEW"
   2027  31D59.0M-N  44D25.0M-E    2101      2          1       "NEJEF_NEW"
   2028  32D30.0M-N  45D45.0M-E    2101      2          1       "UBAYDAH"
   2029  32D57.0M-N  44D16.0M-E    2101      2          1       "AL_IKANDARIYAH"
```

```
  2030  33D26.0M-N  42D54.0M-E     2101      2         1       "AL_MUHUMMADI"
  2031  32D25.0M-N  41D58.0M-E     2101      2         1       "MUDAYSIS"
  2032  34D41.0M-N  43D33.0M-E     2101      2         1       "AL_SAHRA"
  2033  35D08.0M-N  43D43.0M-E     2101      2         1       "AL_FATHAH"
  2034  36D13.0M-N  43D58.0M-E     2101      2         1       "IRBIL"
  2035  36D16.0M-N  42D24.0M-E     2101      2         1       "TALL_AFAR"
  2038  31D26.0M-N  47D40.0M-E     2101      2         1       "SHAIBAH"
 SIDE..MINE.EFF.CLASS..MIN.CEILING(M)..MIN.VIS(M)..CRATER.CREWS..T&L.ATTR.CLASS
   2     1901          300            100          3            10001
 AD.SITES..TYPE.ID...QTY
             2003     1
             2004     1
             2002     1
 REPAIR.RESRCS..ID...QTY
                1     2
                2     1
                3     1
 INT.LEVEL.MX.FACS
 AIR.MUNITIONS..ID..FULL.LOAD..ON.HAND
             2202     300       300
             2203     300       300
             2208     300       300
 RUNWAY..LENGTH(M)..WIDTH..MIN.WTH..CUTS.TO.CLOSE..TGT.ID
             3353     73       25        10        10024
             3658     67       25        10        10024
 POL..CAPACITY..ON.HAND(STONS)
       30000          30000
 AC.IN.OPEN.TGTS..ID
            30001
 SHELTER.TGTS..ID..NUM.ELTS
            40001      100
 REVETMT.TGTS..ID..NUM.ELTS
 MX.TGTS.......ID..NUM.ELTS..FRAC.CAP
            60001      50       1.0
 AIR.MUNT.TGTS.ID..NUM.ELTS..FRAC.CAP
            70001      50       1.0
 SPARES.TGTS...ID..NUM.ELTS..FRAC.CAP
            80001      50       1.0
 POL.TGTS......ID..NUM.ELTS..FRAC.CAP
            90001      50       1.0
 END.AIRBASE

END.AIRBASES
```

To disable munitions re-supply at Blue airbases, the following lines of code in the ***critres.dat*** file were zeroed out.

critres.dat

```
CRITICAL.RESOURCES.380

  NUMBER.OF.CRITICAL.RESOURCES   31

   1101    AIM-7
    TYPE...(1=AIR.MUNT,2=SA.MUNT,3=EQUIP)                    1
    URGENCY.CURVE                                            1
    LOW.RES.INITIAL.STOCK                                    0
    LOW.RES.RESUPPLY...START.TIME(DEC.DAYS)...NUMBER/DAY
    HI.RES.INITIAL.STOCKS...........LOG.FAC.ID...NUMBER
                                        1006       250
    HI.RES.RESUPPLY...TIME(DAYS)...NUMBER...TARGET.TYPE...ID.LIST
    END.RESOURCE

   1102    AAMRAM
    TYPE...(1=AIR.MUNT,2=SA.MUNT,3=EQUIP)                    1
    URGENCY.CURVE                                            1
    LOW.RES.INITIAL.STOCK                                    0
    LOW.RES.RESUPPLY...START.TIME(DEC.DAYS)...NUMBER/DAY
```

```
HI.RES.INITIAL.STOCKS............LOG.FAC.ID...NUMBER
                                      1006          250
HI.RES.RESUPPLY...TIME(DAYS)...NUMBER...TARGET.TYPE...ID.LIST
END.RESOURCE

1103    AIM-9
TYPE...(1=AIR.MUNT,2=SA.MUNT,3=EQUIP)                  1
URGENCY.CURVE                                          1
LOW.RES.INITIAL.STOCK                                  0
LOW.RES.RESUPPLY...START.TIME(DEC.DAYS)...NUMBER/DAY
HI.RES.INITIAL.STOCKS............LOG.FAC.ID...NUMBER
                                      1006          250
HI.RES.RESUPPLY...TIME(DAYS)...NUMBER...TARGET.TYPE...ID.LIST
END.RESOURCE

1106    AGM-65
TYPE...(1=AIR.MUNT,2=SA.MUNT,3=EQUIP)                  1
URGENCY.CURVE                                          1
LOW.RES.INITIAL.STOCK                                  0
LOW.RES.RESUPPLY...START.TIME(DEC.DAYS)...NUMBER/DAY
HI.RES.INITIAL.STOCKS............LOG.FAC.ID...NUMBER
                                      1006          250
HI.RES.RESUPPLY...TIME(DAYS)...NUMBER...TARGET.TYPE...ID.LIST
END.RESOURCE

1107    ARM-88
TYPE...(1=AIR.MUNT,2=SA.MUNT,3=EQUIP)                  1
URGENCY.CURVE                                          1
LOW.RES.INITIAL.STOCK                                  0
LOW.RES.RESUPPLY...START.TIME(DEC.DAYS)...NUMBER/DAY
HI.RES.INITIAL.STOCKS............LOG.FAC.ID...NUMBER
                                      1006          250
HI.RES.RESUPPLY...TIME(DAYS)...NUMBER...TARGET.TYPE...ID.LIST
END.RESOURCE

1108    SPW-45
TYPE...(1=AIR.MUNT,2=SA.MUNT,3=EQUIP)                  1
URGENCY.CURVE                                          1
LOW.RES.INITIAL.STOCK                                  0
LOW.RES.RESUPPLY...START.TIME(DEC.DAYS)...NUMBER/DAY
HI.RES.INITIAL.STOCKS............LOG.FAC.ID...NUMBER
                                      1006          250
HI.RES.RESUPPLY...TIME(DAYS)...NUMBER...TARGET.TYPE...ID.LIST
END.RESOURCE
```

Appendix C

The following files are examples of code used to overwrite the THUNDER data files on a UNIX UltraSPARC workstation using Solaris 2.0 environment.

The file F16.ex is the executable file:

F16.ex

```
cat /usr/home/students/jgrier/scripts/sqF16 |ex -s ./squadron.dat
cat /usr/home/students/jgrier/scripts/acF16 |ex -s ./acserv.dat
```

which uses the following files to search and overwrite existing text. In this example, it scrolls through the squadron.dat file until it locates "F-16_INCIRLIK". It then searches for the first entry of value 36 (in the next 3 line) and replaces it with a value of 48. The wq command at the end saves the changes (write command in UNIX) and quits the sqF16 script.

sqF16

```
/11601  "F-16_INCIRLIK"
s/36/48/3
/11602  "F-16A_AL-KHARJ"
s/24/36/3
/11604  "F-16_DOHA"
s/24/36/3
/11605  "F-16_AL-MINHAD1"
s/24/36/3
/11606  "F-16_AL-MINHAD2"
s/24/36/3
/11607  "F-16_AL-MINHAD3"
s/24/36/3
/11608  "F-16_AL-DHAFRA1"
s/24/36/3
/11609  "F-16_AL-DHAFRA2"
s/24/36/3
/11610  "F-16_AL-DHAFRA3"
s/24/36/3
wq
```

The same logic follows for the acF16 script:

acF16

```
/1016 "F-16 KIT"
s/24/36/3
wq
```

The munitions levels were set using the same type of shell scripts. The following code was used to set the AGM-65 levels:

AGM65.ex

```
cat /usr/home/students/jgrier/scripts/AGM65 |ex -s ./acserv.dat
```

AGM65

```
/1010 "A-10 KIT"
s/1106    390/1106    585/10
/1016 "F-16 KIT"
s/1106    266/1106    399/10
/1008 "AV-8 KIT"
s/1106    290/1106    435/10
/1018 "FA-18 KIT"
s/1106    160/1106    240/10
/1014 "F-14 KIT"
s/1106     10/1106     15/10
wq
```

Note: These files were written with the intent to overwrite the ***squadron.dat*** and ***acserv.dat*** files in the current working directory. The shell scripts were located in my scripts subdirectory, with the appropriate path set in the .cshrc file.

THUNDER generates a report called ***ttgraph.rpt,*** which contains all of the metrics collected (in the macro file). To convert this file to a comma delimited file that MS Excel recognizes, the shell script ***ttgraph.nawk*** was used:

ttgraph.nawk

```
#  Convert ttgraph.rpt to a comma separated file (csv)
#
# Search for lines beginning with double quotes
/^"/ {

     title = $0                      # Get the title of chart
     getline                         # Skip two lines
     getline
     lablen = length($0)             # Determine the length of the variable labels
     xlabel = substr($0, 2, 18)      # Get the x-axis label of chart
     xstart = 21                     # Define the starting position for variables
     icnt = 0                        # Initialize variable counter
     do {
        icnt ++                      # Increment variable counter
        ylabel[icnt] = substr($0, xstart, 10)
        xstart = xstart + 10         # Prepare for next variable
        } while (lablen > xstart)    # Loop through each variable
#
#    Write out titles and labels
#
     printf ("%s\n", title)
     printf ("%s",   xlabel)
     for (i=1; i<=icnt; i++)
        printf (",%s", ylabel[i])
     printf ("\n")

#
#    Read the data
#
     getline                         # Skip a line
     do {
        getline                      # Read a line of data
        if (length($0) > 0) {        # Make sure it it really data
           printf ("%s", $1)
           for (i=2; i<=icnt+1; i++)
              printf(",%s", $i)
```

```
          printf ("\n")
           }
        } while (length($0) > 0)
#
#    Print a separating line
#
     printf ("\n")

