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DLA-92-P10093

DEFENSE CONTRACT MANAGEMENT COMMAND STAFFING ASSISTANCE MODEL

May 1992

OPERATIONS RESEARCH AND ECONOMIC ANALYSIS OFFICE

DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY

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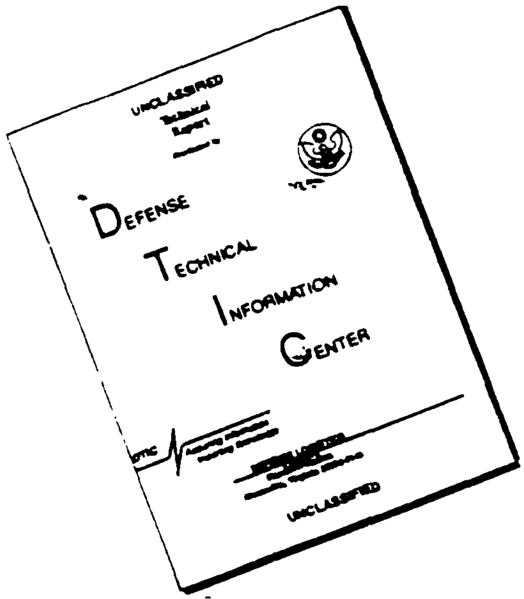

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May 1992

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FOREWORD

The Defense Logistics Agency (DLA) Defense Contract Management Command (DCMC) senior management asked the DLA Operations Research Office at Chicago (DORO-C) to estimate the staffing needed at each of their Defense Plant Representative Offices (DPRO) and Defense Contract Management Area Offices (DCMAO). Models were developed to quantify the relationship between workload indicators and staffing. I wish to thank all the personnel at the five DCMC Districts who helped to identify possible workload indicators and collect the necessary data, personnel at the DLA Performance Standards Support Office (DPSSO) who collected workhour data, and the functional area experts at both the Districts and DLA Primary Staff Elements who helped put the data in perspective.

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Assistant Director
Policy and Plans

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EXECUTIVE SUMMARY

The Defense Logistics Agency (DLA) Defense Contract Management Command (DCMC) manages 30,000 contractors having 500,000 contracts with a value of $750 billion. To accomplish this it has 36 Defense Contract Management Area Offices (DCMAOs) and 81 Defense Plant Representative Offices (DPROs). The staffing of these offices (not including the district headquarters) totals about 17,000.

In order to equitably estimate the staffing needed at each office, DCMC requested that the DLA Operations Research and Economic Analysis Management Support Office (DORO) develop models that use valid workload indicators. The models that resulted use a technique called regression analysis to quantify the relationship between the workload indicators and staffing. For large offices the models estimate staffing for the various functional areas. The methodology then sums these functional area estimates to obtain the overall office estimate. For smaller offices only the overall staffing level is estimated. Regression analysis is recognized by the Department of Defense (DoD) as a viable work measurement technique and was previously used by the Air Force Contract Management Division (AFCMD).

The models are easy to use and visualize, and are relatively easily explained. Also, the models have some important features. They use mostly automated indicators; track contractor business activity; take into account work that is not discretely measurable; account for the impact of performance based management (PBM) initiatives and are able to account for other PBM initiatives as they are implemented.

Decision-makers should use the models to identify and investigate significantly over- and under-resourced activities. Currently, such action (without the models) may be ad hoc and may not focus on the activities most in need of review. If investigation of the variance provides no further justification of the imbalance, then it may be possible to either reduce resources, or redistribute resources or workload among Secondary Level Field Activities (SLFAs). For example, contracts could be transferred by 3-digit zip code area while resources remain in place. Such shifts are an ongoing process anyway. Judicious use of the models, coupled with other analyses or field reviews, can result in important cost savings and avoidances.

SECTION 1

INTRODUCTION

The Defense Logistics Agency (DLA) Defense Contract Management Command (DCMC) is being challenged to become more efficient and effective. Most district commanders are either already using workload indicators to baseline their requirements or are looking for methods to do so. The DCMC wants to ensure that the way resources are applied to workload is consistent across the command. As a result, the DLA Operations Research and Economic Analysis Management Support Office (DORO) was requested to identify workload indicators and develop models that will aid DCMC in decisions with regard to staffing their Defense Plant Representative Offices (DPROs) and their Defense Contract Management Area Offices (DCMAOs).

1.1 SCOPE

The requested tasks were completed within the parameters outlined below:

a. District Headquarters (HQ) staffing is not within the scope of the study.

b. DCMC International, including San Juan, PR, is not within the scope of the study.

c. The data used to create the models is a Mar-Apr-May 1991 average.

d. Program and Technical Support was combined with Industrial Support for modeling purposes.

e. Automated Payroll, Cost And Personnel System (APCAPS) cost code data is used for workyears. Cost codes or job series that were at the Secondary Level Field Activities (SLFAs) that should only be at the District HQ were REMOVED from the workyear counts. The cost codes/functions removed were:

915	- Comptroller Operations
916	- Management Engineering
914	- Civilian Personnel
913	- Plans, Management, Systems and Administration
917	- Accounting and Finance
961	- Systems Management
964	- Word Processing Systems Management
65201	- Contract Entitlement
65701	- Contract Payment Transfer Operations
XXXXX	- Miscellaneous Others

f. Military workyears are included in the analyses since the corresponding work output is included in the workload indicators. Military workyears are subtracted from the total to get the civilian workyears.

g. Reimbursable workyears are not included, EXCEPT in Quality Assurance (QA). (QA Management Information System workload indicators include reimbursables.) DPRO Michoud is not included since its work is reimbursable.

h. The overall staffing resources for DCMC are set by the budget or the anticipated Defense Business Operating Fund (DBOF) processes. Therefore, the models allocate the given number of staffing resources rather than determine the total number of resources required to complete the workload.

i. The models use automated data for workload indicators wherever possible. No additional effort is required by operations workers to collect indicator counts. An exception is that the number of contractor employees and engineers used in some of the DPRO models are not automated.

1.2 OBJECTIVES

The objectives of this study fall into two general categories: identify valid and meaningful workload indicators and develop models to allocate the total resources needed at each DPRO and DCMAO. In addition the models should:

a. assist decision-makers with understanding and evaluating DPRO and DCMAO functional area resource levels in view of valid workload indicators,

b. identify imbalances between the different DPROs and DCMAOs,

c. be useful in review of staffing requests, and

d. be flexible to handle Performance Based Management (PBM) initiatives.

SECTION 2

METHODOLOGY

The general methodology was straightforward. First, previous studies in this general area were reviewed. Second, the candidate workload indicators were selected. Third, the functional areas where staffing would be estimated were defined. Finally, the models were developed (along with including the special features needed to provide the models flexibility and utility).

2.1 PREVIOUS STUDIES

Previous Plant Representative Office (PRO) staffing studies and models include the Air Force Contract Management Division (AFCMD) model, a 1981 Naval Air Systems Command (NAVAIR) PRO model, and the 1989 Defense Analysis Studies Office (DASO) study, "Staffing of Service Plant Representative Offices." The AFCMD model used regression analysis to make an all-inclusive estimate of each Air Force PRO's staffing. Principal indicators were contractor sales to the government and contractor employees. The model also required an on-site management review to set other factors used in the model. The DASO study developed a regression model based on a sample of DLA and Service PROs. It suggested the model be used to question staffing of activities outside a confidence interval rather than for more direct evaluations. After reviewing these studies it was decided that a more comprehensive and detailed study might yield models that were more accurate and usable in DCMC. No previous work using regression analysis to estimate staffing at DCMAOs was identified.

2.2 CANDIDATE WORKLOAD INDICATOR SELECTION

The first step in selecting workload indicators was to determine if the same workload indicators suffice for all SLFAs (both DCMAOs and DPROs). It proved to be logical and statistically feasible to develop separate models for DCMAOs and DPROs. DCMAOs are more stable because they have a mix of contracts, contractors, programs, and commodities. At DPROs the workload is generally in one or a few (usually related) commodities, often dependent on one or a few weapons systems programs. This difference between DCMAOs and DPROs necessitated different types of indicators.

Workload indicator selection at the DCMAOs was fairly straightforward, using mostly traditional indicators for the major functional areas. Indicators tested were primarily suggested by field personnel.

The indicators were screened for logical suitability before they were statistically tested by regression analysis. The ease with which any of these indicators could be manipulated was evaluated. Consideration was then given to incorporating indicators that show whether workload is increasing or decreasing (leading indicators). At times, this process resulted in indicators with a slightly lower correlation to staffing. As a result, a small amount of accuracy was sacrificed, but other important features of the models were enhanced. During this preliminary model evaluation stage, when model statistics were not adequate, we also evaluated several additional workload indicators for better statistical fits.

Interim models were developed and evaluated by DCMC Headquarters staff and functional area experts. The interim models generally confirmed preconcieved ideas about which SLFAs were under-resourced and which were over-resourced. However, there were individual indicators that they felt could be improved. They were also interested in incorporating more leading indicators into the final models.

Due to the unique nature of workload in DPROs, personnel at all DPROs and district headquarters were surveyed for suggested indicators for the models. An important question was: Are there indicators that can track with major contractor downsizings or workload increases? Indicators mentioned more than three times were evaluated further for suitability. These are listed, along with their frequency of response, in Table 2-1. Additional indicators, suggested by DCMC Headquarters functional area experts were also tested to improve the statistical accuracy of the models.

The indicators we looked at for the both the DCMAO and DPRO models, along with further details of the indicator selection process, are in Appendix A.

In a general sense, we made a decision on using unit cost indicators versus volume indicators. Although unit cost may intuitively be a potential indicator, volume is better. Defense Business Operating Fund (DBOF) and the budget are each impacted by unit costs. Within each of these financial systems, cost is equal to unit cost multiplied by volume. However, for the budget the volume is next year's volume. So if a contractor, has its program for bombers reduced from 40 to 2, or 0, the driving factor for cost is volume rather than unit cost. DLA is transitioning from a unit cost driven era into a volume driven era, an era when dramatic declines in volumes of business are expected. This underscores the importance of using leading indicators of volume in the models.

Table 2-1. DCMC Responses to Questionnaire on DPRO Workload Indicators *

Workload Indicator	Frequency Mentioned, by Function			
	Command Office	Contract Mangment	Program & Tech Supt	Total
Contracts On-hand (KOH)	10	12	3	25
Progress Payments	4	14	7	25
Contract Line Items	3	3	1	7
$ Obligated	11	10	2	23
# Fwd Prcng Rate Agrmnts	4	10	0	14
Program Mngd (PM) Contracts	6	1	8	15
Contract Type	3	6	0	9
Unliqu Oblig (ULO)	5	3	1	9
Tech Analsis Cost Prop (TACP)	7	2	12	21
Cost/Sched Control Sys Crit	5	3	10	18
Contractor Size	2	4	1	7
# Contractor Facilities	5	2	1	8
# Engineering Change Proposals	4	2	8	14

* NOTE: Command Office responses apply to indicators impacting total staffing for the CAO. Contract Management and Program and Technical Support responses apply only to the indicators and staffing of their respective functional areas. There were 24 responses from Command Offices, 23 from Contract Management and 16 from Program and Technical Support.

2.3 DEFINITION OF FUNCTIONAL AREAS FOR ESTIMATING

Staffing at each SLFA was segmented into functional areas (for example, Contract Administration, QA operations). Generally these areas are at the 3 digit cost code level but there are exceptions. For example, Contractor Purchasing Systems Reviews (CPSR) are segregated from Pricing, while Program and Technical Support and Industrial Support are estimated together, rather than either separately or by division. The rationale for segmentation, which called for judgment, was to have the functions as large as possible while still having the work performed within them as alike as possible. Organization structure was not a consideration.

In addition, it was necessary to break out small functions because doing so results in less variation in the larger functions of which they are a part. As a result, better estimates can be made for both areas. Regression analysis was <u>not</u> used for very small functions such as QA Specialized Safety, Counsel, etc. Instead, special criteria, or rules of thumb, were developed (See Appendix B).

The functional areas in which the various models were developed are shown in Table 2-2, Workload Indicators Used in DCMAO Models and Table 2-3, Workload Indicators Used in DPRO Models.

2.4 MODEL DEVELOPMENT

After deciding on the valid workload indicators and the functional areas of the different offices to be modeled, the models were developed through regression analysis. A regression model constructs the relationship that best fits the data. It quantifies the relationship between variables thought to be logically linked, for example, workyears and disbursements. The change in one variable is directly related to the change in the other. But the change in one does not necessarily cause the change in the other, for example, disbursements do not cause Contract Management work. If the workload indicator (in this case disbursements), does not cause work, it may serve as a proxy for other variables that do cause work. These other variables may not have been included in the model for a number of reasons. For example, they could not be identified, or data could not be collected for them. Overall, the method compares activities with each other. In so doing, it does not find ideal staffing levels.

Analysis of actual vs. estimated workyears showed that small DPROs and DCMAOs appeared to have different influences affecting staffing than larger ones. In other words, a single model is not relevant for the entire range of activity sizes. As a result, two size ranges are used, and the small and large activities are estimated separately. This method is known technically as piecewise analysis. Table 2-2 lists the indicators used in the DCMAO models.

In addition, several functional areas in the large DPROs seemed to have other influences affecting staffing that were associated with commodity groupings. DPROs, as mentioned previously (Paragraph 2.2 above), tend to not contain a mix of workload by commodity, but rather have the same general commodity grouping. For the large DPROs the analysis showed that for Contract Administration and Cost/Price, there was a difference in staffing patterns between the commodity grouping of "Space/National Aeronautics and Space Administration (NASA)" (9 DPROs) and those that were not in the "Space/NASA" (44 DPROs) grouping. Separate models for "Space/NASA" and "Other than Space/NASA" provided better models. In QA staffing (both Operations and Support), the patterns emerged between the two largest singular commodity groups ("Electronics Related" - 21 DPROs, "Aircraft & Missiles" - 22 DPROs), and the remaining DPROs (all other commodity groupings). To get enough QA data points in each grouping, it was necessary to use all DPROs (large and small). Once again, segregating along commodity lines in QA provided better models. Table 2-3 lists the indicators used in the DPRO models, including commodity grouping segregations.

In developing the required models, previous models were utilized. The Quality Assurance Resource Model (QUARM) (DLA-XX-P90124), a separate model developed at DORO Chicago, evaluates QA operations in-plant resource requirements. A goal of QUARM is that resourcing be consistent with the In-plant Quality Evaluation (IQUE) program, a DLA performance based management initiative. An aim of IQUE is to decrease QA resources directed at contractors whose performance has increased above levels designated in the IQUE program. To help do this, QUARM employs an indicator that measures performance, the QA Evaluation and Sensing Technique (QUEST) Score. QUEST (DLA-91-P90272 - Release 3) was developed at DORO Richmond.

Table 2-2. Workload Indicators Used in DCMAO Models

FUNCTIONAL AREA	INDICATOR(S)
Large DCMAOs (More Than 158 People)	
Contract Admin	KOH(Adj), # Progress Payments, ULO
Cost/Price	Cost/Price Cases, ULO
Property Management	Lines of Stdrd Test Equ, KOH(Adj), ULO
Plant Clearance *	Lines of Property
Terminations **	ULO
Transportn & Packgng	# Govt Bills of Lading, ULO
Prog & Tech Suprt ***	KOH (Adj), CSSR Ks, Disbursements
QA Operations	QA UDB, QA KOH, Nonres Facil, Res Facil
QA Support	QA KOH
Command Support	CAO Personnel not in Command Support
Data Entry	# of Shipments
Small DCMAOs (Less Than 158 People)	
Total Staffing	KOH (Adj)

* Plant Clearance function not required at all DCMAOs.
** Terminations is done only at the 9 DCMAOs collocated with former region headquarters.
*** Includes Industrial Support workload and personnel.

KOH - # Contracts On-hand **ULO** - $ Unliquidated Obligations
UDB - Undelivered $ Balance from QA Mgmnt Information Sys (MIS)

QUARM has been adapted for use in the DCMC Staffing Assistance Models. Since QUARM estimates only QA operations in-plant resources, other models were developed to estimate supervisory and clerical personnel in QA operations (See Appendix B) and QA Operations Support personnel.

Table 2-3. Workload Indicators Used in DPRO Models

FUNCTIONAL AREA	INDICATOR(S)
Large DPROs (More Than 54 People)	
Contract Admin "Space/NASA" Not "Space/NASA"	 KrEng KrEng, ULO, # PM Ks
Cost/Price "Space/NASA" Not "Space/NASA"	 KrEmp, # Cost/Price Cases KrEng, ULO
Property Management	Ks Rcvd, $ Material, GOCO, Tot Govt Prop $
Prog & Tech Suprt *	$ PM Ks, Ks Rcvd, KrEng, CSSR Ks, Eng TACPs
QA Operations "Electron Related" "Aircft & Missles" Other Than Above	 KrEmp, QA KOH KrEmp, QUEST Score, MDRs KrEmp, Mil-Q + Mil-I Facil, QA UDB
QA Support "Electron Related" "Aircft & Missles" Other Than Above	 Mil-I Ks Rcvd, KrEng Mil-Q Ks Rcvd, ULO Total QA Ks Rcvd, QA UDB, KrEmp
Command Support	CAO Personnel not in Command Support
Small DPROs (Less Than 54 People)	
Total Staffing	Tot Govt Prop $, KrEmp, ULO, KOH

* Includes Industrial Support workload and personnel.

KrEng - # Contractor Engineers	**# PM Ks** - # Prog Mngd Contracts
KrEmp - # Contractor Employees	**$ PM Ks** - $ Prog Mngd Contracts
Ks Rcvd - # Contracts Recved	**GOCO** - Govt Owned, Kr Oper facil
CSSR - Cost Schedule Systems Rev	**TACP** - Tech Analysis Cost Prpsl
QUEST - QA Eval & Sens Technique	**MDRs** - Materl Deficncy Repts
MIL-Q - Mil Spec Quality Program	**MIL-I** - Mil Spec Inspect System

Military workyears are included in the estimates. Obviously military personnel contribute to work output. More importantly they cannot be eliminated before estimating because significant variations would arise where the percentage of military personnel differed between activities. To simplify the methodology, all military are removed from the total SLFA estimate in a single step done at the end.

In developing the regression models, typically one or two activities that were at extreme variation from the trend line (outliers) were eliminated and the models were recast. The variations of the outliers, in this study, are believed to be due to special situations or influences that are not present for other activities, rather than random variation.

