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**FORECASTS OF DEFENSE CONTRACT
MANAGEMENT COMMAND UNIT COST
PRODUCTS/SERVICES**

August 1993

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FOR

**DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY
DEFENSE CONTRACT MANAGEMENT COMMAND**
Cameron Station
Alexandria, VA 22304-6100

93-22519

INSIGHT THROUGH ANALYSIS

DORO

CORPORATE RESEARCH

DLA-93-P20340

**FORECASTS OF DEFENSE CONTRACT
MANAGEMENT COMMAND UNIT COST
PRODUCTS/SERVICES**

August 1993

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FOREWORD

This report outlines the methodologies and fiscal year 1994 workload forecasts for the 18 Defense Contract Management Command (DCMC) unit cost products and services. The success of this effort was largely due to the data collection support from numerous offices. These offices included: the Defense Logistics Agency Performance Standards Support Office in Chicago, all of the functional areas in Contract Management and the Policy Group in the Procurement Business Area.

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SECTION 1 INTRODUCTION

1.1 BACKGROUND

Needing better cost visibility, the Department of Defense divided itself into business areas, one of which is the Defense Contract Management Command (DCMC). Products and services were identified in each business area. DCMC chose 18 cost indicators to serve as proxies for all DCMC products and services. The cost of each indicator is currently being calculated. Future DCMC budgets will be based on the projected number of work units completed for each of the 18 indicators.

1.2 SCOPE

Each of the 18 unit cost indicators was considered independently to determine what method could be used to develop a workload forecast. We worked with the indicators at the DCMC level. Results of the DCMC level explorations demonstrated that examining data at a lower organizational level would not have been productive.

1.3 OBJECTIVE

The primary objective was to develop a workload forecasting methodology for each of the 18 DCMC unit cost indicators. Drivers of individual cost indicators were desired that are global, external to Defense Logistics Agency (DLA) and non-tamperable. Finally, a forecast for each of the 18 indicators was requested for fiscal year 1994.

SECTION 2 METHODOLOGY

Regression, time series analysis and ratio analysis were the forecasting techniques we considered. Time series techniques forecast next year from the trends of preceding years. The Department of Defense's (DoD) sharply declining budgets and DCMC's declining workload rendered this approach impractical. Regression involves tying a forecast statistically to another variable. For example, the cost of building a home may be forecast from a formula based on the size of the home in square feet. Size is the independent variable and the item to be forecast, in this case the cost, is the dependent variable. The forecasting formula is produced by using regression analysis on historical data for both variables. Independent variables may be chosen to satisfy the external, non-tamperable and global objectives for our unit cost drivers. Ratio analysis equates the rate of change in a driver with the rate of change in the variable to be forecast. Regression and ratio analysis were used to develop the workload forecasts.

Using regression presented several challenges: identifying possible independent variables that are drivers of our unit cost counts, determining the availability of historical data for both drivers and unit cost indicators, and collecting and analyzing the data. Collecting and analyzing the data consumed the most time.

Personnel from the office of the Executive Director (Contract Management), DLA Performance Standards Support Office (DPSSO), field functional elements and the DLA Operations Research Office (DORO) suggested many possible unit cost workcount drivers. Each suggestion was examined, but most proved impractical due to a lack of historical data. Seven unit cost products/services had no history available. Three other indicators had only two years of history. We explored these indicators using monthly data but did not discover any usable relationships. The swings in monthly data proved random and volatile. Forecasts of indicators with insufficient history were tied to the change in the total of DoD Procurement outlays and Research, Development, Test & Evaluation (RDT&E) outlays from FY 93 to FY 94.

With one exception, the most productive regression analyses used DoD Procurement outlays and RDT&E outlays as independent variables. This data covered the FY 85-92 time period and was expressed in constant FY 93 dollars. DoD published these figures in the document *NATIONAL DEFENSE BUDGET ESTIMATES FOR FY 1994*.