     }
```

Appendix D

Below are the nine Campaign Objectives (CO) identified by XPY and ASPVG, their respective Operational Objectives (OO) and Operational Tasks (OT), as well as the metrics needed to measure each. The highlighted metrics could be measured by the UNCLASSIFIED database. **Bold type face indicates metrics a CLASSIFIED database can measure.** *Items in italics can not be measured by THUNDER.*

CO #1: HALT INVADING ARMIES

OO # 01: Delay/destroy/disrupt lead elements of armored advance

OT # 01: Destroy/damage advancing armored vehicles

Metric: Percent of Tanks Killed
Percent APCs Killed
Time to stop RED advancement
Distance FLOT moved

OT # 02: Destroy/damage accompanying support vehicles

Metric: **Percent Trucks Killed**

OT # 03: Mine/cut key attack routes

Metric: **Number of choke points killed**
Number of choke points repaired
Percent potential RED attack routes closed

OO # 02: Delay/damage reinforcing forces and supplies in the rear

OT # 04: Mine/cut roads and railbeds

Metric: **Number of choke points killed**
Number of rail bridges killed
Number of trans shipment points killed

OT # 05: Destroy/damage armored and other vehicles in convoys or on trains

Metric: **Total number of moving Tanks Killed**
Total number of moving APCs Killed
Total number of re-supply Tanks killed
Total number of re-supply APCs killed

OT # 06: Disrupt field logistics sites, transportation nodes, assembly areas

Metric: Number of Logistics sites destroyed
Number of assembly nodes killed

OT # 07: Drop bridges, block tunnels and other choke points

Metric: Number of bridges destroyed
Number of Tunnels destroyed

OO # 03: Provide fire support to forces in close contact with enemy forces

OT # 08: Destroy/disable/*pin* armored vehicles near line of contact

Metric: **Percent of Tanks near line of contact disabled/killed**
Percent of APCs near line of contact disabled/killed

OT # 09: Disable/*pin* dismounted troops near line of contact

Metric: **Percent of Infantry near line of contact Killed**
Percent of Infantry near line of contact wounded in action

OT # 10: Destroy/suppress artillery and MLRS

Metric: **Percent of self-propelled artillery killed**
Percent of Towed artillery killed
Percent of MLRS killed

CO # 02: MARSHALL AND SUSTAIN IN-THEATER ASSETS

OO # 04: Airlift personnel and materiel into and within distant theaters

OT # 11: Airlift forces and critical support into distant theater

Metric: *Percent TPFDD arrived in theater on time*

OT # 12: Airlift forces and critical support within theater

Metric: *Total troops moved in theater*
Total cargo moved in theater

OT # 13: Airdrop troops and equipment covertly in hostile territory

Metric: **Percent of SOF missions successfully inserted**

OO # 05: Refuel aircraft in flight

OT # 14: Refuel aircraft flying to and from distant theaters

Metrics: *Total number of aircraft refueled*
Percent of total scheduled receivers refueled

OT # 15: Refuel aircraft moving to attack enemy forces

Metric: **Total number of aircraft refueled**
Percent of total scheduled receivers refueled

OT # 16: Refuel aircraft on station or CAP

Metric: **Total number of CAP aircraft refueled**
Percent of total scheduled CAP receivers refueled
Average time to refuel once on station

OO # 06: Recover personnel in distress

OT # 17: Rescue downed aircrews and other personnel in hostile territory

Metric: *Percent of downed aircrew recovered*
Success rate of recovering special ops teams

OT# 18: Medevac wounded personnel to medical facilities

Metric: Total number of patients medevaced

OO # 07 Train and maintain in-theater forces elements

OT # 19: Maintain equipment for high intensity operations (generate sorties)

Metric: **BLUE mean repair time (MRT) by platform**
BLUE aircraft battle damage repair time (ABDRT)
Average BLUE mission preparation time
Average weapon upload/checkout time
Total sorties generated by BLUE
Total number of mission aborts for maintenance

OT # 20: Train and exercise personnel

Metric:

OT # 21: Provide for the morale and welfare of personnel

Metric:

OO # 08: Secure bases

OT # 22: Secure base perimeters

Metric:

OT # 23: Defeat attacks by special ops forces

Metric:

CO # 03: EVICT HALTED ARMIES FROM FRIENDLY TERRITORY

OO # 09: Degrade and overrun defensive positions

OT # 24: Destroy/damage armored and other vehicles in defensive positions

Metric: **Number of Tanks in defensive positions killed**
Number of APCs in defensive positions killed

OT # 25: Disable dismounted troops

Metric: **Number of Infantry in defensive positions killed**
Number of Infantry in defensive positions wounded in action

OT # 26: Neutralize obstacles (mines, fortifications)

Metric:

OT # 27: Mine/cut key routes of retreat

Metric: *Percentage of key routes of retreat blocked*

OO # 02: Delay/damage reinforcing forces and supplies in the rear

OT # 04: Mine/cut roads and railbeds

Metric: Number of choke points killed
Number of rail bridges killed
Number of trans shipment points killed

OT # 05: Destroy/damage armored and other vehicles in convoys or on trains

Metric: Total number of moving Tanks Killed
Total number of moving APCs Killed
Total number of re-supply Tanks killed
Total number of re-supply APCs killed

OT # 06: Disrupt field logistics sites, transportation nodes, assembly areas

Metric: Number of Logistics sites destroyed
Number of assembly nodes killed

OT # 07: Drop bridges, block tunnels and other choke points

Metric: Number of bridges destroyed
Number of Tunnels destroyed

OO # 03: Provide fire support to forces in close contact with enemy forces

OT # 08: Destroy/disable/*pin* armored vehicles near line of contact

Metric: Percent of Tanks near line of contact disabled/killed
Percent of APCs near line of contact disabled/killed

OT # 09: Disable/*pin* dismounted troops near line of contact

Metric: Percent of Infantry near line of contact Killed
Percent of Infantry near line of contact wounded in action

OT # 10: Destroy/suppress artillery and MLRS

Metric: Percent of Self-propelled artillery killed
Percent of Towed artillery killed
Percent of MLRS killed

CO # 04: GAIN, MAINTAIN AIR SUPERIORITY

OO # 10: Defeat air attacks

OT # 28: Destroy/disrupt aircraft and helicopters in flight

Metric: RED aircraft lost due to BLUE air
Percent of RED aircraft shot down
RED/BLUE exchange ratio

OT # 29: Destroy/disrupt cruise missiles in flight

Metric: Percent of cruise missile intercepted in flight

OT # 30: Disrupt sensors on aircraft and weapons

Metric: Losses with EW assets / Losses without EW assets ratio

OT # 31: Execute passive defensive measures in threatened areas

Metric: Total number of BLUE aircraft destroyed on the ground

OO # 11: Suppress generation of air sorties

OT# 32: Crater/mine/damage airfield runways and taxiways

Metric: Percent of RED airfields operable
Percent time RED airfield is operable

OT # 33: Destroy/damage aircraft in the open or in revetments

Metric: Number of RED aircraft destroyed in the open
Number of RED aircraft destroyed in revetments
Ground kills per total kills

OT # 34: Destroy/damage aircraft in hardened shelters

Metric: Number of RED aircraft destroyed in hardened shelters
Number of RED hardened shelters destroyed

OT # 35: Destroy/damage airbase support facilities

Metric: Percent of RED support facilities destroyed by BLUE air

OT # 36: Deny attack helicopter forward area refuel/replenishment points

Metric: Percentage of RED FARPS destroyed by BLUE air

OO # 12: Suppress surface-based air defense

OT # 37: Destroy/damage fixed SAM launchers

Metric: Number of TELs killed
Number of ACQ radars killed
Number of Fire control radars killed
Total number of BLUE aircraft lost to enemy SAMs

OT # 38: Destroy/damage mobile SAM launchers and AAA

Metric: Number of TELARs killed
Number of mobile ACQ radars killed
Number of mobile Fire control radars killed
Total number of BLUE aircraft lost to enemy SAMs

OT # 39: Destroy/disrupt tracking and engagement radars

Metric: Percent of EW/GCI sites operable

OO # 13: Defeat attacking ballistic missiles (BM)

OT # 40: Destroy ballistic missiles in flight (active defense)

Metric: Percent of BMs intercepted by BLUE air

OT # 41: Execute passive defense measures in threatened areas

Metric: Total number of BLUE losses due to BM attack

OO # 14: Suppress the generation of ballistic missile launches

OT # 42: Destroy/damage TELs in the field and disrupt operations

Metric: Percent of BM TELs in field operable

OT # 43: Destroy/damage TELs in garrisons and assembly areas

Metric: Percent of TELs in garrison & assembly areas operable

OT # 44: Destroy/damage fixed TBM launchers

Metric: Percent of TBMs operable

OT # 45: Destroy Tactical Ballistic Missile (TBM) storage areas

Metric: Total number of TBM storage areas destroyed

CO # 05: GAIN, MAINTAIN SEA CONTROL

OO # 15: Sink/disable surface combatants and disrupt their operations

OT # 46: Sink/disable ships at sea and in port

Metric: Percent of surface combatants killed

OT # 47: Mine ports, choke points, and anchorages

Metric: Percent of port processing capacity remaining overall

OT # 48: Disrupt shipborne sensors

Metric:

CO # 06: GAIN, MAINTAIN SPACE CONTROL

OO # 16: Sustain operations of friendly space-based assets

OT # 49: Re-deploy space assets as needed and sustain constellations on orbit

Metric:

OT # 50: Launch satellites on a timely basis

Metric: Average delay of BLUE satellite launches

OO # 17: Protect friendly space-based assets in the face of enemy attack

OT # 51: Destroy/disrupt ASATs in flight

Metric: Percent of RED ASATs destroyed in flight

OT # 52: Evade ASATs

Metric: Percent of BLUE satellites operable

OO # 18: Suppress enemy space based capabilities

OT # 53: Destroy/damage satellites in orbit

Metric: Percent of satellites operable

OT # 54: Destroy/damage launch facilities, tracking stations, and other fixed sites

Metric: Percent of launch facilities, tracking stations and fixed sites operable

OT # 55: Destroy/damage mobile space surveillance and tracking radars

Metric: **Percent of mobile space surveillance and tracking radars operable**

OT # 56: Disrupt links.

Metric: **Percent of Links operable**

CO # 7: GAIN, MAINTAIN INFORMATION DOMINANCE

OO # 19: Provide "eyes, ears, and voice of commanders