Since the models allocate a given number of people, as determined by the budget process, between the different offices, a small adjustment (about 1 percent at the office level) had to be made. These adjustments were due to rounding off to the next whole person and the outlier data points. As discussed above, the models were formulated without the outlier's data. Estimates for the outliers were then made using the models.

The final step in the estimating process is to sum the estimates for the functional areas to get an overall SLFA estimate. The percent difference of the estimate from the actual is calculated for each activity and an average percent difference (regardless of whether plus or minus) is calculated for all activities. Summing functional components to arrive at an overall SLFA estimate has a number of advantages compared to making a single estimate. It:

- can take into account components that may not exist in all activities, (for example, for the terminations function it would distort the results for those 9 activities having a terminations function)

- may result in a smaller error at the SLFA level since the component errors may be + and - and tend to offset

- takes workload complexity into account (this helps address the concern regarding many activities that they are unique, or in some way very different from all others)

- enables the use of thresholds or criteria for small functions where regression analysis cannot be used; for example, QA specialized safety and counsel.

2.5 SPECIAL MODELING CRITERIA

Three important features were designed into the models. The models: track contractor business activity; account for the impact of PBM initiatives (and can be adapted to account for future PBM initiatives); and take into account work that is not discretely measurable.

Certain variables, such as those associated with contractor business activity, can serve as indicators of current and/or future workload. Usually these variables, called leading indicators, are not the sole component of any of the functional models. However, when present they make an important contribution to the overall estimate.

Such indicators, for example, the number of contractor engineers or employees, were used in many of the DPRO models. They can serve as leading or current indicators of staffing changes that should take place. For example, if a contractor associated with a long established DPRO substantially reduces the number of its employees, then there should be a significant and timely decline in the staffing of that DPRO. The staffing model previously used by the AFCMD used number of contractor employees, and contractor sales to the government, to make adjustments to PRO staffing, for instance if a contractor downsized as previously mentioned. These variables will not fit directly as unit cost measures, but they are important for helping to determine both current and future workload.

For the DCMAOs, many of the functional models use unliquidated dollar obligation (ULO) as an indicator. ULO can be a current and/or leading indicator of workload because it represents contractor work yet to be done and DCMC payments yet to be made. The usefulness of ULO as a <u>leading</u> indicator is not as great as that of the DPRO leading indicators (contractor employees and sales). However, DCMAO workload tends to be much more stable than DPRO workload.

The models can be formulated to account for the impact of PBM initiatives. This can be done by incorporating an indicator that measures contractor performance into the model. This was done for some of the Quality Assurance operations DPRO models in this project by using the QUEST score as a variable.

The regression approach is well suited for functions, including those implementing PBM initiatives, that do not have discrete tasks or discretely measurable work products. This applies to such major areas as Quality Assurance and to most areas of Program and Technical Support, except the Technical Analysis of Cost Proposals (TACP).

SECTION 3

RESULTS

A summary of the models and the indicators that were used is in Appendix C. Spreadsheets that sum the functions, and adjust for military, to arrive at total civilian staffing are in Appendices D (DCMAOs) and E (DPROs). The DCMAO and DPRO civilian staffing by district are in Appendices F and G respectively. The total of DCMAO and DPRO staffing by district is in Appendix H.

3.1 SIGNIFICANCE OF WORKLOAD INDICATORS

The workload indicators used in the models show good statistical correlation with staffing levels. Generally the larger functions have better correlations than the smaller ones.

Some workload indicators show statistical correlations with staffing levels that are almost as good as the correlations for the indicators actually used in the models. However, when indicators that correlate well with staffing levels also correlate strongly with each other, both indicators should not be used in the same model at the same time, although each could be used alone. For example, when ULO and Dollar Value Obligated on Contracts (face value) correlate well with a functional staffing level, only one would be used because these two indicators correlate well with each other. Both are not used because the second one essentially does the same job of explaining variation in staffing as the first and therefore does not add adequate accuracy, or explanatory power, to the model. Between these two indicators, other factors entered into selecting ULO as the indicator used in the final model. ULO was a leading indicator and was less subject to being manipulated by field personnel. Indicators tested for use in the models are listed in Appendix A.

3.2 ESTIMATING ERROR

3.2.1 CAUSES OF ESTIMATING ERROR

Part of the unexplained variation in staffing (the error) is due to variables that it was not possible to find or to put into the models. Another part is due to a number of random causes, for example, a commander's personal view on how the Small Business office should be staffed. Such views can vary randomly from person to person. Random variation is to be expected. Nonrandom variations that can be identified are adjusted for, or accounted for, in the models (for example by holding out an activity from the analysis).

3.2.2 LEVEL OF ACCURACY

All measurements, of all kinds, have an associated measurement error, unless the measurement is a discrete count such as the number of people in a room. This covers measurements such as voltage and distance, and includes the measurements DLA makes (by any method), of its resource requirements. For many reasons the size of the measurement error is not always presented with the measurement. Most often the reason is that the error is difficult to assess. For these regression models, the measurement error is presented as the mean absolute percent error (MAPE), which is the average percent error regardless of whether it is positive or negative. The MAPE for each model is listed in Appendix I.

Correlation for larger functions is good (for example, contract management operations and QA operations). The associated error levels are reasonable and acceptable, considering that (except for the QUARM model for QA operations) estimates will not be used for resourcing decisions about individual functional areas. There are greatly diminishing returns in trying to reduce (further explain) remaining levels of error.

Due to these errors, an interval around the estimate is needed to account for the errors. We call the upper and lower numbers of this interval control limits. Control limits are used to help decision makers determine when action might be necessary. An interval around the estimate is calculated with a confidence level of 90 percent (symmetrical about the average value). In other words, the probability is 90 percent that an activity whose actual staffing lies within these control limits is staffed in the same manner as other activities within the interval. Conversely, activities staffed at levels outside these control limits (either above the upper limit or below the lower limit) have a 90 percent probability of not being staffed in the same manner as other activities within the interval. Staffing at activities outside the control limits should be reviewed. The calculation of the control limits, along with actual control limits for the different DCMAOs and DPROs are in Appendix J.

SECTION 4

CONCLUSIONS

The models set a uniform methodology. The level of accuracy is known and the method by which it was determined is easily explained. The estimates also include small organizational functions, so that 100% of the workyears are covered. They are easy to visualize, and offer a basis for comparing activities. Often field personnel claim that certain activities are "different." The models, in view of the parametric comparisons they make, will help address such perceptions of potential differences.

The DCMAOs are more predictable than the DPROs. This is because their workload is more stable and data more accurate. Having a mix of contractors, they have a better chance of offsetting swings in business on just one, or a few, programs. In addition, some contract data for former Service PROs is not yet in MOCAS, which makes data difficult to collect and less reliable.

4.1 BENEFITS

These models will enable DCMC to better allocate resources and more effectively evaluate the impact of changes in budgets and policy. They use statistical measures to compare workload. They show imbalances. Results can be used, for instance, to shift resources from a DCMAO that is over resourced by 30 workyears to one that is under resourced by 30. The use of leading indicators allows the models to identify potential resourcing problem areas. For example, they could identify an accelerating weapons system program that is understaffed relative to its dollar value and importance. Also, they could identify contractor downsizings that will impact DPRO staffing. The model allocates an equitable number of workyears to each district based on the existing total DCMC budget. This should reduce the chance of underutilizing resources in one district that are needed in another. It will give DCMC a defendable, fair, analytical tool for resourcing decisions. Also, it should minimize the effort and time required for making these decisions. Effective use of the models could potentially result in annual savings to DCMC of about 1 percent of SLFA staffing.

4.2 CURRENT STAFFING PATTERNS

The total estimated staffing, at the district level, for the sum of all the DCMAOs (See Appendix F), shows 3 districts (North Central, Mid-Atlantic, West) where the staffing estimates almost exactly equal the actual. The models show the DCMAOs in the South to be underresourced by 103 workyears and those in the Northeast to be overresourced by 98 workyears (See Appendix F).

The model shows DCMAO Cleveland to be overresourced by 87 workyears, and New York overresourced by 57. This is believed to be former Cleveland and New York region personnel filling DCMAO positions. New York and Garden City (which is in the New York metropolitan area) make up 92 of the 98 workyears the Northeast DCMAOs are estimated to be overresourced. On the other hand, Dallas and St. Louis (the other former region sites), were NOT noted to be overresourced. However, positions in DCMAOs (or DPROs) not properly belonging at the SLFA level (for example budgeting), were not counted in the actual staffing. Had they been included, the actual workyears, in DCMAO Dallas for example, would have been higher.

The total estimated staffing for DPROs at each district (See Appendix G) showed more variation. The largest disparity was in the West, shown to be overresourced by 140 workyears in its DPROs. This is because the models estimate the former Service PROs in the West, mostly Air Force, to be overresourced by 150 workyears. Half of this is due to Northrop, Hawthorne, CA. As a result of this finding, a statistical test was performed to see if the former Service PROs, either together or by Service, showed any pattern of over or under staffing (compared to DLA and/or other Service PROs). They did not.

Total staffing by district (See Appendix H) shows the South to be underresourced, both at DCMAOs and DPROs. One possible explanation that was offered to the study team was that in recent years defense business has migrated to the former Atlanta and Dallas regions from other areas.

SECTION 5

RECOMMENDATIONS

5.1 IMPLEMENT MODELS

DCMC-DD and district commanders should use the models to estimate and compare district and SLFA staffing levels, respectively. (Estimates for district headquarters, DCMC International, and reimbursable workyears are not within the scope of this project.) Functional level estimates (within the SLFA) can help decision-makers understand differences in staffing. However, except for QA operations, they should not be the basis for resourcing decisions. QA operations estimates, taken directly from the QUARM model, can be used since QUARM was specifically developed for QA resourcing.

As part of annual operations reviews, district or DLA staff should analyze the causes for significant variances from the model estimate, either plus or minus, and provide narrative explanation. For example, "+9 workyears due to termination of XYZ electronic countermeasures program earlier than planned." In addition, where problems are identified, solutions, possibly involving workload balancing, should be recommended.

5.2 BALANCE RESOURCES

Decision-makers should act regarding significantly over and underresourced activities. This could be done in connection with annual reviews such as those mentioned above. Currently such action (without the models) may be ad hoc, and may not focus on the activities most in need of review. If investigation of the variance provides no further justification of the imbalance, then either resources (where possible) or workload should be redistributed. For example, ULO could be transferred by 3-digit zip code area while resources remain in place. Such shifts are an ongoing process anyway. These models provide an effective analytical means to do this.

5.3 UPDATES

The models should be updated and revalidated, and new estimates made, as required (particularly when changes have been made that will affect staffing resources).

APPENDIX A

SIGNIFICANCE OF WORKLOAD INDICATORS

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Appendix A

Appendix A

WORKLOAD INDICATOR SELECTION

Many indicators tested were excluded from the models for the same reasons. Many simply were not highly correlated with staffing. Others had a strong correlation with an important task, but the task was not an important factor affecting staffing. Other indicators correlated highly with other indicator(s) and thus could not be used together with these other indicators. In some of these cases, a weaker indicator (one not as highly correlated to staffing), may have been used because it could not be manipulated by field personnel. There were also cases of indicators working well in DCMAO models, that seemed to be logical DPRO indicators, but the same DPRO data was either not reliable or available. The following examples illustrate the above process, for indicators previously used in DCMC in the Contract Administration functional area:

- Dollar Value Obligated (face value): had good correlation with staffing, but this data element can be manipulated if completed contracts are not removed from the Mechanization of Contract Administration System (MOCAS).

- Unliquidated Obligation: correlated almost as well as face value, but cannot be manipulated because it represents the value of remaining payments to contractors. Does not correlate well with Contracts on Hand (Adjusted) (see below) and so can be used with it, thereby improving the model. As a result, ULO was chosen instead of face value as one of the indicators.

- Dollar Value of Contracts Received: does not correlate well with staffing in most cases, thus was not used.

- Disbursements: had good correlation with staffing and cannot be manipulated. But, for this specific example, it correlates well with Contracts on Hand (Adjusted) and so cannot be used with it. Disbursement data is not directly available but it can be calculated (for DCMAOs). The data needed to calculate disbursements, however, is not currently available for many former Service PROs.

- Contracts on Hand (Adjusted): Total Contracts on Hand had very good correlation with staffing and can be used with ULO. But it can be manipulated by not removing completed contracts from MOCAS. An adjustment is made to counter this potential for manipulation. This adjustment is a reduction equal to the percentage of contracts in Contract Administration Report (CAR) sections III and IV less the lowest such percentage for any DCMAO.

EVALUATION OF DCMAO INDICATORS

Functnl Area	Indicators Used	Indicators Not Used: Correlated with Indicators Used	Indicators Not Used: Correlation to Staffing Weak
Contract Admin	Contr On Hand(Adj) Progress Payments ULO	# FSCMs in CAO # New FSCMs in CAO Face Value Contr On Hand(BOAs & orders=1 count)	
Cost/ Price	ULO # Cost/Price Cases	Contr On Hand Contr On Hand(BOAs & orders=1 count) Face Value	Cost/Price Preawards
Property Mangment	Lines Special Test Equip (STE) Contr on Hand(Adj) ULO	Face Value $ STE	$ Other Real Property Lines Other Plant Equip $ Other Plant Equip Lines Indust Plant Equip $ Indust Plant Equip Lines Special Tooling(ST) $ ST Lines Military Property $ Military Property $ Material
Termin	ULO	Face Value	Contr On Hand
Transp & Pkgng	Govt Bills Lading ULO	Face Value	# of Shipments Contr On Hand
Data Entry	# Shipments		Contr On Hand Face Value ULO

EVALUATION OF DCMAO INDICATORS (Cont.)

Functnl Area	Indicators Used	Indicators Not Used: Correlated with Indicators Used	Indicators Not Used: Correlation to Staffing Weak
Prog & Tech Spt (incl Ind Spt)	Contr On Hand(Adj) # CSSR Contr Disbursements	ULO Face Value Progress Payments Ind Spt Preawards # Cat I Prod Contr	Face Value-Prog Mngd Contr # C/SCSC Cont Engrng Surv Contr Prod Surv Contr Engrng Chng Prop Engrng Tech Anal Cost Prop(TACP) Ind Spt TACP # Prog Mngd Contr
QA Oper	QA Und $ Bal(UDB) QA Contr On Hand # Res Facil # Nonres Facil	$ Contr Rcvd Total Mil-I + Mil-Q Facil # Other QA Prov Facil Total # Facil QA Contr Rcvd	# Over/Above Monthly Avg Prod Qual Def Rprts QUEST Score Travel Hours
QA Spt	QA Contr on Hand		

EVALUATION OF DPRO INDICATORS

Functnl Area	Indicators Used	Indicators Not Used: Correlated with Indicators Used	Indicators Not Used: Correlation to Staffing Weak
Contract Admin *	# Cntrctr Enginrs # Prog Mngd Contr ULO	# Cntrctr Employs Face Value-Prog Mngd Contr Contr On Hand Face Value Cntrctr Sales-Govt Total $ Govt Prop	# Def Acquis Brd Prog Supported
Cost/ Price *	ULO # Cntrctr Enginrs # Cntrctr Employs # Cost/Price Cases	Cntrctr Sales-Govt Face Value # Cntrctr Employs	# Def Acquis Brd Prog Supported Contr on Hand
Property Mangment	# Contr Rcvd $ Material GOCO,0-1 Dummy Var Total $ Govt Prop	Face Value ULO Lines STE + ST $ STE + ST Lines Facility $ Facility	$ Other Real Property # Def Acuqis Brd Prog Supported Lines Military Property $ Military Property Lines ST $ ST
Prog & Tech Spt (incl Ind Spt)	Contr Rcvd # CSSR Contr Engineering TACPs Face Value-Prog Mngd Contr # Cntrctr Enginrs	ULO Face Value Cntrctr Employs # Prog Mngd Contr Contr on Hand	Cat I Prod Contr Progress Paymnts # C/SCSC Cont Enrng Surv Contr Ind Spt TACPs Prod Surv Contr Engrng Chng Pro
QA Oper *	# Cntrctr Employs QA Contr On Hand Monthly Avg Prod Qual Def Rprts QUEST Score Total Mil-I + Mil-Q Facil QA UDB	$ Contr Rcvd # Res Facil QA Contr Rcvd Total # Facil	# Nonres Facil # Other QA Prov Facil # Over/Above Req

EVALUATION OF DPRO INDICATORS (Cont.)

Functnl Area	Indicators Used	Indicators Not Used	
		Correlated with Indicators Used	Correlation to Staffing Weak
QA Spt *	QA Contr on Hand # Cntrctr Employs # Mil-Q Contr Rcvd ULO QA Contr Rcvd QA UDB # Cntrctr Employs		

* All indicators used for all models in the functional area are listed, those not used may include some of the same indicators (used in one model, not in the other).

APPENDIX B

SPECIAL CRITERIA FOR SMALL FUNCTIONS

Appendix B

SPECIAL CRITERIA FOR SMALL FUNCTIONS

B-1.1 CONTRACTOR PURCHASING SYSTEMS REVIEW (CPSR)

It was not possible to get CPSR workload indicator data by DCMAO. Had such data been obtained it would have been possible to develop DCMAO models similar to those for other functions. District level data was used instead. A regression analysis was done by district. The model that resulted showed one CPSR workyear (including supervisory and clerical) for each eight contractors in the program. The threshold that determines the number of contractors in the program is in the FAR. District level estimates were allocated to DCMAOs based on the percentage of actual CPSR personnel in the DCMAO compared to the district. The DCMAO estimates were reduced by 3 percent to make them resource neutral DLA-wide (111 actual vs 111 estimated). (The CPSR analyst at General Dynamics, Pomona was considered to be part of DCMAO Santa Ana for this analysis.)

B-1.2 SMALL BUSINESS

There is a portion of the Small and Disadvantaged Business (SADBU) workload that is "fixed." That is, every DCMAO requires a SADBU specialist. The additional SADBU workload is due to monitoring small business subcontracting plans, required for every contract over $500,000 awarded to a large contractor. Therefore, half of the SADBU positions in the DCMAOs are "fixed," the other 36 "variable" positions are supported by the requirement to monitor small business subcontracting plans. As of May 1991, there were 260.7 subcontracting plans for each of these "variable" positions. Small Business staffing was estimated for each DCMAO as:

1 + 0.003835 times the # of subcontracting plans

(0.003835 means persons per subcontracting plan).

