CURRENT RESULTS FROM THE ANALYSIS OF COST DATA FOR COMPUTER PROGRAMMING

T. Fleishman

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DEPUTY FOR ENGINEERING AND TECHNOLOGY
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L. G. Hanscom Field, Bedford, Massachusetts

(Prepared under Contract No. AF 19(628)-5166 by the System Development Corporation, 2500 Colorado Ave., Santa Monica, Calif.)

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FOREWORD

This report was prepared for the Air Force Electronic Systems Division, Deputate for Engineering and Technology, Directorate of Computers, as part of a continuing research effort being conducted by the Programming Management Project at System Development Corporation. The Project is led by V. LaBolle whose direction and suggestions in the writing of this document are gratefully acknowledged.

The other members of the Project, E. A. Nelson, G. F. Weinwurm and H. J. Zagorski, also provided valuable review and criticism.

Special thanks are extended to our editor, Ann Walker, and our typists, Carol Castillo and Judy Ross, for their contributions in the preparation of this report.

This technical report has been reviewed and is approved.

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ABSTRACT

This report describes the third cycle in the continuing research to develop cost estimating relationships between cost and cost factors, to be used in the management of computer programming. Several features of the work are presented, including basic assumptions of the analyses, definitions, data collection and validation procedures, and application of statistical techniques such as correlation and multivariate regression analyses.

The analysis is being performed with 169 data points, representing computer programming efforts completed by System Development Corporation, various industrial organizations, and agencies of the United States Air Force. Several characteristics of the data base are presented, e.g., source, size, range of selected variables, average age of the data points, and applications and computer languages used. In addition, statistical tests were performed to ascertain the presence of subsamples in our data; the results of these tests are also presented.

The report concludes with recommendations for the collection and validation of more accurate data, as well as for general improvements in the approach and methods implemented in the work.

CONTENTS

SECTION I

INTRODUCTION

1. Purpose of the Report. This report describes the current work in the third cycle of analysis to derive estimating equations for the costs of computer program production. In the first two cycles of this work, data from computer programming efforts completed at System Development Corporation (SDC) were analyzed. This third cycle includes, in addition, data from other sources, namely 14 Air Force and 7 industrial programming organizations.

The purpose of the work in this cycle is twofold: to search the data for significant subsamples that are more homogeneous in terms of cost and, as a result, lead to estimating equations with better precision than that exhibited by equations derived from the entire sample. If significant subsamples are identified, it is expected that these can be the basis for more thorough analyses to yield still further improvements in cost estimating equations.

The analysis in this third cycle is not complete, e.g., no estimating equations have been derived as yet. Such results will be included in another document scheduled to appear early this fall.

This report includes characteristics of the data base such as the sources of the data, their age and descriptive statistics, e.g., the mean and standard deviation, for the various cost measures, production rates and computer usage rates found in the entire sample as well as the various subsamples. The subsamples are based upon division of the sample according to programming language (machine-oriented versus procedure-oriented), programming application (software, business, scientific, other computer programs), and computer class (large, medium or small as characterized by cost).

In addition, the data in these divisions were tested to see if they indeed formed subsamples that are distinctly different. Using cost measures such as man months and months elapsed, production and computer usage rates as the basis for comparison, these preliminary tests show the presence of some subsamples in the data and also confirm previous findings of our research. For example, the use of a procedure-oriented language (POL) as compared with the use of a machine-oriented language (MOL or assembly language) appears to result in a higher production rate (machine language instructions per man month) and a lower computer usage rate (computer hours per thousand machine language instructions) as well as significant differences in the means for the basic cost measures. The statistical tests used assume that the data are distributed normally and that the variances of the samples compared are equal. Although our data do not completely conform to these conditions, we nevertheless feel that the results presented do provide an insight into the significant differences in the samples tested, and they can be used, with caution, along with other methods of cost prediction and control.

Further analysis of the data is continuing, and the results are to be published later this year in the form of a Management Handbook which will also contain other management aids such as schedules, charts, checklists, and summaries of pertinent expert opinions regarding computer programming management.

Meanwhile, this report is intended to serve as the following:

- A technical reference for the Management Handbook (that will contain the actual cost-estimating equations derived from the analysis) by describing the methods and data used to obtain the results.

- Feedback to the several organizations that supplied inputs to this analysis by providing a complete matrix of data that permits individual contributors to compare (or) analyze their inputs with other data.

- A statistical description, e.g., range, mean, standard deviation of the data for the costs, production rates, and computer usage rates in each hypothesized subsample.

- An exhibit of early analytical results based upon statistical tests to determine the significance of the divisions into subsamples.

- An evaluation of the feedback received and results to date and recommendations for modifying the present assumptions and methods for future work.

2. Background. Since 1964, the SDC Programming Management Project has been performing research in the management of computer programming. This report, one of a series, represents work done under the sponsorship of the Air Force Electronic Systems Division, Deputate for Engineering and Technology, Directorate of Computers.

The general aim of the Project is to develop techniques, standards, and guidelines for managers of computer programming and buyers of the resultant products. In the work for ESD, these aids have been in the form of linear cost estimating equations, describing relationships between costs and cost factors (variables thought to influence computer programming costs).

The work has been conducted in cycles, this report describing the third such cycle. What we term a "research cycle" consists of the following:

- Design (or redesign) of the questionnaire used to collect the data.

- Collection of data that characterize completed programming efforts.

- Validation of these data by identifying anomalies and gaps and then coordinating with the original respondents to clarify and complete the questionnaires.

- Application of statistical techniques, intuition, and experience, first to reduce the total number of cost factors to be considered as independent variables, and then to derive the equations. This is done, for example, by using multiple regression and predictor selection algorithms to relate the remaining cost factors as independent variables to the cost measures as dependent variables.

The first cycle explored the feasibility of using multivariate statistics to derive estimating equations by using 27 data points, all representing computer programs completed within SDC (1). The second cycle repeated the previous analysis, using an enlarged data base of 74 sample points, also representing computer programming projects completed within SDC. That phase of the research resulted in the development of several task indices, i.e., weighted composites of two or more cost factors, and the use of Stanine confidence band techniques as an aid to estimating computer programming costs (2, 3). The third phase of the research, described in this report, is being conducted with 169 points and is aimed at the following:

- Deriving equations with improved accuracy and/or usefulness by using subsamples based upon divisions, such as types of computers used in program production, and types of programming applications, e.g., business, scientific, etc.

- Extending the use of the data base by testing a series of hypotheses of interest to management, e.g., MOL/POL comparison.

- Measuring the improvement in statistical prediction and trying to identify paths for further research.

The remainder of this report consists of the following sections:

- Section II--a description of data characteristics, e.g., source, size, age, etc., and a preliminary report on the results of the subsample tests being performed with the data.