OT # 57: Provide timely, accurate information on enemy activities, force disposition

Metric:

OT # 58: Provide timely, accurate assessment of battle results

Metric:

OT # 59: Provide timely, accurate reports on friendly force disposition

Metric:

OT # 60: Provide timely, accurate reports on the weather

Metric:

OT # 61: Provide timely, accurate dissemination of commanders' intent

Metric:

OO # 20: Degrade command and control of enemy forces

OT # 62: Destroy/damage command bunkers

Metric: **Percent of command bunkers operable**
Data transmission rate

OT # 63: Destroy/damage mobile command posts

Metric: **Number of C3 Antennas killed**
Number of C3 Vans killed
Data transmission rate

OT # 64: Disrupt enemy communications

Metric: *Average communication data transmission rate*

OT # 65: Destroy/disrupt airborne command, control, and surveillance platforms

Metric: **Number of Mainstays killed**
Average time Mainstay is on station

OT # 66: Destroy/disrupt ground-based radars and other sensors

Metric: **Percent of EW/CGI sites operable**

OO # 21: Sow confusion in enemy situational awareness

OT # 67: Effect deceptions/false targets to mask friendly deployments and assets

Metric: **Number of decoys killed**

OT # 68: Disseminate dis-information to enemy commanders and forces

Metric:

CO # 8: DENY POSSESSION AND USE OF WEAPONS OF MASS DESTRUCTION (WMD)

OO # 22: Damage/deny facilities for producing and storing WMD

OT # 69: Destroy production plants

Metric: **Percent of production plant destroyed**

OT # 70: Destroy weapon storage sites or deny access

Metric: **Percent of WMD storage facilities destroyed**

OO # 13: Defeat attacking ballistic missiles (BM)

OT # 40: Destroy ballistic missiles in flight (active defense)

Metric: **Percent of BMs intercepted by BLUE air**

OT # 41: Execute passive defense measures in threatened areas

Metric: **Total number of BLUE losses due to BM attack**

OO # 14: Suppress the generation of ballistic missile launches

OT # 42: Destroy/damage TELs in the field and disrupt operations

Metric: **Percent of BM TELs in field operable**

OT # 43: Destroy/damage TELs in garrisons and assembly areas

Metric: **Percent of TELs in garrison & assembly areas operable**

OT # 44: Destroy/damage fixed TBM launchers

Metric: **Percent of TBMs operable**

OT # 45: Destroy Tactical Ballistic Missile (TBM) storage areas

Metric: **Total number of TBM storage areas destroyed**

OO # 10: Defeat air attacks

OT # 28: Destroy/disrupt aircraft and helicopters in flight

Metric: RED aircraft lost due to BLUE air
Percent of RED aircraft shot down
RED/BLUE exchange ratio

OT # 29: Destroy/disrupt cruise missiles in flight

Metric: Percent of cruise missile intercepted in flight

OT # 30: Disrupt sensors on aircraft and weapons

Metric: Losses with EW assets / Losses without EW assets ratio

OT # 31: Execute passive defensive measures in threatened areas

Metric: Total number of BLUE aircraft destroyed on the ground

OO # 11: Suppress generation of air sorties

OT# 32: Crater/mine/damage airfield runways and taxiways

Metric: Percent of RED airfields operable
Percent time RED airfield is operable

OT # 33: Destroy/damage aircraft in the open or in revetments

Metric: Number of RED aircraft destroyed in the open
Number of RED aircraft destroyed in revetments
Ground kills per total kills

OT # 34: Destroy/damage aircraft in hardened shelters

Metric: Number of RED aircraft destroyed in hardened shelters
Number of RED hardened shelters destroyed

OT # 35: Destroy/damage airbase support facilities

Metric: Percent of RED support facilities destroyed by BLUE air

OT # 36: Deny attack helicopter forward area refuel/replenishment points

Metric: Percentage of RED FARPS destroyed by BLUE air

CO # 9: SUPPRESS NATIONAL CAPACITY TO WAGE WAR

OO # 23: Disrupt national POL system

OT# 71: Disrupt/Damage POL refineries and storage facilities

Metric: *POL production rate*
Percent POL storage facilities destroyed

OT # 72: Sever key petroleum pipelines

Metric: *POL transfer rate*
Percent pipelines destroyed

OT # 73: Disrupt off-load sites at ports and transshipment points

Metric: Percentage of RED transshipment points operable

OT # 74: Disrupt/damage POL control facilities

Metric: Percent POL control facilities operable

OO # 24: Disrupt national power generation

OT # 75: Disrupt/disable power plants and hydroelectric facilities

Metric: Percent of power plants/hydroelectric facilities operable
Average total power output

OT # 76: Disrupt/disable substations and transformers

Metric: Number of substations killed
Number of Trans shipment points killed

OT # 77: Sever power lines

Metric: Number of Power lines destroyed

OT # 78: Disable/destroy alternative stand alone" power sources

Metric: Number of stand alone power sources

OT # 79: Disrupt/disable grid control facilities

Metric: Number of gird control facilities killed

OO # 25: Disrupt national communications system

OT # 80: Disrupt/disable key telephone switching centers

Metric: Number of key telephone switching centers killed

OT# 81: Sever land lines

Metric: Number of land lines killed

OT # 82: Disrupt/damage key communication nodes

Metric: Number of fixed C2 nodes killed
Number of mobile C2 nodes killed

OO # 26: Disrupt national transportation system.

OT # 83: Disrupt airports, seaports, and transshipment points

Metric: Percent of airports, seaports and transshipment points operable

OT # 84: Disrupt railroad marshaling yards

Metric: Percent of Marshaling yards destroyed

OT # 85: Mine/cut roads, railroads, and waterways

Metric: Number of roads cut
Number of waterways destroyed
Number of railroads destroyed

OT # 86: Drop bridges and block choke points

Metric: Percent of bridges destroyed
Percent of choke points open

OT # 87: Disrupt/damage network control and navigation facilities

Metric: Number of network control facilities destroyed
Number of navigation facilities destroyed

OO # 27: Damage/disrupt war-supporting industry

OT # 88: Destroy defense-related plants and equipment

Metric: **Percent of defense related plants operable**
Percent reduction in farm production
Percent reduction in vehicle production
Percent reduction in metal production
Percent of research learning centers destroyed

OT # 89: Disrupt flow of war-supporting imports

Metric: **Percent of inventory destroyed**

OO # 28: Disrupt political direction of enemy society, economy, war effort

OT # 90: Destroy/damage key directing organs and leadership cadres

Metric: **Number of offices destroyed**

OT # 91: Destroy leadership and internal security facilities

Metric: **Number of internal security facilities killed**
Number of leaders killed

OT # 92: Disseminate dis-information among leadership and population

Metric:

OO # 29: Reduce motivation of enemy troops to resist friendly action

OT # 93: Disseminate disinformation, warning of impending attacks

Metric:

OT # 94: Create belief that operating combat equipment will bring certain harm

Metric:

OT # 95: Create belief that reinforcements and supplies not forthcoming

Metric:

Appendix E

The chart below represents the Plackett-Burman experimental design used to reduce the number of input variables. Variables are in coded form.

Plackett-Burman Design

Run	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}	x_{21}	x_{22}	x_{23}
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1
3	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1
4	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1
5	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1
6	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1
7	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1
8	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1
9	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	1	-1
10	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	1	-1	-1
11	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	-1	-1	1
12	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	-1	1	1
13	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	1	1	-1
14	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	1	-1	-1
15	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	-1	1
16	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	1	1
17	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1
18	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1
19	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1	-1
20	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1	1
21	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1	1
22	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	1
23	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1
24	1	1	1	1	-1	1	-1	1	1	-1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	-1
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Where
X_1 = F15C
X_2 = F16
X_3 = F15E
X4 = F111
X5 = F4G
X_7 = EF111
X_8 = F117
X_9 = AWACS
X_{10} = JSTARS
X_{11} = TOMAHAWK
X_{13} = AIM9
X_{14} = 20MM
X_{15} = MK82
X_{16} = AGM65
X_{17} = ARM88
X_{19} = B-LETHAL
X_{20} = CBU87
X_{21} = CBU97
X_{22} = LGB
X_{23} = GPS

The following table represents the 2_{III}^{4-1} Fractional Factorial Design used to model the main and some second-order interaction effects. Variables are in coded form.

Run	*A10*	*F15E*	*AGM65*	*MK82*
1	-1	-1	-1	-1
2	-1	-1	1	1
3	-1	1	-1	1
4	-1	1	1	-1
5	1	-1	-1	1
6	1	-1	1	-1
7	1	1	-1	-1
8	1	1	1	1
9	0	0	0	0
10	0	0	0	0

Appendix F
THUNDER Output

The following three tables lists the aggregate values for the output collected from the first independent observation of the Plackett-Burman experimental design.

Thunder Output
Plackett-Burman Design
Observation 1

	Tank(d)	Tank(o)	APC(d)	APC(o)	Inf(d)	Inf(o)	Arty(d)	Arty(o)	Halt(days)	Halt(dist)	Restore(days)	Push	TmpRdBrid	TSPT
Run 01-1	9774.0	8665.8	8492.2	9853.3	1247.1	3044.5	2730.0	1949.5	5.5	-22.7	7.15	9'.2	8.8	4.1
Run 02-1	7805.8	7587.4	6143.6	8450.7	941.6	2322.6	2075.2	1952.0	5.5	-22.4	7.34	85.1	10.2	1.9
Run 03-1	8744.7	8429.2	7674.0	9700.3	1085.9	3021.7	2423.3	2073.1	5.0	-22.6	7.17	90.0	7.7	1.6
Run 04-1	8513.3	9206.8	7458.1	9731.7	1004.0	3082.0	2337.1	2094.2	5.0	-23.0	7.20	91.9	7.6	0.5
Run 05-1	9473.0	8660.6	8301.5	9174.3	1216.9	2746.5	2664.0	1867.8	5.5	-23.0	7.15	91.3	7.0	0.7