B-1.3 QUALITY ASSURANCE SAFETY

The District Specialized Safety (QA Safety) Managers make good assessments of QA Safety resourcing needs at the SLFAs. This is because they use the guidelines in DLAM 8280.1, Specialized Safety Manual, Appendix C, Specialized Safety Risk Assessment System. Although these are not all inclusive and intended to be applied at the facility level, readily available data that corresponded to elements in the guidelines was used to develop QA Safety staffing estimates.

Because it was evident from discussions with the District Specialized Safety Managers that they shifted resources where they are needed, SLFAs that do not now have QA Specialists (workload is covered by QA Safety specialists at nearby SLFAs) were assumed to not need QA Safety positions for purposes of this model. Regression runs showed these data elements to correlate highly with QA Safety staffing, but there just was not enough variability in staffing to develop regression models.

Separate methodologies were developed for DCMAOs and DPROs. The rule of thumb for DCMAOs was, using the indicator dollars of one-of-a-kind type property (special tooling plus special test equipment): one QA Specialist for less than $75 million of this property, two QA Specialists for between (and including) $75 million and $150 million of this property, and three QA Specialists where this property exceeds $150 million.

The DPRO methodology used three indicators: dollars of other plant equipment and special tooling, and QA Undelivered Dollar Balance. It allocated one QA Specialist for UDB greater than $900 million, another for special tooling dollars exceeding $75 milion, and another for other plant equipment greater than $70 million.

B-1.4 QUALITY ASSURANCE OPERATIONS SUPERVISORY AND CLERICAL

QA operations supervisory and clerical staffing was estimated as percentage of QA operations staffing. The estimates are obtained by multiplying QA non-supervisory and clerical operations personnel by 0.318 for the DCMAOs and 0.348 for the DPROs. This means that QA operations supervisory and clerical are 24 percent of total operations in the DCMAOs and 26 percent in the DPROs. This does NOT include any QA Support personnel. The implication is that there is about one supervisor and one clerical worker for each six operations workers in QA.

B-1.5 COUNSEL

Very few counsel staff are currently in DCMAOs. As a result, the project analysts reviewed the DLA-G methodology for placing DCMAO counsel staff and used current actuals in lieu of estimates.

APPENDIX C

SUMMARY OF THE MODELS AND INDICATORS

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LARGE DCMAO MODELS
(With More Than 158 People)

Large DCMAOs

NORTH CENTRAL	MID-ATLANTIC	NORTHEAST
Chicago	Baltimore	Boston
Denver	Cleveland	Garden City
Grand Rapids	Dayton	Hartford
Indianapolis	Detroit	New York
St Louis	Philadelphia	Syracuse
Twin Cities	Pittsburgh	
	Reading	
	Springfield	

SOUTH	WEST
Atlanta	El Segundo
Birmingham	Phoenix
Dallas	San Francisco
Orlando	Santa Ana
San Antonio	Van Nuys

NOTE: Any outliers that were not used in a particular model are noted after the equation has been explained.

Contract Administration: $R^2 = 0.74$ *

Wkyrs = (0.00214 * X1) + (0.625 * X2) + (0.00422 * X3) + 11.7

X1 = Cont on Hand(Adjusted) X3 = Unliquidated Obligation(ULO)
X2 = # of Progress Payments

Outliers: Cleveland, Baltimore

* The Coefficient of Determination (R^2) measures how much of the total variation in the dependent variable (workyears in the Contract Administration function for the above model) is explained by the regression equation. The R^2 is expressed as a percentage. For example, the regression equation above explains 74 percent of the variation in Contract Administration workyears at the large DCMAOs.

Cost/Price: $R^2 = 0.59$

Wkyrs = (0.119 * X1) + (0.00206 * X2) + 5.5

X1 = # of Cost/Price Cases X2 = ULO

Outliers: Cleveland, Reading

Property Management: $R^2 = 0.70$

Wkyrs = (0.000394 * X1) + (0.000194 * X2) + (0.000488 * X3) + 3.5

X1 = # of Lines- Spec Test Eqpmt X3 = ULO
X2 = Cont on Hand(Adjusted)

Outliers: Cleveland, Baltimore, Indianapolis

Transportation & Packaging: $R^2 = 0.44$

Wkyrs = (0.00607 * X1) + (0.000309 * X2) + 5.5

X1 = # of GBLS X2 = ULO

Outliers: Cleveland, New York, Van Nuys

Program & Technical Support and Industrial Support: $R^2 = 0.77$

Wkyrs = (0.00214 * X1) + (0.846 * X2) + (0.1207 * X3) + 18.4

X1 = Cont on Hand(Adjusted) X3 = Disbursements
X2 = # of CSSR Contracts

Outlier: Cleveland

QA Operations (for all size DCMAOs): $R^2 = 0.91$

Workhours/mo = (0.0000005007 * X1) + (0.44921 * X2) + (6.626016 * X3) + (180.33 * X4) + 2465

X1 = QA Undelivered $ Balance X3 = # of Non Resident Facil
X2 = # of QA Cont on Hand X4 = # of Resident Facil

Note: Wkyrs = (workhours/mo)/145

QA Support: $R^2 = 0.48$

Wkyrs = (0.0009407054 * X1) + 7.81

X1 = # of QA Cont on Hand

Outliers: Cleveland, Detroit

<u>Command Support</u>: $R^2 = 0.39$

Wkyrs = (0.02 * X1) + 2.8

X1 = # of DCMAO personnel not in Command Support

Outliers: Cleveland, St Louis

<u>Data Entry</u>: $R^2 = 0.33$

Wkyrs = (0.00087 * X1) + 2.3

X1 = # of Shipments

Outlier: Cleveland

THE FOLLOWING FUNCTIONS ARE NOT PERFORMED AT EVERY LARGE DCMAO:

<u>Plant Clearance</u> (not done at Grand Rapids, Indianapolis, Baltimore, Pittsburgh, Reading, Birmingham): $R^2 = 0.64$

Wkyrs = (0.0000135 * X1) + 1.2

X1 = # of Lines of Property

Outlier: Cleveland

<u>Terminations</u> (only done at the 9 DCMAOs collocated with former region locations headquarters - Atlanta, Boston, Chicago, Cleveland, Dallas, Los Angeles, New York, Philadelphia, St. Louis): $R^2 = 0.85$

Wkyrs = (0.00024 * X1) + 4.2

X1 = ULO (for activities serviced)

Outliers: Cleveland, New York

LARGE DPRO MODELS
(With More Than 54 People)

Large DPROs

NORTH CENTRAL
Boeing Mil Airpl, Wichita, KS
FMC Minneapolis
GMC Allison
Honeywell/Alliant Techsystems
Martin Marietta, Denver, CO
McDonnell Douglas, St Louis, MO
Thiokol

SOUTH
Bell Helicp Textron, Ft Wth, TX
General Dynamics, Ft Wth, TX
Lockheed Aero Sys, Marietta, GA
LTV Aerospace & Def, Dallas, TX
Martin Marietta, Orlando, FL
Pratt & Whitney, W Palm Bch, FL
Rockwell, Richardson, TX
Texas Instruments, Dallas, TX

NORTHEAST
Eaton AIL, Deer Park, NY
GE Aircraft Engine, Lynn, MA
GE Pittsfield, MA
Grumman, Bethpage, NY
GTE Govt Systems
Hamilton Standard
IBM Owego, NY
Lockheed Sanders, Nashua, NH
Pratt & Whitney, E Hartford, CT
Raytheon, Burlington, MA
Textron Lycoming, Stratford, CT
Unisys Great Neck, NY
UTC Sikorsky, Stratford, CT

WEST
Aerojet, Sacramento, CA
Boeing, Seattle, WA
Douglas Aircraft, Long Bch, CA
FMC
General Dynamics, Pomona, CA
General Dynamics, San Diego, CA
Hughes, Fullerton, CA
Hughes, Los Angeles, CA
Hughes Missile, Tuscon, AZ
Lockheed, Sunnyvale, CA
McD Doug Helicopters, Mesa, AZ
McD Doug Space, Hunt Bch, CA
Northrop, Hawthorne, CA
Rockwell, Anaheim, CA
Rockwell, Canoga Park,CA
TRW, Redondo Beach, CA

MID-ATLANTIC
Boeing Helicopter, Phil, PA
GE Aerospace Delaware Val, NJ
GE Aircraft Engines, Cincin, OH
General Dynamics, Lima, OH
General Dynamics, Warren, MI
IBM Manassas
Loral Systems Group
Westinghouse, Baltimore, MD
Westinghouse, Cleveland, OH

NOTE: Models for the following functions were developed using all of the Large DPROs listed above, except where outliers are noted after the formula.

Property: $R^2 = 0.71$

Wkyrs = (0.006619 * X1) + (0.004806 * X2) + (1.10 * X3) + (.0294 * X4) + 5.24

X1 = # Cont Received
X2 = $ Value of Material
X3 = 1 if GOCO, 0 if Not (Gov. Owned Cont Operated)
X4 = $ Value of Property

Outliers: Westinghouse, Baltimore; Hughes, Los Angeles; Boeing Mil Airpl, Wichita; Northrop, Hawthorne.

Program & Tech-ical Support and Industrial Support: $R^2 = 0.80$

Wkyrs = (0.001159 * X1) + (0.08793 * X2) + (0.00121 * X3) + (0.6268 * X4) + (0.66134 * X5) + 6.9

X1 = Face Val Prog Mngd Cont
X2 = # of Cont Received
X3 = # of Cont Engineers
X4 = # of CSSR Cont
X5 = # Engr TACPs

Outliers: McD Doug, ST.L, MO; IBM Manassas; Martin Marietta, Denver, CO; Northrop, Hawthorne, CA.

Command Support: $R^2 = 0.56$

Wkyrs = (0.05 * X) + 2

X = # of People in DPRO not including command support

Outliers: Gen Dyn, FT Wrth, TX; LTV Aerospace & Defense, Dallas, TX.

Contract Administration and Cost/Price:

Analysis that DPROs in the commodity grouping of "Space/NASA" were staffed differently than those not in this grouping. Therefore, separate models were developed for "Space/NASA" and "Other than Space/NASA" for these two functional areas.

The following models were developed using the Large "Space/NASA" DPROs listed below, except where an outlier is noted.

NORTH CENTRAL
Martin Marietta, Denver, CO
Thiokol

NORTHEAST
Hamilton Standard

SOUTH
Martin Marietta, Orlando, FL

WEST
General Dynamics, San Diego, CA
Rockwell, Canoga Park,CA
Hughes, Los Angeles, CA
McD Doug Space, Hunt Bch, CA
TRW, Redondo Beach, CA

Contract Administration: $R^2 = 0.68$

Wkyrs = (0.001805 * X1) + 2.73

X1 = # of Cont Engineers

Outlier: Gen Dyn, San Diego, CA.

Cost/Price: $R^2 = 0.92$

Wkyrs = (0.0007265 * X1) + (0.236 * X2) - 5.37

X1 = # of Cont Employees X2 = # of Cost/Price Cases

The following models were developed using the Large DPROs ("Other than Space/NASA") listed below, except where outliers are noted.

MID-ATLANTIC
Boeing Helicopter, Phil, PA
GE Aerospace Delaware Val, NJ
GE Aircraft Engines, Cincin, OH
General Dynamics, Lima, OH
General Dynamics, Warren, MI
IBM Manassas
Loral Systems Group
Westinghouse, Baltimore, MD
Westinghouse, Cleveland, OH

SOUTH
Bell Helicp Textron, Ft Wth, TX
General Dynamics, Ft Wth, TX
Lockheed Aero Sys, Marietta, GA
LTV Aerospace & Def, Dallas, TX
Pratt & Whitney, W Palm Bch, FL
Rockwell, Richardson, TX
Texas Instruments, Dallas, TX

NORTHEAST
Eaton AIL, Deer Park, NY
GE Aircraft Engine, Lynn, MA
GE Pittsfield, MA
Grumman, Bethpage, NY
GTE Govt Systems
IBM Owego, NY
Lockheed Sanders, Nashua, NH
Pratt & Whitney, E Hartford, CT
Raytheon, Burlington, MA
Textron Lycoming, Stratford, CT
Unisys Great Neck, NY
UTC Sikorsky, Stratford, CT

WEST
Aerojet, Sacramento, CA
Boeing, Seattle, WA
Douglas Aircraft, Long Bch, CA
FMC
General Dynamics, Pomona, CA
Hughes, Fullerton, CA
Hughes Missile, Tuscon, AZ
Lockheed, Sunnyvale, CA
McD Doug Helicopters, Mesa, AZ
Northrop, Hawthorne, CA
Rockwell, Anaheim, CA

NORTH CENTRAL
Boeing Mil Airpl, Wichita, KS
FMC Minneapolis
GMC Allison
Honeywell/Alliant Techsystems
McDonnell Douglas, St Louis, MO

Contract Administration: $R^2 = 0.69$

Wkyrs = (0.001436 * X1) + (0.001439 * X2) + (0.0731 * X3) + 11.4

X1 = # of Cont Engineers
X2 = ULO
X3 = # of Program Managed Contracts

Cost/Price: $R^2 = 0.78$

Wkyrs = (0.0009775 * X1) + (0.0007089 * X2) + 5.24

X1 = # of Cont Engineers
X2 = ULO

Outliers: Gen Dyn, Ft Wth, Tx; Gen Dyn, Warren, MI; Gen Dyn, Lima, OH.

Quality Assurance:

Analysis showed commodity to be an influence in QA staffing (both Operations and Support) in DPROs. When DPROs were stratified by commodity groups, substantially better models resulted. To get enough data points, it was necessary to use all DPROs, both large and small. The two largest singular commodity groups ("Electronics Related", "Aircraft & Missiles") had enough facilities to produce regression models. The remaining commodities were then modeled as a group.

The following QA Operations and Support models were developed using the Large DPROs in the "Electronics Related" commodity grouping.

NORTH CENTRAL
Magnavox
Northrop, Rolling Meadows, IL

MID-ATLANTIC
Allied Signal, Teterboro, NJ
IBM Manassas
ITT Defense Group
Kearfott/Plessey
Westinghouse, Baltimore, MD

WEST
Hughes, Fullerton, CA
Rockwell, Anaheim, CA

SOUTH
AT&T Technol, Burlington, NC
Harris Melbourne, Palm Bay, FL
Rockwell, Richardson, TX
Texas Instruments, Dallas, TX

NORTHEAST
Eaton AIL, Deer Park, NY
GTE Govt Systems
IBM Owego, NY
Link Flight Simulation
Lockheed Sanders, Nashua
Raytheon, Burlington, MA
Textron Def Sys, Wilmington, MA
Unisys Great Neck, NY

QA Operations: $R^2 = 0.93$

Workhours/mo = (0.179805 * X1) + (0.770394 * X2) + 662.2

X1 = # Cont Employees X2 = # of QA Cont on Hand

Note: Wkyrs = (workhours/mo)/145

QA Support: $R^2 = 0.42$

Wkyrs = (0.0334 * X1) + (0.0005339 * X2) + 2.53

X1 = # of Type B Cont Recvd X2 = # of Cont Engineers

The following QA Operations and Support models were developed using the Large DPROs in the "Aircraft & Missiles" commodity grouping.

NORTH CENTRAL
McDonnell Douglas, St Louis, MO
Sundstrand

MID-ATLANTIC
GE Aerospace Delaware Val, NJ
Westinghouse, Cleveland, OH

SOUTH
Bell Helicp Textron, Ft Wth, TX
General Dynamics, Ft Wth, TX
Lockheed Aero Sys, Marietta, GA
LTV Aerospace & Def, Dallas, TX
McD Doug, Titusville, FL
McD Doug Rockwell, Tulsa, OK
Pratt & Whitney, W Palm Bch, FL
Rockwell Duluth, GA

WEST
Aerojet, Sacramento, CA
Boeing, Seattle, WA
Douglas Aircraft, Long Bch, CA
Ford, Newport Beach, CA
General Dynamics, Pomona, CA
Hughes Missile, Tuscon, AZ
McD Doug Helicopters, Mesa, AZ

NORTHEAST
Grumman, Bethpage, NY
Kaman Aerospace
UTC Sikorsky, Stratford, CT

QA Operations: $R^2 = 0.81$

Workhours/mo = (0.14776 * X1) + (71.79 * X2) - (30.203 * X3) + 3646.54

X1 = # Cont Employees X3 = QUEST Score
X2 = # of MDRs

QA Support: $R^2 = 0.76$

Wkyrs = (0.007143 * X1) + (0.001397 * X2) + 3.94

X1 = # of Type A Cont Recvd X2 = ULO

The following QA Operations and Support models were developed using the Large DPROs in all commodity groupings other than "Electronics Related" and "Aircraft & Missiles" listed below, except where an outlier is noted.