- Section III--a summary of the deficiencies of the research model and the methods used in the work to date, with recommendations for changes in both for future work.

- Section IV--appendices, which contain:

  A. A review of the research model for the analysis.

  B. An outline of the data collection and validation procedures used to form our data base.

  C. A description of the statistical methods applied to the data.

D. A data matrix representing the responses of the agencies who contributed data to our sample. This appendix includes the definition and coding of all items used in the questionnaire.

E. A list of variables that were formed by combining or transforming some of the items that make up the data collection questionnaire.

F. A list showing the correlation coefficients of selected variables with the four cost measures--man months, computer hours, months elapsed, object instructions generated, and the formed variables--object production rate and object computer usage rate.

SECTION II

DATA CHARACTERISTICS AND PRELIMINARY SUBSAMPLE ANALYSIS

1. Introduction. The data described in this Section represent the combined sample after the completion of the third collection effort conducted by the Programming Management Project.

At the conclusion of the third effort, 106 points had been collected, 66 points from 7 industrial firms and 40 points from 14 agencies of the United States Air Force. These 106 points combined with the SDC data on hand--74 points--resulted in an initial data base of 180 points. During validation of the data, five external sample points were dropped because of the general unreliability of the data. Eventually, 6 more points--all SDC data--were dropped in the early stages of statistical analysis because they were considered to be too large and hence unrepresentative in terms of cost, e.g., 1653 man months. As a result, 169 data points were used as input to the statistical analysis. Appendix B describes the collection and validation of these data as well as the deletion of the data points.

The first parts of this Section describe the entire data base in terms of data sources, age of the data, and descriptive statistics. The second part of this Section deals with similar characteristics for various subsamples of the data and also presents the results of statistical tests on the means.

The larger size of the data base permitted us to continue the subsample identification and testing that was initiated in previous cycles of our work (2,3). The subsamples that were proposed for this analysis were grouped into categories based on programming application, source language, developmental computer size and interprogram communication.

Descriptive statistics, e.g., mean, standard deviation, were derived for each proposed group, and then used to test for the presence of subsamples by means of significance tests. The descriptive statistics for each group along with the results of the tests, are presented in table form.

2. Sources of the Data Base. The present data base of 169 data points represents 131 programming efforts completed at 8 industrial organizations (including SDC) and 38 points submitted by 14 agencies of the United States Air Force. The eight industrial organizations include four companies whose main function is software design and production, and four whose primary endeavor is hardware development. The 14 USAF programming agencies are support organizations in larger commands.

Table I illustrates each organization's contribution to the data base.

TABLE I

DISTRIBUTION OF DATA BY SOURCE

Organization			Number of Data Points Submitted
Govt		U. S. Air Force*	38
Industry	Computer Software Research and Development	Company A	6
		Company B	1
		Company C	1
		Company D	69
	Computer Hardware and Aerospace	Company E	2
		Company F	3
		Company G	21
		Company H	28
		Total	169

*Note: Data represent 14 separate USAF organizations

3. Age of the Data Base. One of the most apparent features of the electronic data processing field is the rapidity of change. We have seen such swift developments in computer hardware that early obsolescence is taken for granted. Although this obsolescence does not seem to be prevalent in software development, we do find significant year-to-year advances in the availability of software packages and compiler design. Therefore, the currency of the data should be taken into account in the interpretation of analysis results, since the time interval to validate and analyze the data (see Appendices B and C), ranges from nine months to a year. In effect, the resultant equations reflect programming as it was two years ago, and it may be quite different today.

Table II lists the starting dates of the computer programs in our sample and the average age of the data.

TABLE II

AGE OF THE DATA BASE

Data Point Programming Start Date	Age of Data Point (Years)	Number of Points	Percent of Total
1965	.5	36	21.3
1964	1.5	72	42.6
1963	2.5	27	16.0
1962	3.5	16	9.5
1961	4.5	17	10.1
1960	5.5	1	.5
	Total	169	100.0
Average Age of Data Base: 2.0 Years			

4. Size of Programs in Sample. The histograms for two cost measures, Man Months and Months Elapsed (Figures 1 and 2), illustrate the general distribution of the data in terms of man months and months elapsed. The range of the programs is quite wide, but the smaller programs dominate the distribution of our sample. This seems to indicate that programs requiring an approximate production time of 5 to 15 man months and 2 to 8 elapsed months are the most common.

No histograms were constructed for computer hours and number of object instructions, due to the extreme range of these variables. However, Table III contains the range, mean, and standard deviation for the cost measures, production rates and computer usage rates for the total sample.