Termination for Convenience was the one unit cost service for which we used a different independent variable. We found the number of terminations dockets (or cases) opened the previous year an excellent driver for the number of dockets closed.

**SECTION 3
RESULTS**

3.1 FORECASTING METHODOLOGIES

We forecast the unit cost products/services using regression and ratio analysis.

We regressed the unit cost work counts against DoD outlays for Procurement, RDT&E and the sum of both. These outlays, expressed in constant FY 93 dollars, logically effect DCMC workload. We used the outlays from the previous year, where possible, to reflect the budget to workload lag. In the case of terminations, cases opened the previous year proved a more satisfactory driver. Regression analysis produced forecasts for the following:

PRODUCT/SERVICE NUMBER (PSN)	TITLE
6100	Quality Assurance
6170	Transportation
6180	Termination for Convenience

For five other unit cost indicators, we chose data elements from the RCS 448 report to serve as proxies for a unit cost count. We then regressed the proxy against the aforementioned DoD budget data to derive a forecasting formula for the proxy. We computed the unit cost forecast by multiplying the proxy forecast by an adjustment factor. The adjustment factor was derived from the ratio of the unit cost product/service to the proxy count. This approach worked for the following indicators:

PRODUCT/SERVICE NUMBER (PSN)	TITLE
6010	Core Contract Administration
6030	Pricing/Negotiations
6070	Progress Payments

The six unit cost indicators listed above comprise over 65% of the total costs captured by the unit cost system. The remaining unit cost work counts were forecasted by multiplying the annualized workcounts for FY 93 (derived from April data) times the ratio of the FY 94 sum of DoD Procurement and RDT&E outlays to the FY 93 sum of Procurement and RDT&E outlays. DoD budget data was expressed in constant FY 94 dollars. This ratio couples the concept of a global, external to DLA variable with the fact of a sharply declining DoD budget.

3.2

UNIT COST FORECASTING RESULTS

The FY 94 unit cost forecasts follow. Appendix A contains the formulae and calculations for each forecast. This Appendix also includes regression statistics and a list of proxy variables.

PSN	TITLE	FY 93 (Thru May) ANNUALIZED	FY 94 FORECAST
6010	Core Contract Administration	320,783	281,096
6020	Preaward Surveys	6,222	5,765
6030	Pricing/Negotiations	14,402	12,492
6040	Over and Above Work Requests	123,269	114,208
6050	Price-Related Systems Surveillance		N/A *
6060	Large Businesses' Plans for Sub- contracting with Small Businesses and Disadvantaged Businesses	4,700	4,354
6070	Progress Payments	42,737	41,371
6080	Cost Surveillance	19,176	17,767
6090	Property Management	28,598	26,496
6100	Quality Assurance (QA)	292,565	271,953
6110	Mandatory QA Inspection Requirements	10,788	9,995
6120	Program Integration	12,374	11,464
6130	Engineering Surveillance	21,924	20,313
6140	Manufacturing Systems Evaluation	5,784	5,359
6150	Production Surveillance	304,614	282,225
6160	Flight Operations	1,382	1,280
6170	Transportation	111,254	103,202
6180	Termination for Convenience	5,136	5,908

* No work unit to count has yet been defined for this PSN; therefore no forecast was produced.

SECTION 4 CONCLUSIONS

The forecasts generated in this report fulfill the objective of using unit cost drivers that are global, external to DLA and non-tamperable.

Most forecasting techniques rely heavily on historical data. Unfortunately, sufficient historical data is not available for many of the unit cost indicators.

Yearly data yields the most promising statistical relationships. Monthly data is prone to volatile, seemingly random swings.

Useful forecasts, tied to global DoD budget items, can be produced to assist DCMC management in predicting DCMC budgets. When changes occur in the DoD budget, new unit cost estimates can easily be generated using these forecasting methods.

SECTION 5
RECOMMENDATIONS

The forecasts produced in this report should be used by DCMC management as an input in estimating future DCMC budgets.

As more unit cost history becomes available, these forecasts should be reevaluated and revised.