NORTH CENTRAL
Boeing Mil Airpl, Wichita, KS
FMC Minneapolis
GMC Allison
Honeywell/Alliant Techsystems
Martin Marietta, Denver, CO
Thiokol

SOUTH
E-Systems, Greenville, TX
Grumman, St Augustine, FL
Grumman, Stuart, FL
Martin Marietta, Orlando, FL
Pemco Aeroplex, Birmingham, AL

MID-ATLANTIC
BMY, Marysville, OH
Boeing Helicopter, Phil, PA
GE Aircraft Engines, Cincin, OH
General Dynamics, Lima, OH
General Dynamics, Warren, MI
Loral Systems Group
Williams International

WEST
FMC
General Dynamics, San Diego, CA
Hughes, Los Angeles, CA
McD Doug Space, Hunt Bch, CA
Rockwell, Canoga Park,CA
TRW, Redondo Beach, CA
Westinghouse, Sunnyvale, CA

NORTHEAST
GE Aircraft Engine, Lynn, MA
GE Burlington, MA
GE Burlington, VT
GE Pittsfield, MA
Hamilton Standard
Harris, Syosset, NY
Pratt & Whitney, E Hartford, CT
Textron Lycoming, Stratford, CT

QA Operations: $R^2 = 0.69$

Workhours/mo = (326.2 * X1) + (0.066394 * X2) + (0.0000003532 * X3) + 1453.5

X1 = # Cont Employees
X2 = # of Mil I + Mil Q Facilities
X3 = QA Undelivered $ Balance

Outlier: Thiokol

QA Support: $R^2 = 0.69$

Wkyrs = (0.022589 * X1) + (0.001224 * X2) + (0.00017099 * X3) + 2.9

X1 = # of QA Cont Recvd
X2 = QA Undelivered $ Balance
X3 = # of Contractor Employees

Outlier: Thiokol

Small DCMAOs Total Staffing Model
(Less Than 158 People)

Small DCMAOs

NORTH CENTRAL	NORTHEAST	SOUTH
Cedar Rapids	Bridgeport	Clearwater
Milwaukee		
Wichita		

WEST
San Diego
Seattle

Total Staffing: $R^2 = 0.88$

Wkyrs = (0.00534 * X) + 111.5

X = # of Cont on Hand (Adjusted)

Outlier not used in model formulation: Wichita

Small DPROs Total Staffing Model
(Less Than 54 People)

Small DPROs

NORTH CENTRAL
Hercules
Magnavox
Northrop, Rolling Meadows, IL
Sundstrand

NORTHEAST
GE Burlington, MA
GE Burlington, VT
Harris, Syosset, NY
Kaman Aerospace
Link Flight Simulation
Textron Def Sys, Wilmington, MA

WEST
Ford, Newport Beach, CA
Westinghouse, Sunnyvale, CA

MID-ATLANTIC
Allied Signal, Teterboro, NJ
BMY, Marysville, OH
ITT Defense Group
Kearfott/Plessey
Williams International

SOUTH
AT&T Technol, Burlington, NC
E-Systems, Greenville, TX
Grumman, Stuart, FL
Grumman, St Augustine, FL
Harris Melbourne, Palm Bay, FL
McD Doug, Titusville, FL
McD Doug Rockwell, Tulsa, OK
Pemco Aeroplex, Birmingham, AL
Rockwell Duluth, GA
A/C Program Mgmt Off, Atl, GA

Total Staffing: $R^2 = 0.74$

$$\text{Wkyrs} = (0.021927 * X1) + (0.001114 * X2) + (0.008438 * X3) + (0.006188 * X4) + 30.15$$

X1 = $ Value Govt Property
X2 = # of Cont Employees
X3 = ULO
X4 = Cont on Hand

Outliers not used in model formulation: AT&T, Harris, APMO

APPENDIX D

SPREADSHEETS SUMMING DCMAO FUNCTIONS

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Appendix D

LARGE DCMAOs

TOTAL CIVILIAN STAFFING BY FUNCTION

ACTUAL VS ESTIMATED

DCMAO	DIST	COMMAND & COMMAND SUPPORT ACT	EST	ERR %	CONTRACT MANAGEMENT ACT	EST	ERR %	PROGRAM & TECH SUPPORT AND INDUSTRIAL SUPPORT ACT	EST	ERR %	QUALITY ASSURANCE ACT	EST	ERR %	TOTAL DCMAO ACT	EST	ERR %
Chicago	C	11.7	12.5	-6.6	64.6	71.1	-10.0	30.6	40.7	-33.1	109.0	124.0	-13.8	215.9	248.3	-15.0
Denver	C	14.2	13.1	7.4	54.7	58.4	-6.8	32.4	36.6	-13.0	128.0	130.6	-2.1	229.3	238.8	-4.2
Grand Rapids	C	11.1	9.4	15.8	40.8	42.8	-4.9	17.2	23.8	-38.2	94.0	86.3	8.2	163.1	162.2	0.5
Indianapolis	C	11.8	11.4	3.7	56.0	55.9	0.2	25.7	26.8	-4.4	96.0	77.3	19.5	189.5	171.4	9.5
St Louis	C	26.3	17.4	33.9	77.6	78.4	-1.0	36.2	29.7	17.8	104.0	97.9	5.8	244.1	223.4	8.5
Twin Cities	C	8.7	11.5	-32.0	57.7	50.4	12.6	28.4	33.0	-16.2	85.0	91.4	-7.6	179.8	186.3	-3.6
Baltimore	M	18.3	19.1	-4.4	213.3	248.4	-16.4	80.7	80.0	0.8	115.0	132.2	-15.0	427.3	479.8	-12.3
Cleveland	M	20.4	14.7	28.1	103.1	68.3	33.7	53.1	33.7	36.6	182.0	155.2	14.7	358.6	271.9	24.2
Dayton	M	14.2	12.6	11.3	79.1	75.5	4.5	45.3	45.9	-1.3	173.0	191.2	-10.5	311.6	325.2	-4.4
Detroit	M	15.0	14.5	3.1	74.2	65.1	12.2	44.1	37.3	15.4	109.0	92.4	15.3	242.3	209.4	13.6
Philadelphia	M	16.2	19.2	-18.4	126.6	137.5	-8.6	65.2	69.5	-6.6	185.0	230.3	-23.8	394.0	456.5	-15.9
Pittsburgh	M	7.7	10.3	-34.2	31.1	42.7	-37.3	21.6	27.6	-27.5	110.0	109.4	0.5	170.4	190.0	-11.5
Reading	M	9.3	10.9	-17.1	29.5	47.3	-60.4	31.9	30.7	3.8	150.0	123.9	17.4	220.7	212.8	3.6
Springfield	M	19.0	17.9	5.9	110.3	89.6	18.8	52.5	50.2	4.4	211.0	210.0	0.5	392.8	367.6	6.4
Boston	N	19.3	20.9	-8.2	129.3	110.5	14.5	54.6	54.6	-0.1	184.0	162.4	11.7	387.2	348.5	10.0
Garden City	N	22.6	20.6	8.9	104.9	89.4	14.7	49.9	48.1	3.7	212.0	195.9	7.6	389.4	354.0	9.1
Hartford	N	18.9	15.7	16.7	69.3	79.8	-15.1	39.2	43.5	-10.9	154.0	160.5	-4.2	281.4	299.5	-6.4
New York	N	14.6	15.3	-4.5	109.3	90.4	17.3	54.3	42.5	21.7	118.0	91.0	22.9	296.2	239.2	19.3
Syracuse	N	13.5	17.0	-26.3	86.6	75.7	12.6	56.7	44.3	21.9	151.0	178.1	-18.0	307.8	315.2	-2.4
Atlanta	S	8.8	11.7	-32.8	63.1	88.6	-40.5	38.7	44.5	-14.9	137.0	140.5	-2.6	247.6	285.3	-15.2
Birmingham	S	14.2	13.2	7.0	73.2	85.8	-17.3	42.6	44.2	-3.8	204.0	199.5	2.2	334.0	342.7	-2.6
Dallas	S	21.7	22.6	-4.2	104.7	110.4	-5.4	71.5	57.7	19.3	174.0	200.0	-14.9	371.9	390.7	-5.1
Orlando	S	10.0	8.8	11.5	51.6	66.2	-28.2	30.6	31.4	-2.6	89.0	116.5	-30.9	181.2	222.9	-23.0
San Antonio	S	11.3	12.0	-6.1	62.9	60.4	4.0	49.6	41.1	17.1	141.0	149.7	-6.2	264.8	263.2	0.6
El Segundo	W	21.2	18.7	11.9	114.4	118.3	-3.4	50.9	57.7	-13.3	235.0	172.3	26.7	421.5	366.9	13.0
Phoenix	W	10.0	14.7	-46.5	71.3	71.8	-0.7	41.7	48.2	-15.5	160.0	143.6	10.2	283.0	278.2	1.7
San Francisco	W	15.7	14.6	6.8	93.5	84.5	9.7	34.6	47.4	-37.0	154.0	171.3	-11.2	297.8	317.8	-6.7
Santa Ana	W	11.6	18.0	-55.1	130.1	131.2	-0.9	55.9	68.6	-22.8	204.0	209.9	-2.9	401.6	427.7	-6.5
Van Nuys	W	19.6	18.9	3.6	129.8	118.2	9.0	67.2	63.6	5.3	203.0	228.8	-12.7	419.6	429.5	-2.4
Mean Absolute (Average %)				16.3			14.4			14.8			11.7			8.9

LARGE DCMAOS

COMMAND AND COMMAND SUPPORT

ACTUAL VS ESTIMATED

		-----	-----	-----	-----	-----Includes	Military-----	-----	-----	-----	-----	-----	-----	MILI-	TOTAL COMMAND & COMMAND SUPPORT		
		COMMAND SUPPORT			DATA ENTRY			SMALL BUSINESS			COUNSEL			TARY	CIVILIAN		
DCMAO	DIST	ACT	EST	% ERR	ACT	EST	% ERR	ACT	EST	% ERR	ACT	ACT	% ERR	ACT	ACT	EST	% ERR
Chicago	C	3.9	7.5	-92.5	5.0	3.3	34.3	2.8	1.7	40.3	1.0	1.0		1.0	11.7	12.5	-6.8
Denver	C	9.0	7.7	14.4	3.0	3.9	-30.7	2.2	1.5	31.8	2.0	2.0		2.0	14.2	13.1	7.7
Grand Rapids	C	6.1	6.3	-4.0	4.0	2.5	36.6	2.0	1.5	26.5				1.0	11.1	9.4	15.8
Indianapolis	C	5.8	6.9	-18.7	3.0	2.7	10.8	3.0	1.8	40.1	1.0	1.0		1.0	11.8	11.4	3.7
St Louis	C	16.3	7.8	52.2	2.0	2.9	-47.2	3.0	1.6	45.2	6.0	6.0		1.0	26.3	17.4	33.9
Twin Cities	C	6.2	6.7	-7.3	1.5	3.0	-97.2	2.0	2.9	-43.7	1.0	1.0		2.0	8.7	11.5	-32.0
Baltimore	M	13.4	11.8	11.6	4.9	4.5	8.4	1.0	3.8	-276.6				1.0	18.3	19.1	-4.4
Cleveland	M	15.4	10.3	33.3	4.0	3.9	2.4	2.0	1.5	25.4				1.0	20.4	14.7	28.1
Dayton	M	10.0	9.4	6.2	4.2	3.3	20.8	2.0	1.9	5.7				2.0	14.2	12.5	11.3
Detroit	M	9.0	7.9	11.8	5.0	5.9	-17.0	2.0	1.7	12.5				1.0	15.0	14.5	3.1
Philadelphia	M	9.9	11.1	-12.4	4.2	5.6	-32.9	2.1	2.5	-17.7	1.0	1.0		1.0	16.2	19.2	-18.4
Pittsburgh	M	6.7	6.5	3.5	1.0	3.4	-238.7	1.0	1.5	-48.3				1.0	7.7	10.3	-34.2
Reading	M	8.3	7.5	9.7	2.5	3.9	-55.3	1.0	1.5	-48.7				2.0	9.3	10.9	-17.1
Springfield	M	10.9	11.1	-2.1	9.1	6.7	26.7	1.0	2.1	-107.5				2.0	19.0	17.9	5.9
Boston	N	6.3	11.1	-76.0	8.0	5.6	30.5	3.0	2.2	25.3	4.0	4.0		2.0	19.3	20.9	-8.2
Garden City	N	11.9	11.0	7.4	7.5	5.9	21.2	1.2	1.7	-39.0	3.0	3.0		1.0	22.5	20.6	8.5
Hartford	N	12.0	8.7	27.7	4.0	5.3	-32.4	2.9	1.8	39.3	1.0	1.0		1.0	18.9	15.7	16.7
New York	N	4.2	9.2	-119.6	5.5	3.0	45.3	3.9	2.0	46.0	3.0	3.0		2.0	14.6	15.3	-4.5
Syracuse	N	7.2	9.4	-30.6	2.3	4.3	-87.9	3.0	2.3	22.6	3.0	3.0		2.0	13.5	17.0	-26.3
Atlanta	S	6.8	8.1	-19.4	3.0	3.4	-14.3	1.0	2.1	-116.0				2.0	8.8	11.7	-32.8
Birmingham	S	10.3	9.9	4.3	3.9	3.2	17.8	2.0	2.1	-7.4				2.0	14.2	13.2	7.0
Dallas	S	8.1	10.7	-32.1	3.6	4.1	-13.7	4.0	1.8	54.5	7.0	7.0		1.0	21.7	22.6	-4.2
Orlando	S	8.7	6.7	23.1	2.3	2.9	-28.1	2.0	2.2	-10.4				3.0	10.0	8.8	11.5
San Antonio	S	8.0	8.4	-4.9	3.3	2.7	19.5	1.0	1.9	-93.5				1.0	11.3	12.0	-6.1
El Segundo	W	13.6	11.7	14.1	4.1	4.3	-5.0	3.5	2.7	22.8	2.0	2.0		2.0	21.2	18.7	11.9
Phoenix	W	7.0	8.8	-25.7	3.0	4.4	-46.3	1.0	2.5	-146.7				1.0	10.0	14.7	-46.5
San Francisco	W	7.9	9.2	-15.9	5.8	3.4	41.4	3.0	3.1	-2.4	1.0	1.0		2.0	15.7	14.6	6.3
Santa Ana	W	8.8	11.3	-28.6	2.7	4.6	-72.1	1.1	3.0	-174.5				1.0	11.6	18.0	-55.1
Van Nuys	W	12.5	11.6	6.9	6.2	5.6	10.1	2.9	3.7	-26.7	1.0	1.0		3.0	19.6	18.9	3.5

Mean Absolute Percent Error: 16.3

Notes:

1. Counsel personnel are assumed to be suitably allocated to DCMAOs based on a method developed by DLA-G. Since this staff is very small and since counsel staff has not yet been moved from district HQ to DCMAOs in all districts, actual staffing was used in lieu of a new, separately developed estimate.

CASE DEMOs
CONTRACT MANAGEMENT
ACTUAL VS ESTIMATED

Includes Military (CONTR OPERATIONS through MGT DAYS); Civilian (TOTAL CONTR MGMT)

REGION	DIST	CONTR OPERATIONS ACT	EST	% ERR	COST/PRICE ACT	EST	% ERR	CONTR FUNCTIONAL SYS REVIEW ACT	EST	% ERR	PROPERTY MGT ACT	EST	% ERR
Chicago	C	33.2	41.9	-26.1	9.5	8.0	15.7	3.0	2.9	[illegible]	5.2	5.5	-5.9
Denver	C	31.6	34.2	-8.4	9.7	8.2	15.3				3.9	5.2	-32.4
Grand Rapids	C	23.8	25.1	-5.5	7.9	7.2	8.3				5.4	5.9	-8.5
Indianapolis	C	31.1	28.7	7.8	14.3	15.4	-7.7				2.0	5.1	-155.6
St Louis	C	38.8	34.8	10.4	6.4	10.1	-57.7	10.0	9.6	4.0	4.4	4.7	-7.9
Twin Cities	C	36.4	29.0	20.4	8.0	8.2	-2.3				5.4	5.3	2.0
Baltimore	M	169.0	203.2	-20.2	19.6	18.9	3.6				21.5	20.5	4.6
Cleveland	M	58.8	31.8	45.8	8.9	9.9	-11.4	8.0	7.1	11.3	6.6	5.0	24.4
Dayton	M	52.8	48.3	8.4	8.4	8.9	-6.0				5.8	6.6	-13.1
Detroit	M	47.5	43.8	7.9	11.1	8.8	20.5				7.1	5.2	26.6
Philadelphia	M	71.6	85.2	-19.0	10.9	9.5	12.6	14.0	12.4	11.4	9.6	9.2	4.0
Pittsburgh	M	21.9	25.8	-17.7	3.0	7.2	-140.9				3.8	4.8	-26.2
Reading	M	20.2	28.6	-41.4	2.0	7.5	-277.0				4.3	5.1	-18.3
Springfield	M	78.7	61.1	22.4	14.4	11.6	19.4	3.0	2.7	10.0	8.4	7.1	15.2
Boston	N	72.3	53.5	26.0	14.2	12.2	14.0	11.0	10.0	[illegible]	10.0	9.5	5.3
[illegible]	N	77.0	66.1	14.2	11.7	9.5	19.1				8.1	7.1	12.4
Hartford	N	49.0	54.8	-11.8	6.1	10.6	-73.5				5.9	6.7	-14.4
New York	N	59.6	51.4	13.7	13.9	9.5	31.9	9.0	12.1	[illegible]	6.1	6.0	2.2
Syracuse	N	55.9	45.7	18.2	17.8	15.5	13.1				8.4	8.1	3.8
Atlanta	S	27.2	43.2	-58.7	8.1	9.9	-21.6	7.0	8.7	-24.3	4.2	6.0	-42.9
Birmingham	S	51.1	59.8	-17.0	7.2	11.1	-54.2				9.5	8.6	9.1
Dallas	S	52.8	57.7	-9.3	13.3	10.1	23.9	8.0	9.9	23.8	5.3	7.4	-39.7
Orlando	S	29.8	40.2	-35.0	8.1	10.0	-23.6				6.4	6.0	6.7
San Antonio	S	30.0	37.5	1.3	10.2	8.0	21.5				7.2	5.5	23.8
El Segundo	W	54.1	60.3	-11.5	17.5	15.8	9.7	11.0	9.3	15.5	9.6	8.8	8.6
Phoenix	W	44.1	44.7	-1.3	10.4	10.7	-3.0				9.2	7.9	14.0
San Francisco	W	[illegible]	49.4	8.1	13.2	12.4	5.7	8.0	6.8	[illegible]	8.9	7.6	14.6
Santa Ana	W	80.3	86.9	-8.2	21.0	16.8	20.1	11.0	9.3	15.5	10.1	10.2	-1.0
Van Nuys	W	82.0	70.2	14.3	12.8	17.5	-36.4	11.0	9.3	15.5	10.0	12.0	-19.6