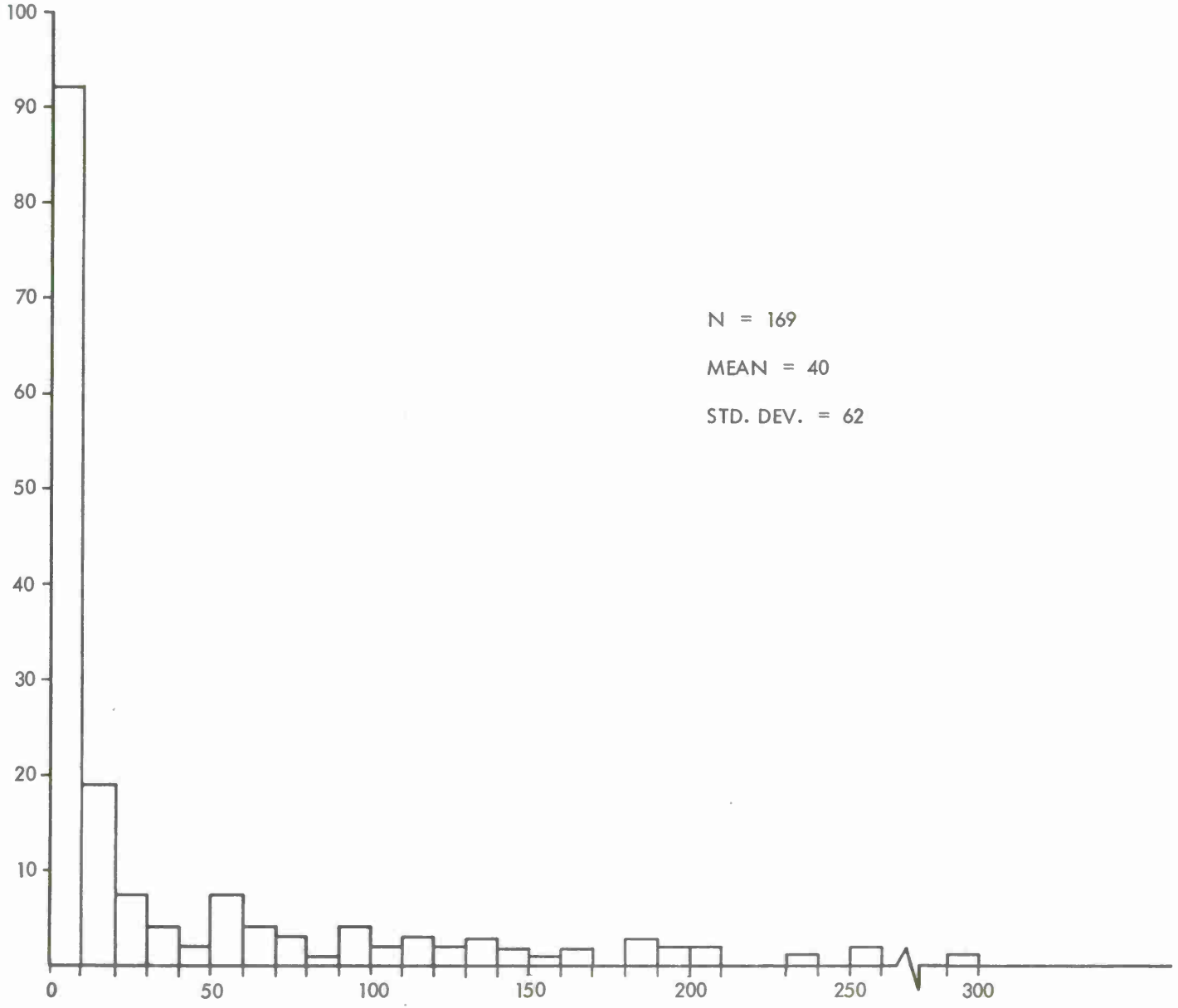

Figure 1. Histogram of Man Months

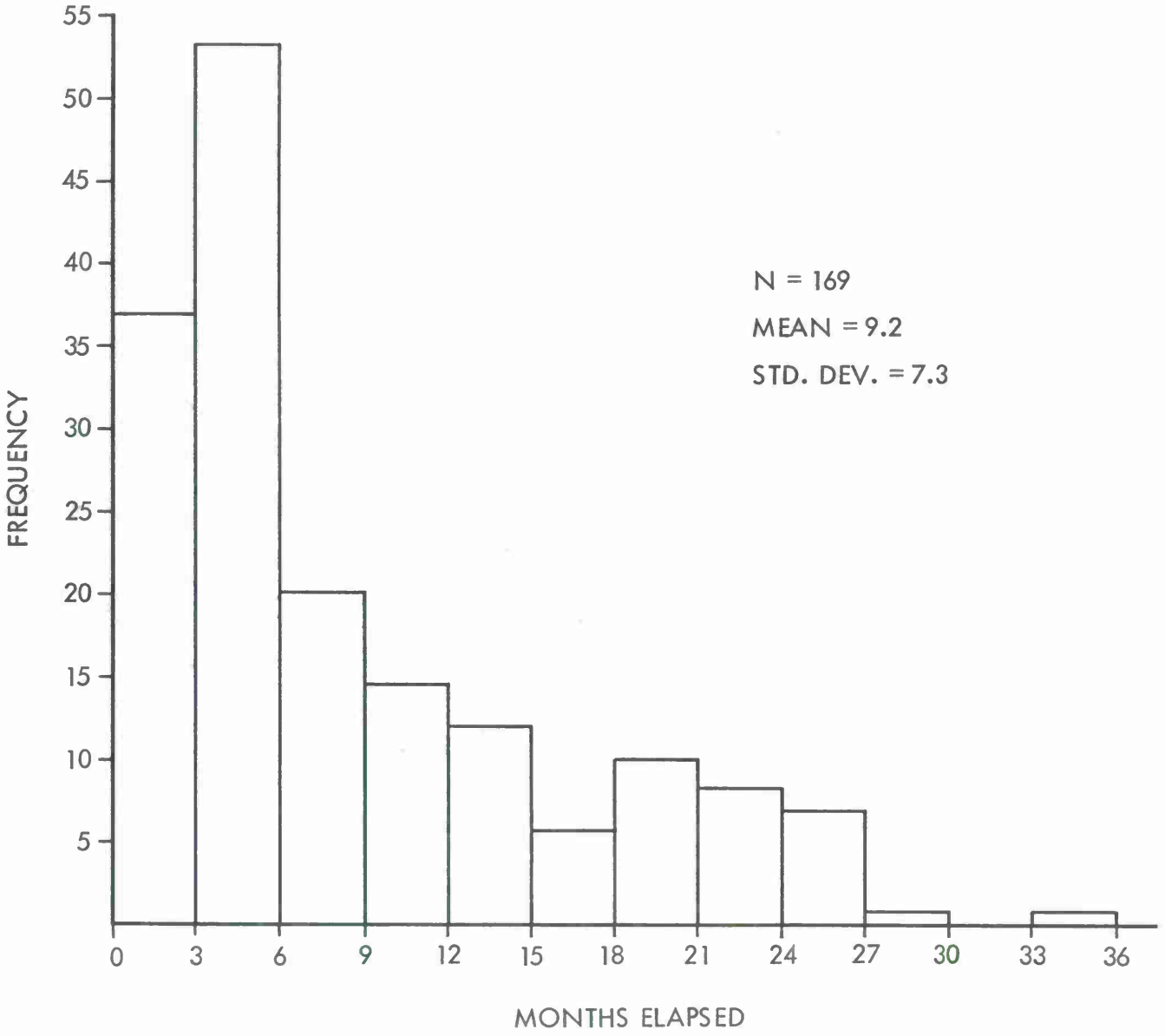

Figure 2. Histogram of Months Elapsed

TABLE III

STATISTICS OF COST MEASURES, PRODUCTION RATES AND COMPUTER USAGE RATES FOR TOTAL SAMPLE, N = 169

	Max	Min	Mean	S.D.
Months Elapsed	36	1	9.2	7.3
Computer Hours	2650	1	237	464
Number of Object Instructions Generated	217000	150	12152	21682
Man Months	300	1	40	62
Source Production Rate (Source Instructions per Man Month)	6500	10	475	787
Object Production Rate (Object Instructions per Man Month)	13889	10	970	1820
Source Computer Usage Rate (Computer Hours per 1000 Source Instructions)	331	.23	31	45
Object Computer Usage Rate (Computer Hours per 1000 Object Instructions)	294	.05	24	38

5. Subsample Descriptions. In the previous two cycles of our work, the statistical methods used to derive estimating equations were applied to the total data base without any attempt to distinguish between program characteristics, such as application, source language, etc., although some initial attempts were made to develop estimating equations for subsamples established by restricting the ranges of the cost measure, man months (3).