Run 06-1	9348.4	7857.6	8211.9	9167.9	1189.5	2819.7	2630.8	1886.8	5.5	-23.2	7.15	92.0	6.6	1.4
Run 07-1	7674.1	7577.6	6264.6	8381.9	925.3	2509.6	2087.7	1966.7	5.5	-22.4	7.29	86.7	6.9	2.7
Run 08-1	8817.7	7432.5	7015.5	8239.8	1090.1	2321.5	2993.6	1502.5	6.0	-22.7	7.26	89.4	9.4	1.2
Run 09-1	8471.4	7311.7	6853.0	7633.8	1087.1	2325.7	2993.6	1502.5	6.0	-22.7	7.35	89.6	7.7	0.3
Run 10-1	8618.5	6727.6	6964.1	8097.4	1052.2	2557.5	2993.6	1502.5	6.0	-22.5	7.27	91.2	9.4	1.1
Run 11-1	8688.4	7608.0	7114.0	7494.5	1090.2	2132.2	2993.6	1502.5	6.0	-24.0	7.40	85.1	7.3	0.7
Run 12-1	9473.4	7811.7	8363.4	9134.5	1187.9	2820.3	2657.9	1865.5	5.5	-23.1	7.15	91.1	7.5	0.4
Run 13-1	8732.2	7405.4	7025.4	8087.3	1059.4	2413.7	2993.6	1502.5	6.0	-23.3	7.37	87.8	9.3	4.6
Run 14-1	9688.9	8476.5	8510.6	9590.7	1194.1	2980.5	2693.8	1913.5	5.5	-22.9	7.18	9C.4	9.7	2.8
Run 15-1	8467.7	7691.2	6825.2	7818.6	1053.0	2162.0	2993.6	1502.5	6.0	-23.0	7.30	92.6	8.9	0.0
Run 16-1	8462.0	7361.2	6935.1	7726.2	1055.7	2387.4	2993.6	1502.5	6.0	-23.1	7.29	91.3	7.9	2.5
Run 17-1	8880.6	8720.3	7630.8	10500.8	1048.7	3203.9	2414.7	2219.3	5.0	-23.0	7.18	90.3	9.8	1.4
Run 18-1	9565.6	7812.0	8299.0	9553.0	1205.7	2960.4	2656.9	1916.0	5.5	-23.0	7.19	91.9	8.1	3.7
Run 19-1	8704.6	6616.0	7260.9	7748.0	1092.3	2569.1	2993.6	1502.5	6.0	-23.2	7.27	90.2	7.9	1.9
Run 20-1	8824.1	6496.0	7208.8	7695.3	1081.4	2403.6	2993.6	1502.5	6.0	-23.4	7.30	83.2	9.0	3.9
Run 21-1	10351.0	6488.4	9180.4	7969.0	1368.6	2933.9	2993.6	1502.5	6.0	-22.8	7.19	90.0	7.5	1.6
Run 22-1	9761.4	8642.2	8422.1	9759.4	1220.1	2908.5	2696.2	1953.0	5.5	-22.7	7.15	91.8	9.5	1.8
Run 23-1	8077.7	7578.1	6512.2	8825.2	968.2	2611.3	2137.4	2075.6	5.5	-23.2	7.29	89.6	10.1	1.0
Run 24-1	8848.3	9578.9	7458.8	10779.0	1035.0	3102.9	2381.3	2285.2	5.0	-22.5	7.15	91.8	10.6	4.0
Run 25-1	9076.3	6885.7	7589.1	7344.2	1178.1	2146.8	2512.1	1517.4	6.0	-22.5	8.39	84.8	7.8	0.9
Run 25-1	8978.8	6906.8	7466.1	7296.3	1170.1	2111.4	2494.6	1502.7	6.0	-22.0	8.38	85.5	8.1	1.0

Thunder Output
Plackett-Burman Design
Observation 1 (cont)

	RedAALosses	RedSALosses	RedAGLosses	BlueAALosses	BlueSALosses	BlueAGLosses	Runways	ACinOpen	ABAmmo(H)	ABMaint(S)	ABSpares(S)
Run 01-1	384.1	209.9	5.1	-397.3	-318.3	-0.1	0.7	4.0	53.6	175.8	22.9
Run 02-1	345.7	221.0	5.7	-459.0	-263.4	-0.2	0.7	5.1	44.2	148.3	17.3
Run 03-1	339.5	218.4	6.1	-418.1	-326.9	-0.2	1.4	5.0	51.9	160.7	23.3
Run 04-1	336.7	242.6	5.6	-414.9	-327.4	-0.1	0.4	4.8	27.9	127.7	16.6
Run 05-1	332.3	235.9	4.7	-386.8	334.7	-0.1	0.2	3.6	24.4	124.2	16.1
Run 06-1	339.6	233.3	5.4	-392.5	-328.8	0.0	0.1	4.5	20.6	124.7	16.8
Run 07-1	369.2	220.2	5.1	-376.5	-274.5	0.0	0.4	3.9	21.7	124.9	15.8
Run 08-1	336.1	236.2	5.9	-406.7	-255.4	0.0	0.3	5.1	26.5	125.5	17.4
Run 09-1	388.5	209.6	4.4	-411.2	-277.6	0.0	0.2	3.8	23.6	130.3	19.8
Run 10-1	349.5	239.1	5.4	-402.8	-252.3	0.0	0.4	4.7	29.6	130.5	16.2
Run 11-1	361.7	211.1	4.9	-435.1	-272.4	-0.1	0.6	4.4	21.1	126.4	16.5
Run 12-1	384.3	216.6	5.3	-395.0	-346.6	0.0	0.5	4.7	34.3	130.5	18.2
Run 13-1	378.7	218.0	4.0	-384.6	-281.9	-0.1	0.3	3.3	15.4	117.4	15.5
Run 14-1	342.7	235.4	5.3	-414.1	-292.9	-0.1	0.1	4.6	27.4	137.8	18.9
Run 15-1	342.0	227.6	5.2	-444.3	-266.3	0.0	0.7	4.5	37.8	146.7	20.6
Run 16-1	376.5	208.1	5.5	-397.6	-286.8	-0.1	0.3	4.7	28.3	137.7	19.5
Run 17-1	375.5	226.0	5.[illegible]	-401.7	-316.1	-0.1	0.0	4.6	15.8	112.6	15.4
Run 18-1	348.8	219.1	5.[illegible]	-432.9	-315.6	-0.1	0.1	4.3	21.4	127.2	18.9
Run 19-1	376.4	214.0	4.9	-428.5	-276.8	0.0	0.6	3.9	35.6	162.1	21.4
Run 20-1	337.8	231.5	6.5	-415.2	-257.3	-0.2	0.3	5.5	38.9	141.6	18.3
Run 21-1	374.4	211.5	4.7	-394.7	-349.4	-0.1	0.2	3.8	23.6	128.2	19.3
Run 22-1	363.7	227.0	6.2	-387.2	-320.5	0.0	0.3	5.1	29.9	132.4	14.8
Run 23-1	381.7	207.2	4.4	-414.8	-266.6	-0.1	0.4	3.6	33.2	144.1	16.9
Run 24-1	400.4	199.2	5.6	-427.2	-310.1	0.0	0.8	5.0	46.2	167.3	22.0
Run 25-1	347.9	224.2	4.1	421.9	270.0	0.1	0.3	3.4	25.0	128.1	19.5
Run 25-1	346.7	229.4	3.8	422.5	273.4	0.1	0.4	3.2	24.8	125.0	19.3

Thunder Output
Plackett-Burman Design
Observation 1 (cont)

	C3Ant	C3Van	ADTel	ADRadar	CmdBunker	Mainstay	Helo	StoneBldg	NBCFacil
Run 01-1	1.7	4.9	2722.3	4424.5	366.9	0.3	166.4	75.8	196.6
Run 02-1	0.2	0.3	2139.1	3843.5	401.2	0.1	170.9	76.0	150.9
Run 03-1	0.0	0.0	2540.2	3851.0	420.4	0.3	157.4	75.8	195.3
Run 04-1	0.0	0.0	2483.8	3726.8	436.5	0.1	144.5	77.1	153.1
Run 05-1	0.1	0.6	2484.5	3654.4	367.3	0.3	163.5	72.5	194.7
Run 06-1	0.0	0.0	2495.8	3663.0	379.2	0.3	159.2	69.2	195.5
Run 07-1	0.1	0.1	2138.2	3320.9	365.0	0.4	148.1	71.1	194.2
Run 08-1	0.0	0.1	2139.9	3485.8	312.7	0.1	159.8	73.0	196.2
Run 09-1	0.1	0.2	2097.8	3367.4	438.2	0.2	142.3	76.8	151.6
Run 10-1	0.5	1.0	2215.7	3871.3	386.7	0.2	145.6	78.1	152.9
Run 11-1	0.0	0.0	2059.3	3324.9	439.7	0.2	159.5	74.7	153.9
Run 12-1	0.0	0.0	2505.6	3862.8	431.2	0.2	157.3	72.9	153.3
Run 13-1	0.3	2.2	2141.0	3615.3	359.0	0.3	148.0	76.9	151.5
Run 14-1	0.0	0.0	2619.1	3884.4	337.4	0.4	163.4	75.1	194.8
Run 15-1	0.0	0.0	2093.7	3516.0	436.3	0.1	164.5	78.3	151.7
Run 16-1	0.1	0.4	2136.1	3473.2	400.4	0.2	137.5	77.5	194.3
Run 17-1	0.2	0.7	2625.7	4042.9	357.0	0.3	155.9	75.1	154.1
Run 18-1	0.5	1.1	2535.8	3889.3	380.2	0.2	154.7	75.0	151.3
Run 19-1	0.0	0.1	2222.3	3668.2	424.7	0.2	140.0	74.7	194.0
Run 20-1	0.2	0.7	2181.5	3600.7	334.0	0.2	150.5	76.8	196.2
Run 21-1	0.0	0.0	2541.4	3843.4	432.8	0.2	139.9	75.5	153.1
Run 22-1	0.0	0.2	2636.4	4219.9	386.1	0.2	164.4	75.8	153.7
Run 23-1	0.2	0.3	2241.2	3723.2	347.8	0.2	158.5	74.8	194.6
Run 24-1	0.0	0.1	2664.3	4248.1	352.0	0.4	171.7	71.5	195.8
Run 25-1	0.0	0.1	2068.0	2611.9	394.0	0.3	153.7	72.3	192.9
Run 25-1	0.0	0.1	2042.6	2584.3	392.2	0.3	154.9	71.7	193.8

The following three tables lists the aggregate values for the output collected from the second independent observation of the Plackett-Burman experimental design.

Thunder Output
Plackett-Burman Design
Observation 2

	Tank(d)	Tank(o)	APC(d)	APC(o)	Inf(d)	Inf(o)	Arty(d)	Arty(o)	Halt(days)	Halt(dist)	Restore(days)	Push	TmpRdBrid	TSPT
Run 01-2	9248.5	9196.9	8019.9	10562.6	1130.7	3357.1	2472.8	2216.5	5.0	-22.9	7.17	91.5	9.6	2.8
Run 02-2	7838.4	7699.8	6145.4	8689.7	954.6	2359.0	2077.7	2018.2	5.5	-22.0	7.29	88.7	10.4	0.3
Run 03-2	7852.3	9669.5	6886.0	10980.3	915.1	3255.7	2114.7	2527.3	4.5	-23.5	7.17	91.5	8.1	2.7
Run 04-2	10340.9	7598.3	9180.0	8108.6	1381.7	2693.7	2993.6	1502.5	6.0	22.7	7.13	91.2	7.0	0.0
Run 05-2	8670.0	9584.2	7691.4	9867.2	1076.5	2920.6	2388.3	2156.3	5.0	-22.7	7.17	89.9	6.6	2.3
Run 06-2	7578.0	9706.5	6612.6	10944.1	856.6	3237.2	2038.5	2494.8	4.5	-22.7	7.15	91.9	7.7	0.2
Run 07-2	7767.7	7637.8	6445.9	8309.0	880.9	2368.0	2087.1	1991.3	5.5	-24.1	7.27	89.8	7.1	1.4
Run 08-2	7891.1	8330.7	6211.4	8382.3	941.2	2268.6	2055.5	1907.3	5.5	-22.5	7.31	88.4	10.5	0.0
Run 09-2	7615.8	8264.4	6184.1	8714.5	922.4	2612.9	2053.6	2046.8	5.5	-22.8	7.35	91.6	7.7	2.0
Run 10-2	8665.7	6549.2	7035.9	7798.8	1116.7	2592.3	2993.6	1502.5	6.0	-22.6	7.34	82.8	9.3	2.4
Run 11-2	8685.3	7568.1	7196.8	7662.7	1099.4	2176.2	2993.6	1502.5	6.0	-24.4	7.33	91.0	7.6	1.8
Run 12-2	10339.7	6925.8	9188.9	8212.0	1351.1	2578.6	2993.6	1502.5	6.0	-22.7	7.16	91.5	8.0	0.0
Run 13-2	8542.5	7370.0	6775.2	8343.8	1077.6	2484.7	2993.6	1502.5	6.0	-23.3	7.32	92.5	8.6	6.0
Run 14-2	8896.5	9350.1	7895.5	10210.8	1059.0	3009.2	2443.5	2141.0	5.0	-22.9	7.19	88.0	9.3	2.6
Run 15-2	8728.8	7387.3	7090.4	7915.2	1058.7	2367.4	2993.6	1502.5	6.0	-23.7	7.27	90.8	9.3	0.1
Run 16-2	6540.9	9035.1	5287.0	8788.9	814.5	2609.5	1776.5	2128.5	5.0	-21.7	7.32	91.0	7.0	1.7
Run 17-2	7692.4	9508.0	6515.6	11084.6	861.3	3445.1	2010.8	2511.4	4.5	-23.3	7.24	87.0	11.8	0.3
Run 18-2	9621.1	7742.1	8310.3	9312.3	1251.3	2745.7	2681.9	1833.5	5.5	-23.1	7.17	92.1	8.1	4.8
Run 19-2	8504.9	6763.5	6982.1	7884.3	1074.0	2434.6	2993.6	1502.5	6.0	-21.7	7.30	93.0	6.5	1.7
Run 20-2	8541.1	6121.6	6835.6	7216.3	1077.5	2418.1	2993.6	1502.5	6.0	-22.6	7.38	78.6	9.1	6.7
Run 21-2	10280.7	6422.9	9056.0	7955.8	1347.7	2960.0	2936.2	1445.6	7.0	-22.3	8.23	82.3	7.9	1.9
Run 22-2	8928.0	9470.9	7635.6	10273.7	1029.9	2952.7	2400.2	2210.1	5.0	-23.0	7.15	92.20	11.0	0.3
Run 23-2	8209.8	7649.4	6663.4	8900.9	1002.8	2588.1	2174.6	2106.4	5.5	-23.6	7.56	92.5	11.2	0.0
Run 24-2	8027.2	10206.1	6888.1	11441.8	870.96	3472.75	2110.6	2568.8	4.5	-22.3	7.16	91.9	11.1	9.1
Run 25-2	9076.3	6885.7	7589.1	7344.2	1178.1	2146.8	2512.1	1517.4	6.0	-22.5	8.39	84.8	7.8	0.9
Run 26-2	8465.2	7800.9	7193	8311.0	1038.0	2325.8	2326.2	1851.6	5.5	-22.9	8.23	90.3	7.6	1.4

Thunder Output
Plackett-Burman Design
Observation 2 (Cont)

	RedAALosses	RedSALosses	RedAGLosses	BlueAALosses	BlueSALosses	BlueAGLosses	Runways	ACinOpen	ABAmmo(H)	ABMaint(S)	ABSpares(S)
Run 01-2	390.3	205.8	3.8	-401.0	-313.8	-0.1	0.4	3.4	43.4	171.7	20.8
Run 02-2	343.4	225.0	6.8	-450.0	-263.8	-0.1	0.4	6.3	40.3	155.0	16.6
Run 03-2	323.5	233.7	4.6	-409.9	-312.0	-0.1	0.5	3.8	55.9	166.5	23.4
Run 04-2	345.7	230.6	4.5	-409.9	-332.6	-0.2	0.0	3.4	27.5	132.6	17.0
Run 05-2	343.5	238.5	4.1	-382.5	-335.4	0.0	0.2	3.6	35.8	124.7	17.3
Run 06-2	336.6	232.1	3.7	-392.9	-327.6	0.0	0.0	2.9	28.9	124.7	17.6
Run 07-2	368.8	220.7	6.1	-365.5	-288.9	-0.2	0.2	4.7	21.2	126.4	17.9
Run 08-2	328.0	235.7	5.0	-366.5	-278.7	-0.2	0.1	3.6	23.3	127.6	17.3
Run 09-2	368.6	203.3	3.4	-388.3	-271.0	0.0	0.3	2.8	24.6	131.2	18.0
Run 10-2	350.9	234.2	4.1	-417.4	-251.6	0.0	0.6	3.6	28.1	130.4	15.6
Run 11-2	367.7	206.3	4.5	-436.2	-281.0	0.0	0.3	4.0	21.2	123.7	16.3
Run 12-2	384.1	222.8	4.9	-371.7	-356.1	0.0	0.5	4.1	48.0	131.2	16.8
Run 13-2	370.8	219.3	5.6	-385.3	-282.0	0.0	0.2	4.4	25.9	121.5	17.1
Run 14-2	341.4	242.3	6.4	-410.8	-297.4	-0.1	0.0	5.8	25.1	136.2	20.6
Run 15-2	339.7	229.6	4.7	-441.6	-250.7	0.0	0.6	4.0	37.0	143.7	21.5
Run 16-2	372.9	216.4	5.5	-389.0	-282.1	-0.2	0.5	4.4	18.0	138.7	21.4
Run 17-2	363.5	230.9	4.7	-382.4	-317.0	0.0	0.0	3.9	17.4	115.7	16.8
Run 18-2	361.6	202.9	5.0	-463.5	-331.4	0.0	0.0	4.1	18.6	126.5	16.8
Run 19-2	385.2	209.1	4.7	-450.8	-273.2	0.0	0.9	3.8	33.3	161.7	21.9
Run 20-2	336.8	235.7	8.8	-423.7	-257.8	-0.2	0.6	7.7	33.6	140.1	17.9
Run 21-2	372.7	213.7	4.8	-392.0	-354.3	-0.2	0.5	3.3	17.4	131.5	17.4
Run 22-2	370.6	222.5	6.5	-383.1	-334.7	0.0	0.1	5.5	29.1	135.0	15.5
Run 23-2	383.7	198.3	3.3	-431.0	-270.3	-0.1	0.3	2.7	35.2	142.0	18.0
Run 24-2	388.4	196.8	6.5	-411.5	-305.6	0.0	0.9	5.9	44.5	168.7	21.4
Run 25-2	347.9	224.2	4.1	-421.9	-270.0	-0.1	0.3	3.4	25.0	128.1	19.5
Run 25-2	342.1	226.5	6.1	-403.9	-277.0	0.0	0.1	4.9	23.6	130.6	20.1

Thunder Output
Plackett-Burman Design
Observation 2 (Cont)