REGION	FLIGHT OPERATIONS ACT	EST	% ERR	TRANSPORTATION ACT	EST	% ERR	TERMINATIONS ACT	EST	% ERR	MGT DAYS ACT	TOTAL CONTR MGMT ACT	EST	% ERR
Chicago	3.0	2.6	[illegible]	8.2	7.0	14.9	5.5	6.3	11.9	3.0	[illegible]	[illegible]	[illegible]
Denver	3.0	3.7	-24.6	9.5	10.1	-5.8				3.0	[illegible]	[illegible]	[illegible]
Grand Rapids				5.7	6.6	-15.7				2.0	[illegible]	[illegible]	[illegible]
Indianapolis				9.6	7.7	19.5				1.0	[illegible]	[illegible]	[illegible]
St Louis	1.0	2.2	[illegible]	9.0	7.0	22.6	10.0	11.9	-19.4	2.0	[illegible]	[illegible]	1.0
Twin Cities	2.0	2.2	[illegible]	6.9	6.8	1.0				1.0	[illegible]	[illegible]	[illegible]
Baltimore				7.2	9.7	-35.3				4.0	[illegible]	[illegible]	[illegible]
Cleveland	2.0	2.1	[illegible]	10.6	7.5	29.5	10.2	6.9	32.0	2.0	[illegible]	[illegible]	[illegible]
Dayton	1.0	2.1	[illegible]	12.1	10.7	11.8				1.0	[illegible]	[illegible]	[illegible]
Detroit	4.0	1.9	52.1	6.5	7.4	-14.3				2.0	[illegible]	[illegible]	[illegible]
Philadelphia	7.0	5.8	17.4	7.9	7.8	1.5	7.6	9.6	-26.3	2.0	[illegible]	[illegible]	[illegible]
Pittsburgh				4.4	6.9	-57.9				2.0	[illegible]	[illegible]	[illegible]
Reading				4.0	7.1	-78.5				1.0	[illegible]	[illegible]	[illegible]
Springfield	2.0	2.4	22.4	6.8	7.7	-12.8				3.0	[illegible]	[illegible]	[illegible]
Boston	5.0	4.5	11.0	10.7	11.8	-10.3	11.1	10.3	7.3	2.0	[illegible]	[illegible]	[illegible]
[illegible]	1.0	1.5	[illegible]	10.1	8.3	17.9				3.0	[illegible]	[illegible]	[illegible]
Hartford	4.0	2.6	[illegible]	6.3	7.1	-12.9				2.0	[illegible]	[illegible]	[illegible]
New York	1.0	1.3	[illegible]	12.3	6.5	47.4	10.4	6.6	[illegible]	3.0	[illegible]	[illegible]	[illegible]
Syracuse	2.0	1.8	7.9	5.5	7.6	-38.3				3.0	[illegible]	[illegible]	[illegible]
Atlanta	2.0	4.0	[illegible]	9.2	9.9	-8.0	7.4	9.0	21.6	2.0	[illegible]	[illegible]	[illegible]
Birmingham				7.4	8.3	-12.7				2.0	[illegible]	[illegible]	[illegible]
Dallas	6.0	6.6	[illegible]	12.7	12.0	5.9	8.6	8.7	1.6	2.0	[illegible]	[illegible]	[illegible]
Orlando	2.0	2.3	16.5	7.3	9.6	-31.9				2.0	[illegible]	[illegible]	[illegible]
San Antonio	3.0	2.4	21.1	7.5	10.0	-33.2				3.0	[illegible]	[illegible]	[illegible]
El Segundo	4.0	2.9	[illegible]	8.1	9.5	-17.9	14.1	15.6	-10.8	4.0	[illegible]	[illegible]	[illegible]
Phoenix	1.0	1.9	[illegible]	7.6	7.6	-0.2				1.0	[illegible]	[illegible]	[illegible]
San Francisco	2.0	2.1	[illegible]	[illegible]	8.2	15.9				2.0	[illegible]	[illegible]	[illegible]
Santa Ana	2.0	1.8	[illegible]	8.7	9.3	-6.7				3.0	[illegible]	[illegible]	[illegible]
Van Nuys	3.0	2.4	[illegible]	12.0	7.8	35.0				1.0	[illegible]	[illegible]	[illegible]

Mean Absolute (Average) Percent Error [illegible]
Weighted Average [illegible]

LARGE DCMAOs
PROGRAM & TECHNICAL SUPPORT
& INDUSTRIAL SUPPORT
ACTUAL VS ESTIMATED

	MILI-TARY ACT	CIVILIAN		
		ACTUAL	ESTIMATED	% ERROR
Chicago		30.6	40.7	-33.1
Denver		32.4	36.6	-13.0
Grand Rapids		17.2	23.8	-38.2
Indianapolis		25.7	26.8	-4.4
St Louis		36.2	29.7	17.8
Twin Cities		28.4	33.0	-16.2
Baltimore	1.0	80.7	80.0	0.9
Cleveland		53.1	33.7	36.5
Dayton		45.3	45.9	-1.3
Detroit		44.1	37.3	15.4
Philadelphia		65.2	69.5	-6.5
Pittsburgh		21.6	27.6	-27.8
Reading		31.9	30.7	3.8
Springfield		52.5	50.2	4.4
Boston		54.6	54.6	-0.1
Garden City		49.9	48.1	3.7
Hartford		39.2	43.5	-10.9
New York		54.3	42.5	21.7
Syracuse		56.7	44.3	21.9
Atlanta		38.7	44.5	-14.9
Birmingham		42.6	44.2	-3.8
Dallas		71.5	57.7	19.3
Orlando		30.6	31.4	-2.6
San Antonio		49.6	41.1	17.1
El Segundo		50.9	57.7	-13.3
Phoenix		41.7	48.2	-15.5
San Francisco		34.6	47.4	-37.0
Santa Ana	1.0	55.9	68.6	-22.8
Van Nuys	1.0	67.2	63.6	5.3

Mean Absolute (Average) Percent Error: 14.3

LARGE DCMAOS
QUALITY ASSURANCE CIVILIAN STAFFING
ACTUAL VS ESTIMATED

		OPERATIONS			OPERATIONS SUPV'Y AND CLERICAL			SUPPORT			SAFETY			TOTAL QUALITY ASSURANCE		
		ACT	EST	ERR %	ACT	EST	ERR %	ACT	EST	ERR %	ACT	EST	ERR %	ACT	EST	ERR %
Chicago	C	76.0	82.9	-9.1	20.0	25.4	-31.9	12.0	13.7	-14.4	1	1	0.0	109.0	124.0	-13.8
Denver	C	89.9	89.4	0.6	29.1	28.4	2.3	8.0	11.8	-47.9	1	1	0.0	128.0	130.6	-2.1
Grand Rapids	C	63.0	56.8	9.7	19.0	18.1	5.1	12.0	11.4	5.2	0	0	0.0	94.0	86.3	8.2
Indianapolis	C	68.0	50.9	25.2	15.0	16.2	-7.9	13.0	10.3	21.1	0	0	0.0	96.0	77.3	19.5
St Louis	C	73.2	65.2	10.9	20.8	20.7	0.2	8.0	11.0	-37.1	2	1	50.0	104.0	97.9	5.8
Twin Cities	C	54.8	60.4	-10.3	18.2	19.2	-5.4	10.0	10.8	-8.0	2	1	50.0	85.0	91.4	-7.6
Baltimore	M	81.6	90.1	-10.5	21.4	28.6	-33.7	11.0	11.5	-4.5	1	2	-100.0	115.0	132.2	-15.0
Cleveland	M	122.3	106.7	12.8	40.7	33.9	16.6	18.0	13.7	24.1	1	1	0.0	182.0	155.2	14.7
Dayton	M	130.5	131.0	-0.4	26.5	41.6	-57.0	15.0	17.6	-17.1	1	1	0.0	173.0	191.2	-10.5
Detroit	M	68.9	60.8	11.8	18.1	19.3	-7.0	21.0	11.3	46.4	1	1	0.0	109.0	92.4	15.3
Philadelphia	M	137.2	156.9	-14.4	32.8	49.9	-52.0	15.0	22.4	-49.5	1	1	0.0	186.0	230.3	-23.8
Pittsburgh	M	80.6	73.9	8.4	23.4	23.5	-0.6	5.0	11.0	-120.1	1	1	0.0	110.0	109.4	0.5
Reading	M	82.5	84.1	-1.9	53.5	26.7	50.0	13.0	12.1	6.8	1	1	0.0	150.0	123.9	17.4
Springfield	M	144.6	140.0	3.2	41.4	44.5	-7.5	24.0	24.4	-1.8	1	1	0.0	211.0	210.0	0.5
Boston	N	106.5	110.2	-3.4	62.4	35.0	43.8	14.0	16.1	-15.0	1	1	0.0	184.0	162.4	11.7
Garden City	N	127.9	130.5	-2.0	53.1	41.5	34.3	20.0	23.0	-14.8	1	1	0.0	212.0	195.9	7.6
Hartford	N	97.4	108.6	-11.8	32.6	34.6	-6.1	22.0	16.1	26.9	2	1	50.0	154.0	160.5	-4.2
New York	N	58.4	59.7	-2.2	42.6	19.0	55.5	16.0	10.4	35.1	1	2	-100.0	118.0	91.0	22.9
Syracuse	N	103.2	123.7	-19.8	29.8	39.3	-31.9	17.0	13.2	22.6	1	2	-100.0	151.0	178.1	-18.0
Atlanta	S	107.2	95.1	11.3	16.8	30.2	-79.6	12.0	14.2	-18.7	1	1	0.0	137.0	140.5	-2.6
Birmingham	S	143.0	138.9	2.9	45.0	44.2	1.9	14.0	14.4	-2.8	2	2	0.0	204.0	199.5	2.2
Dallas	S	118.4	136.8	-15.5	29.5	43.5	-47.1	25.0	18.7	25.2	1	1	0.0	174.0	200.0	-14.9
Orlando	S	61.9	78.1	-26.1	17.1	24.8	-45.4	9.0	12.6	-39.6	1	1	0.0	89.0	116.5	-30.9
San Antonio	S	82.8	103.7	-25.2	47.2	33.0	30.1	10.0	12.0	-20.1	1	1	0.0	141.0	149.7	-6.2
El Segundo	W	178.0	117.6	33.9	35.0	37.4	-6.8	20.0	16.3	18.5	2	1	50.0	235.0	172.3	26.7
Phoenix	W	100.3	95.5	4.8	46.7	30.4	35.0	11.0	15.7	-43.0	2	2	0.0	160.0	143.6	10.2
San Francisco	W	106.6	119.2	-11.9	34.4	37.9	-10.1	12.0	12.2	-1.5	1	2	-100.0	194.0	171.3	-11.2
Santa Ana	W	154.6	144.3	6.6	35.4	45.9	-29.5	11.0	16.7	-51.5	3	3	0.0	204.0	209.9	-2.9
Van Nuys	W	148.2	156.5	-5.6	25.8	49.7	-92.6	27.0	20.6	23.7	2	2	0.0	203.0	228.8	-12.7

Mean Absolute (Average) Percent E 11.7

Note: Baltimore QA Support, both Actual and Estimated, have been reduced by 1 workyear to remove military.

SMALL DCMAOs
TOTAL STAFFING
ACTUAL VS ESTIMATED

DCMAO	DIST	MILITARY ACT*	Civilian ACT	Civilian EST	Civilian ERR %
Cedar Rapids	C	2	120.8	124.3	-2.9
Milwaukee	C	2	123.7	129.3	-4.5
Wichita	C	2	141.1	123.8	12.3
Bridgeport	N	2	121.2	129.4	-6.8
Clearwater	S	1	130.5	128.5	1.5
San Diego	W	5	153.0	157.9	-3.2
Seattle	W	2	141.1	138.4	1.9

Mean Absolute Percent Error: 4.7

* Note:

1. Military personnel are removed to get civilian workyears. The military for Wichita does NOT include 1 in QA and 1 in Flight Operations which were not included in the workyear counts and so are not removed.

APPENDIX E

SPREADSHEETS SUMMING DPRO FUNCTIONS

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Appendix E

[illegible]

[illegible]

DPRO	DIST	COMMAND AND COMMAND SUPPORT ACT	EST	ERR %	CONTRACT MANAGEMENT ACT	EST	ERR %	PRGM & TECH SUPT AND IND SUPPORT ACT	EST	ERR %	QUALITY ASSURANCE ACT	EST	ERR %	TOTAL DPRO ACT	EST	ERR %
Boeing Mil Airpl, Wichita, KS	C	2.5	4.4	-76	41.0	23.4	43.0	21.2	11.1	47.5	40	44.1	-10.0	104.8	83.1	20.7
FMC Minneapolis	C	5.4	2.8	47	23.7	26.9	-13.3	14.0	14.1	-0.7	16	22.1	-37.9	59.1	65.6	-11.4
CMC Allison	C	3.6	3.1	14	24.9	30.5	-22.5	11.2	16.1	-43.9	24	39.5	-64.5	63.7	89.2	-40.1
Honeywell/Alliant Tecnsystems	C	4.4	8.4	-91	34.1	39.3	-15.2	32.7	30.7	6.2	75	89.8	-19.7	146.2	168.1	-15.0
Martin Marietta, Denver, CO	C	5.1	5.4	-6	26.7	23.8	11.0	25.0	25.0	-0.0	43	56.9	-32.4	99.8	111.1	-11.3
McDonnell Douglas, St L, MO	C	12.0	15.2	-27	74.5	82.4	-10.6	104.3	141.7	-35.8	83	94.8	-14.2	273.8	334.1	-22.0
Thiokol	C	6.2	7.5	-21	13.7	21.7	-58.1	14.2	18.2	-28.0	96	43.1	55.1	130.1	90.4	30.5
Boeing Helicopter, Phil, PA	M	4.9	4.2	14	26.0	26.1	-0.5	23.9	26.3	-10.1	32	37.4	-16.7	86.8	94.0	-8.3
GE Aerospace Delaware Val, NJ	M	10.0	9.3	7	44.8	49.9	-11.3	31.9	39.9	-25.1	99	61.3	38.0	185.7	160.4	13.6
GE A/C Engines, Cincin, OH	M	5.0	6.0	-20	37.2	35.8	3.6	21.7	19.6	9.6	52	80.2	-54.2	115.9	141.7	-22.2
General Dynamics, Lima, OH	M	5.2	3.9	24	19.6	17.2	12.5	16.5	13.5	18.0	37	24.9	32.6	78.3	59.5	23.9
General Dynamics, Warren, MI	M	3.2	4.6	-44	17.9	17.6	1.9	16.8	8.3	50.4	33	23.7	28.3	70.9	54.1	23.6
IBM Manassas	M	1.9	4.6	-144	32.1	30.2	6.1	12.3	26.5	-115.4	25	21.7	13.3	71.3	83.0	-16.3
Loral Systems Group	M	2.0	5.1	-154	28.7	24.7	14.0	11.4	14.5	-27.6	39	37.5	4.0	81.1	81.8	-0.9
Westinghouse, Baltimore, MD	M	4.0	4.4	-11	30.4	38.9	-27.8	28.2	19.8	29.7	43	46.9	-9.1	105.6	110.0	-4.2
Westinghouse, Cleveland, OH	M	2.6	4.4	-68	25.9	22.6	12.6	12.0	8.9	26.1	27	25.3	6.2	67.5	61.2	9.4
Eaton AIL, Deer Park, NY	N	3.1	3.3	-7	25.0	21.2	15.3	16.0	16.1	-0.6	19	18.4	3.1	63.1	59.0	6.5
GE Aircraft Engine, Lynn, MA	N	2.0	5.3	-165	41.3	24.6	40.5	29.9	24.2	18.9	50	40.9	18.3	123.2	95.0	22.9
GE Pittsfield, MA	N	3.1	4.5	-44	29.0	26.7	7.9	27.4	16.6	39.5	30	36.9	-23.2	89.5	84.7	5.3
Grumman, Bethpage, NY	N	12.4	8.8	29	67.7	60.7	10.3	56.6	53.6	5.2	78	86.6	-11.1	214.7	209.8	2.3
GTE Govt Systems	N	2.0	2.5	-25	21.5	32.0	-49.0	14.1	17.1	-21.6	32	24.3	24.1	69.6	76.0	-9.1
Hamilton Standard	N	1.0	4.3	-332	15.9	15.2	4.2	12.2	16.0	-30.8	36	48.8	-35.6	65.1	84.3	-29.6
IBM Owego, NY	N	1.5	0.3	78	20.9	26.7	-27.9	21.4	13.6	36.2	22	20.3	7.6	65.8	61.0	7.2
Lockheed Sanders, Nashua, NH	N	2.7	4.1	-53	24.0	27.9	-16.3	14.5	18.1	-24.9	22	27.2	-23.7	63.2	77.4	-22.4
Pratt & Whitney, E Hartfd, CT	N	4.6	4.2	9	24.5	31.3	-27.8	18.4	25.1	-36.3	55	59.7	-8.5	102.5	120.3	-17.3
Raytheon, Burlington, MA	N	4.8	10.0	-107	79.8	71.0	11.1	53.4	46.4	13.1	80	96.9	-21.1	218.0	224.2	-2.9
Textron Lycoming, Stratfd, CT	N	1.0	3.3	-232	21.0	25.1	-19.3	13.2	13.3	-1.1	28	29.6	-5.8	63.2	71.3	-12.9
Unisys Great Neck, NY	N	5.8	2.9	50	36.2	30.8	15.0	19.7	22.2	-12.4	20	30.6	-52.9	81.7	86.4	-5.8
UTC Sikorsky, Stratford, CT	N	6.0	6.6	-9	40.7	32.5	19.3	46.2	41.7	9.7	52	61.3	-17.9	144.9	142.4	1.8
Bell Helicp Txtrn, Ft Wth, TX	S	6.4	4.5	29	26.7	28.7	-7.6	33.9	35.2	-3.8	26	38.7	-48.8	93.0	107.1	-15.2
General Dynamics, Ft Wth, TX	S	12.5	6.7	47	66.5	50.6	23.9	47.1	48.5	-2.9	86	77.8	9.6	212.1	183.6	13.5
Lockheed Aer Sys, Mariett, GA	S	4.0	5.0	-26	23.2	32.3	-39.1	17.1	17.0	0.4	33	43.4	-31.6	77.3	97.8	-26.5
LTV Aerosp & Def, Dallas, TX	S	9.5	4.1	56	28.1	33.4	-18.7	16.2	21.1	-30.1	35	50.8	-45.2	88.8	109.4	-23.2
Martin Marietta, Orlando, FL	S	3.3	4.3	-44	12.1	15.3	-26.8	7.3	18.8	-157.7	45	44.4	1.3	67.4	82.9	-23.0
Pratt & Whitny, W Plm Bch, FL	S	5.2	2.4	53	23.0	35.3	-53.6	15.4	21.0	-36.5	25	30.9	-23.5	68.6	89.7	-30.7
Rockwell, Richardson, TX	S	3.2	3.6	-14	24.1	24.2	-0.5	10.7	9.3	13.2	15	16.0	-7.0	53.0	53.1	-0.3
Texas Instruments, Dallas, TX	S	4.9	6.8	-38	35.9	48.9	-36.2	50.4	43.3	14.1	63	61.4	2.5	154.2	160.4	-4.0
Aerojet, Sacramento, CA	W	3.7	3.6	4	20.3	27.4	-35.1	18.7	15.4	17.8	29	22.9	21.0	71.7	69.3	3.4
Boeing, Seattle, WA	W	11.3	9.1	20	64.6	62.7	2.9	47.4	36.6	22.7	67	68.9	-2.8	190.3	177.3	6.8
Douglas A/C, Long Beach, CA	W	6.8	4.0	41	23.8	28.9	-21.4	30.2	22.3	26.1	42	44.3	-5.4	102.8	99.5	3.2
FMC	W	2.0	3.6	-78	19.9	22.3	-12.0	8.1	12.9	-59.0	41	35.9	12.4	71.0	74.7	-5.2
Gen Dynamics, Pomona, CA	W	8.9	5.5	38	26.2	29.2	-11.3	19.6	23.2	-18.3	41	26.0	36.5	95.7	83.9	12.4
Gen Dynamics, San Diego, CA	W	2.8	3.7	-33	33.7	24.5	27.2	13.8	20.9	-51.5	81	65.7	18.9	131.3	114.9	12.5
Hughes, Fullerton, CA	W	3.0	2.2	26	27.4	35.9	-31.0	11.2	18.4	-64.0	42	36.1	14.1	83.6	92.5	-10.7
Hughes, Los Angeles, CA	W	9.6	8.4	13	63.8	50.4	20.9	22.4	27.6	-23.2	67	59.2	11.6	162.8	145.7	10.5
Hughes Missile, Tuscon, AZ	W	8.0	4.3	46	24.6	30.6	-24.2	20.7	15.8	23.6	34	32.3	5.1	87.3	82.9	5.0
Lockheed, Sunnyvale, CA	W	8.4	6.6	21	43.5	47.3	-8.6	23.3	12.3	47.2	85	92.2	-8.5	160.3	156.5	1.2
McD Doug Helicp, Mesa, AZ	W	7.8	6.0	23	26.9	25.6	4.9	30.2	18.7	38.2	59	49.3	16.5	123.9	99.6	19.6
McD Doug Space, Hunt Bch, CA	W	2.1	4.8	-129	18.0	17.5	3.0	8.9	12.4	-39.0	44	49.7	-12.9	73.0	84.3	-15.5
Northrop, Hawthorne, CA	W	11.4	8.4	26	63.4	21.2	66.6	42.3	18.4	56.6	66	62.7	5.0	183.1	110.7	39.5
Rockwell, Anaheim, CA	W	4.1	4.3	-5	20.5	26.5	-29.4	13.6	14.0	-2.6	24	25.4	-5.7	62.2	70.2	-12.8
Rockwell, Canoga Park, CA	W	4.4	5.3	-20	6.1	8.7	-42.7	11.9	18.7	-57.2	82	48.6	40.7	104.4	81.3	22.1
TRW, Redondo Beach, CA	W	5.2	5.5	-6	24.1	31.3	-29.8	18.0	19.2	-6.5	38	44.5	-17.0	85.3	100.4	-17.7
Mean Absolute (Average) Percent Error:				51.7			20.9			29.0			20.6			14.2