In this third cycle, the analysis of subsamples is the central issue in trying to derive improved estimating equations. Four categories of subsamples were selected for analysis based on (a) the fact that these factors were commonly hypothesized as affecting programming costs, and (b) the availability of data in our sample. The subsamples that were proposed for study in this analysis were grouped into the following categories:

- Programming Application
- Production Source Language
- Production Computer Size
- Interprogram Communications

Each of these is defined in detail below.

a. Programming Application consists of the following types of programs:

(1) Business applications, where storage and retrieval with large files of data were the predominant operations. Applications include inventory control, financial report preparation, customer billing, and payroll calculations.

(2) Scientific applications, where procedure-oriented calculations were made on relatively small data input, for example: geodetic studies, network adjustments, and statistical analyses.

(3) Utility and support, where the computer programs developed were to be used as tools for support of computer operations and programming per se, for example: compilers, executive routines, master tape generators, and data conversion for use on different types of hardware.

(4) Other applications, where on-line, real-time computation and response were the primary operations, e.g., satellite control and tracking programs.

Table IV shows the data distribution by application and contributor.

TABLE IV

DISTRIBUTION OF DATA BY PROGRAMMING APPLICATION

			Total Data Points	Type of Program			
				Business	Scientific	Computer Software	Other
Govt		U. S. Air Force*	38	26	10	2	
Industry	Computer Software Research and Development	Company A	6	3		3	
		Company B	1			1	
		Company C	1	1		0	
		Company D	69	17	12	5	35
	Computer Hardware and Aerospace	Company E	2		2		
		Company F	3	2	1		
		Company G	21	19	2		
		Company H	28	11		17	
		Total	169	79	27	28	35

*Note: Data represent 14 separate USAF organizations.

b. Production Source Language. Consists of programs using the following source languages:

(1) Procedure-Oriented Language (POL)--a computer-independent language that describes how the process of solving the problem is to be carried out.[1]

(2) Machine-Oriented Language (MOL)--a language designed for interpretation and use by a specific computer.[1]

Of the 169 data points, 46 were written in POL and 123 were produced using MOL.

Several POLs were implemented, such as JOVIAL, COBOL, FORTRAN, ALGOL, GECOM and ALTAC. The source instructions used to produce the 123 programs coded in MOL represent the various machine languages corresponding to the production computers listed in Table VI.

Table V illustrates the distribution of the Programs coded in POL and MOL.

TABLE V

DISTRIBUTION OF DATA BY PRODUCTION SOURCE LANGUAGE

ORGANIZATION			Total Data Points	Production Source Language					
				POLs				MOLs	
				JOVIAL	COBOL	FORTRAN	Other POLs	Auto-Coder	Machine Language
Govt		U. S. Air Force*	38	1	3	4	6	13	11
Industry	Computer Software Research and Development	Company A	6						6
		Company B	1				1		
		Company C	1						1
		Company D	69	15					54
	Computer Hardware and Aerospace	Company E	2			1			1
		Company F	3						3
		Company G	21		6	1	3		11
		Company H	28		3	2		6	17
		Total	169	16	12	8	10	19	104

*Note: Data represent 14 separate USAF organizations.

[1] Glossary of Data Processing and Communications Terms, Honeywell Information Services, Wellesley Hills, Massachusetts, 1964.

TABLE VI

PRIMARY COMPUTERS USED IN THE PRODUCTION OF THE DATA POINTS

Manufacturer	Primary Development Computer	No. of Data Points on which Computer was Used
Autonetics	Recomp II	1
Burroughs	220	1
	825	5
Control Data Corporation	160A	15
	1604 A/B	9
	3600	4
General Electric	225	11
	235	2
	425	2
IBM	360/30	7
	1401	9
	1410	13
	1440	1
	7010	1
	7040	14
	7044	3
	7080	8
	7090	7
	7094	11
	FSQ/7*	17
	FSQ/8*	3
	FSQ/32*	7
Digital Equipment Corporation	PDP 1	1
Philco	2000-210	6
	212	2
RCA	301	5
	501	1
UNIVAC	1107	3

*Note: These computers were specially designed for military command and control systems, although they can be used for many programming applications.

c. Production Computer Size. Based on equivalent purchase cost, using the following size classifications:

(1) Large--machines costing $750,000 or more

(2) Medium--machines costing over $100,000 but less than $750,000

(3) Small--machines costing less than $100,000

Table VI lists the 28 primary computers used in producing the computers in the data base. In several cases, more than one machine was used in program developments; however, the above division only considered the computer that was used for the major portion of the programming effort.

d. Program Communications. Attempts to distinguish between programs that were produced as parts of a larger system, requiring program interfaces, and stand-alone programs requiring no interfaces with other programs. One hundred nineteen points represented computer programs that were produced as parts of larger systems. For example, a simple payroll program was considered a "stand-alone" program, while the graphic display portion of a command and control system was categorized as part of a larger system.

6. Tests of Subsample Statistics. After dividing the data points into these subsamples, descriptive statistics--the mean, standard deviation, the minimum, the maximum--were derived for the cost measures, as well as the source and object production rates--instructions per man month--and source and object computer usage rates--computer hours per 1000 instructions.

These descriptive statistics were then compared by applying t and F tests[2] to assess the significance of differences between the means of the various subsamples or divisions of our data.

The results of the t and F tests for program applications, production source language and development computer size are tabulated in Tables VII, VIII, and IX respectively. Each table contains the range, mean, and standard deviation for the cost measures, production rates, and computer usage rates. The means for each variable were examined by the significance tests and the resultant

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[2]The t and F tests are used to determine the statistical reliability of the observed difference between the means of selected groups. The t distribution is used to test the significance between two means; the F distribution is used when more than two observed means are to be examined. For a detailed description of these tests see Dixon, W. J. and F. J. Massey. Introduction to Statistical Analysis, New York, Mc Graw-Hill, 1957 and Hays, W. L., Statistics for Psychologists, New York, Holt, Rinehart and Winston, 1963, Chapters 10 and 11.

TABLE VII

PROGRAMMING APPLICATIONS:

STATISTICS OF COST MEASURES, PRODUCTION RATES, AND COMPUTER USAGE RATES

Programming Applications	# of Pts.	Months Elapsed				Computer Hours				Object Instr.				Man Months			
		Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.
Business	79	36	1	6.4	6.2	2100	1	73	250	217000	200	11022	28027	185	1	13.2	26.2
Scientific	27	21	1	8.7	6.0	850	1	137	224	58300	217	13560	16537	232	1	42.0	67.2
Utility and Support	28	27	3	16.2	7.4	2650	5	766	730	50000	1000	18528	13673	260	1	92.7	63.3
Other	35	29	4	10.3	6.6	1420	2	263	395	56000	150	8481	10984	300	1	54.7	81.6
Significance of Population Means		$p < .01$[1]				$p < .01$				$p < .05$				$p < .01$			

Programming Applications	# of Pts.	Source Instr./MM				Object Instr./MM				Object Computer Usage Rate				Source Computer Usage Rate			
		Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.
Business	79	6500	21	679	1067	13889	26	1521	2388	80	.23	12	18	115	.23	21	27
Scientific	27	1744	26	368	428	7250	83	882	1479	140	.25	18	28	211	.25	31	51
Utility and Support	28	2000	10	294	378	2055	10	410	558	294	1.10	57	68	331	2.53	63	74
Other	35	669	41	256	166	1527	56	292	267	129	3.86	30	28	129	3.86	32	28
Significance of Population Means		$p < .01$				$p < .01$				$p < .01$				$p < .05$			

[1] p = probability of falsely rejecting the hypothesis that the population means are equal, e.g., $p < .01$, indicates that if the hypothesis is rejected, it will be done incorrectly less than 1 out of 100 times.