At the end of FY 94, the models should be evaluated to see if they are accurate predictors. If modifications are needed to improve the models, they should be made at that time.

The forecasting models should be run each May so that results can be used in the budget formulation process.

APPENDIX A
FORECASTING FORMULAE

**APPENDIX A
FORECASTING FORMULAE**

REGRESSION FORECASTS

Regressions were run on the following yearly DoD budget data expressed as constant FY 93 \$ in millions:

- Procurement Outlays (Shown as PROC)
- RDT&E Outlays (Shown as RDT&E)
- Total Procurement and RDT&E Outlays (Shown as TOTAL)

Since DCMC work lags behind the actual budget outlays, we used the outlays from the previous year as the drivers, where possible.

The Coefficient of Determination or R^2 is that portion of the total variation in the dependent variable (unit cost work count) that is explained by the regression equation. For example, the R^2 in PSN 6010 shows that the regression equation explains 84.9 percent of the variation in the number of contracts closed.

Outliers are those fiscal years that have been excluded from the analysis due to their extreme values. Outliers cloud underlying statistical relationships.

FY94 FORECAST CALCULATIONS

(Budget figures in constant FY 93 \$ in millions)

6010 * Core Contract Administration

Formula: $[1.307 (\text{FY 94 TOTAL}) + 177,370] \times .92 = \text{Contracts Closed}$

Forecast: $[1.307 (98,063) + 177,370] \times .92 = 281,096$

R^2 : 84.9%

Period: FY 85 - FY 92 Outliers: FY 88 & FY 90

6030 * Pricing

Formula: $[\.26398 (\text{FY 94 PROC}) - 6,910] \times 1.37 = \text{Pricing Cases}$

Forecast: $[\.26398 (60,719) - 6,910] \times 1.37 = 12,492$

R^2 : 82.4%

Period: FY 85 - FY 92 Outliers: FY 86, FY 90 & FY 91

6070 * Progress Payments

Formula: $[\.10127 (\text{FY93 RDT\&E}) + 3,115] \times 6.0 = \text{Progress Payments}$

Forecast: $[\.10127 (37,328) + 3,115] \times 6.0 = 41,371$

R^2 : 95.8%

Period: FY 85 - FY 92 Outliers: FY 87, FY 88 & FY 92

6100 Quality Assurance (QA)

Formula: $3.46889 \text{ (FY 94 TOTAL)} - 68,217 = \text{QA Contracts Closed}$

Forecast: $3.46889 \text{ (98,063)} - 68,217 = 271,953$

R^2 : 80.9%

Period: FY 86 - FY 92 Outliers: FY 88 & FY 91

6170 Transportation

Formula: $1.12923 \text{ (FY 94 PROC)} + 34636 = \text{Government Bills of Lading (GBLs)}$

Forecast: $1.12923 \text{ (60,719)} + 34,636 = 103,202$

R^2 : 83.3%

Period: FY 86 - FY 92 Outliers: FY 89 & FY 90

6180 Terminations

Formula: $1.184 \text{ (FY 93 TERM. DOCKETS OPENED)} - 322 = \text{Terminations}$

Forecast: $1.184 \text{ (5262)} - 322 = 5,908$

R^2 : 98.2%

Period: FY 86 - FY 92 Outliers: None

* Regressions for these PSNs were actually run against proxy variables from the RCS 448 report as listed below. A ratio of the annualized unit cost workcount (through May) to an annual proxy count was calculated. We multiplied the regression formula results by these ratios to produce the unit cost forecasts.