LARGE DPROs

COMMAND SUPPORT: ACTUAL VS ESTIMATED

DPRO	DIST	---MILITARY--- FLT OPS ACT	OTHER ACT	----Civilian---- ACT	EST	ERR %
Boeing	C	7.0	3.0	2.6	4.4	-70.1
FMC Minneapolis	C		2.0	5.4	2.8	47.5
GMC Allison	C		2.0	3.6	3.1	13.5
Honeywell	C		1.0	4.4	8.4	-90.9
Martin Marietta	C		2.0	5.1	5.4	-5.8
McDonnell Douglas	C	4.0	1.0	12.0	15.2	-26.8
Thiokol	C		1.0	6.2	7.5	-20.7
Boeing Helicopter	M	6.0	2.0	4.9	4.2	13.7
GE Delaware Valley	M		2.0	10.0	9.3	7.1
GE Aircraft Evendale	M		2.0	5.0	6.0	-20.4
Gen Dyn Lima	M		2.0	5.2	3.9	24.4
Gen Dyn Warren	M		1.0	3.2	4.6	-43.9
IBM Manassas	M		1.0	1.9	4.6	-144.2
Loral	M		1.0	2.0	5.1	-154.3
Westinghouse Baltimore	M		3.0	4.0	4.4	-11.1
Westinghouse Cleveland	M		1.0	2.6	4.4	-67.5
Eaton AIL	N		2.0	3.1	3.3	-6.8
GE Aircraft Engine Lynn	N		3.0	2.0	5.3	-164.7
GE Pittsfield	N		2.0	3.1	4.5	-43.9
Grumman Bethpage	N		4.0	12.4	8.8	29.4
GTE Govt Systems	N		3.0	2.0	2.5	-24.8
Hamilton Standard	N		1.0	1.0	4.3	-331.7
IBM Owego	N		5.0	1.5	0.3	78.2
Lockheed Sanders	N		1.0	2.7	4.1	-53.1
Pratt & Whitney	N		3.0	4.6	4.2	8.6
Raytheon	N		3.0	4.8	10.0	-107.4
Textron Lycoming	N		2.0	1.0	3.3	-232.3
Unisys Great Neck	N		3.0	5.8	2.9	49.6
UTC Sikorsky	N	5.0	3.0	6.0	6.6	-9.3
Bell Helicopter	S	4.0	2.0	6.4	4.5	29.4
GD Ft. Worth	S	5.0	6.0	12.5	6.7	46.6
Lockheed	S	7.0	1.0	4.0	5.0	-26.1
LTV Aerospace	S		2.0	9.5	4.1	56.3
Martin Marietta	S		1.0	3.0	4.3	-44.4
Pratt & Whitney	S		3.0	5.2	2.4	53.2
Rockwell Richardson	S		1.0	3.2	3.6	-13.6
Texas Instruments	S		3.0	4.9	6.8	-38.5
Aerojet Sacramento	W		2.0	3.7	3.6	3.6
Boeing Seattle	W	4.0	3.0	11.3	9.1	19.7
Douglas Air Long Beach	W	2.0	3.0	6.8	4.0	41.1
FMC	W		2.0	2.0	3.6	-78.4
Gen Dynamics Pomona	W		1.0	8.9	5.5	38.4
Gen Dynamics San Diego	W		5.0	2.8	3.7	-32.8
Hughes Fullerton	W		4.0	3.0	2.2	26.2
Hughes Los Angeles	W		2.0	9.6	8.4	12.6
Hughes Missile Tuscon	W		2.0	8.0	4.3	46.2
Lockheed Sunnyvale	W		4.0	8.4	6.6	21.0
McD Doug Helicopters	W	5.0	2.0	7.8	6.0	22.7
McD Doug Space	W		1.0	2.1	4.8	-129.5
Northrop Hawthorne	W	6.0	3.0	11.4	8.4	25.9
Rockwell Anaheim	W		1.0	4.1	4.3	-5.3
Rockwell Canoga Park	W		2.0	4.4	5.3	-19.5
TRW Redondo Beach	W		1.0	5.2	5.5	-5.7

Mean Absolute (Average) Percent Error: 51.7

LARGE DPROs

CONTRACT MANAGEMENT: ACTUAL VS ESTIMATED

		Includes Military									MILI-			
		CONTRACT OPS			COST/PRICE			PROPERTY MGT			TARY	TOTAL CONTR MGMT		
DPRO	DIST	ACT	EST	ERR %	ACT	EST	ERR %	ACT	EST	ERR %	ACT	ACT	EST	ERR %
Boeing Mil Airpl, Wichita, KS	C	24.2	15.1	37.4	10.8	6.9	35.7	7.0	2.3	67.1	1.0	41.0	23.4	43.0
FMC Minneapolis	C	14.9	17.3	-15.9	6.3	7.6	-20.0	3.5	3.0	13.5	1.0	23.7	26.9	-13.1
GMC Allison	C	15.1	16.8	-11.2	7.1	9.0	-27.3	2.7	4.7	-73.5		24.3	30.5	-22.5
Honeywell/Alliant Techsystems	C	22.1	26.7	-20.7	9.7	11.1	-15.7	5.3	4.5	14.5	2.0	34.1	39.3	-15.2
Martin Marietta, Denver, CO	C	14.9	12.0	19.4	10.0	9.1	8.9	4.8	5.6	-17.3	3.0	26.7	23.8	11.0
McDonnell Douglas, St L, MO	C	45.4	50.9	-12.1	23.8	24.9	-4.6	8.3	9.6	-15.9	3.0	74.5	82.4	-10.6
Thiokol	C	8.6	15.7	-83.0	3.2	4.0	-25.7	1.9	1.9	-0.3		13.7	21.7	-58.1
Boeing Helicopter, Phil, PA	M	12.3	15.7	-27.6	10.1	7.6	24.7	3.6	2.8	21.2		26.0	26.1	-0.5
GE Aerospace Delaware Val, NJ	M	26.4	32.6	-23.4	15.3	15.2	0.7	5.1	4.1	19.6	2.0	44.8	49.9	-11.3
GE A/C Engines, Cincin, OH	M	26.8	22.9	14.5	9.3	12.7	-36.1	3.1	2.3	26.8	2.0	37.2	35.8	3.6
General Dynamics, Lima, OH	M	15.6	11.9	23.5	0.0			5.0	6.2	-24.4	1.0	19.6	17.2	12.5
General Dynamics, Warren, MI	M	13.9	14.0	-0.7	0.0			6.0	5.5	7.5	2.0	17.9	17.6	1.9
IBM Manassas	M	23.5	18.3	22.3	7.8	8.9	-14.7	1.8	3.9	-119.4	1.0	32.1	30.2	6.1
Loral Systems Group	M	19.6	15.8	19.2	7.6	6.9	9.8	1.5	2.0	-32.5		28.7	24.7	14.0
Westinghouse, Baltimore, MD	M	15.9	25.4	-59.7	12.5	14.3	-14.7	5.0	2.1	57.4	3.0	30.4	38.9	-27.8
Westinghouse, Cleveland, OH	M	18.8	14.3	23.9	6.1	6.8	-10.9	1.0	1.5	-54.9		25.9	22.6	12.6
Eaton AIL, Deer Park, NY	N	13.1	14.7	-12.2	11.9	7.5	36.7	3.0	1.9	35.1	3.0	25.0	21.2	15.3
GE Aircraft Engine, Lynn, MA	N	24.6	16.2	34.0	16.9	6.6	60.9	0.8	2.7	-243.1	1.0	41.3	24.6	40.5
GE Pittsfield, MA	N	21.9	15.3	30.2	4.1	7.6	-84.6	3.0	3.9	-28.8		29.0	26.7	7.9
Grumman, Bethpage, NY	N	44.9	35.8	20.2	18.8	18.8	-0.3	5.0	7.0	-40.8	1.0	67.7	60.7	10.3
GTE Govt Systems	N	15.6	19.6	-25.4	5.1	10.3	-102.6	0.8	2.1	-166.4		21.5	32.0	-49.0
Hamilton Standard	N	10.9	6.5	40.4	4.0	6.7	-68.4	1.0	2.0	-101.0		15.9	15.2	4.2
IBM Owego, NY	N	15.4	16.2	-4.9	5.0	7.7	-53.6	0.5	2.9	-479.9		20.9	26.7	-27.9
Lockheed Sanders, Nashua, NH	N	16.5	17.2	-4.0	6.7	8.7	-29.1	0.8	2.1	-162.1		24.0	27.9	-16.3
Pratt & Whitney, E Hartfd, CT	N	14.3	20.1	-40.3	11.2	11.3	-0.9	1.0	2.0	-96.3	2.0	24.5	31.3	-27.8
Raytheon, Burlington, MA	N	54.0	42.8	20.6	20.8	22.6	-8.9	5.0	5.5	-9.5		79.8	71.0	11.1
Textron Lycoming, Stratfd, CT	N	13.1	14.2	-8.5	5.8	6.9	-18.5	4.1	6.0	-45.7	2.0	21.0	25.1	-19.3
Unisys Great Neck, NY	N	23.4	17.8	24.0	8.8	9.3	-5.6	4.0	3.7	8.1		36.2	30.6	15.5
UTC Sikorsky, Stratford, CT	N	28.3	18.5	34.5	7.2	8.5	-18.2	5.2	5.8	-10.9		40.7	32.8	19.3
Bell Helicp Txtrn, Ft Wth, TX	S	13.8	18.9	-37.2	11.1	7.5	32.8	2.8	3.3	-19.3	1.0	26.7	28.7	-7.6
General Dynamics, Ft Wth, TX	S	33.4	31.7	5.1	31.4	17.3	44.8	6.7	6.6	1.8	5.0	56.5	50.6	23.9
Lockheed Aer Sys, Mariett, GA	S	15.4	19.5	-26.8	5.6	10.0	-79.2	4.2	4.7	-12.0	2.0	23.2	32.3	-39.1
LTV Aerosp & Def, Dallas, TX	S	17.0	19.8	-16.2	9.1	10.0	-10.9	3.1	4.6	-48.8	1.0	28.1	33.4	-18.7
Martin Marietta, Orlando, FL	S	8.5	9.3	-9.0	2.8	3.7	-32.1	0.8	2.4	-196.9		12.1	15.3	-26.3
Pratt & Whitny, W Plm Bch, FL	S	12.4	21.4	-72.4	9.1	11.7	-28.5	3.5	4.3	-21.7	2.0	23.0	35.3	-53.6
Rockwell, Richardson, TX	S	17.4	15.7	9.6	5.7	6.9	-21.7	1.0	1.5	-54.3		24.1	24.2	-0.5
Texas Instruments, Dallas, TX	S	24.2	31.0	-28.2	10.9	17.7	-62.0	2.8	2.2	21.5	2.0	35.9	48.9	-36.2
Aerojet, Sacramento, CA	W	10.6	17.4	-63.8	6.8	7.4	-9.4	3.9	3.6	7.1	1.0	20.3	27.4	-35.1
Boeing, Seattle, WA	W	41.6	40.7	2.2	24.7	24.1	2.4	6.3	5.9	6.0	8.0	64.6	62.7	2.9
Douglas A/C, Long Beach, CA	W	14.7	18.2	-24.0	7.0	9.1	-30.3	3.1	2.5	18.1	1.0	23.8	28.9	-21.4
FMC	W	10.0	13.8	-38.1	7.8	6.8	13.4	2.1	1.7	17.5		19.9	22.3	-12.0
Gen Dynamics, Pomona, CA	W	14.9	16.6	-11.5	6.3	7.4	-17.9	5.0	5.1	-2.2		26.2	29.2	-11.3
Gen Dynamics, San Diego, CA	W	20.1	10.2	49.3	11.0	9.5	13.7	2.6	4.8	-86.4		33.7	24.5	27.2
Hughes, Fullerton, CA	W	18.4	21.9	-19.3	7.0	12.0	-71.2	3.0	3.0	1.6	1.0	27.4	35.9	-31.0
Hughes, Los Angeles, CA	W	31.1	26.8	13.7	21.1	23.5	-11.1	15.6	4.2	73.3	4.0	63.8	50.4	20.9
Hughes Missile, Tuscon, AZ	W	14.0	20.5	-46.5	10.1	9.1	10.3	3.5	4.0	-13.7	3.0	24.6	30.6	-24.2
Lockheed, Sunnyvale, CA	W	25.3	27.4	-8.2	16.1	16.5	-2.3	4.2	5.5	-30.6	2.0	43.6	47.3	-8.5
McD Doug Helicp, Mesa, AZ	W	17.1	16.2	5.1	7.7	8.1	-4.6	3.1	2.3	25.4	1.0	26.9	25.6	4.9
McD Doug Space, Hunt Bch, CA	W	12.1	11.1	8.2	4.5	4.4	5.0	1.3	2.0	-51.8		18.0	17.5	3.0
Northrop, Hawthorne, CA	W	32.5	18.2	43.9	31.3	9.4	70.5	8.1	2.6	68.0	9.0	63.4	21.2	66.6
Rockwell, Anaheim, CA	W	14.0	18.5	-32.3	8.4	9.7	-16.1	2.1	2.2	-7.0	4.0	20.5	26.5	-29.4
Rockwell, Canoga Park, CA	W	4.4	6.9	-57.2	1.5	1.1	24.6	1.2	1.7	-38.0	1.0	6.1	8.7	-42.7
TRW, Redondo Beach, CA	W	15.5	20.2	-30.3	7.9	10.8	-39.0	3.8	3.2	14.9	3.0	24.1	31.3	-29.8

Mean Absolute (Average) Percent Error: 20.9

Without: Thiokol, GTE Govt Systems, Pratt & Whitney, and Northrop Hawthorne: 17.9

LARGE DPROs

PROGRAM & TECH SUPPORT AND IND SUPPORT: ACTUAL VS ESTIMATED

DPRO	DIST	MILITARY ACT	Civilian ACT	Civilian EST	Civilian ERR %
Boeing	C	2.0	21.2	11.1	47.5
FMC Minneapolis	C		14.0	14.1	-0.7
GMC Allison	C		11.2	16.1	-43.9
Honeywell	C		32.7	30.7	6.2
Martin Marietta, Denver	C	[illegible]	25.0	25.0	-0.0
McDonnell Douglas, St Louis	C	12.0	104.3	141.7	-35.8
Thiokol	C	2.0	14.2	18.2	-28.0
Boeing Helicopter	M		23.9	26.3	-10.1
GE Delaware Valley	M	3.0	31.9	39.9	-25.1
GE Aircraft Evendale	M	4.0	21.7	19.6	9.6
Gen Dyn Lima	M	2.0	16.5	13.5	18.0
Gen Dyn Warren	M		16.8	8.3	50.4
IBM Manassas	M		12.3	26.5	-115.4
Loral	M		11.4	14.5	-27.6
Westinghouse Baltimore	M	1.0	28.2	19.8	29.7
Westinghouse Cleveland	M		12.0	8.9	26.1
Eaton AIL	N	1.0	16.0	16.1	-0.6
GE Aircraft Engine Lynn	N		29.9	24.2	18.9
GE Pittsfield	N		27.4	16.6	39.5
Grumman Bethpage	N	6.0	56.6	53.6	5.2
GTE Govt Systems	N		14.1	17.1	-21.6
Hamilton Standard	N		12.2	16.0	-30.8
IBM Owego	N		21.4	13.6	36.2
Lockheed Sanders	N		14.5	18.1	-24.9
Pratt & Whitney	N	1.0	18.4	25.1	-36.3
Raytheon	N		53.4	46.4	13.1
Textron Lycoming	N		13.2	13.3	-1.1
Unisys Great Neck	N		19.7	22.2	-12.4
UTC Sikorsky	N	8.0	46.2	41.7	9.7
Bell Helicopter	S		33.9	35.2	-3.8
GD Ft. Worth	S	3.0	47.1	48.5	-2.9
Lockheed	S	3.0	17.1	17.0	0.4
LTV Aerospace	S		16.2	21.1	-30.1
Martin Marietta	S		7.3	18.8	-157.7
Pratt & Whitney	S	1.0	15.4	21.0	-36.5
Rockwell Richardson	S	1.0	10.7	9.3	13.2
Texas Instruments	S		50.4	43.3	14.1
Aerojet Sacramento	W		18.7	15.4	17.8
Boeing Seattle	W	9.0	47.4	36.6	22.7
Douglas Air Long Beach	W		30.2	22.3	26.1
FMC	W		8.1	12.9	-59.0
Gen Dynamics Pomona	W		19.6	23.2	-18.3
Gen Dynamics San Diego	W	2.0	13.8	20.9	-51.5
Hughes Fullerton	W		11.2	18.4	-64.0
Hughes Los Angeles	W	6.0	22.4	27.6	-23.2
Hughes Missile Tuscon	W	1.0	20.7	15.8	23.6
Lockheed Sunnyvale	W	14.0	23.3	12.3	47.2
McD Doug Helicopters	W		30.2	18.7	38.2
McD Doug Space	W	3.0	8.9	12.4	-39.0
Northrop Hawthorne	W	3.0	42.3	18.4	56.6
Rockwell Anaheim	W	2.0	13.6	14.0	-2.6
Rockwell Canoga Park	W	1.0	11.9	18.7	-57.2
TRW Redondo Beach	W	4.0	18.0	19.2	-6.5
Mean Absolute (Average) Percent Error:					29.0
Without IBM Man., Martin Marietta, FMC, Hughes Fullerton:					23.3