TABLE VIII

MACHINE- AND PROCEDURE-ORIENTED LANGUAGE:

STATISTICS OF COST MEASURES, PRODUCTION RATES, AND COMPUTER USAGE RATES

Production Language	# of Pts.	Months Elapsed				Computer Hours				Object Instr.				Man Months			
		Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.
Machine-Oriented Language	123	29	1	9.6	6.9	2650	1	289	499	82000	150	11024	14521	300	1	48	68
Procedure-Oriented Language	46	36	1	8.2	8.3	2100	2	99	317	217000	217	15231	34445	185	1	18	34
Significance of Population Means		N. S.[2]				$p < .01$[1]				N. S.				$p < .01$			

Production Language	# of Pts.	Source Instr./MM				Object Instr./MM				Source Computer Usage Rate				Object Computer Usage Rate			
		Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.
Machine-Oriented Language	123	6500	10	511	854	7250	10	610	1069	331	.25	31	46	294	.50	30	43
Procedure-Oriented Language	46	3667	22	389	579	13889	105	1977	2838	211	1.20	32	43	53	.30	10	14
Significance of Population Means		N. S.				$p < .05$				N. S.				$p < .01$			

[1] p = probability of falsely rejecting the hypothesis that the population means are equal, e.g., $p < .01$, indicates that if the hypothesis is rejected, it will be done incorrectly less than 1 out of 100 times.

[2] N. S. = not significant at the 5 percent level.

TABLE IX

DEVELOPMENT COMPUTER SIZE[1]:

STATISTICS OF COST MEASURES, PRODUCTION RATES, AND COMPUTER USAGE RATES

Development Computer Size[1]	# of Pts.	Months Elapsed				Computer Hours				Object Instr.				Man Months			
		Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.
Large	105	36	1	10.6	8.1	2650	2	307	520	83336	150	13999	15807	300	1	54	71
Medium	53	27	1	7.0	5.4	1918	1	127	350	217000	200	10048	31185	169	1	16	32
Small	11	17	1	6.6	4.5	633	1	107	186	35000	335	4825	10109	64	2	13	19
Significance of Population Means		$p < .01$[2]				$p < .05$				$p < .05$				$p < .01$			

Development Computer Size[1]	# of Pts.	Source Instr./MM				Object Instr./MM				Source Computer Usage Rate				Object Computer Usage Rate			
		Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.	Max	Min	Mean	S.D.
Large	105	5200	10	394	658	13889	10	950	1926	331	.23	36	51	294	.25	27	43
Medium	53	6500		677	1036	8040	60	1153	1791	178	1.25	22	33	178	.31	18	30
Large	11	815	26	320	227	1075	25	380	336	80	1.11	32	24	80	1.10	31	25
Significance of Population Means		N. S.[3]				$p < .01$				N. S.				N. S.			

[1]Small--purchase price under $100,000.
Medium--purchase price between $100,000 and $750,000.
Large--purchase price over $750,000.

[2]p = probability of falsely rejecting the hypothesis that the population means are equal, e.g., $p < .01$, indicates that if the hypothesis is rejected, it will be done incorrectly less than 1 out of 100 times.

[3]N. S. = not significant at the 5 percent level.

probability level of significance[3] is shown below the appropriate costs and rates. If the tests indicated no significant difference in the observed means, the notation N. S. was placed under the specific variable.

No table was compiled for the Program Communication subsample since, with the exception of man months, the means of the variables were not significantly different. The tests did show that programs produced as entities in themselves took approximately one half the production effort in terms of man months than programs produced as part of larger systems. In spite of these preliminary results, we still feel that subsampling based on interprogram communication is an important factor to be considered in cost estimation of computer programming, and further study may eliminate the reasons for the initial lack of statistical confirmation in this analysis.

Based on our sample, the tests indicate the following:

- POLs (see Table VIII) are more effective than MOLs in terms of man months, computer hours, object instructions per man month and computer hours per 1000 object instructions. These results confirm earlier findings derived with a smaller sample in the second cycle (2).

- The average POL expansion ratio is three to four MOL instructions per one POL instruction; this also substantiates earlier findings.

- Software programs (see Table VII)--the tools of programming such as compilers, executives, and utility routines--require more production time (months elapsed) and effort (man months and computer hours) than other applications.

- Business applications (see Table VII), on the other hand, appear to be less difficult to produce, for example, measured in terms of production rate, and require less computer hours than the other applications.

These early results appear to have strong statistical significance. For example, the probability that such differences could occur by chance are in some cases less than one in one hundred and in other cases less than five in one hundred. These tests, the t and the F, should be made on the means of variables with symmetrical distributions that approach the normal bell-shaped curve and that have approximately euqal variances. The data being analyzed

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[3]The results of the t and F tests are given in the form of the probability of falsely rejecting the hypothesis that the means of the subsamples are equal. Thus, a $p < .01$ means that if the hypothesis is rejected, it will be done incorrectly less than 1 out of 100 times.

in this cycle show some skewness or nonsymmetry and outliers may have to be deleted in some case or winsorized in others, i.e., replaced by an artificial piece of data that is more representative, if further study indicates that such outliers significantly bias the analysis.

Also, in interpreting these results it should be noted that the t and F tests can only assess existing differences in the means of the selected subsamples; they in no way indicate the nature of these differences. They may be due to a variety of causes, ranging from sampling error to other underlying factors. For example, part of the difference detected in the means for Business and Software applications may be due to the heavy use of POLs in Business applications and the common use of MOLs in developing Software programs.

SECTION III

EVALUATION OF WORK TO DATE AND RECOMMENDATIONS FOR FUTURE WORK

During the second cycle, we began to evaluate the methods used and the results obtained in developing guidelines for improvements in the future work. We have not tested the derived equations, i.e., we have not used them to estimate costs before production of a large number of computer programs, and then, after their completion to compare these estimates with actual costs. Therefore, this evaluation is based upon (1) feedback from readers of our reports, (2) the statistics that measure the expected errors in the estimates calculated by the equations, (3) a quality assessment of the data used, and (4) reflection of the methods used and the work sequence. We plan to continue this evaluation during the remainder of the third cycle.