PSN RCS 448 Proxy Data Elements

6010 - 030A038 (Prime Contracts Closed, ACO Assigned - Total) +

040B008 (Prime Contracts for Support Administration Closed, ACO Assigned) +

050B008 (Subcontracts for Support Administration Closed, ACO Assigned)

6030 - 140A007 (Pricing Cases Completed)

6070 - 622B158 (Physical Progress Reviews Completed)

RATIO FORECASTS

The following forecasts were produced by:

1. Annualizing the FYTD unit cost workcount from unit cost reports through May. For PSN 6040 the May FYTD count was 82,179. The unit cost number was annualized as follows:
 $(82,179/8) \times 12 = 123,269.$

2. The change in the DoD budget for Procurement and RDT&E outlays was as follows (expressed in constant FY 94 \$ in millions):

	<u>FY 93</u>	<u>FY 94</u>
PROCUREMENT OUTLAYS	70,157	62,174
RDT&E OUTLAYS	38,199	38,215

TOTAL	108,356	100,389
	100,389	
	-----	= 92.65%
	108,356	

3. We multiplied the annualized figure of 130,941 by .9265 to account for the reduced DoD budget and produce the FY 94 forecast.
 $123,269 \times .9265 = 114,208$

PSN	TITLE	ANNUALIZING		FORECASTING FORMULA
		FYTD 93 COUNTS	(THRU APRIL)	
6020	Preaward Surv.	4,148	$\times (12/8) =$	$6,222 \times .9265 = 5,765$
6040	Over & Above	82,179	$\times (12/8) =$	$123,269 \times .9265 = 114,208$
6060	Lge Busi. Subs	3,133	$\times (12/8) =$	$4,700 \times .9265 = 4,354$
6080	Cost Surveil.	12,784	$\times (12/8) =$	$19,176 \times .9265 = 17,767$
6090	Prop. Manag.	19,065	$\times (12/8) =$	$28,598 \times .9265 = 26,496$
6110	Mand. QA Req.	7,192	$\times (12/8) =$	$10,788 \times .9265 = 9,995$
6120	Prog. Integ.	8,249	$\times (12/8) =$	$12,374 \times .9265 = 11,464$
6130	Eng. Surveil.	14,616	$\times (12/8) =$	$21,924 \times .9265 = 20,313$
6140	Man. Sys. Eval.	3,856	$\times (12/8) =$	$5,784 \times .9265 = 5,359$
6150	Prod. Surveil.	203,076	$\times (12/8) =$	$304,614 \times .9265 = 282,225$
6160	Flight Ops	921	$\times (12/8) =$	$1,382 \times .9265 = 1,280$

APPENDIX B
FYTD UNIT COST STATISTICS

**APPENDIX B
FYTD UNIT COST STATISTICS
(MAY 1993)**

RANKED IN ORDER OF PERCENT OF TOTAL COSTS

PSN	TITLE	COSTS	PERCENT	UNITS
6100	QUALITY ASSURANCE	275,976,220	40.7% *	195,043
6010	CORE CONTRACT ADMIN.	106,516,027	15.7% *	213,855
6130	ENGINEERING SURVEILLANCE	49,593,814	7.3%	14,616
6150	PERFORMANCE SURVEILLANCE	45,263,935	6.7%	203,076
6030	PRICING/NEGOTIATION	45,157,822	6.7% *	9,601
6120	PROGRAM INTEGRATION	27,843,469	4.1%	8,249
6090	PROPERTY MANAGEMENT	27,711,045	4.1%	19,065
6050	PRICE-RELATED SYS. SURV.	22,609,754	3.3%	0
6110	MANDATORY QA INSP.	21,671,416	3.2%	7,192
6140	MANUFACTURING SYS. SURV.	12,002,097	1.8%	3,856
6180	TERMINATION / CONVENIENCE	9,727,450	1.4% *	3,424
6170	TRANSPORTATION	8,907,314	1.3% *	74,169
6160	FLIGHT OPERATIONS	6,590,337	1.0%	921
6020	PREAWARD SURVEYS	6,553,564	1.0%	4,148
6040	OVER & ABOVE WORK REQ.	3,769,058	0.6%	82,179
6070	PROGRESS PAYMENTS	3,659,010	0.5% *	28,491
6080	COST SURVEILLANCE	2,846,042	0.4%	12,784
6060	LRG BUSINESS' SUBCONT.	1,683,292	0.2%	3,133

* Forecasts based on regression formulae

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