LARGE DPROS

QUALITY ASSURANCE CIVILIAN STAFFING: ACTUAL VS ESTIMATED

Activity	Dist	OPERATIONS ACT	OPERATIONS EST	OPERATIONS ERR %	OPERATIONS SUPVY AND CLERICAL ACT	OPERATIONS SUPVY AND CLERICAL EST	OPERATIONS SUPVY AND CLERICAL ERR %	SUPPORT ACT	SUPPORT EST	SUPPORT ERR %	QA SAFETY ACT	QA SAFETY EST	QA SAFETY ERR %	TOTAL QUALITY ASSURANCE ACT	TOTAL QUALITY ASSURANCE EST	TOTAL QUALITY ASSURANCE ERR %
Boeing Mil Airpl, Wichita, KS	C	24.0	24.9	-3.8	3.0	8.7	-187.0	12.0	9.6	20.0	1	1	0	40	44.1	-10.3
FMC Minneapolis	C	12.0	16.4	-36.5	4.0	5.7	-42.0	0.0	0.0	0.0				16	22.1	-37.9
GMC Allison	C	15.1	24.2	-60.2	5.9	8.4	-43.1	3.0	6.8	-128.1				24	39.5	-64.5
Honeywell/Alliant Techsystems	C	55.5	60.6	-9.2	16.5	21.1	-28.0	3.0	8.1	-169.1				75	89.8	-19.7
Martin Marietta, Denver, CO	C	23.3	33.5	-44.1	7.7	11.7	-50.9	11.0	10.7	2.6	1	1	0	43	56.9	-32.4
McDonnell Douglas, St Louis	C	42.0	49.6	-18.1	16.0	17.2	-7.8	24.0	26.9	-12.2	1	1	0	83	94.8	-14.2
Thiokol	C	66.9	23.6	54.8	10.1	8.2	18.5	16.0	8.3	48.3	3	2	33	96	43.1	55.1
Boeing Helicopter, Phil, PA	M	21.3	19.5	8.5	2.7	6.8	-152.7	8.0	11.1	-38.5				32	37.4	-16.7
GE Aerosp Delaware Valley, NJ	M	72.3	38.6	46.6	22.7	13.4	40.8	3.0	8.3	-175.6	1	1	0	99	61.3	38.0
GE A/C Engines, Cincin, OH	M	30.6	44.3	-44.7	2.4	15.4	-537.5	18.0	19.5	-8.6	1	1	0	52	80.2	-54.2
Gen Dyn Lima, OH	M	19.4	15.6	19.5	14.6	5.4	62.7	3.0	3.9	-28.7				37	24.9	32.6
Gen Dyn Warren, MI	M	17.9	15.0	16.5	9.1	5.2	42.6	6.0	3.5	41.9				33	23.7	28.3
IBM Manassas	M	12.1	13.2	-8.7	11.9	4.6	61.5	1.0	3.9	-292.3				25	21.7	13.3
Loral	M	20.0	21.1	-5.9	8.0	7.3	8.6	11.0	9.0	18.6				39	37.5	4.0
Westinghouse Baltimore, MD	M	25.0	29.3	-17.3	12.0	10.2	14.8	5.0	6.4	-27.4	1	1	0	43	46.9	-9.1
Westinghouse Cleveland, OH	M	21.2	14.7	30.6	1.8	5.1	-187.6	4.0	5.5	-36.9				27	25.3	6.2
Eaton AIL, Deer Park, NY	N	9.3	10.4	-12.1	4.7	3.5	23.2	5.0	4.4	12.0				19	18.4	3.1
GE Aircraft Engine Lynn	N	21.3	24.5	-14.8	12.7	8.5	32.9	16.0	7.9	50.7				50	40.9	18.3
GE Pittsfield	N	20.4	21.0	-3.1	3.6	7.3	-102.7	6.0	8.6	-43.4				30	36.9	-23.2
Grumman Bethpage	N	41.2	47.5	-15.4	18.8	16.5	12.1	18.0	22.6	-25.4				78	86.6	-11.1
GTE Govt Systems	N	20.5	15.0	26.7	5.5	5.2	5.7	6.0	4.1	32.1				32	24.3	24.1
Hamilton Standard	N	18.3	30.1	-64.7	8.7	10.5	-19.5	9.0	8.3	7.7				36	48.8	-35.6
IBM Owego	N	11.9	12.3	-3.1	5.1	4.3	16.8	5.0	3.8	23.8				22	20.3	7.6
Lockheed Sanders, Nashua NH	N	13.0	16.9	-30.3	7.0	5.9	16.5	2.0	4.5	-122.8				22	27.2	-23.7
Pratt & Whitney, E Hartford	N	30.6	33.9	-11.0	8.4	11.8	-40.3	16.0	13.9	13.1				55	59.7	-8.5
Raytheon, Burlington, VT	N	55.2	65.0	-17.8	18.8	22.6	-20.1	6.0	9.3	-54.5				80	96.9	-21.1
Textron Lycoming, Stratford	N	16.3	18.7	-14.6	6.7	6.5	2.3	5.0	4.4	12.3				28	29.6	-5.8
Unisys Great Neck, NY	N	12.4	17.4	-40.7	2.6	5.0	-128.0	5.0	7.2	-43.5				20	30.5	-52.9
UTC Sikorsky, Stratford, CT	N	30.6	35.3	-15.3	6.4	12.3	-91.1	15.0	13.7	8.4				52	61.3	-17.8
Bell Helicopter	S	13.1	23.5	-79.5	4.9	8.2	-67.3	8.0	7.0	12.5				26	38.7	-48.8
GD Ft. Worth	S	41.0	40.4	1.5	20.0	14.0	29.8	23.0	21.3	7.2	2	2	0	86	77.8	9.5
Lockheed Aero Sys, Marietta	S	13.8	24.1	-75.0	9.2	8.4	9.4	9.0	10.0	-10.9	1	2	-100	33	43.4	-31.6
LTV Aerosp & Def, Dallas TX	S	22.0	29.9	-36.3	4.0	10.4	-156.8	8.0	9.5	-19.0	1	1	0	35	50.8	-45.2
Martin Marietta, Orlando FL	S	33.8	28.5	15.6	6.2	9.9	-58.9	5.0	6.0	-20.6				45	44.4	1.3
Pratt & Whitney	S	13.0	16.2	-24.7	3.0	5.6	-87.9	9.0	9.0	-0.4				25	30.9	-23.5
Rockwell, Richardson TX	S	8.7	9.4	-8.6	4.3	3.3	24.6	2.0	3.4	-68.3				15	16.0	-7.0
Texas Instruments, Dallas, TX	S	37.8	37.9	-0.2	13.2	13.2	-0.1	12.0	10.4	13.6				63	61.4	2.5
Aerojet Sacramento	W	15.4	12.7	17.4	7.6	4.4	41.8	5.0	4.8	4.4	1	1	0	29	22.9	21.0
Boeing Seattle	W	40.8	40.9	-0.3	18.2	14.2	22.0	6.0	11.8	-96.2	2	2	0	67	68.9	-2.8
Douglas Aircraft Long Beach	W	23.8	23.5	1.6	2.2	8.2	-275.3	14.0	10.7	23.9	2	1	50	42	44.3	-5.4
FMC	W	29.3	21.6	26.1	6.7	7.5	-11.9	5.0	6.8	-35.3				41	35.9	12.4
Gen Dynamics Pomona	W	20.1	15.9	20.9	10.9	5.5	49.0	10.0	4.6	54.5				41	26.0	36.5
Gen Dynamics San Diego	W	41.1	40.3	1.8	30.9	14.0	54.7	9.0	11.4	-26.2				81	65.7	18.9
Hughes Fullerton	W	23.2	22.0	5.3	10.8	7.6	28.9	8.0	6.4	19.9				42	36.1	14.1
Hughes Los Angeles	W	40.0	35.8	10.5	18.0	12.4	30.9	9.0	11.0	-22.2				67	59.2	11.6
Hughes Missile Tuscon	W	10.7	19.1	-78.2	8.3	6.7	19.4	15.0	6.4	57.0				34	32.3	5.1
Lockheed, Sunnyvale, CA	W	85.0	92.2	-8.5										85	92.2	-8.5
McD Doug Helicopters, Mesa	W	30.6	31.3	-2.3	16.4	10.9	33.8	12.0	7.1	40.4				59	49.3	15.5
McD Doug Space, Hunt Bch, CA	W	28.8	30.1	-4.6	8.2	10.5	-27.3	7.0	9.1	-29.5				44	49.7	-12.9
Northrop, Hawthorne, CA	W	66.0	62.7	5.0										66	62.7	5.0
Rockwell Anaheim	W	11.9	15.5	-29.8	6.1	5.4	11.4	6.0	4.5	24.9				24	25.4	-5.7
Rockwell Canoga Park	W	68.0	28.3	58.5	5.0	9.8	-98.4	8.0	9.6	-19.5	1	1	0	82	48.6	40.7
TRW Redondo Beach	W	22.6	25.9	-18.5	4.4	9.3	-111.9	11.0	8.4	23.6				38	44.5	-17.0

Mean Absolute (Average) Percent 20.6

SMALL DPROs
TOTAL STAFFING
ACTUAL VS ESTIMATED

		MILI-TARY (1)	Civilian ACT	Civilian EST	Civilian ERR %
Hercules	C		50.0	43.9	12.2
Magnavox	C	1	44.5	43.2	2.8
Northrop	C	1	36.6	43.6	-19.0
Sundstrand	C	2	44.6	42.6	4.4
Allied Signal	M	1	52.1	52.0	0.2
BMY	M	1	38.5	35.0	9.1
ITT	M	1	47.9	49.6	-3.6
Kearfott/Plessey	M	2	46.8	44.9	4.1
Williams	M	1	31.5	32.8	-4.2
GE Burlington, MA	N	1	42.0	40.8	3.0
GE Burlington, VT	N	1	35.8	35.8	-0.1
Harris	N	1	43.7	33.7	22.8
Kaman Aerospace	N	1	39.9	39.6	0.7
Link Flight Simulation	N	2	39.5	39.4	0.3
Textron Defense	N	1	36.7	36.1	1.5
AT&T	S	1	27.8	53.5	-92.4
E-Systems	S	2	49.6	49.8	-0.4
Grumman Stuart	S	2	29.1	30.4	-4.6
Grumman St. Augustine	S	2	35.9	31.2	13.1
Harris Melbourne	S	1	44.8	46.3	-3.2
McD Doug Titusville	S	2	34.6	36.3	-4.9
McD Doug Rockwell	S	1	32.5	37.6	-15.7
Pemco Aeroplex	S	1	51.9	47.6	8.2
Rockwell Duluth	S	1	33.7	38.0	-12.8
A/C Prgm Mgmt Office	S	2	50.0	33.0	34.0
Ford Newport Beach	W	4	39.8	41.7	-4.8
Westinghouse Sunnyvale	W	1	42.7	44.1	-3.4
Mean Absolute (Average) Percent Error:					10.6
Without AT&T:					7.4

Notes:

1. Military personnel are removed to get civilian workyears. (These military do NOT include QA and Flight Operations, which were not included in the counts and so are not removed.

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APPENDIX F

DCMAO CIVILIAN STAFFING BY DISTRICT

TOTAL DCMAO CIVILIAN STAFFING BY DISTRICT
(Workyears)

	ACT	EST	ERR %	"EARNINGS" (EST-ACT)
North Central				
Chicago	215.9	248.3	-15.0	32.4
Denver	229.3	238.8	-4.2	9.5
Grand Rapids	163.1	162.2	0.5	-0.9
Indianapolis	189.5	171.4	9.5	-18.1
St Louis	244.1	223.4	8.5	-20.7
Twin Cities	179.8	186.3	-3.6	6.5
Cedar Rapids	120.8	124.3	-2.9	3.5
Milwaukee	123.7	129.3	-4.5	5.6
Wichita	141.1	123.8	12.3	-17.3
Total Dist DCMA	1607.3	1608.0	-0.0	0.7
Mid Atlantic				
Baltimore	427.3	479.8	-12.3	52.5
Cleveland	358.6	271.9	24.2	-86.7
Dayton	311.6	325.2	-4.4	13.6
Detroit	242.3	209.4	13.6	-32.9
Philadelphia	394.0	456.5	-15.9	62.5
Pittsburgh	170.4	190.0	-11.5	19.6
Reading	220.7	212.8	3.6	-7.9
Springfield	392.8	367.6	6.4	-25.2
Total Dist DCMA	2517.7	2513.2	0.2	-4.5
Northeast				
Boston	387.2	348.5	10.0	-38.7
Garden City	389.4	354.0	9.1	-35.4
Hartford	281.4	299.5	-6.4	18.1
New York	296.2	239.2	19.3	-57.0
Syracuse	307.8	315.2	-2.4	7.4
Bridgeport	121.2	129.4	-6.8	8.2
Total Dist DCMA	1783.2	1685.7	5.5	-97.5
South				
Atlanta	247.6	285.3	-15.2	37.7
Birmingham	334.0	342.7	-2.6	8.7
Dallas	371.9	390.7	-5.1	18.8
Orlando	181.2	222.9	-23.0	41.7
San Antonio	264.8	263.2	0.6	-1.6
Clearwater	130.5	128.5	1.5	-2.0
Total Dist DCMA	1530	1633.3	-6.8	103.3
West				
El Segundo	421.5	366.9	13.0	-54.6
Phoenix	283.0	278.2	1.7	-4.8
San Francisco	297.8	317.8	-6.7	20.0
Santa Ana	401.6	427.7	-6.5	26.1
Van Nuys	419.6	429.5	-2.4	9.9
San Diego	153.0	157.9	-3.2	4.9
Seattle	141.1	138.4	1.9	-2.7
Total Dist DCMA	2117.6	2116.4	0.1	-1.2
Avg Abs % Error			8.1	
Total DLA DCMAO	9555.8	9556.6		0.8

APPENDIX G

DPRO CIVILIAN STAFFING BY DISTRICT

TOTAL DPRO CIVILIAN STAFFING BY DISTRICT
WORK YEARS

North Central	ACT	EST	ERR %	"EARNINGS"
Boeing Mil Airpl, Wichita, KS	104.8	83.1	20.7	[illegible]
FMC Minneapolis	59.1	65.8	-11.4	6.7
GMC Allison	63.7	89.2	-40.[illegible]	25.5
Honeywell/Alliant Techsystems	146.2	168.1	-15.0	21.9
Martin Marietta, Denver, CO	99.8	111.1	-11.3	11.3
McDonnell Douglas, St Louis, MO	273.8	334.1	-22.0	60.3
Thiokol	130.1	90.4	30.5	-39.7
Hercules	50	43.9	12.2	-6.1
Magnavox	44.5	43.2	2.8	-1.3
Northrop, Rolling Meadows, IL	36.6	43.6	-19.0	7.0
Sundstrand	44.6	42.6	4.4	-2.0
Total District: 11 DPROs	1053.2	1115.2	-5.9	62.0

Mid Atlantic	ACT	EST	ERR %	"EARNINGS"
Boeing Helicopter, Phil, PA	86.8	94.0	-8.3	7.2
GE Aerospace Delaware Val, NJ	185.7	160.4	13.6	-25.3
GE Aircraft Engines, Cincin, OH	115.9	141.7	-22.2	25.8
General Dynamics, Lima, OH	78.3	59.6	23.9	-18.7
General Dynamics, Warren, MI	70.9	54.1	23.6	-16.8
IBM Manassas	71.3	83.0	-16.3	11.7
Loral Systems Group	81.1	81.8	-0.8	0.7
Westinghouse, Baltimore, MD	105.6	110.0	-4.2	4.4
Westinghouse, Cleveland, OH	67.5	61.2	9.4	-6.3
Allied Signal, Teterboro, NJ	52.1	52.0	0.2	-0.1
BMY, Marysville, OH	38.5	35.0	9.1	-3.5
ITT Defense Group	47.9	49.6	-3.6	1.7
Kearfott/Plessey	46.8	44.9	4.1	-1.9
Williams International	31.5	32.8	-4.2	1.3
Total District: 14 DPROs	1079.9	1060.1	1.8	-19.6