Although, at present, we have no standards to assess what level of accuracy is needed or attainable for such estimating equations, we feel the standard errors of estimate, the measures of estimating precision for the equations derived (in the second cycle) are too large. For example, the ratio of expected actual costs to estimated costs can be as large as 100 percent in some cases. Further, some of the cost factors in the equations, although statistically significant, do not have strong intuitive appeal.

The third cycle may yield equations with more intuitive appeal and estimating precision. To try to obtain more appealing variables in the equations, we are changing the sequence of analysis by first deriving equations to estimate the size and number of instructions of computer programs and then using these relationships to form independent variables to appear in the equations for man months and computer hours. Also, in an attempt to reduce the standard errors of estimate, we expect to derive these equations for subsamples whose costs would be more homogeneous.

We have some doubts about the reliability of the new data. Despite the lengthy effort to validate the data, we feel some of the terms used in the questions were still not interpreted in a uniform manner by all respondents.

There are several positive aspects of the results to date. Aside from the catalytic effects of stimulating an analytic approach to the cost question and promoting the need to identify and collect costs expended for programming products, the results to date provide the following benefits:

- A checklist of cost factors to consider in estimating costs.
- A large collection of numerical data for various types of programming efforts that can be used for comparison with estimated or actual costs.

- Bivariate relationships between cost measures, such as man months versus computer hours, that can help managers make estimates and compare actual costs.

- Estimating equations that supply a systematic way for estimating costs and that are suitable for comparison with estimates made by other techniques.

- Probabalistic confirmation or denial of various hypotheses (such as those in Section II) by using numerical data on the impact of types of tools and applications on costs and resource usage rates.

We now identify some probable causes for the lack of appeal and accuracy in the results to date.

1. Growing Dimensions of ADP. One explanation for the large variation in our data is the rapid growth of ADP that can be represented in many dimensions that appear to influence costs. For example, consider the increasing range of computer design and power, computer configurations, programming languages, computer programs for support, programmer proficiency and experience, and types of applications. If indeed these influence cost as has been hypothesized, then their increasing range should increase the range of cost data.

2. The Questionnaire. The mail-out questionnaire has been the primary data collection tool used in our work. Appendix D shows the items in the current version. Both the mechanics of its use and its contents have shown several shortcomings as follows:

- Despite two modifications in the second and third cycles based upon feedback, experience, and analytical results, the items used still lack precise, commonly understood definitions that would permit consistent answers.

- Although our plan was to reduce the number of items in the questionnaire in each revision, the number of items has remained about the same--approximately 90. In the first cycle, the sample size--27 data points--was too small for us to confidently discard items, so the questionnaire for the second cycle, although revised, remained about the same size. Unfortunately, to take advantage of the opportunity to collect the data from Air Force and industrial organizations, we had to distribute the questionnaire for the third cycle before we completed the analysis in the second cycle; so again we could not streamline the questionnaire. As a result, the current, rather lengthy questionnaire discourages quick accurate responses and requires extensive data handling and extra analytical procedures to arrive at estimating equations.

3. Data Validation. The validation procedure, described in Appendix B, is a time-consuming process that was aggravated by the size and structure of the questionnaire and the method by which it was administered. Communication with project members and individual respondents was minimal at the time the questionnaires were completed, because we only dealt with a central contact in each contributing organization. Thus, inevitable misunderstandings led to a lengthy process of validation to clarify the data.

The validation was not completely successful. In some cases, the original respondent was no longer available at the time of validation, and a lengthy search had to be initiated to locate the person. In other instances, the data needed to rectify certain questionnable items could not be found, and the data point had to be discarded.

4. Sampling. It is doubtful that the data sample obtained so far is a representative one. Defining a suitable statistical sample that can serve as a basis for generalizing the results to the entire population of computer programming jobs is a very difficult problem. The characteristics of this population are not well defined and, as indicated earlier, its dimensions are changing rapidly.

The following recommendations are put forth as some possible solutions to the above problems:

- Renew the research effort to define and describe computer programming jobs to determine more meaningful predictor variables for assessing program complexity, difficulty, and size.

- Improve the definition of a data point (1) to differentiate between runs, subprograms, subroutines, programs, and program systems, and (2) to define beginning and end points more precisely for the phases of programming included in a data point.

- Collect and analyze data for a subset of programming jobs. For example, the preliminary subsample study described in Section II of this report indicates that, based on the cost measures, production rates and computer usage rates, MOL/POL and programming applications are likely candidates for further study. Restricting the collection and analysis to such subsets of programming activities would result in a reduction in the variation of collected costs and cost factors, and consequently, reduce the data anomalies produced by a collection procedure that entails various computer programs and programming procedures.

- Before attempting widespread use of the questionnaire, test it thoroughly by means of trial interviews with programmers and programming managers. This would serve a dual purpose: (1) highlight existing inconsistencies, and (2) indicate the factors that should be included in, or deleted from, the questionnaire.

- Eliminate the "yes or no" response items and replace these with a more meaningful numerical value or scale.

- Supplement the data collected by questionnaire with program listings, which would supply more accurate data for several items now in the questionnaire.

- Collect the data by means of personal interviews rather than by mail and/or phone to reduce the number of misinterpretations that occur from installation to installation. Although these initial interviews would be more expensive, they would considerably reduce the need for the prolonged and costly validation, such as that carried out in this cycle.

- Attempt to include some form of direct coding for questionnaire responses to allow more accurate and efficient transfer and storage of data by computer.

Although we feel that the above recommendations would alleviate many of the existing problems, it would be virtually impossible--at present--to design an experiment in which none of these difficulties were present. For example, since the lack of standard terminology in the EDP industry abets the misunderstanding and misinterpretation of questionnaire items, which in turn leads to inaccurate data and unreliable results, we doubt that the data validation could be completely avoided with any collection procedure. Thus, the recommendations are proposed to improve our methods, and not to solve the difficulties that are encountered in any basic research.

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APPENDIX A

BASIC ASSUMPTIONS OF THE RESEARCH MODEL

In beginning the work to derive the cost estimating relationships for computer programming, we established a model that would provide a scientific frame of reference for the analysis. This model has been used in the work during all three cycles of the research and consists of the following assumptions:

- In collecting data for the analyses, we have assumed that computer programming has certain common characteristics that can be generalized, i.e., that the cost factors that explain the variation in the costs of computer programming can be selected from a comprehensive collection that has been divided into three groups corresponding to requirements, resources, and environment for computer programming.

- These cost factors can be formulated into items for a questionnaire, and the same set of questions can be used to collect data on all computer programs.