	C3Ant	C3Van	ADTel	ADRadar	CmdBunker	Mainstay	Helo	StoneBldg	NBCFacil
Run 01-2	0.6	1.9	2797.4	4504.9	364.5	0.2	157.6	80.9	196.5
Run 02-2	0.0	0.0	2161.5	3886.4	403.8	0.1	174.4	78.0	151.7
Run 03-2	0.1	0.4	2628.3	3942.0	421.6	0.4	157.4	74.4	198.0
Run 04-2	0.0	0.0	2507.8	3816.3	439.7	0.2	152.6	74.9	152.8
Run 05-2	1.5	1.9	2486.1	3677.8	384.4	0.2	175.2	67.1	193.3
Run 06-2	0.3	0.2	2485.0	3633.7	371.6	0.2	155.5	70.4	196.1
Run 07-2	0.0	0.0	2052.6	3210.6	380.0	0.1	151.8	72.8	196.1
Run 08-2	0.0	0.0	2041.8	3431.0	312.5	0.1	155.0	76.1	196.6
Run 09-2	0.1	0.5	2195.4	3466.4	435.2	0.3	146.5	76.3	149.7
Run 10-2	0.1	0.4	2181.1	3766.8	388.5	0.2	148.4	73.1	153.1
Run 11-2	0.0	0.0	2107.4	3384.9	441.1	0.4	156.5	76.8	154.1
Run 12-2	0.0	0.0	2472.9	3851.2	432.1	0.2	158.1	72.4	154.4
Run 13-2	0.4	0.9	2158.9	3674.5	369.8	0.5	149.6	75.2	156.1
Run 14-2	0.0	0.0	2615.8	3855.0	339.9	0.4	167.1	72.6	195.6
Run 15-2	0.0	0.0	2182.3	3543.1	438.6	0.1	149.7	82.0	152.4
Run 16-2	0.4	1.1	2095.4	3392.9	401.0	0.3	133.4	75.8	192.9
Run 17-2	0.7	2.1	2607.1	4066.7	356.3	0.3	152.8	78.5	155.2
Run 18-2	1.5	2.5	2435.2	3763.9	385.0	0.3	156.3	72.7	152.0
Run 19-2	0.1	0.2	2186.4	3618.2	423.4	0.1	146.3	73.9	193.9
Run 20-2	0.5	2.0	2126.0	3566.1	333.4	0.3	144.1	80.4	194.6
Run 21-2	0.0	0.0	2521.6	3821.8	430.5	0.1	139.7	74.9	150.3
Run 22-2	0.0	0.0	2601.1	4234.6	390.5	0.2	163.0	74.7	155.3
Run 23-2	0.0	0.0	2251.2	3642.4	352.8	0.1	162.5	73.9	193.6
Run 24-2	0.0	0.0	2737.0	4369.7	350.4	0.4	161.5	73.6	194.8
Run 25-2	0.0	0.1	2068.0	2611.9	394.0	0.3	153.7	72.3	192.9
Run 25-2	0.1	0.1	2122.9	2649.1	393.7	0.1	145.8	71.2	192.4

The following table lists the aggregate values for the output collected from the first independent observation of the Fractional Factorial experimental design.

Thunder Output
Fractional Factorial Design
Observation 1

	Tank(d)	Tank(o)	APC(d)	APC(o)	Inf(d)	Inf(o)	Arty(d)	Arty(o)	Halt(days)	Halt(dist)	Restore(days)	Push
Run1	7725	7868	6376	8882	938	2497	2106	2081	5.5	-22.9	8.29	91.3
Run2	7563	8536	6144	8039	913	2183	2048	1849	5.5	-22.6	8.35	88.5
Run3	7681	7520	6325	8211	903	2410	2049	1961	5.5	-23.2	8.35	87.6
Run4	7766	8316	6339	8214	931	2259	2071	1937	5.5	-23.2	8.35	85.9
Run5	8493	8484	7472	9586	993	2921	2318	2110	5.0	-23.0	8.22	87.2
Run6	9495	8785	8336	9184	1195	2618	2654	1858	5.5	-22.6	8.15	93.5
Run7	8436	8450	7329	9593	1003	2900	2300	2116	5.0	-22.8	8.20	90.1
Run8	9390	8679	8189	8975	1163	2672	2621	1833	5.5	-23.2	8.19	90.6
Run9	8362	6926	6787	7279	1060	2200	2292	1619	6.0	-23.0	8.37	88.8
Run10	8694	8247	7365	8712	1064	2471	2394	1920	5.5	-23.2	8.18	90.5

	TmpRdBrid	TSPT	RedAALosses	RedSALosses	RedAGLosses	BlueAALosses	BlueSALosses	BlueAGLosses	Runways	ACinOpen	ABAmmo(H)
Run1	6.4	1.5	327.2	245.0	6.3	-399.3	-262.5	0.0	0.3	4.7	13.0
Run2	7.3	0.9	331.4	242.3	5.4	-396.4	-271.2	0.0	0.3	4.6	18.2
Run3	8.0	0.9	331.3	235.1	5.1	-425.9	-286.9	-0.1	0.6	4.5	22.6
Run4	7.8	0.0	332.5	226.7	4.6	-420.4	-262.9	0.0	0.4	3.9	23.7
Run5	7.0	1.8	326.1	244.9	5.1	-388.4	-332	0.0	0.3	4.3	13.3
Run6	7.0	1.0	335.1	238.9	4.2	-407	-330.9	-0.1	0.3	3.6	17.4
Run7	8.3	1.2	341.5	225.6	4.9	-431.9	-335.9	0.0	0.4	4.1	16.0
Run8	7.6	1.2	345.7	228.0	5.0	-419.8	-328.5	0.0	0.0	4.2	22.1
Run9	8.4	0.1	372.8	226.6	3.7	-393.1	-229.8	-0.1	0.1	2.9	14.3
Run10	7.2	1.7	333.1	239.8	4.8	-395.1	-310.3	0.0	0.1	4.1	12.0

	ABMaint(S)	ABSpares(S)	C3Ant	C3Van	ADTel	ADRadar	CmdBunker	Mainstay	Helo	StoneBldg	NBCFacil
Run1	111.1	15.1	0	0	2098	3252.8	422	0.1	154.4	69.3	152.8
Run2	110.5	15.6	0	0	1979.8	3121.9	417.3	0.3	162.7	70.6	152.5
Run3	125.2	20	0	0.2	2064.8	3237.1	435.4	0.2	149.6	73.2	149.7
Run4	129.4	21.8	0	0	2034.5	3232	434.2	0.1	157.8	71.8	151.6
Run5	112.9	15.5	0	0.2	2395.7	3494.7	423.2	0.1	155.7	70	151.9
Run6	109	15.4	0	0	2402.8	3467.1	417.9	0.1	170.5	71.2	152.1
Run7	120.9	20.4	0	0.2	2379.2	3473.6	430	0.3	154.7	71.7	151.8
Run8	125.1	20.8	0	0.2	2412.4	3552	431.6	0.2	171.9	73.6	152.6
Run9	97.9	17.1	0.1	0.3	1938.6	2373.5	391.2	0.4	154.1	70.8	150
Run10	117.1	16.7	0	0	2245.3	3399.4	426.8	0.3	162	70.5	152.2

The following table lists the aggregate values for the output collected from the second independent observation of the Fractional Factorial experimental design.

Thunder Output
Fractional Factorial Design
Observation 2

	Tank(d)	Tank(o)	APC(d)	APC(o)	Inf(d)	Inf(o)	Arty(d)	Arty(o)	Halt(days)	Halt(dist)	Restore(days)	Push
Run1	7587.2	7463.4	6253.5	8060.8	896.5	2458.1	2048.7	1880.8	5.5	-23.7	8.4	80.8
Run2	8423.6	7742.0	6883.4	7711.2	1049.4	1991.0	2302.2	1719.4	6.0	-23.3	8.0	88.3
Run3	8603.4	6819.3	7103.3	7901.8	1058.7	2351.3	2364.0	1772.6	6.0	-23.8	8.0	90.3
Run4	8522.7	7644.9	6958.8	7324.0	1056.6	1994.2	2301.0	1615.5	6.0	-23.3	8.0	86.0
Run5	10216.3	6836.8	9028.3	8300.1	1351.2	2645.6	2932.6	1549.6	6.0	-22.9	8.0	90.6
Run6	9234.0	8762.0	8005.6	9206.5	1153.5	2711.3	2599.0	1858.6	5.5	-23.0	8.2	90.9
Run7	10087.1	6799.0	8797.7	8268.3	1309.8	2666.6	2860.6	1580.0	6.0	-22.7	8.0	90.8
Run8	10188.1	7929.0	8841.2	8288.5	1334.0	2431.1	2875.7	1543.5	6.0	-22.8	8.0	89.2
Run9	8522.2	8237.0	7179.8	8583.3	1018.1	2381.5	2297.7	1911.2	5.5	-23.1	8.2	88.6
Run10	9296.4	7354.4	7771.7	7589.5	1179.5	2117.0	2578.0	1538.1	6.0	-22.6	8.0	87.1

	TmpRdBrid	TSPT	RedAALosses	RedSALosses	RedAGLosses	BlueAALosses	BlueSALosses	BlueAGLosses	Runways	ACInOpen	ABAmmo(H)
Run1	8.5	0.9	331.1	238.6	5.0	-394.2	-263.7	0.0	0.2	4.2	27.4
Run2	7.5	1.8	330.2	246.3	4.3	-399.1	-267.3	0.0	0.4	3.3	17.1
Run3	7.4	0.5	332.1	229.2	5.1	-419.5	-266.2	-0.1	0.5	3.8	22.1
Run4	7.0	1.4	338.5	221.6	4.6	-433.3	-274.5	0.0	0.3	3.4	25.1
Run5	7.2	1.6	330.8	235.2	4.2	-390.9	-328.9	0.0	0.3	3.3	21.8
Run6	7.1	1.0	333.5	234.8	5.0	-403.3	-320.8	0.0	0.4	4.2	19.0
Run7	7.7	3.6	327.1	229.8	5.5	-404.2	-322.9	0.0	0.5	4.7	22.4
Run8	7.8	0.1	334.8	227.5	5.4	-424.9	-325.0	0.0	0.5	4.5	21.9
Run9	7.8	0.0	332.8	244.3	4.7	-421.0	306.8	-0.1	0.2	4.0	22.2
Run10	7.6	1.1	329.2	238.0	3.8	-412.6	-310.7	0.0	0.2	2.8	26.6

	ABMaint(S)	ABSpares(S)	C3Ant	C3Van	ADTel	ADRadar	CmdBunker	Mainstay	Helo	StoneBldg	NBCFacil
Run1	110.2	17.3	0.1	0.1	2009.0	3202.2	416.1	0.2	146.3	71.9	149.9
Run2	110.1	17.3	0.0	0.0	1983.5	3111.7	414.7	0.2	162.7	70.9	152.4
Run3	125.4	19.2	0.1	0.1	2114.3	3316.6	432.5	0.1	150.2	70.4	151.9
Run4	124.5	19.9	0.1	0.3	1987.1	3199.1	434.8	0.2	166.3	71.6	153.4
Run5	110.2	15.4	0.0	0.0	2414.2	3530.1	418.9	0.2	154.5	70.3	150.9
Run6	108.8	16.0	0.2	0.2	2406.4	3465.6	422.7	0.2	168.7	69.7	151.2
Run7	126.4	19.8	0.1	0.2	2414.6	3675.5	433.1	0.2	154.4	72.1	152.2
Run8	126.8	20.1	0.0	0.0	2388.2	3629.0	432.9	0.1	174.7	73.1	153.1
Run9	114.2	15.2	0.0	0.0	2160.6	3259.4	424.1	0.2	165.6	70.5	153.8
Run10	115.1	14.5	0.1	0.3	2137.9	3301.7	422.8	0.3	165.3	73.3	149.7

Appendix G

The following tables reflect the factor loadings derived from Factor Analysis with varimax rotation for each design. **Boldface** values indicate the highest loadings for that factor.

Factor Scores

Plackett Burman Design

Rotated Components

	EVICT	OCA	HALT	Air Sup	C3	Air Sup	Interdiction
Tank(d)	0.04	0.06	**0.96**	0.01	-0.12	0.05	-0.06
Tank(o)	**0.86**	-0.06	0.12	-0.12	-0.04	0.04	-0.01
APC(d)	0.19	0.04	**0.96**	-0.01	-0.01	0.03	-0.06
APC(o)	**0.90**	-0.02	0.26	-0.25	-0.14	0.04	-0.11
Inf(d)	-0.12	0.01	**0.95**	0.13	-0.05	0.02	-0.03
Inf(o)	**0.72**	0.00	0.50	-0.33	-0.08	-0.07	-0.08
Arty(d)	-0.77	0.03	**0.42**	-0.18	-0.07	0.02	0.14
Arty(o)	**0.96**	-0.05	-0.05	-0.15	-0.02	-0.03	-0.14
Halt(days)	**-0.94**	0.09	-0.01	0.17	-0.07	-0.04	0.07
Halt(dist)	0.40	-0.27	-0.09	0.35	-0.14	0.10	0.05
Restore(days)	-0.31	-0.01	-0.22	0.84	0.03	-0.02	-0.04
Push	0.42	-0.03	0.49	-0.25	0.08	-0.13	0.31
TmpRdBrid	0.25	-0.07	-0.34	-0.19	**-0.56**	0.16	0.00
TSPT	0.00	-0.08	0.04	-0.29	**-0.60**	-0.15	**-0.56**
RedAALosses	0.08	-0.11	-0.04	-0.18	-0.15	**-0.86**	-0.02
RedSALosses	0.05	0.41	0.10	0.13	0.05	**0.78**	0.11
RedAGLosses	0.17	-0.31	-0.02	-0.51	0.08	**0.68**	-0.10
BlueAALosses	-0.11	0.00	0.05	**0.90**	0.05	0.00	-0.13
BlueSALosses	-0.06	0.11	0.06	**0.80**	0.03	0.17	-0.16
BlueAGLosses	-0.04	0.11	0.12	**0.50**	0.27	-0.23	0.04
Runways	0.14	**-0.84**	-0.24	-0.07	0.06	0.01	0.10
ACinOpen	0.17	-0.25	-0.10	-0.52	0.09	**0.66**	0.01
ABAmmo(H)	0.20	**-0.91**	-0.06	-0.12	-0.23	0.16	-0.01
ABMaint(S)	0.12	**-0.91**	-0.01	-0.13	-0.24	-0.09	-0.11
ABSpares(S)	-0.06	**-0.87**	0.23	0.03	-0.04	-0.20	-0.08
C3Ant	0.05	-0.19	0.19	0.00	**-0.83**	-0.16	0.03
C3Van	0.00	-0.11	0.21	0.00	**-0.87**	-0.21	-0.03
ADTel	**0.69**	-0.07	**0.64**	-0.25	-0.13	0.00	-0.10
ADRadar	**0.53**	-0.17	0.32	**-0.60**	-0.41	0.00	0.08
CmdBunker	-0.17	-0.28	0.11	0.04	**0.46**	-0.27	**0.68**
Mainstay	0.35	0.04	0.16	0.16	-0.06	-0.33	**-0.68**
Helo	0.54	-0.22	-0.03	0.09	-0.23	0.33	-0.14
StoneBldg	-0.32	-0.11	-0.12	-0.29	-0.39	0.10	**0.62**
NBCFacil	0.02	-0.34	0.01	0.15	0.04	0.09	**-0.80**

Rotation Matrix

0.77	-0.27	0.29	-0.41	-0.25	0.04	-0.13
0.09	0.53	0.75	0.32	0.11	-0.14	-0.13
-0.53	-0.30	0.47	-0.35	-0.37	-0.29	0.25
0.03	-0.44	-0.06	0.58	-0.28	-0.42	-0.46
-0.01	-0.60	0.34	0.25	0.55	0.35	0.19
-0.25	0.03	0.12	0.07	-0.43	0.76	-0.40
0.23	0.04	-0.04	0.45	-0.47	0.15	0.70

Factor Scores
Fractional Factorial Design

Rotated Components

	Halt	Air Sup	Evict	Air Sup	c3	Inter	Air sup
Tank(d)	**0.97**	0.12	-0.16	0.00	-0.03	0.05	0.10
Tank(o)	-0.12	-0.18	**0.51**	0.08	-0.02	0.16	0.07
APC(d)	**0.98**	0.10	-0.05	-0.03	-0.05	0.06	0.09
APC(o)	0.43	-0.04	**0.83**	0.09	-0.07	0.32	-0.10
Inf(d)	**0.95**	0.12	-0.21	-0.02	-0.05	0.05	0.16
Inf(o)	0.58	0.14	**0.70**	-0.34	0.06	0.12	-0.03
Arty(d)	**0.97**	0.10	-0.13	-0.05	-0.03	0.08	0.14
Arty(o)	-0.59	-0.08	**0.69**	0.03	-0.06	0.24	-0.29
Halt(days)	0.29	0.25	**-0.89**	-0.15	-0.04	0.03	0.18
Halt(dist)	**0.84**	-0.29	-0.12	0.24	0.04	-0.21	0.13
Restore(days)	-0.44	-0.19	**0.83**	-0.05	0.00	-0.24	-0.01
Push	**0.69**	0.14	-0.12	0.02	-0.02	**0.63**	-0.20
TmpRdBrid	-0.25	0.05	0.41	-0.28	-0.41	**-0.69**	0.01
TSPT	0.27	0.05	-0.21	-0.49	0.18	0.09	0.44
RedAALosses	-0.27	0.30	-0.05	**0.73**	0.22	0.08	-0.10
RedSALosses	-0.22	**-0.68**	0.25	-0.11	-0.55	0.10	-0.06
RedAGLosses	0.12	**0.85**	0.49	-0.05	-0.02	-0.04	0.01
BlueAALosses	0.08	**-0.44**	0.34	**-0.63**	-0.24	0.17	**0.44**
BlueSALosses	-0.20	-0.20	0.25	0.26	-0.30	-0.05	**-0.77**
BlueAGLosses	0.24	-0.16	-0.07	0.07	0.12	-0.21	**0.90**
Runways	0.33	**0.75**	-0.09	-0.08	-0.09	0.41	0.22
ACinOpen	0.22	**0.66**	0.66	-0.03	-0.11	-0.11	0.02
ABAmmo(H)	-0.19	-0.07	-0.05	-0.18	0.42	**-0.82**	-0.15
ABMaint(S)	0.21	**0.81**	-0.39	0.06	0.18	-0.24	-0.21
ABSpares(S)	-0.07	**0.94**	-0.20	0.03	0.04	-0.07	0.20