Northeast	ACT	EST	ERR %	"EARNINGS"
Eaton AIL, Deer Park, NY	63.1	59.0	6.5	-4.1
GE Aircraft Engine, Lynn, MA	123.2	95.0	22.9	-28.2
GE Pittsfield, MA	89.5	84.7	5.3	-4.8
Grumman, Bethpage, NY	214.7	209.8	2.3	-4.9
GTE Govt Systems	69.6	76.0	-9.1	6.4
Hamilton Standard	65.1	84.3	-29.6	19.2
IBM Owego, NY	65.8	61.0	7.2	-4.8
Lockheed Sanders, Nashua, NH	63.2	77.4	-22.4	14.2
Pratt & Whitney, E Hartford, CT	102.5	120.3	-17.3	17.8
Raytheon, Burlington, MA	218.0	224.2	-2.9	6.2
Textron Lycoming, Stratford, CT	63.2	71.3	-12.9	8.1
Unisys Great Neck, NY	81.7	86.4	-5.8	4.7
UTC Sikorsky, Stratford, CT	144.9	142.4	1.8	-2.5
GE Burlington, MA	42.0	40.8	3.0	-1.2
GE Burlington, VT	35.8	35.8	-0.1	0.0
Harris, Syosset, NY	43.7	33.7	22.8	-10.0
Kaman Aerospace	39.9	39.6	0.7	-0.3
Link Flight Simulation	39.5	39.4	0.3	-0.1
Textron Def Sys, Wilmington, MA	36.7	36.1	1.5	-0.6
Total District: 19 DPROs	1602.1	1617.3	-0.9	15.2

TOTAL DPRO CIVILIAN STAFFING BY DISTRICT (CONTINUED)
(Workyears

South	ACT	EST	ERR %	"EARNINGS"
Bell Helicp Textron, Ft Wth, TX	93.0	107.1	-15.2	14.1
General Dynamics, Ft Wth, TX	212.1	183.5	13.5	-28.6
Lockheed Aero Sys, Marietta, GA	77.3	97.8	-26.5	20.5
LTV Aerospace & Def, Dallas, TX	88.8	109.4	-23.2	20.6
Martin Marietta, Orlando, FL	67.4	82.9	-23.0	15.5
Pratt & Whitney, W Palm Bch, FL	68.6	89.7	-30.7	21.1
Rockwell, Richardson, TX	53.0	53.2	-0.3	0.2
Texas Instruments, Dallas, TX	154.2	160.4	-4.0	6.2
AT&T Technol, Burlington, NC	27.8	53.5	-92.4	25.7
E-Systems, Greenville, TX	49.6	49.8	-0.4	0.2
Grumman, Stuart, FL	29.1	30.4	-4.6	1.3
Grumman, St Augustine, FL	35.9	31.2	13.1	-4.7
Harris Melbourne, Palm Bay, FL	44.8	46.3	-3.2	1.5
McD Doug, Titusville, FL	34.6	36.3	-4.9	1.7
McD Doug Rockwell, Tulsa, OK	32.5	37.6	-15.7	5.1
Pemco Aeroplex, Birmingham, AL	51.9	47.6	8.2	-4.3
Rockwell Duluth, GA	33.7	38.0	-12.8	4.3
A/C Program Mgmt Off, Atl, GA	50.0	33.0	34.0	-17.0
Total District: 18 DPROs	1204.3	1287.7	-6.9	83.4

West	ACT	EST	ERR %	"EARNINGS"
Aerojet, Sacramento, CA	71.7	69.3	3.4	-2.4
Boeing, Seattle, WA	190.3	177.3	6.8	-13.0
Douglas Aircraft, Long Beach, CA	102.8	99.5	3.2	-3.3
FMC	71.0	74.7	-5.2	3.7
General Dynamics, Pomona, CA	95.7	83.9	12.4	-11.8
General Dynamics, San Diego, CA	131.3	114.9	12.5	-16.4
Hughes, Fullerton, CA	83.6	92.5	-10.7	8.9
Hughes, Los Angeles, CA	162.8	145.7	10.5	-17.1
Hughes Missile, Tuscon, AZ	87.3	82.9	5.0	-4.4
Lockheed, Sunnyvale, CA	160.3	158.5	1.2	-1.8
McD Doug Helicopters, Mesa, AZ	123.9	99.6	19.6	-24.3
McD Doug Space, Hunt Bch, CA	73.0	84.3	-15.5	11.3
Northrop, Hawthorne, CA	183.1	110.7	39.5	-72.4
Rockwell, Anaheim, CA	62.2	70.2	-12.8	8.0
Rockwell, Canoga Park,CA	104.4	81.3	22.1	-23.1
TRW, Redondo Beach, CA	85.3	100.4	-17.7	15.1
Ford, Newport Beach, CA	39.8	41.7	-4.8	1.9
Westinghouse, Sunnyvale, CA	42.7	44.1	-3.4	1.4
Total District: 18 DPROs	1871.2	1731.4	7.5	-139.8
Total DLA: 79 DPROs	6810.7	6811.7	-0.0	1.0
Mean Abs (Average) % Error:			13.2	
Without Outliers- AT&T, GMC All, Northrop Haw:			11.4	

Note: "Earnings" are estimated workyears minus actual workyears.

APPENDIX H

TOTAL DCMAO AND DPRO STAFFING BY DISTRICT

TOTAL SLFA CIVILIAN
STAFFING BY DISTRICT *
(Workyears)

	ACT	EST	ERR %	"EARNINGS" (EST - ACT)
North Central:				
11 DPROs	1,053.2	1,115.2	-5.9	62.0
9 MAOs	1,607.3	1,608.0	-0.0	0.7
Total	2,660.5	2,723.2	-2.4	62.7
Mid Atlantic:				
14 DPROs	1,079.9	1,060.1	1.8	-19.8
8 MAOs	2,517.7	2,513.2	0.2	-4.5
Total	3,597.6	3,573.3	0.7	-24.3
Northeast:				
19 DPROs	1,602.1	1,617.3	-0.9	15.2
6 MAOs	1,783.2	1,685.7	5.5	-97.5
Total	3,385.3	3,303.0	2.4	-82.3
South:				
18 DPROs	1,204.3	1,287.7	-6.9	83.4
6 MAOs	1,530.0	1,633.3	-6.8	103.3
Total	2,734.3	2,921.0	-6.8	186.7
West:				
18 DPROs	1,871.2	1,731.4	7.5	-139.8
7 MAOs	2,117.6	2,116.4	0.1	-1.2
Total	3,988.8	3,847.8	3.5	-141.0
Total DLA:				
79 DPROs	6,810.7	6,811.7		1.0
36 MAOs	9,555.8	9,556.6		0.8
	16,366.5	16,368.3		1.8

* International, Michoud, and reimbursable workyears (except in QA) are NOT included.

APPENDIX I

MEAN ABSOLUTE PERCENT ERRORS FOR THE MODELS

Appendix I

MEAN ABSOLUTE PERCENT ERRORS FOR THE MODELS (AVERAGE ERRORS)

	MAPE
29 Large DCMAOs	
Contract Management	14.4
Prog & Tech Support & Ind Support	14.8
Quality Assurance	11.7
Command Support	16.1
Total Staffing	8.9
7 Small DPROs	4.7
All 36 DCMAOs	8.1
All DCMAOs Without 2 Outliers (Cleveland & Orlando)	7.1
53 Large DPROs	
Contract Management	20.9
Prog & Tech Support & Ind Support	29.0
Quality Assurance	20.6
Command Support	51.7
Total 53 Large DPROs	14.2
27 Small DPROs	10.6
Without AT&T	7.4
All 80 DPROs	13.2
All DPROs Without 3 Outliers (AT&T, GMC Allison & Northrop Hawthorne)	11.4

APPENDIX J

CONTROL LIMITS

TABLE OF CONTENTS
Appendix J

CALCULATION OF CONTROL LIMITS

There are four models for total staffing. The small DCMAO model is simple linear regression (only one variable in the equation). The small DPROs use a multiple linear regression model (more than one variable in the equation). The models for the large activities (both DCMAOs and DPROs) are the summation of individual multiple linear regression models. Because of the different types of models involved, the control limits were calculated differently (different equations, same 90 percent probability).

Since the model for small DCMAOs used simple linear regression, the formula for a 90 percent prediction interval was used. Because the equation is geared for the mean (average) value of the independent variable (in this case adjusted contracts on hand), it contains a correction for these values the further they are from the mean. The equation is applied on a point by point basis; therefore, there is a separate upper and lower control limit for each estimate.

The small DPRO model uses multiple linear regression (in this case there are four variables). There is no formula for limits with multiple linear regression. However, the statistical package used for these linear regression analyses calculates a standard error of the estimate, the key term in the equation for the simple linear regression limits. Also, the correction factor in the simple linear regression formula compensates for values away from the mean by widening the limits away from the mean. Tighter limits were assumed to be adequate. Any error would be on the side of falsely identifying as improperly staffed, facilities that really were properly staffed. For our purposes, the equation to calculate intervals for simple linear regression (without the correction factor for the independent variable) was deemed to be an adequate proxy for the small DPRO multiple linear regression control limits. As in the simple linear regression calculation, there are separate upper and lower control limits for each estimate.

The total staffing models for the large DCMAOs and DPROs are an aggregate of individual models. The approach was to select the statistic describing the actual and estimated values that best approximated the normal distribution. Using this statistic, we then calculated the interval with a 90 percent probability it would contain the actual value. The equation used the mean and standard deviation calculated by our statistical package. This statistic was the percent of error (the percent the estimate varied from the actual). Because this calculation is done for the entire distribution (not point by point as in the previous two equations), there is only one upper and one lower control limit for the entire range of data.

EQUATIONS USED TO CALCULATE CONTROL LIMITS

Small DCMAOs

$$\text{Control Limits} = Y_i \pm t * \text{SEE} \sqrt{1 + \frac{1}{n} + \frac{(X_i - \bar{X})^2}{\text{CSS}}}$$

Where: Y_i is the model estimate,

t is the value from the Table of Critical Values of the Student's t Distribution,

SEE is the standard error of the estimate,

n is the sample size,

X_i is the actual value of the independent variable,

$\bar{X}$ is the mean value of the independent variable, and

CSS is the Corrected Sum of the Squares.

Small DPROs

$$\text{Control Limits} = Y_i \pm t * \text{SEE}$$

Where: Y_i is the model estimate,

t is the value from the Table of Critical Values of the Student's t Distribution, and

SEE is the standard error of the estimate.

Large DCMAOs and large DPROs

$$\text{Control Limits} = \bar{X} \pm z * \text{STD DEV}$$

Where: $\bar{X}$ is mean value of the estimate,

z is the value from the Table for Cumulative Probabilities of the Standard Normal Distribution, and

STD DEV is the standard deviation.

CONTROL LIMITS - SMALL DCMAOs

DCMAO	DIST	EST	LOWER CONTROL LIMIT	ACT	UPPER CONTROL LIMIT	
Cedar Rapids	C	123.6	111.8	122.8	135.4	
Milwaukee	C	128.5	117.1	125.7	139.9	
Wichita	C	123.1	111.2	143.1	135.0	*
Bridgeport	N	128.6	117.2	123.2	140.0	
Clearwater	S	126.7	115.2	131.5	138.3	
San Diego	W	159.5	145.1	158.0	173.8	
Seattle	W	137.4	126.1	143.1	148.7	

CONTROL LIMITS - SMALL DPROs

DPRO	DISTRICT	EST	LOWER CONTROL LIMIT	ACT	UPPER CONTROL LIMIT
Hercules	C	43.8	38.1	50.0	49.6 *
Magnavox	C	44.2	38.4	45.5	49.9
Northrop	C	44.5	38.8 *	37.6	50.2
Sundstrand	C	44.6	38.8	46.6	50.3
Allied Signal	M	52.9	47.2	53.1	58.6
BMY	M	35.9	30.2	39.5	41.7
ITT	M	50.6	44.8	48.9	56.3
Kearfott/Plessey	M	46.8	41.1	48.8	52.5
Williams	M	33.8	28.0	32.5	39.5
GE Burlington, MA	N	41.7	36.0	43.0	47.4
GE Burlington, VT	N	36.8	31.0	36.8	42.5
Harris	N	34.7	29.0	44.7	40.4 *
Kaman Aerospace	N	40.6	34.8	40.9	46.3
Link Flight Simulation	N	41 3	35.6	41.5	47.1
Textron Defense	N	37.1	31.4	37.7	42.8
AT&T	S	54.4	48.7 *	28.8	60.1
E-Systems	S	51.7	46.0	51.6	57.5
Grumman Stuart	S	32.4	26.7	31.1	38.1
Grumman St. Augustine	S	33.1	27.4	37.9	38.9
Harris Melbourne	S	47.2	41.5	45.8	52.9
McD Doug Titusville	S	38.2	32.5	36.6	44.0
McD Doug Rockwell	S	38.5	32.8	33.5	44.3
Pemco Aeroplex	S	48.6	42.8	52.9	54.3
Rockwell Duluth	S	39.0	33.2	34.7	44.7
A/C Prgm Mgmt Office	S	34.9	29.2	52.0	40.7 *
Ford Newport Beach	W	45.7	39.9	43.8	51.4
Westinghouse Sunnyvale	W	45.1	39.3	43.7	50.8

CONTROL LIMITS - LARGE DCMAOs

DCMAO	PERCENT ERROR	
Orlando	-23.0%	*
Philadelphia	-15.9%	
Atlanta	-15.2%	
Chicago	-15.0%	
Baltimore	-12.3%	
Pittsburgh	-11.5%	
San Francisco	-6.7%	
Santa Ana	-6.5%	
Hartford	-6.4%	
Dallas	-5.1%	
Dayton	-4.4%	
Denver	-4.2%	
Twin Cities	-3.6%	
Birmingham	-2.6%	
Syracuse	-2.4%	
Van Nuys	-2.4%	
Grand Rapids	0.5%	
San Antonio	0.6%	
Phoenix	1.7%	
Reading	3.6%	
Springfield	6.4%	
St Louis	8.5%	
Garden City	9.1%	
Indianapolis	9.5%	
Boston	10.0%	
El Segundo	13.0%	
Detroit	13.6%	
New York	19.3%	*
Cleveland	24.2%	*

LOWER CONTROL LIMIT - (- 18.8) %

UPPER CONTROL LIMIT - 17.6 %

CONTROL LIMITS - LARGE DPROS

DPRO	PERCENT ERROR	
GMC Allison	-40.1%	•
Pratt & Whitny, W Plm Bch, FL	-30.7%	•
Hamilton Standard	-29.6%	
Lockheed Aer Sys, Mariett, GA	-26.5%	
LTV Aerosp & Def, Dallas, TX	-23.2%	
Martin Marietta, Orlando, FL	-23.0%	
Lockheed Sanders, Nashua, NH	-22.4%	
GE A/C Engines, Cincin, OH	-22.2%	
McDonnell Douglas, St L, MO	-22.0%	
TRW, Redondo Beach, CA	-17.7%	
Pratt & Whitney, E Hartfd, CT	-17.3%	
IBM Manassas	-16.3%	
McD Doug Space, Hunt Bch, CA	-15.5%	
Bell Helicp Txtrn, Ft Wth, TX	-15.2%	
Honeywell/Alliant Techsystems	-15.0%	
Textron Lycoming, Stratfd, CT	-12.9%	
Rockwell, Anaheim, CA	-12.8%	
FMC Minneapolis	-11.4%	
Martin Marietta, Denver, CO	-11.3%	
Hughes, Fullerton, CA	-10.7%	
GTE Govt Systems	-9.1%	
Boeing Helicopter, Phil, PA	-8.3%	
Unisys Great Neck, NY	-5.8%	
FMC	-5.2%	
Westinghouse, Baltimore, MD	-6.2%	
Texas Instruments, Dallas, TX	-4.2%	
Raytheon, Burlington, MA	-2.9%	
Loral Systems Group	-0.9%	
Rockwell, Richardson, TX	-0.3%	
Lockheed, Sunnyvale, CA	1.2%	
UTC Sikorsky, Stratford, CT	1.8%	
Grumman, Bethpage, NY	2.3%	
Douglas A/C, Long Beach, CA	3.2%	
Aerojet, Sacramento, CA	3.4%	
Hughes Missile, Tuscon, AZ	5.0%	
GE Pittsfield, MA	5.3%	
Eaton AIL, Deer Park, NY	6.5%	
Boeing, Seattle, WA	5.8%	
IBM Owego, NY	7.2%	
Westinghouse, Cleveland, OH	9.4%	
Hughes, Los Angeles, CA	10.5%	
Gen Dynamics, Pomona, CA	12.4%	
Gen Dynamics, San Diego, CA	12.5%	
General Dynamics, Ft Wth, TX	13.5%	
GE Aerospace Delaware Val, NJ	13.6%	
McD Doug Helicp, Mesa, AZ	19.6%	
Boeing Mil Airpl, Wichita, KS	20.7%	
Rockwell, Canoga Park,CA	22.1%	
GE Aircraft Engine, Lynn, MA	22.9%	
General Dynamics, Warren, MI	23.6%	
General Dynamics, Lima, OH	23.9%	
Thiokol	30.5%	•
Northrop, Hawthorne, CA	39.5%	•

LOWER CONTROL LIMIT - (- 30.5) %

UPPER CONTROL LIMIT - 26.2 %

REPORT DOCUMENTATION PAGE

OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
May 1992

3. REPORT TYPE AND DATES COVERED
Final

4. TITLE AND SUBTITLE
Defense Contract Management Command Staffing Assistance Model

5. FUNDING NUMBERS

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
HQ Defense Logistics Agency (DLA-LO)
Cameron Station
Alexandria, VA 22304-6100

8. PERFORMING ORGANIZATION REPORT NUMBER
DLA-92-P10093

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Defense Contract Management Command (DCMC-DA)
Cameron Station
Alexandria, VA 22304-6190

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Public release; unlimited distribution

12b. DISTRIBUTION CODE

13. ABSTRACT
This set of models uses workload indicators to equitably estimate the total staffing resources needed at each DCMAO and DPRO. Regression analysis is used to identify those apparently logical workload indicators that have statisticaly valid correlations with staffing. It also quantifies the relationship between thse valid indicators and the staffing. The average error is about 7 percent for the DCMAO model. For the DPRO model, the average error, about 11 percent, is higher because contractor activity at DPROs is less stable and the data is less reliable. The essence of the methodology is simply to estimate resources by comparing workload versus resources at all of the different activities. As a result, it is easy to visualize . The models use most automated indicators, track contractor business activity, and can take into account work that is not discretely measurable. They set a uniform, analytical approach for Headquarters DCMC, and DCMC district commanders, to compare workload, and to balance and allocate resources. The models also highlight patterns in staffing, and by using control limits they identify activities that are potentially over or under resourced. Judicious use of the models, coupled with other analyses or field reviews, can result in important savings and avoidances.

14. SUBJECT TERMS
workload indicators, staffing resources, personnel allocation, regression analysis

15. NUMBER OF PAGES
86

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	