- The primary costs, such as manpower, measured in man months, and computer time, measured in hours, can be considered as dependent variables that can be predicted by a linear combination of cost factors used as independent variables. Values for these variables can be obtained as numerical answers to items in a survey questionnaire to be completed by knowledgeable individuals associated with a particular effort.

- The analyses performed to derive estimating equations are restricted to program production costs, i.e., those that are incurred in program design, code, and test activities. These activities include associated documentation as well as work on the data base. (This particular set of activities was chosen because they appear to be common to almost all computer programming work.) Therefore, the scope of the work to date does not include activities that may constitute a more generalized model of computer programming associated with large information processing systems; the programming activities, for example, the system design and analysis that may precede computer program design and test of the total system that may follow test of the computer program design, and the test of the total system that may follow test of the computer program components, have been deliberately excluded to help us collect a large, consistent sample of data.

- Each member of the sample, i.e., the questionnaire data describing each completed programming project, is referred to as a data point. To qualify as a data point, the data must be for a programming effort

that resulted in the smallest set of instructions (1) whose purpose is defined by someone other than the programmer, (2) which is deliverable to the user as a package, and (3) which is loaded into the computer as a unit or an integral part of a system, e.g., a subprogram, to achieve the stated purpose.

One of these basic assumptions was modified in conducting the analysis described in this report. Specifically, the assumption that all computer programming has certain generalizable characteristics regardless of application and resources used was partially abandoned by the formation of subsamples that differentiated among characteristics of computer programs and their products. In the first two phases of the work the data bases were too small to permit extensive analysis of subsamples. However, in the third cycle, we felt that we had enough data to examine cost differences for several types of computer programs and production techniques such as the following:

- Utility and support programs, e.g., compilers, executives, etc.
- Process-oriented (scientific) computer programs, e.g., algebraic and statistical calculations.
- File-oriented (business) computer programs, e.g., payroll, billings, etc.
- All other computer programs not in above, such as command and control.
- Computer programs developed with machine-oriented languages as opposed to those developed with procedure-oriented languages.
- Computer programs produced with small, medium or large computers (with size determined on cost basis).
- Computer programs which were produced as parts of a larger system, opposed to programs developed as total entities in themselves.

APPENDIX B

DATA COLLECTION AND VALIDATION

The following describes the design of the questionnaire and the type of sample acquired as well as how the data were collected and validated in the third cycle.

1. Design of Questionnaire. The data used as inputs in the analysis in all three phases of the cost-estimation work have been collected by means of a questionnaire, which consists of items called cost factors, that are variables thought to affect computer programming costs, and various measures of cost.

Numerous cost factors were identified and formulated on the basis of previous surveys of program development experience. Specifically, the factors represent answers by managers to such questions as, "Why did you overrun your budget?" or, "Why did your program cost more or take longer to develop than another program that appears to be similar?" These factors became items in the data collection questionnaire, and subsequently, variables in statistical analyses.

Although some revisions were made after the first cycle and during the second, most of the items in the questionnaire for the third cycle were the same as those used in the previous two cycles.

The presumed factors were classified into the following logical groupings:

- The job to be done
- The resources that are expected to be available
- The nature of the expected working environment

These groups were divided into seven categories; an additional section for costs comprised the following eight divisions of the questionnaire:

SUMMARY OF COSTS

- Cost Measures. Measures of cost in terms of resources such as man months, computer hours, and elapsed time.

REQUIREMENTS (the job to be done)

- Operational Requirements and Design. Operational characteristics of the system into which the computer program will fit as a component, e.g., number of ADP centers in system, rating of information system complexity.

- Program Design and Production. Factors in the design, coding, and test of the computer program, e.g., number of classes of items in the data base, number of types of output messages.

RESOURCES

- Data Processing Equipment. Characteristics of the hardware required to produce and test a program, including all input, output, and peripheral equipment, e.g., number of words in core storage, number and types of I/O equipment.

- Programming Personnel. Characteristics of the personnel needed to completely develop the computer program, e.g., number of programmers classified as coder, programmer, senior programmer, system programmer; years of experience for each category of programmer with language used, computer used, and specific application.

- Utility Computer Programs. Characteristics of the computer programs used as tools to produce the subject computer program, e.g., programming language used in coding, number of free support programs available.

- Management Procedures. Factors associated with the plans, policies, practices, and review techniques used in the administration of all phases of program development, e.g., existence of a documented management plan for processing of program design changes and standards for coding and flow charting.

- Development Environment. Factors describing relationships with external organizations, including customers and other contractors, e.g., number of agencies concurring on design specifications and computer facility operated on the basis of open shop, closed shop, time-sharing.

This organization was intended to permit separation of the questionnaire into sections, so that each section could be easily delegated within the responding organization to the personnel most qualified to complete it. Appendix D contains a complete set of the factors and costs used in the questionnaire for the third cycle, as well as the data gathered in the latest collection effort.

The questionnaires used for data collection in the second and third cycles were modifications of those used in the first and second cycles respectively. Extensive revision was not possible since the data collected by past questionnaires were to be combined with data from the new collection effort in order to build up the size of the base. Further, the data collection for the third cycle was begun before the analysis of the second cycle was complete; therefore, little or no feedback could be introduced in the questionnaire for the third collection effort. Despite these restrictions, the following revisions

were made in the questionnaire before it was sent to the Air Force and industrial organizations:

a. Questions that were found to yield unreliable answers were deleted.

b. Questions were amplified to gather more detailed data.

c. Frequently misinterpreted questions were supplemented with definitions of the ambiguous terms.

d. Comments were solicited from respondents on which cost factors they deemed most important to cost prediction.

2. Design of the Sample. As in the previous data collection efforts, no rigorous sample design was used. To expedite the analysis in the first two iterations, only data from within System Development Corporation were collected. The third cycle, reported here, is the first attempt to gather and analyze data from non-SDC sources. In all three collection efforts, the two definitions outlined in Appendix A were used to control the sample data, by specifying (a) the scope of the programming process and (b) what constitutes a program data point.

3. Validation of the Data. Each completed questionnaire that was received became a component of a data matrix. The matrix consisted of 94 columns representing the data and 106 rows representing the data points collected outside of SDC. Every questionnaire was examined, and if an item was (a) left blank, (b) apparently misinterpreted, or (c) not consistent with other items in the particular collection form, a mark was placed in the appropriate cell of the matrix.

The completed matrix indicated several items which were misinterpreted or left blank frequently enough to be considered unreliable. Some of these variables, e.g., number of instructions discarded due to operational changes, were dropped from further consideration in the analysis; it was felt that even with extensive follow-up, it would be difficult to obtain statistically valid responses for these items due to the unavailability of the required data.