C3Ant	-0.11	0.05	0.36	-0.07	**0.85**	0.12	0.22
C3Van	-0.04	-0.07	-0.19	0.07	**0.91**	-0.20	0.16
ADTel	**0.92**	0.12	0.32	-0.05	0.02	0.14	0.04
ADRadar	**0.91**	0.26	0.22	-0.15	0.10	0.03	0.04
CmdBunker	0.28	**0.74**	-0.26	0.21	0.40	-0.11	-0.29
Mainstay	0.01	**-0.83**	-0.10	-0.04	0.32	-0.24	0.14
Helo	0.33	-0.05	-0.10	**0.92**	-0.04	0.03	0.06
StoneBldg	0.17	0.11	-0.33	0.10	-0.01	**-0.85**	0.25
NBCFacil	0.01	0.50	-0.16	0.54	-0.28	0.21	-0.36

Rotation Matrix

0.85865	0.413	-0.23498	-0.00878	0.0668	0.11146	0.14132
0.39955	-0.5688	0.58426	-0.27556	-0.20786	0.19776	0.13127
-0.06426	0.56442	0.62178	0.23075	-0.17693	0.28591	-0.35269
-0.12033	0.37799	0.31905	-0.63699	0.28213	-0.40453	0.30307
0.14692	-0.1582	0.32808	0.57206	0.64043	-0.31479	0.09626
0.19938	-0.00593	0.04716	0.125	-0.52787	-0.77674	-0.24575
-0.1521	0.13927	0.07186	0.34945	-0.39069	0.0257	0.82273

Appendix H

This appendix contains the stepwise linear regression results for both the Plackett-Burman and Fractional Factorial designs.

Stepwise Regression: Total Combat Index
Plackett-Burman Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
36215947	13	2785842	0.9507	0.909	0.378401	378.6534

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	62020.34	1	0.0	0.000	1.000
	X	F15C	566.15	1	7692697.0	2.761	0.121
	X	F16	989.35	1	23491661.0	8.433	0.012
	X	F15E	706.15	1	11967454.0	4.296	0.059
		F111		1	868854.1	0.295	0.597
		F4G		1	10961.7	0.004	0.953
	X	A10	4931.75	1	583730000.0	209.535	0.000
		EF111		1	1400635.0	0.483	0.500
	X	F117	774.70	1	14404012.0	5.170	0.041
		AWACS		1	256327.9	0.086	0.775
		JSTARS		1	325466.3	0.109	0.747
	X	TOM	649.00	1	10108954.0	3.629	0.079
		AIM120		1	619342.8	0.209	0.656
		AIM9		1	1121.6	0.000	0.985
		20MM		1	1388165.0	0.478	0.502
		MK82		1	1175123.0	0.402	0.538
	X	AGM65	771.50	1	14285266.0	5.128	0.041
	X	ARM88	584.18	1	8190520.0	2.940	0.110
	X	DELAY	659.49	1	10438118.0	3.747	0.075
		LETHAL		1	2592623.0	0.925	0.355
		CBU87		1	256789.2	0.086	0.775
	X	CBU97	-583.31	1	8165987.0	2.931	0.111
		LGB		1	1046653.0	0.357	0.561
	X	GPS	-497.09	1	5930336.0	2.129	0.168

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0	583730000.0	0.7946	-15.260	2
2	F16	Entered	0.0564	23491661.0	0.8266	-14.150	3
3	F117	Entered	0.1167	14404012.0	0.8462	-12.700	4
4	AGM65	Entered	0.1044	14285266.0	0.8656	-11.240	5
5	F15E	Entered	0.1219	11967454.0	0.8819	-9.699	6
6	DELAY	Entered	0.134	10438118.0	0.8961	-8.096	7
7	TOM	Entered	0.1255	10108954.0	0.9099	-6.481	8
8	ARM88	Entered	0.1523	8190520.0	0.9210	-4.792	9
9	CBU97	Entered	0.1378	8165987.0	0.9322	-3.103	10
10	F15C	Entered	0.1322	7692697.0	0.9426	-1.396	11
11	GPS	Entered	0.1683	5930336.0	0.9507	0.378	12

Stepwise Regression: Halt Index
Plackett-Burman Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
2242094.2	10	224209.4	0.9811	0.9527	9.476379	327.4854

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	24412.82	1	0.00	0.000	1.000
		F15C	?	1	64667.40	0.267	0.618
		F16	?	1	94.41	0.000	0.985
	X	F15E	263.93	1	1671754.00	7.456	0.021
	X	F111	234.54	1	1320235.00	5.888	0.036
		F4G	?	1	2484.74	0.010	0.923
	X	A10	1672.46	1	67130805.00	299.411	0.000
	X	EF111	233.55	1	1309094.00	5.839	0.036
	X	F117	-654.18	1	10270678.00	45.808	0.000
	X	AWACS	-181.84	1	793593.40	3.540	0.089
	X	JSTARS	-293.28	1	2064245.00	9.207	0.013
		TOM	?	1	309083.20	1.439	0.261
	X	AIM120	500.48	1	6011405.00	26.812	0.000
	X	AIM9	298.55	1	2139170.00	9.541	0.012
		20MM	?	1	156655.00	0.676	0.432
	X	MK82	656.23	1	10335150.00	46.096	0.000
		AGM65	?	1	23990.73	0.097	0.762
	X	ARM88	-306.12	1	2248978.00	10.031	0.010
	X	DELAY	-430.68	1	4451715.00	19.855	0.001
		LETHAL	?	1	92231.20	0.386	0.550
		CBU87	?	1	302985.50	1.406	0.266
	X	CBU97	296.72	1	2112979.00	9.424	0.012
	X	LGB	364.66	1	3191417.00	14.234	0.004
	X	GPS	232.79	1	1300607.00	5.801	0.037

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0	67130805	0.5661	57.794	2
2	MK82	Entered	0.0247	10335150	0.6532	43.769	3
3	F117	Entered	0.0129	10270678	0.7398	29.844	4
4	AIM120	Entered	0.035	6011405	0.7905	22.524	5
5	DELAY	Entered	0.0497	4451715	0.828	17.621	6
6	LGB	Entered	0.0759	3191417	0.8549	14.673	7
7	ARM88	Entered	0.1173	2248978	0.8739	13.186	8
8	AIM9	Entered	0.1103	2139170	0.8919	11.869	9
9	CBU97	Entered	0.0945	2112979	0.9098	10.593	10
10	JSTARS	Entered	0.0778	2064245	0.9272	9.3923	11
11	F15E	Entered	0.0881	1671754	0.9413	8.8002	12
12	F111	Entered	0.1048	1320235	0.9524	8.7532	13
13	EF111	Entered	0.0813	1309094	0.9634	8.7234	14
14	GPS	Entered	0.0527	1300607	0.9744	8.7069	15
15	AWACS	Entered	0.0893	793593.4	0.9811	9.4764	16

Stepwise Regression: Evict Index
Plackett-Burman Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
34386474	13	2645113	0.8615	0.7336	3.385193	392.472

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	22144.03	1	0.00	0.000	1.000
		F15C	?	1	3207482.00	1.234	0.288
	X	F16	576.01	1	7962854.00	3.010	0.106
		F15E	?	1	1197335.00	0.433	0.523
		F111	?	1	568999.20	0.202	0.661
		F4G	?	1	54950.94	0.019	0.892
	X	A10	2088.13	1	104650000.00	39.562	0.000
		EF111	?	1	3675.38	0.001	0.972
	X	F117	1042.72	1	26094193.00	9.865	0.008
		AWACS	?	1	968177.30	0.348	0.566
		JSTARS	?	1	2813432.00	1.069	0.322
	X	TOM	520.02	1	6490016.00	2.454	0.141
	X	AIM120	-496.47	1	5915500.00	2.236	0.159
		AIM9	?	1	1934949.00	0.716	0.414
		20MM	?	1	1242332.00	0.450	0.515
	X	MK82	-646.88	1	10042993.00	3.797	0.073
	X	AGM65	554.38	1	7375959.00	2.789	0.119
	X	ARM88	648.13	1	10081584.00	3.811	0.073
	X	DELAY	748.66	1	13451743.00	5.086	0.042
		LETHAL	?	1	1283623.00	0.465	0.508
		CBU87	?	1	795704.20	0.284	0.604
	X	CBU97	-661.47	1	10500916.00	3.970	0.068
	X	LGB	-458.18	1	5038184.00	1.905	0.191
	X	GPS	-508.84	1	6214076.00	2.349	0.149

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.0003	1.05E+08	0.4216	-7.868	2
2	F117	Entered	0.0336	26094193	0.5268	-8.437	3
3	DELAY	Entered	0.1058	13451743	0.581	-7.761	4
4	CBU97	Entered	0.1395	10500916	0.6233	-6.795	5
5	ARM88	Entered	0.1357	10081584	0.6639	-5.787	6
6	MK82	Entered	0.1233	10042993	0.7043	-4.776	7
7	F16	Entered	0.1561	7962854	0.7364	-3.56	8
8	AGM65	Entered	0.1599	7375959	0.7661	-2.286	9
9	TOM	Entered	0.175	6490016	0.7923	-0.925	10
10	GPS	Entered	0.1721	6214076	0.8173	0.4635	11
11	AIM120	Entered	0.1693	5915500	0.8412	1.8812	12
12	LGB	Entered	0.1908	5038184	0.8615	3.3852	13

Stepwise Regression: Air Sup Index
Plackett-Burman Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
6048888.6	19	318362.6	0.6258	0.5077	-8.72978	335.2895

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	-7215.75	1	0.00	0	1
	X	F15C	-138.51	1	460429.40	1.446	0.244
	X	F16	-192.17	1	886272.70	2.784	0.112
		F15E	?	1	291809.70	0.912	0.352
		F111	?	1	97741.61	0.296	0.593
		F4G	?	1	5304.43	0.016	0.901
	X	A10	-527.75	1	6684481.00	20.996	0.000
		EF111	?	1	27.74	0.000	0.993
	X	F117	-168.84	1	684180.20	2.149	0.159
		AWACS	?	1	37572.51	0.113	0.741
		JSTARS	?	1	13920.17	0.042	0.841
		TOM	?	1	370811.80	1.176	0.293
		AIM120	?	1	217322.60	0.671	0.424
		AIM9	?	1	1987.44	0.006	0.940
		20MM	?	1	39236.51	0.118	0.736
	X	MK82	140.37	1	472867.20	1.485	0.238
		AGM65	?	1	145735.30	0.444	0.514
		ARM88	?	1	347811.50	1.098	0.309
	X	DELAY	-196.70	1	928581.40	2.917	0.104
		LETHAL	?	1	205461.00	0.633	0.437
		CBU87	?	1	5997.68	0.018	0.895
		CBU97	?	1	199910.50	0.615	0.443
		LGB	?	1	52285.33	0.157	0.697
		GPS	?	1	316572.50	0.994	0.332

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.0004	6684481	0.4135	-16.87	2
2	DELAY	Entered	0.1277	928581.4	0.4709	-15.38	3
3	F16	Entered	0.125	886272.7	0.5258	-13.86	4
4	F117	Entered	0.1662	684180.2	0.5681	-12.23	5
5	MK82	Entered	0.2421	472867.2	0.5973	-10.48	6
6	F15C	Entered	0.2439	460429.4	0.6258	-8.73	7

Stepwise Regression: C3 Index
Plackett-Burman Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
1422115.1	22	64641.59	0.7023	0.6617	-15.2167	291.6485

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	-5010.90	1	0.00	0.000	1.000
		F15C	?	1	53638.21	0.823	0.375
	X	F16	-120.98	1	351287.20	5.434	0.029
	X	F15E	-63.75	1	97537.50	1.509	0.232
		F111	?	1	74973.08	1.169	0.292
		F4G	?	1	784.33	0.012	0.915
	X	A10	-347.99	1	2906357.00	44.961	0.000
		EF111	?	1	14278.88	0.213	0.649
		F117	?	1	12696.00	0.189	0.668
		AWACS	?	1	1001.04	0.015	0.904
		JSTARS	?	1	3621.13	0.054	0.819
		TOM	?	1	45675.38	0.697	0.413
		AIM120	?	1	156.06	0.002	0.962
		AIM9	?	1	17930.67	0.268	0.610
		20MM	?	1	6700.04	0.099	0.756
		MK82	?	1	19.44	0.000	0.987
		AGM65	?	1	48168.96	0.736	0.401
		ARM88	?	1	16182.43	0.242	0.628
		DELAY	?	1	38576.20	0.586	0.453
		LETHAL	?	1	23801.40	0.357	0.556
		CBU87	?	1	1548.83	0.023	0.881
		CBU97	?	1	16422.20	0.245	0.626
		LGB	?	1	1377.14	0.020	0.888
		GPS	?	1	22668.91	0.340	0.566

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0	2906357	0.6084	-18.34	2
2	F16	Entered	0.0305	351287.2	0.6819	-17.03	3
3	F15E	Entered	0.2323	97537.5	0.7023	-15.22	4

Stepwise Regression: OCA Index
Plackett-Burman Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
355133.65	13	27317.97	0.7436	0.507	3.129159	273.576

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	-1062.058	1	0.0	0.000	1.000
		F15C	?	1	33810.0	1.263	0.283
	X	F16	-45.975	1	50728.8	1.857	0.196
		F15E	?	1	15200.7	0.537	0.478
		F111	?	1	9227.7	0.320	0.582
		F4G	?	1	471.7	0.016	0.902
	X	A10	-74.617	1	133623.5	4.891	0.046
		EF111	?	1	1145.4	0.039	0.847
	X	F117	-97.908	1	230065.0	8.422	0.012
		AWACS	?	1	9266.9	0.322	0.581
		JSTARS	?	1	24180.8	0.877	0.368
	X	TOM	-43.125	1	44634.4	1.634	0.224
	X	AIM120	50.367	1	60883.2	2.229	0.159
		AIM9	?	1	8407.5	0.291	0.600
		20MM	?	1	11414.5	0.399	0.540
	X	MK82	69.108	1	114623.1	4.196	0.061
	X	AGM65	-41.025	1	40393.2	1.479	0.246
	X	ARM88	-53.075	1	67606.9	2.475	0.140
	X	DELAY	-67.817	1	110378.4	4.041	0.066
		LETHAL	?	1	11214.7	0.391	0.543
		CBU87	?	1	3810.2	0.130	0.725
	X	CBU97	57.192	1	78501.3	2.874	0.114
	X	LGB	43.792	1	46025.0	1.685	0.217
	X	GPS	46.867	1	52715.6	1.930	0.188

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	F117	Entered	0.0388	230065	0.1661	-11.82	2
2	A10	Entered	0.0962	133623.5	0.2625	-11	3
3	MK82	Entered	0.1096	114623.1	0.3453	-10.01	4
4	DELAY	Entered	0.1028	110378.4	0.425	-8.981	5
5	CBU97	Entered	0.1548	78501.28	0.4816	-7.672	6
6	ARM88	Entered	0.1761	67606.94	0.5304	-6.268	7
7	AIM120	Entered	0.1896	60883.23	0.5744	-4.805	8
8	GPS	Entered	0.2137	52715.63	0.6124	-3.269	9
9	F16	Entered	0.2147	50728.82	0.649	-1.716	10
10	LGB	Entered	0.2296	46025.04	0.6823	-0.122	11
11	TOM	Entered	0.2293	44634.37	0.7145	1.4851	12
12	AGM65	Entered	0.2456	40393.21	0.7436	3.1292	13

Stepwise Regression: Interdiction Index
Plackett-Burman Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
82326.17	11	7484.197	0.9548	0.8972	9.261879	239.569

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	-1887.9231	1	0.0	0.000	1.000
	X	F15C	-29.1875	1	20445.8	2.732	0.127
	X	F16	-56.1958	1	75791.3	10.127	0.009
		F15E	?	1	9239.5	1.264	0.287
	X	F111	29.6208	1	21057.5	2.814	0.122
		F4G	?	1	1818.3	0.226	0.645
	X	A10	-220.8125	1	1170196.0	156.356	0.000
		EF111	?	1	383.2	0.047	0.833
	X	F117	-96.4208	1	223127.5	29.813	0.000
		AWACS	?	1	8373.9	1.132	0.312
	X	JSTARS	-23.8042	1	13599.3	1.817	0.205
	X	TOM	-31.4292	1	23707.0	3.168	0.103
		AIM120	?	1	6590.2	0.870	0.373
		AIM9	?	1	10546.2	1.469	0.253
		20MM	?	1	5289.6	0.687	0.427
	X	MK82	21.9958	1	11611.6	1.551	0.239
	X	AGM65	-21.7458	1	11349.2	1.516	0.244
	X	ARM88	-42.7208	1	43801.7	5.853	0.034
	X	DELAY	-36.9042	1	32686.0	4.367	0.061
		LETHAL	?	1	4545.8	0.584	0.462
		CBU87	?	1	4248.0	0.544	0.478
	X	CBU97	43.9458	1	46349.7	6.193	0.030
	X	LGB	32.4458	1	25265.6	3.376	0.093
	X	GPS	28.5875	1	19613.9	2.621	0.134

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0	1170196	0.6426	19.592	2
2	F117	Entered	0.0021	223127.5	0.7652	7.3304	3
3	F16	Entered	0.0405	75791.32	0.8068	4.4862	4
4	CBU97	Entered	0.0887	46349.67	0.8322	3.5237	5
5	ARM88	Entered	0.0822	43801.67	0.8563	2.7241	6
6	DELAY	Entered	0.116	32686.02	0.8743	2.635	7
7	LGB	Entered	0.1525	25265.57	0.8881	3.0202	8
8	TOM	Entered	0.1529	23707.02	0.9011	3.5049	9
9	F111	Entered	0.1648	21057.45	0.9127	4.159	10
10	F15C	Entered	0.1575	20445.84	0.9239	4.8522	11
11	GPS	Entered	0.1508	19613.88	0.9347	5.5986	12
12	JSTARS	Entered	0.2176	13599.32	0.9422	6.7294	13
13	MK82	Entered	0.246	11611.6	0.9486	7.9873	14
14	AGM65	Entered	0.2438	11349.15	0.9548	9.2619	15

Stepwise Linear Regression: Total Combat Index
Fractional Factorial Design

Response:	Response
Stepwise Regression Control	
Prob to Enter	0.25
Prob to Leave	0.1

Direction
Rules:

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
44781376	8	5597672	0.7043	0.6674	-3.71247	157.1472

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	54725.20	1	0.00	0.000	1.0000
	X	A10	3651.63	1	106670000.00	19.057	0.0024
		F15E	?	1	378885.10	0.060	0.8139
		AGM65	?	1	1088550.00	0.174	0.6887
		MK82	?	1	1001820.00	0.160	0.7009
		A10*AGM65	?	2	3576115.00	0.260	0.7791
		A10*MK82	?	2	1671723.00	0.116	0.8921
		F15E*AGM65	?	3	2137338.00	0.084	0.9661
		F15E*MK82	?	3	3868270.00	0.158	0.9204
		A10*F15E	?	2	380965.30	0.026	0.9747
		AGM65*MK82	?	3	2092450.00	0.082	0.9671

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.0024	1.07E+08	0.7043	-3.712	2

Stepwise Linear Regression: Halt Index
Fractional Factorial Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction
Rules:

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
4448790.2	6	741465	0.9103	0.8655	0.192755	138.0556

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	26421.80	1	0.0	0.0000	1.0000
	X	A10	2248.13	2	44084281.0	29.7280	0.0008
		F15E	?	1	9316.1	0.0100	0.9224
	X	AGM65	366.88	2	4728531.0	3.1890	0.1139
		MK82	?	1	159895.1	0.1860	0.6839
	X	A10*AGM65	675.63	1	3651753.0	4.9250	0.0683
		A10*MK82	?	2	316415.3	0.1530	0.8628
		F15E*AGM65	?	2	165836.3	0.0770	0.9268
		F15E*MK82	?	0	0.0	?	?
		A10*F15E	?	2	74657.3	0.0340	0.9667
		AGM65*MK82	?	2	225236.3	0.1070	0.9013

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.0003	40432528	0.815	-1.477	2
2	A10*AGM65	Entered	0.1139	4728531	0.9103	0.1928	4

Stepwise Linear Regression: Evict Index
Fractional Factorial Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction
Rules:

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
8210076.9	8	1026260	0.2619	0.1697	-3.60206	140.1829

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	13225.90	1	0.0	0.0000	1.0000
	X	A10	603.50	1	2913698.0	2.8390	0.1305
		F15E	?	1	122512.5	0.1060	0.7542
		AGM65	?	1	702112.5	0.6550	0.4451
		MK82	?	1	161312.0	0.1400	0.7191
		A10*AGM65	?	2	939473.0	0.3880	0.6945
		A10*MK82	?	2	259880.0	0.0980	0.9080
		F15E*AGM65	?	3	923193.0	0.2110	0.8847
		F15E*MK82	?	3	521185.0	0.1130	0.9488
		A10*F15E	?	2	163125.0	0.0610	0.9416
		AGM65*MK82	?	3	904037.0	0.2060	0.8880

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.1305	2913698	0.2619	-3.602	2

Stepwise Linear Regression: Air Sup Index
Fractional Factorial Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction
Rules:

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
905174.65	7	129310.7	0.7682	0.702	-1.88992	120.133

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	9544.90	1	0.0	0.0000	1.0000
	X	A10	498.13	1	1985028.0	15.3510	0.0058
		F15E	?	1	7140.1	0.0480	0.8343
	X	AGM65	356.13	1	1014600.0	7.8460	0.0265
		MK82	?	1	3321.1	0.0220	0.8867
		A10*AGM65	?	1	34191.1	0.2360	0.6447
		A10*MK82	?	2	3336.3	0.0090	0.9908
		F15E*AGM65	?	2	7155.3	0.0200	0.9804
		F15E*MK82	?	3	44652.4	0.0690	0.9734
		A10*F15E	?	2	9696.3	0.0270	0.9734
		AGM65*MK82	?	2	5877.3	0.0160	0.9838

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.0206	1985028	0.5084	-1.525	2
2	AGM65	Entered	0.0265	1014600	0.7682	-1.89	3

Stepwise Linear Regression: C3 Index
Fractional Factorial Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction
Rules:

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
1017.275	4	254.3187	0.9772	0.9488	4.745589	58.22298

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	-806.90	1	0.0	0.0000	1.0000
	X	A10	-65.38	2	36207.3	71.1850	0.0007
	X	F15E	24.63	1	4851.1	19.0750	0.0120
	X	AGM65	-12.88	2	3342.3	6.5710	0.0545
	X	MK82	12.63	1	1275.1	5.0140	0.0887
	X	A10*AGM65	-15.88	1	2016.1	7.9280	0.0480
		A10*MK82	?	1	276.1	1.1180	0.3680
		F15E*AGM65	?	1	276.1	1.1180	0.3680
		F15E*MK82	?	0	0.0	?	?
		A10*F15E	?	1	0.1	0.0000	0.9859
		AGM65*MK82	?	1	0.1	0.0000	0.9859

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.0009	34191.13	0.7653	22.301	2
2	F15E	Entered	0.0438	4851.125	0.8739	11.208	3
3	A10*AGM65	Entered	0.1056	3342.25	0.9487	6.1871	5
4	MK82	Entered	0.0887	1275.125	0.9772	4.7456	6

Stepwise Linear Regression: Interdiction Index
Fractional Factorial Design

Response: Response
Stepwise Regression Control
Prob to Enter 0.25
Prob to Leave 0.1

Direction
Rules:

Current Estimates

SSE	DFE	MSE	RSquare	RSquare Adj	Cp	AIC
859582	8	107447.8	0.5566	0.5012	-3.76771	117.6162

Lock	Entered	Parameter	Estimate	nDF	SS	F Ratio	Prob>F
X	X	Intercept	6339.50	1	0.0	0.0000	1.0000
	X	A10	367.25	1	1078981.0	10.0420	0.0132
		F15E	?	1	23980.5	0.2010	0.6675
		AGM65	?	1	16020.5	0.1330	0.7262
		MK82	?	1	32004.5	0.2710	0.6189
		A10*AGM65	?	2	16220.5	0.0580	0.9445
		A10*MK82	?	2	46796.5	0.1730	0.8454
		F15E*AGM65	?	3	54793.0	0.1130	0.9485
		F15E*MK82	?	3	56185.0	0.1170	0.9466
		A10*F15E	?	2	26430.5	0.0950	0.9106
		AGM65*MK82	?	3	50475.0	0.1040	0.9542

Step History

Step	Parameter	Action	Sig Prob	Seq SS	RSquare	Cp	p
1	A10	Entered	0.0132	1078981	0.5566	-3.768	2

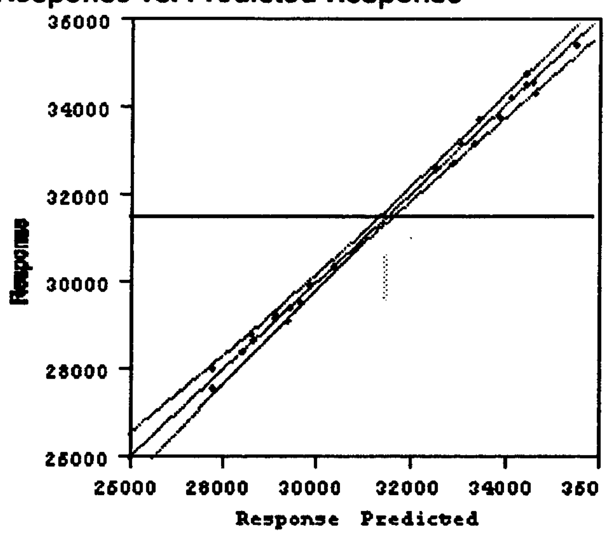
Appendix I

This appendix contains the Response vs. Predicted Response and Residual vs. Response plots for both the Plackett-Burman and Fractional Factorial designs. Plots were created for each of the indices calculated.

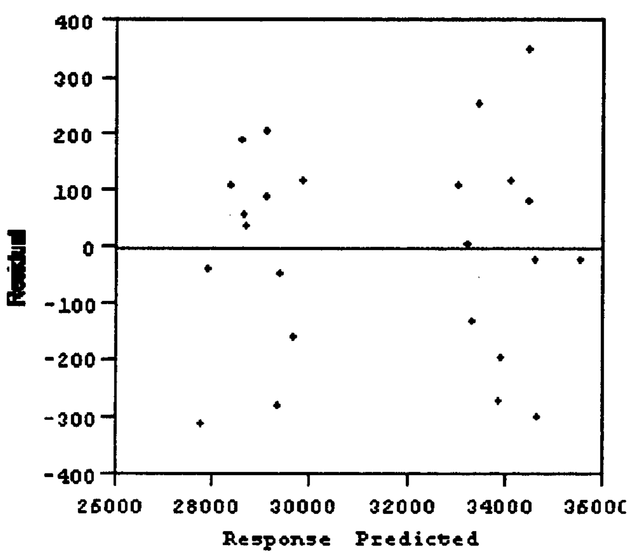
Total Combat Index Plots

Plackett-Burman Design

Response vs. Predicted Response



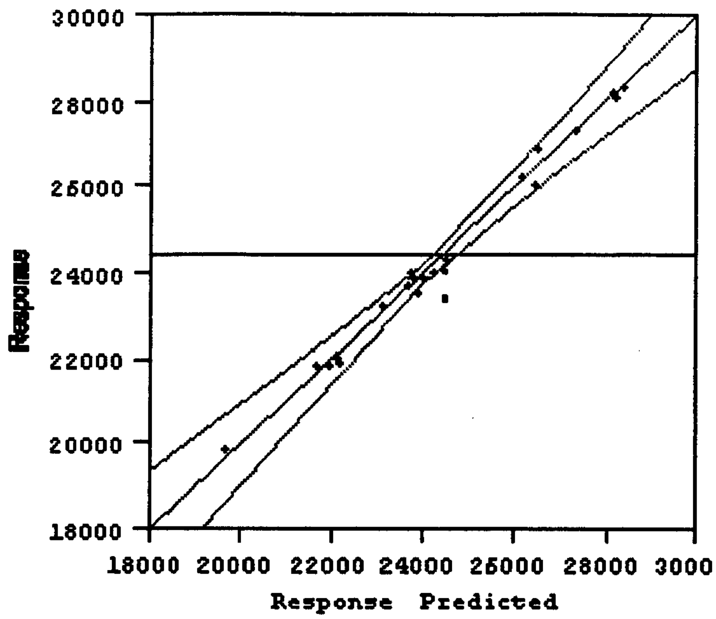
Residual vs. Response



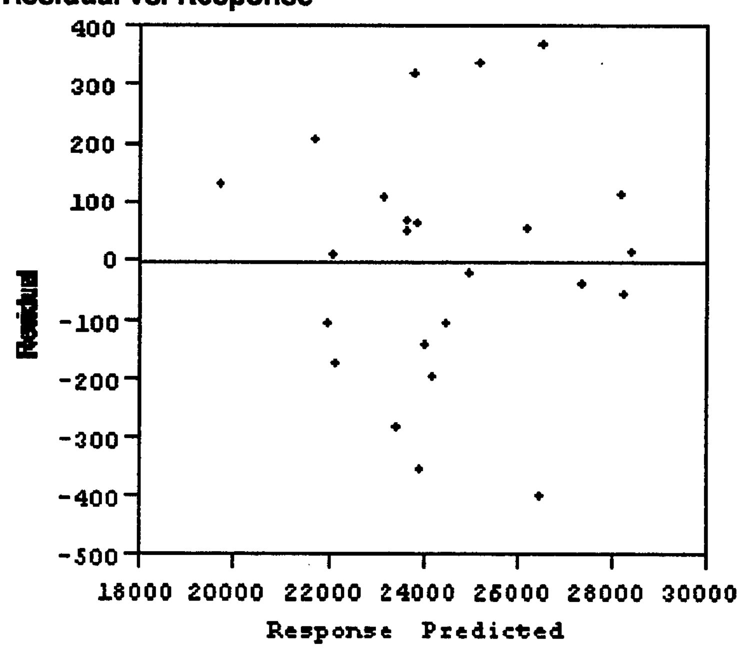
Halt Index Plots

Plackett-Burman Design

Response vs. Predicted Response



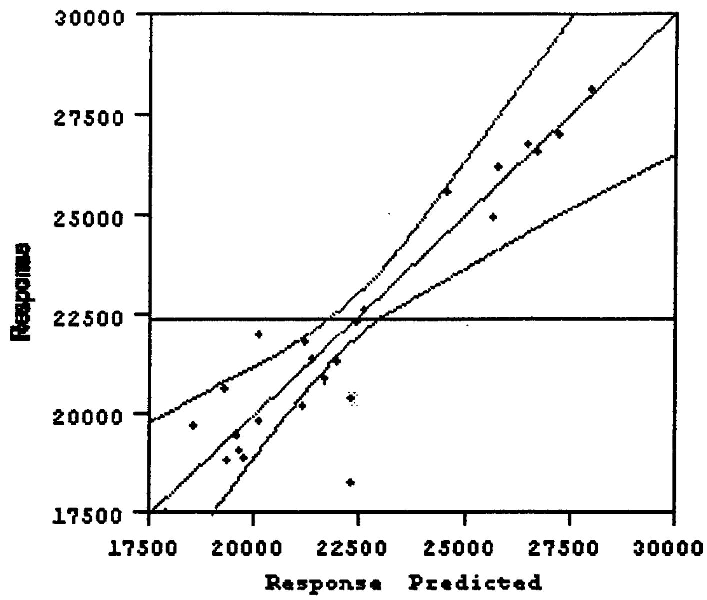
Residual vs. Response



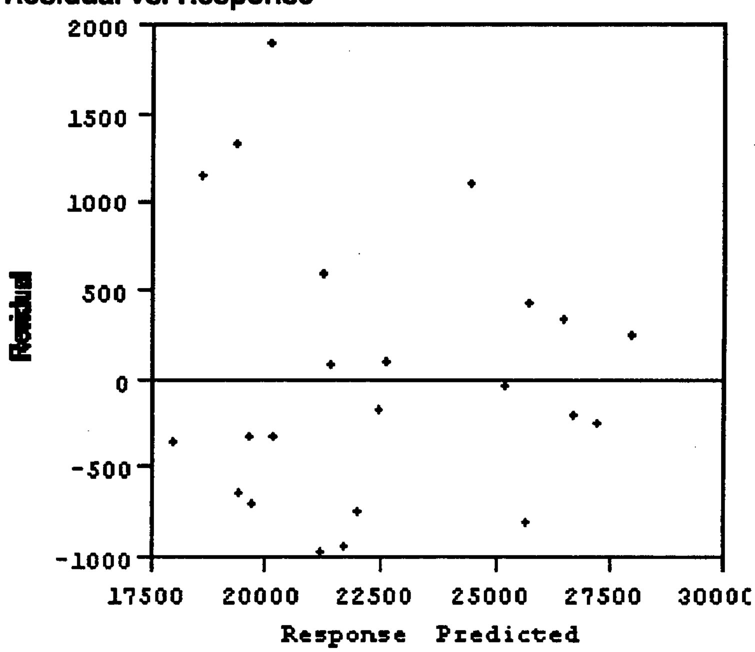
Evict Index Plots

Plackett-Burman Design

Response vs. Predicted Response



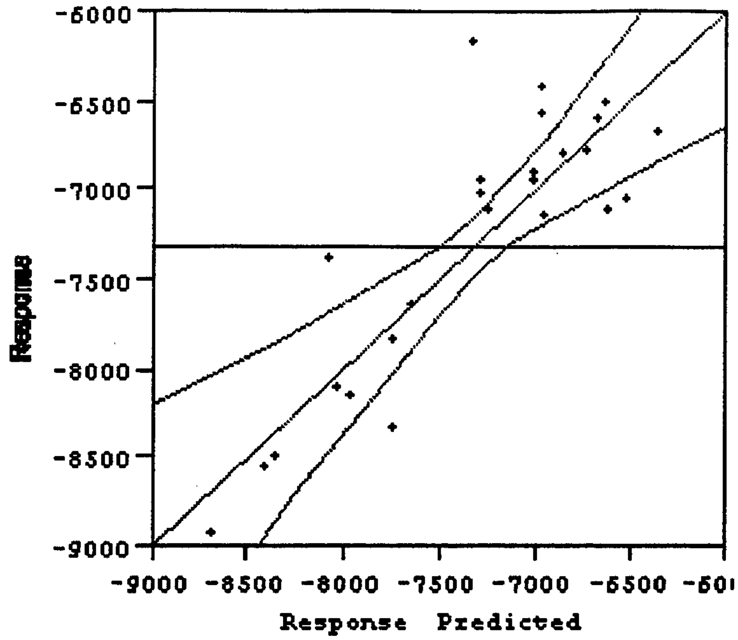
Residual vs. Response



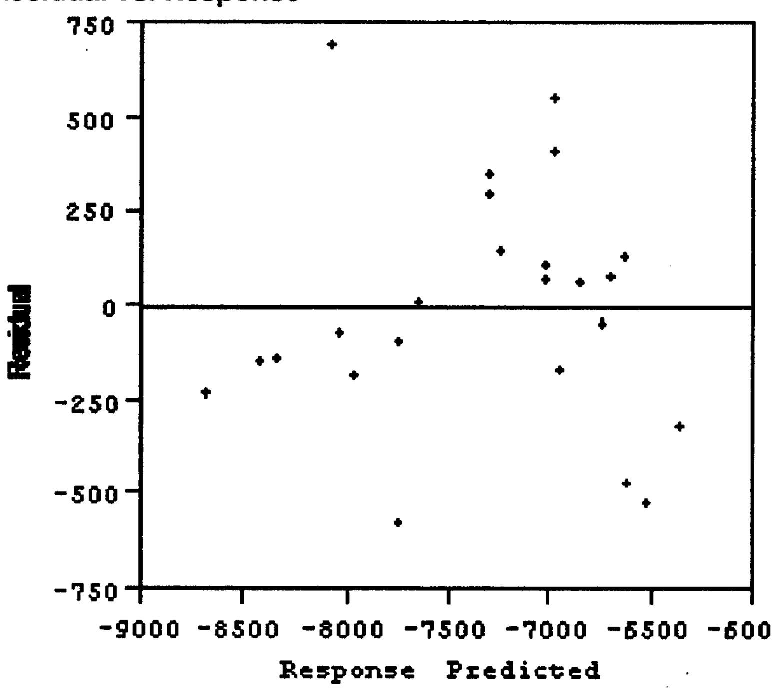
Air Sup Index Plots

Plackett-Burman Design

Response vs. Predicted Response



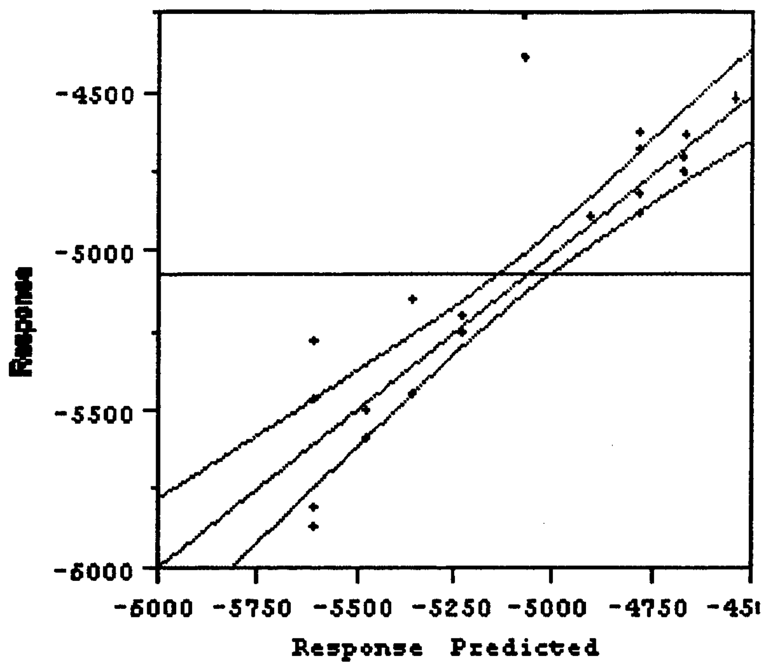
Residual vs. Response



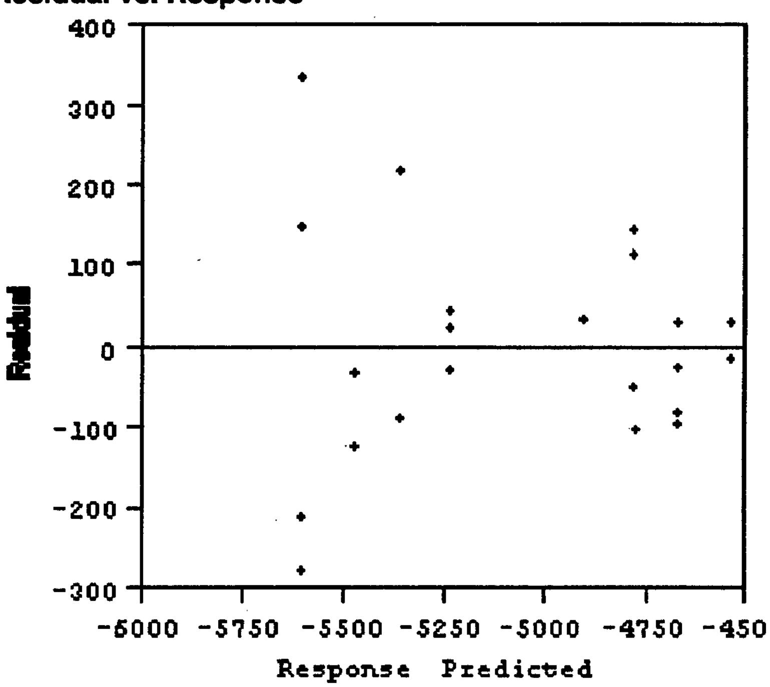
C3 Index Plots

Plackett-Burman Design

Response vs. Predicted Response



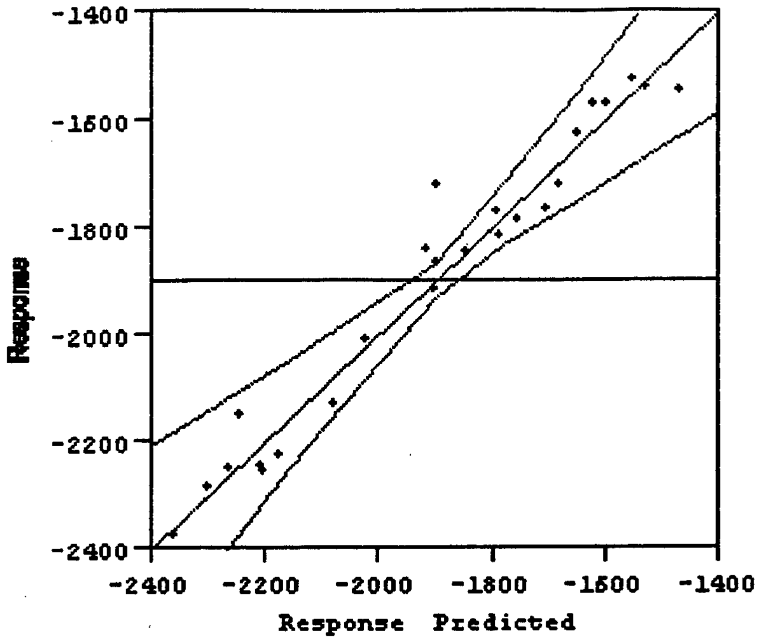
Residual vs. Response



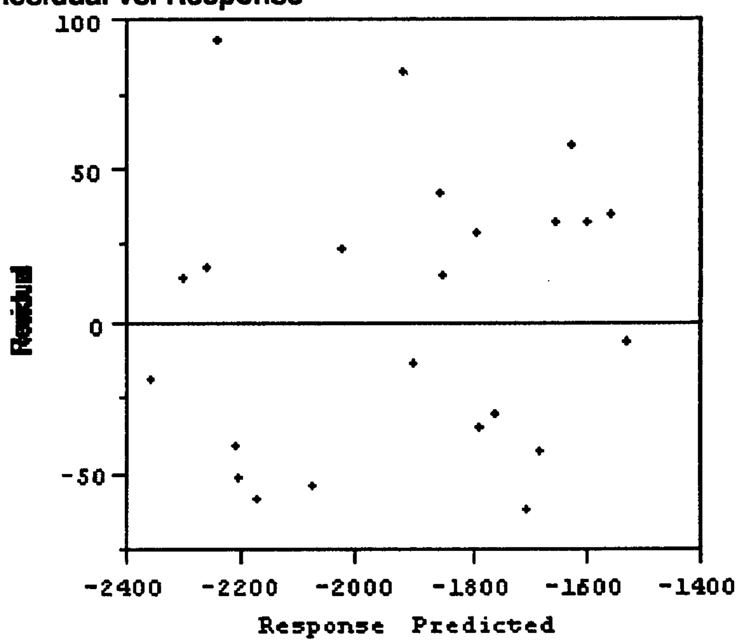
Interdiction Index Plots

Plackett-Burman Design

Response vs. Predicted Response



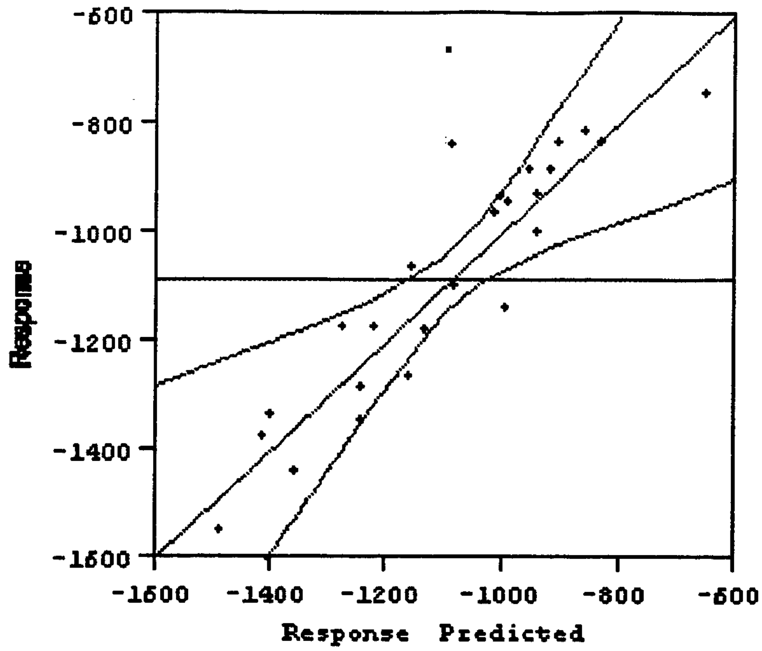
Residual vs. Response



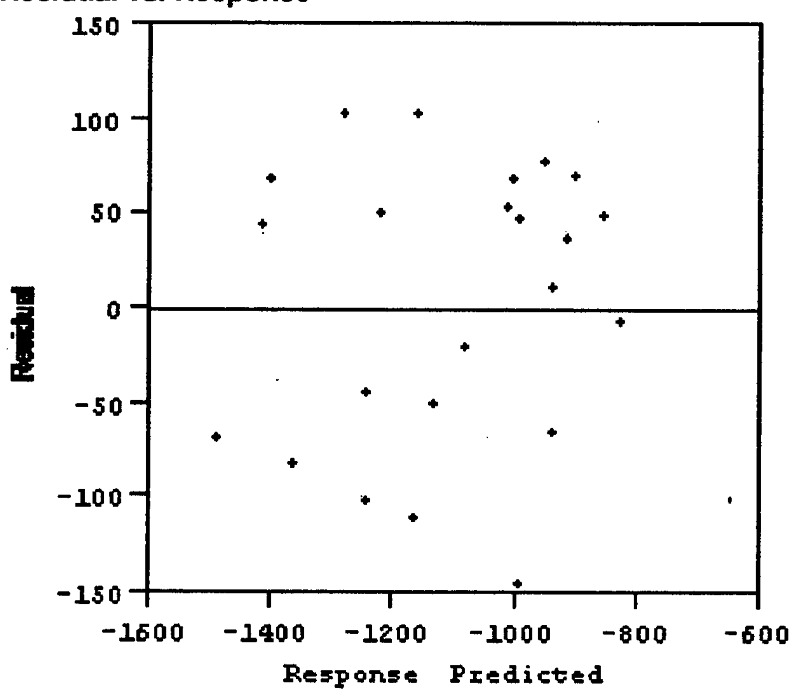
OCA Index Plots

Plackett-Burman Design

Response vs. Predicted Response



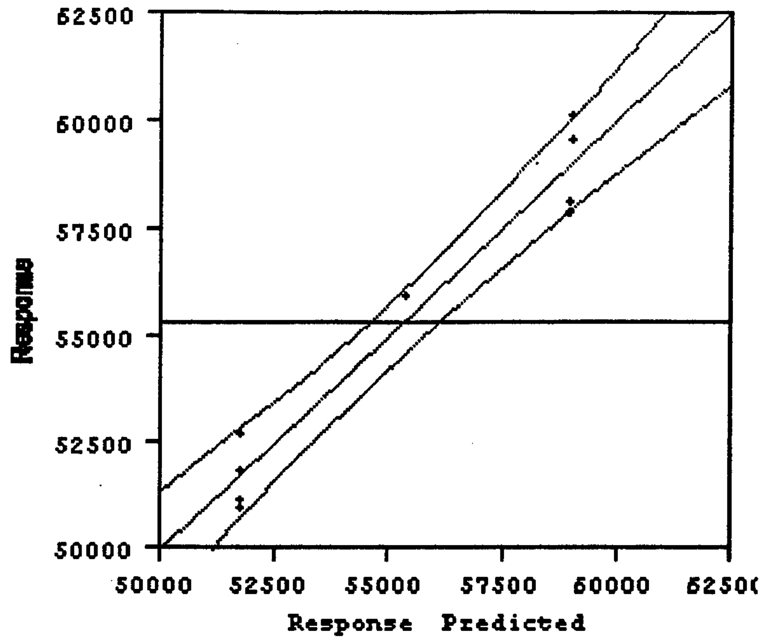
Residual vs. Response



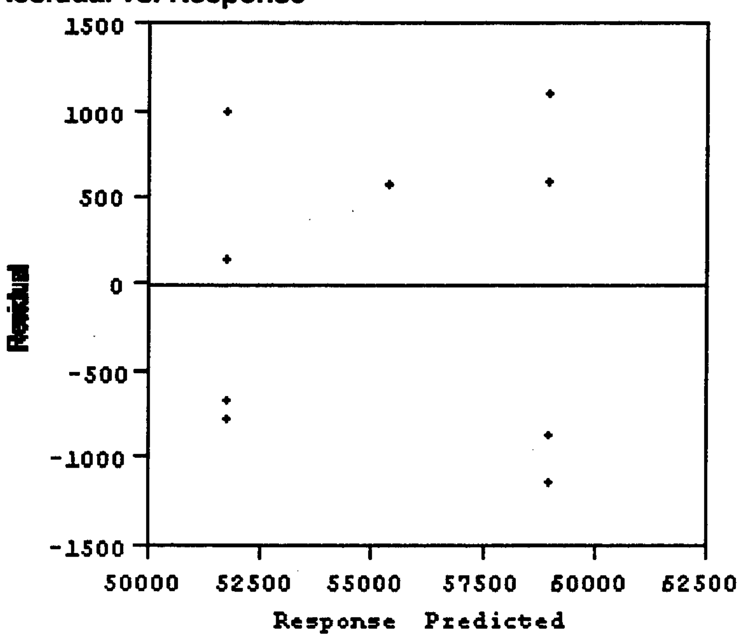
Total Combat IndexPlots

2_{III}^{4-1} **Fractional Factorial Design**

Response vs. Predicted Response



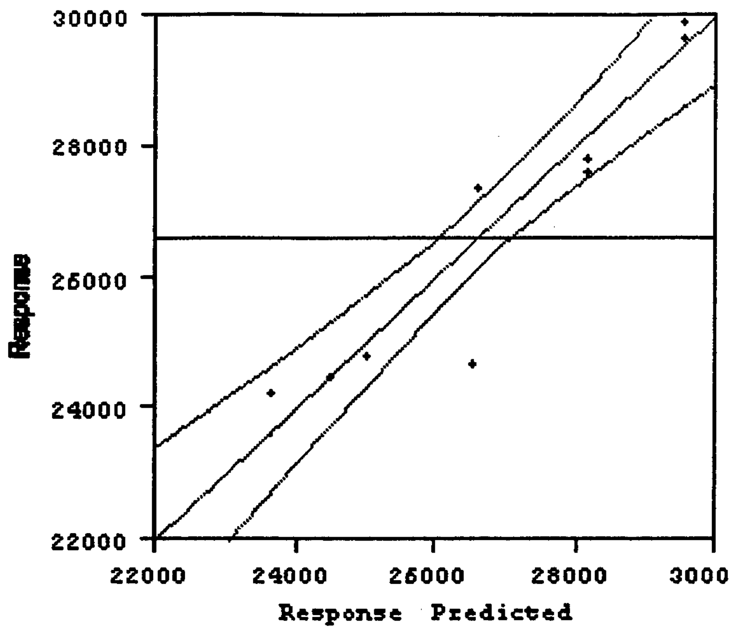
Residual vs. Response



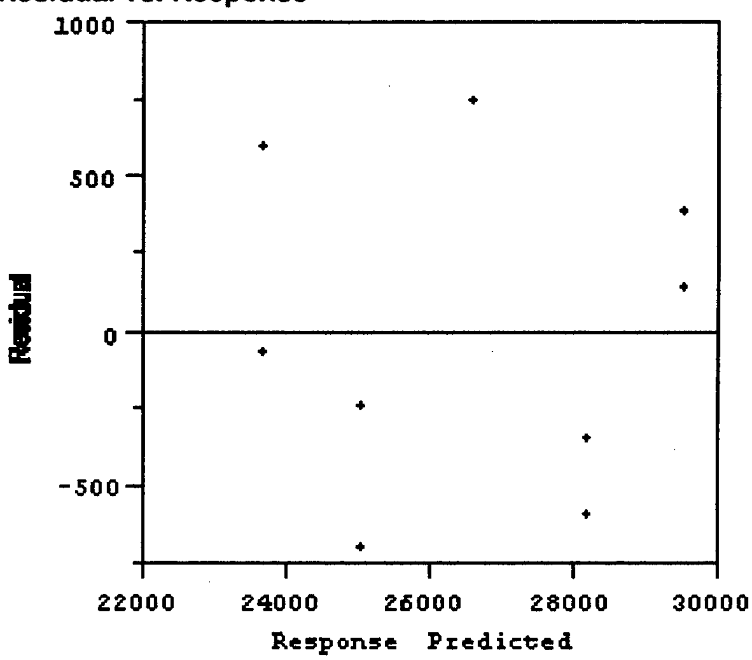
Halt Index Plots

2_{III}^{4-1} Fractional Factorial Design

Response vs. Predicted Response



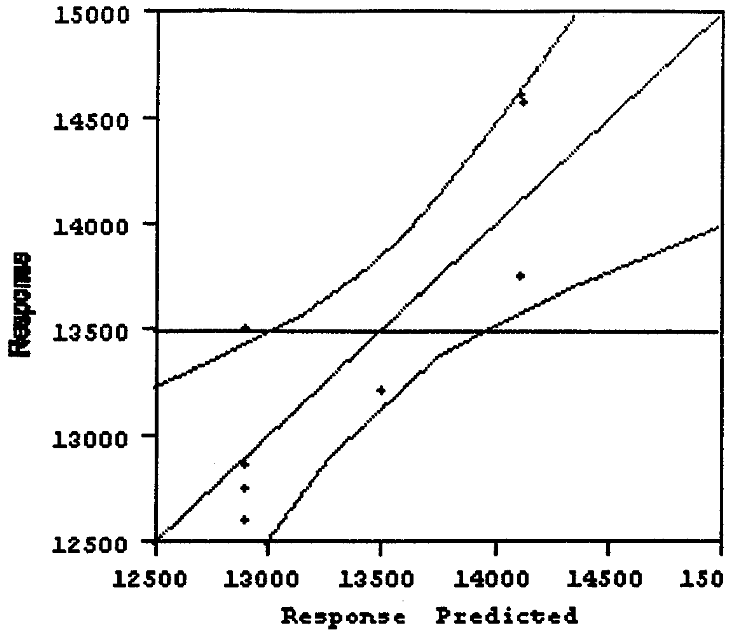
Residual vs. Response



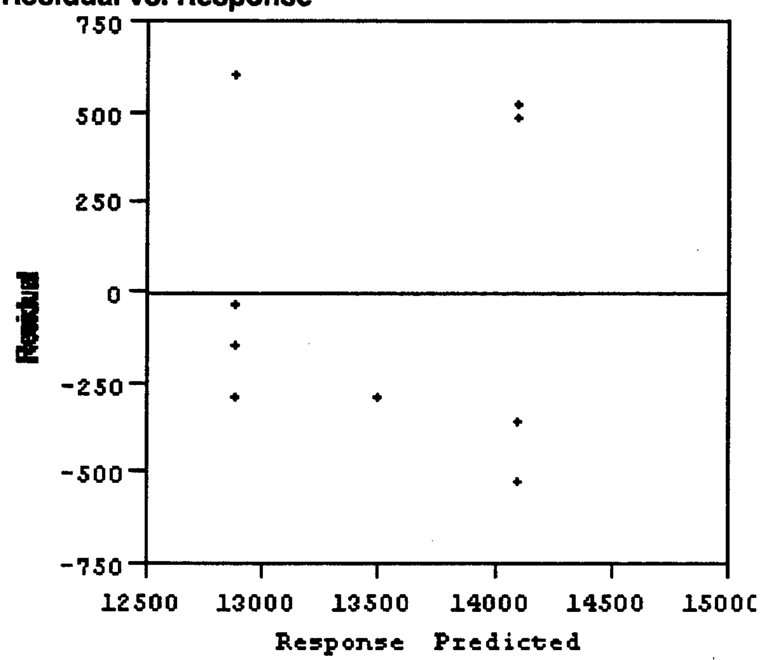
Evict Index Plots

2_{III}^{4-1} **Fractional Factorial Design**

Response vs. Predicted Response



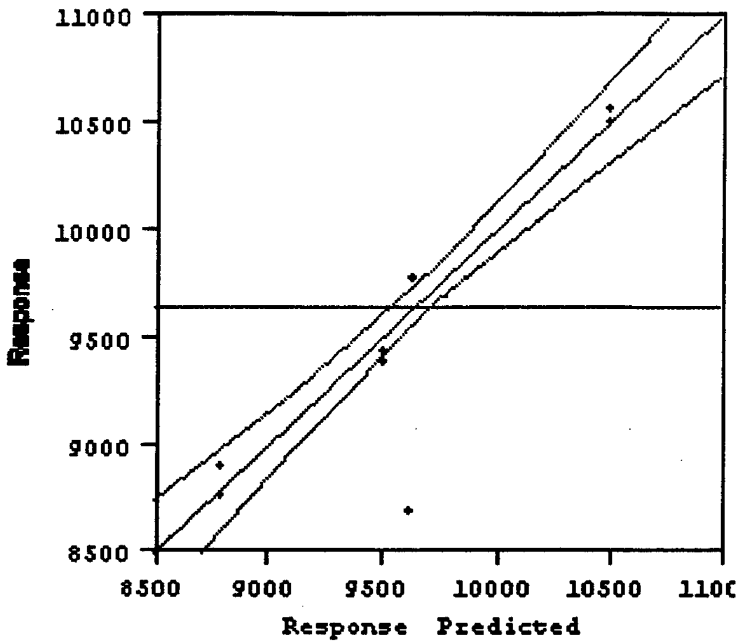
Residual vs. Response



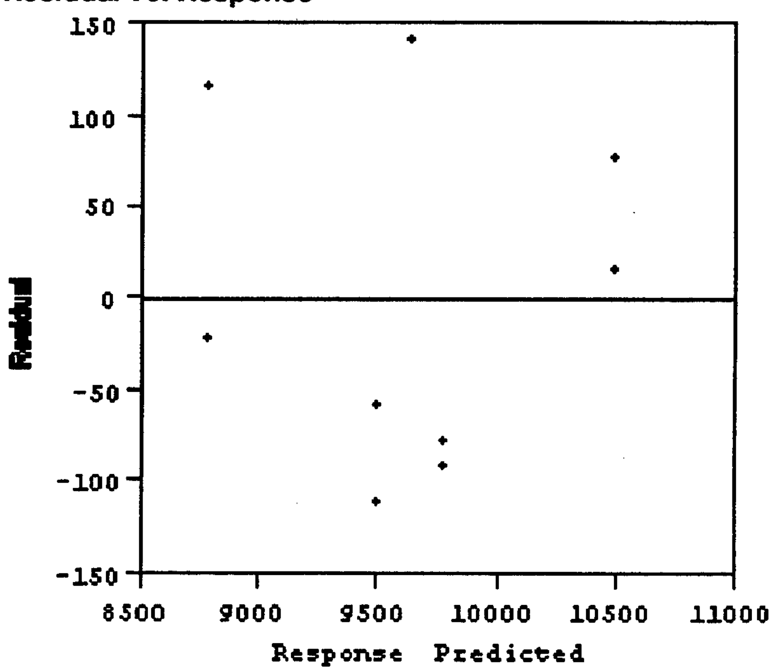
Air Sup Index Plots

2^{4-1}_{III} **Fractional Factorial Design**

Response vs. Predicted Response



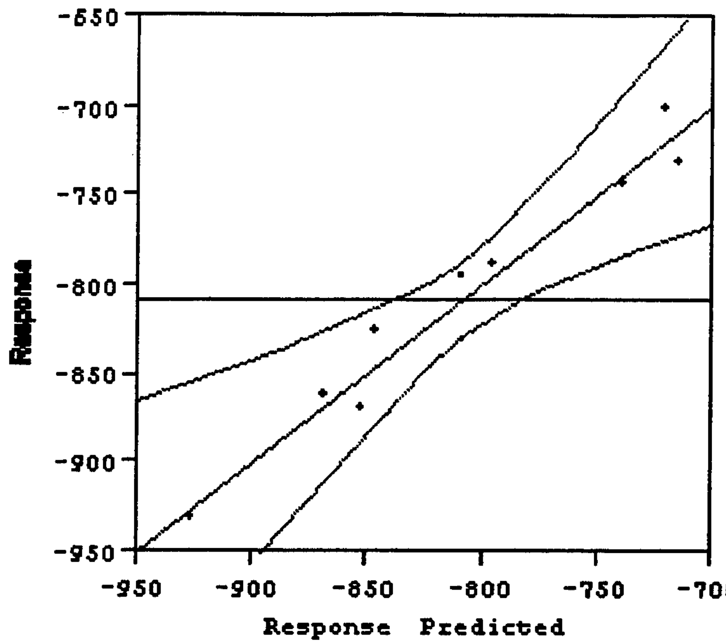
Residual vs. Response



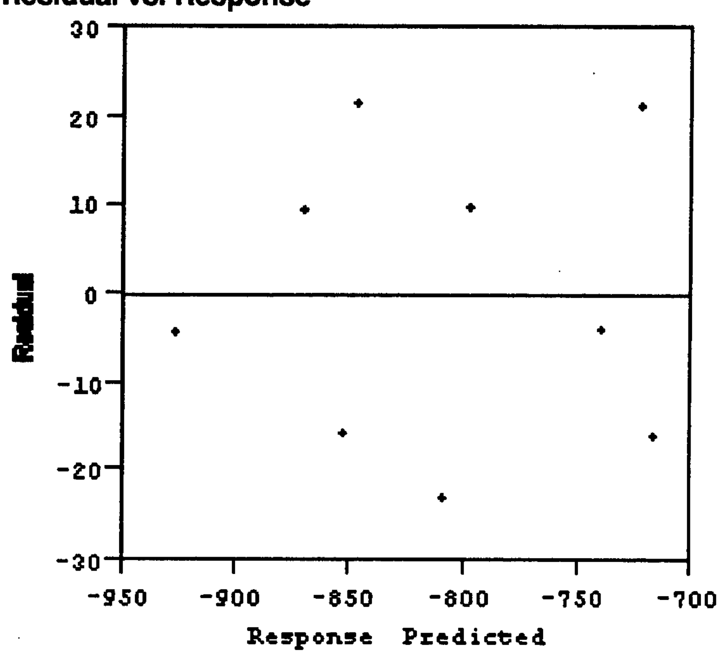
C3 Index Plots

2_{III}^{4-1} Fractional Factorial Design

Response vs. Predicted Response



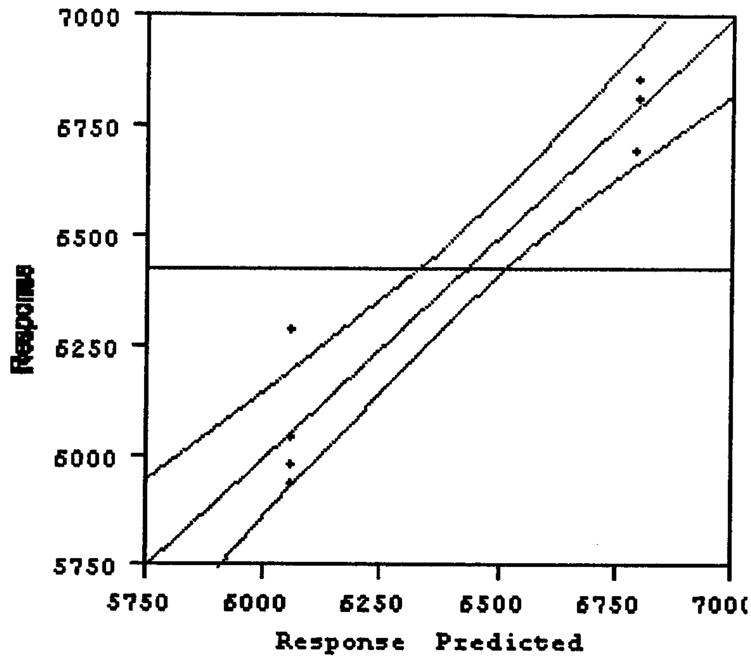
Residual vs. Response



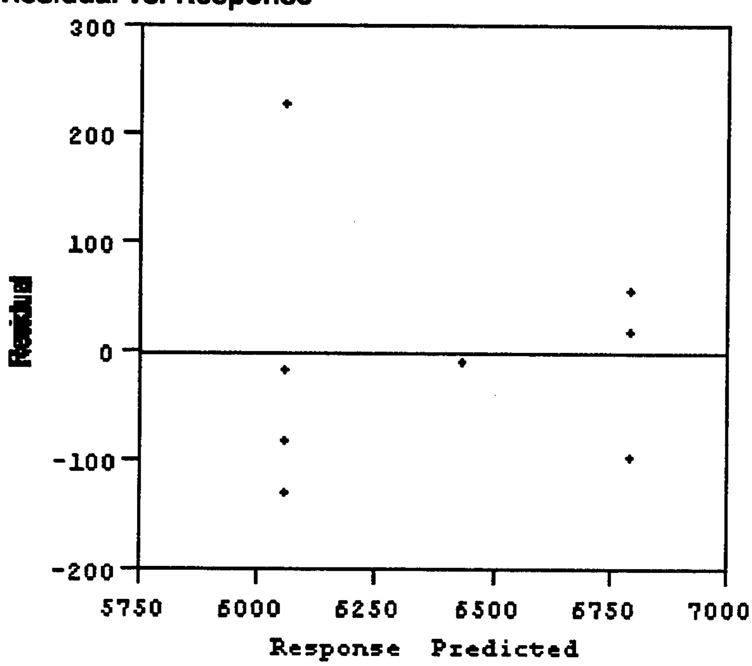
Interdiction Index Plots

2_{III}^{4-1} **Fractional Factorial Design**

Response vs. Predicted Response



Residual vs. Response



Appendix J

The following is an extract from Air Force Instruction (AFI) 65-503. Attachment A10-1 lists the fly-away costs for every aircraft type in the USAF inventory. Attachment A11-1 lists the unit cost for each munition/submunition.

AFI 65-503 Attachment A10-1 5 January 1996

Table A10-1

Unit Flyaway Costs

(FY 96 Constant $ in Millions)

BOMBERS	
B-1B	278.5
B-2A	1,120.2
B-52C	44.5
B-52D	38.7
B-52G	40.1
B-52H	51.6

CARGO/TRANSPORT	
C-5A	124.5
C-5B	184.2
C-7A	3.8
C-9A/C	15.4
C-12A/D/F/J	1.9
C-17A	199.9
C-20A	20.8
C-21A	3.1
C-22A/B	16.8
C-23A	4.3
C-26A	4.2
C-29A	15.3
C-123B	3.4
C-130A	16.6
C-130B	14.1
C-130E	10.4
C-130H	14.1
NC-130A	14.2
NC-130H	24.0
WC-130E	9.4
WC-130H	12.1
C-131A	6.1
C-131B	4.7
C-131D	3.9
C-131E	4.1
NC-131H	19.5
C-135A	16.3
WC-135B	14.0
C-137B	22.2
C-137C	32.6
C-140A/B	8.9
C-141A	28.5
C-141B	40.9

FIGHTER/ATTACK	
A-7D	10.1
A-7K	19.6
A-10A	9.6
F-4C	9.6
F-4D	9.1
F-4E	10.4
F-5A/B	3.5
F-5E	6.1
F-5F	8.7
F-15A/B	26.2
F-15C/D	29.0
F-15E	30.8
F-16A/B	13.3
F-16C/D	16.2
F-106A/B	24.2
F-111A	35.7
F-111D	35.1
F-111E	35.7
F-111F	37.8
FB-111A	41.0
F-22	87.5

TANKER	
KC-10A	86.8
HC-130N	12.7
HC-130P	12.1
KC-135A	17.3
KC-135B	29.8
KC-135E	31.7
KC-135R	52.2
HH-53C	10.7
TRAINER	
AT-38B	5.3
T-33A	0.7
T-37A/B/C	1.0
T-38A	3.7
T-39A/B/C	4.9
T-41A/C/D	0.1
T-43A	21.7
T-46A	13.0

RECON/BATTLE MGMNT/C3I	
E-3A/B/C	121.6
E-4A	101.6
E-4B	215.6
DC-130A	14.2
EC-130E	26.1
HC-130N	12.7
RC-135A	55.0
RC-135B	70.1
EC-135A	19.0
EC-135C	38.3
EC-135G	20.3
EC-135H	21.5
EC-135J	38.3
EC-135K	20.3
EC-135L	16.7
EC-135N	33.3
EC-135P	19.9
RF-4C	9.8
RF-5A	3.7

HELICOPTER	
CH-53C	9.3
HH-1H	1.6
TH-1F	1.3
UH-1F	1.4
UH-1H	1.0
UH-1N	2.4
UH-1P	1.3
HH-3E	4.4
HH-53B	9.2
HH-60D	15.5
UH-60A	7.4

OTHER	
O-2A	0.4
O-2B	0.4
OA-37B	1.9
OV-10A	2.2
UC-3B/C/E	3.8
VC-9C	19.8

Unit Flyaway Costs

(FY 96 Constant $ in Millions)

ELEC WAFARE/COMBAT		SPECIAL OPS FORCES	
F-4G	14.5	AC-130A	18.0
EF-111A	98.2	AC-130H	14.9
		HC-130H	14.0
		MC-130H	59.9
		MH-53H	18.9
		MH-53J	19.5
		MH-60G	9.0

The factors in this table represent the approximate original cost of out of-production and in-production aircraft in terms of the then-year dollars of a specific fiscal year. They may be used to estimate an order of magnitude cost for various planning exercises.

a. Average Unit Flyaway Cost. The average unit flyaway cost (equates to rollaway and sailaway) related to the production of a usable end-time of military hardware. Flyaway cost is defined in DoD Manual 7110.1-M and includes the cost of procuring the basic unit (airframe, hull, chassis,etc.), a percentage of basic unit for changes allowance, propulsion equipment, electronics, armament, other installed Government-furnished equipment, and nonrecurring production costs.

b. The following items are included in the determination of a unit flyaway cost under Appropriation 3010 (Aircraft Procurement).

(1) Airframe.

(2) Propulsion.

(3) Electronics.

(4) Avionics.

(5) Engineering Change Orders (ECO), if any.

(6) Government Furnished Equipment.

(7) First destination transportation unless a separate line item.

(8) System and project management and system test and evaluation if funded by the Aircraft Procurement Appropriation (that is, 3010).

(9) Warranties.

(10) Recurring costs (both contract and in-house.

(11) Nonrecurring cost (both contract and in-house.

Unit Flyaway Costs

(12) Advance buy costs.

c. Unit flyaway cost does not include:

(1) Research, Test, and Evaluation Appropriation (that is, 3600 expenditures).

(2) Weapons and Armament (except if part of the airframe; e.g., the 30MM GAU-81A gun on the A-10).

(3) Peculiar ground support equipment.

(4) Peculiar training equipment.

(5) Technical data.

(6) Initial spares and replacement spares.

d. AF Form 1537, Weapon System Budget Estimate, is used as the basic data source for most of the cost factor computations. Other sources include:

(1) Selected Acquisition Reports (SAR).

(2) AF/LG, and XO; SAF/AQ and HQ AFMC.

e. In regards to flyaway cost and modifications, it is important to note that this table reflects only those modifications which produced a new MDS. For example, the EF-111A was modified from the F-111A. Major aircraft modifications which do not produce a new MDS are not included. Thus the unit flyaway cost for the B-52H reflects the unit flyaway cost as originally produced and then inflated to the constant dollars of a specific fiscal year. Since subsequent modifications to the B-052H did not produce a new MDS, the modifications are not included in the unit flyaway cost of the B-052H.

f. The flyaway cost factors represent average costs weighted by the "buy" size per fiscal year. The cost factors are not normalized to any particular "buy" quantity. HQ USAF Weighted Inflation Indices, which are based on OSD inflation and outlay rates, are used to convert constant year cost information to "Then-Year" dollars (tables A47-1 through A47-10).

OPR: SAF/FMCCF, Capt Pat Rose, DSN 227-0184 or (703) 697-0184, Pentagon, Room 4D178.

Table A11-1. Munitions Acquisition Cost.

WEAPON	DODIC	FY95 $
ROCKETS		
2.75" HE W/MK66	R21AA	358.61
2.75" WP W/MK66	R31AA	416.45
2.75" SIGNATURE	Z75TB	400.98
SIGNALS,MARKERS,FLARES		
AIRBURST SIMULATOR M74A1	L366	23.94
ALA-17	LY12	353.06
FIRE STARTER	L621	
FLARE,SURFACE TRIP	L495	23.06
GROUNDBURST SIMULATOR	L594	7.29
LUU-2B FLARE	L440	553.86
LUU-4	L443	450.00
M-206 CART FLARE	L429	29.36
MJU-10B FLARE	L461	63.43
MJU-2	LW61	131.31
MJU-23 FLARE	L462	1,024.69
MJU-7B FLARE	L429	21.31
RR-170	LY07	1.84
RR-180 CHAFF	SY16	8.07
RR-185		
RR-188 CHAFF	LY98	2.05
SIGNAL PERS DISTRESS KIT	L119	88.36
SMOKEY SAM SIMULATOR	YW33	96.00
CARTRIDGES		
.50 CALIBER API	A545	2.03
.50 CALIBER 4-I	A557	2.88
.50 BALL	A555	1.93
.50 CALIBER API-T	A576	3.06
5.56MM BALL	A059	0.55
5.56MM BALL	A071	0.31
5.56MM TRACER	A063	0.55
7.62MM BALL & TRACER OR BALL	A130	0.51
7.62MM 4-I	A131	0.54
7.62MM MATCH GRUDGE	A171	0.75
7.62MM TR	A140	0.38
20MM HCI PGU-28	A677	16.07
20MM PGU-27	A678	5.34
20MM TPT BULK PGU-30	A6797	.96
30MM TP	B116	9.43
30MM HEI	B103	24.75
40MM HEDO	B546	14.76
40MM TP M781/M888	B519	3.79
40MM HEDP	B542	15.34

Table A11-1. Munitions Acquisition Cost.

WEAPON	DODIC	FY95 $
40MM CS	B567	8.95
40MM API	B552	7.82
40MM TP	B584	17.38
105MM HE	C432	160.00
105MMWP	C433	63.72
12 GA SHOTGUN 00 BUCKSHOT	A011	0.33
9MM BALL	A363	0.16
CLUSTER BOMBS		
CBU-52	C521A	2,280.00
CBU-58	C582A	2,973.00
CBU-71	C714B	4,692.00
CBU-87	C872A	12,370.00
CBU-87(WCMD)		42,370.00
CBU-89	C891B	39,090.00
CBU-97(SFW)	C971A	395,000.00
CBU-97(SFW)(WCMD)		425,000.00
MK-20 ROCKEYE	C205E	5,269.93
BOMBS		
BDU-33 25LB	ZP61C	16.00
BDU-50	ZR52A	892.00
BDU-56	ZR61A	3,644.00
BLU-109	BG9GB	220,656.00
GBU-24(MK-84)	BL4DH	56,091.00
GBU-24(12K)	BL9HB	59,874.00
GBU-27	BL9SB	57,531.00
GBU-28	BL5DA	91,192.00
JDAM/MK-84		36,176.00
JSOW/BASELINE		157,727.00
JSOW/BLU-108		291,897.00
MK-82	BR25A	2,890.87
MK-84 INERT	F262	2,602.52
MK-84	BR41M	8,345.34
M-117	BC71E	986.48

Table A11-1. Munitions Acquisition Cost.

WEAPON	DODIC	FY95 $
MISSILES		
AGM-65A MAVERICK	M65AA	17,505.00
AGM-65B MAVERICK	M65BA	19,000.00
AGM-65D MAVERICK	M65DA	112,000.00
AGM-65G MAVERICK	M65GA	109,763.00
AGM-84 HARPOON	M84AA	334,100.00
AGM-86C CALCM		600,000.00
AGM-88C HARM	M88AC	236,403.00
AGM-130 A/C IR	M304R	357,000.00
AGM-130 TV	M304T	331,000.00
AGM-142A HAVE NAP		737,000.00
AGM-142D HAVE NAP		635,000.00
AIM-7M		208,620.00
AIM-9M		43,520.00
AIM-120B AMRAAM		500,000.00

Munitions Designators

Designator	Description
AGM	Air To Ground Missile
AIM	Air To Air Infrared Missile
ALA	Ancillary Light Assy.
API	Armor Piercing Incendiary
API-T	Armor Piercing Incend.w/TR
BDU	Simulated Bomb Units
CBU	Cluster Bomb Unit
CS	Chemical Fill
GBU	Guided Bomb Unit
HE	High Explosive
HED	High Explosive
HEI	High Explosive Incendiary
HEIT	High Explosive Dual Purpose
LAU	Launcher
LUU	Laminating Unit
M	Model Designator
MK	Mark/Model Designator
MJU	Munition Countermeasure
PGU	Ammunition Unit
RR	Radar Reflector
SAM	Surface To Air Missile
S&I	Smoke & Illuminating
TP	Target Practice

TPT	TP-Tracer
TR	Tracer
WP	White Phosphorous

Munitions Acquisition Cost. Table A11-1 provides the cost of munitions listed in AFR 50-21 . Munitions costs reflect the contract price per unit as of the last procurement-escalated to constant year dollars. Associated item costs are included in the unit price.

Data Source: AFR 50-21 & HQ USAF/ACP/MMWDS

OPR: AF/XOOT, Maj Topp, DSN: 225-7003

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VITA

Maj James B. Grier was born on 8 November 1961 at Hagerstown, Maryland. He earned his Bachelors of General Studies from the University of Maryland, College Park, and was a Distinguished Graduate of AFROTC, earning a Regular Commission as the top graduate of the class of 1984. He attended the Euro-NATO Joint Jet Pilot Training (ENJPPT) program at Sheppard AFB, earning his aeronautical rating in December 1985.

His first operational tour was as an F-111E Instructor Pilot, assigned to the 55th Tactical Fighter Squadron, RAF Upper Heyford, UK in November 1986. He was assigned to Operating Location Romeo (OL-R), 8th Air Support Operations Group, Vilseck Germany in April 1990, where he served as an Air Liaison Officer (ALO) for 1st Brigade, 1st Armored Division. During this assignment, he deployed to Desert Shield/Desert Storm, were he served as both Brigade and Division ALO for the Royal Saudi Land Forces's Khalid Division. Maj Grier transitioned to the F-16C Blk 40 in Jan 1992 and was assigned to the 421st Fighter Squadron, Hill AFB, Utah, were he served as an Instructor Pilot and Flight Commander.

He entered the School of Engineering at the Air Force Institute of Technology in August 1995. Upon receiving a Master of Science degree from the institution, he was assigned to the Air Staff, HQ USAF/XPP, Pentagon ADM VA.

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13. ABSTRACT *(Maximum 200 words)*

A General Officer Steering Group, chaired by HQ USAF/XOM tasked action to develop and implement evaluation and analysis support to 'lead turn" the Program Objective Memorandum (POM) and Joint Warfare Capability Assessment (JWCA) process. This evaluation process should be designed to supply measures of the "health" of the Air Force program in light of the Defense Planning Guidance (DPG) and the Chairman's Program Assessment (CPA).

The Air Force needs to be able to quickly evaluate various alternative force structures with regards to it's combat capability, measured in terms of theater level campaign objectives (CO). HQ USAF/XOM tasked HQ USAF/XPY to develop a "quick turn" tool to perform iterative "exercises" , allowing for comparison of alternative force structures within 24 to 48 hours.

Using Factor Analysis and Response Surface Methodology, this thesis successfully developed a "quick turn" tool designed to capture the cost and capabilities of alternative force structures, linking dollars spent to campaign level measures of outcome.

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