After further study of the matrix, we began the validation process to improve the quality of the data. A package containing the following items was sent to each respondent:

a. A duplicate copy of the questionnaire originally completed by the respondent, for reference.

b. A supplementary form containing

(1) clarification and definition of five frequently misinterpreted items, and

(2) two additional items that were deleted from the original questionnaire but were later found to be needed in combining the new data with the SDC data.

c. A list of questions on specific items in that particular respondent's questionnaire.

Each contributor was then contacted by telephone to discuss details of his particular problems. In most cases, questionable items were corrected. However, in a few instances, certain problems could not be corrected, either because the original respondent was no longer available or the existing records could not provide the answers. Five data points were finally dropped due to the general unreliability, or unavailability of the data.

Therefore, 101 new data points of the original 106 remained to be combined with the 74 data points from SDC used in the second cycle. The total 175 data points became the inputs to the statistical analysis for the third cycle. On the basis of the statistical characteristics, e.g., outliers, six more data points were eliminated, leaving 169 points for further analysis.

APPENDIX C

STATISTICAL METHODS

1. The Linear Multivariate Regression Method. The primary statistical tool employed in the work to date has been multivariate regression analysis. Mathematically, this method involves the fitting, by least-squares procedures, of an equation of the form:

$$Y = A + b_1X_1 + b_2X_2 + \ldots b_nX_n = A + \sum_{i=1}^{n} b_iX_i$$

where:

Y = The value of the cost measure to be estimated.

A = A constant.

b_i = The relative weight assigned to the "ith" cost predictor.

X_i = The value of the "ith" cost predictor.

Each estimate is subject to prediction error as compared to actual costs. This error is determined by the estimating power of the predictors used and the interrelationships between them.

The statistical model does not guarantee meaningful prediction equations per se. This meaningfulness must come from the choice of the predictor variables used and their definition and interpretation.

2. Formal Analysis. The formal analysis of the research consists of the following two main tasks:

- Winnowing of variables
- Development of cost estimating equations

Winnowing consists of reducing the number of independent variables to be considered as predictors in the derivation of cost estimating equations. This is a rather difficult task when the number of available predictors is very large. The following steps were used as a basis for reducing the variables to be considered:

a. Examination of Raw Data. The responses to the questionnaire were tabulated in a data matrix (see Appendix D) in which each column (variable) was examined and evaluated. Six of the original variables were immediately rejected for one or more of the following reasons: (1) frequently left blank,

(2) unavailability of data for validation, (3) apparently ambiguous question, (4) lack of intuitive appeal based on judgment and previous experience. In addition, five data points were found to have numerous questionable values for variables that could not be resolved by follow-up procedures. These were dropped from the analysis.

A frequency distribution analysis was made of all cost and predictor variables and six more data points were dropped, due to the extremely large size of their costs. Their inclusion would have biased the least squares computations in their favor while resulting in equations of little predictive value for estimating the bulk of programming efforts. The deletion of these six points resulted in a considerable reduction in the range of all cost measures. For instance, before these points were eliminated, the range of man months extended from 1 to 1653; after elimination, the upper boundary of the range was reduced to 300 man months (see Figure 1).

b. Scatterplot Analysis. Following the above analysis, machine scatterplots (6) were obtained for all potential predictors against the four primary cost measures. Visual analysis of these scatterplots was made for the purpose of detecting discontinuities and other unusual characteristics of the data. Such conditions were noted whenever they occurred, and this information was considered in the predictor winnowing process.

c. Correlation Analysis. In the next analysis, a complete correlation matrix was computed (6). This matrix depicted the statistical relationship of each predictor with every other predictor and with each cost measure. Correlation analysis is used as an aid in winnowing variables by allowing predictors to be selected that have high correlations with cost and low correlations with each other (4). All of the above considerations, in conjunction with available programming management experience and judgment, were used to develop a winnowed (i.e., reduced) set of predictor variables.

d. Regression Analysis. After the correlation analysis, there were still too many predictor variables to allow computation of meaningful estimating equations. Trial multivariate regression analyses are now being used to further reduce the list of potential predictors. These regression solutions do not lead directly to the final prediction equations but they do allow a more complete analysis of the interaction of predictor variables when used in an estimating formula.

In using regression analysis as a predictor selection device, we are examining the computed standard regression coefficient (beta coefficient) for each predictor in the trial solution (5). If this coefficient is very low or if its algebraic sign is contrary to good judgment, the variable is generally rejected. In a few instances, variables with low (but meaningful) beta coefficients are being retained due to their extremely high intuitive appeal. A complete series of trial regression runs is planned with various

combinations and selections of predictors regressed against each cost measure. After this series of runs, the best rational and statistical solution will be chosen for each cost measure.

3. Development of Cost-Estimating Equations. A multiple regression computer program (7) operating in conjunction with the IBM 7094 computer is the primary tool used to compute the many trial regression solutions required. The program computes and outputs the following statistics: weighted regression coefficients, means, standard deviations, intercorrelations for the predictors being regressed, the standard error of estimate, the coefficient of determination, the multiple correlation coefficient, and the regression constants. The program also includes a subsetting option, which selects the best statistical predictors based on predictor cost correlations and intercorrelations. When this option is used, the statistical outputs of the program are augmented by the following: the difference in the multiple correlation between the chosen predictors and the total input set of predictors, and the corresponding F ratio relating to the significance of the difference between the variances accounted for by the partial set and the total set input.

Of the statistics output by the program, the standard error of estimate and the coefficient of determination are the principal indices used to assess the statistical accuracy of the estimating equations. The standard error of estimate is a measure of the estimating precision of the equation, and the coefficient of determination (the multiple correlation squared) indicates the proportion of the variance in the cost measure that is accounted for by the equation. High statistical accuracy for an estimating equation is indicated by a low standard error of estimate and a high coefficient of determination.

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APPENDIX D

LIST OF QUESTIONNAIRE ITEMS AND CORRESPONDING DATA MATRIX

This Appendix contains a list of 94 variables corresponding to the items in the data collection questionnaire. Also included are the values submitted by the respondents for each of the variables and the coding used (if any) in recording the data.

The data for the 169 points in the sample are presented in 12 groups. Each group begins with a fold-out page consisting of definitions for 8 variables. Following the definitions, there are 4 pages of values (169 points), corresponding to the variables on the fold-out. The 169 data points are numbered in ascending (but not sequential) order; the last number is 205.

It should be noted that several variables were scaled, e.g., recorded in thousands. Also, blank data in this matrix are denoted by a negative zero (-0).

(pages 36 and 37 blank)

Sample Number

8 Average Round-Trip Distance per man trip. Entered directly from questionnaire. If distance was less than 10 miles, a zero was entered.

7 Number of Man Trips required for concurrence during program design, code, and test. Entered from questionnaire. If the average round-trip distance was less than 10 miles, a zero was entered.

6 Computer Hours used by all computers implemented in program design, code, and test.

5 Months Elapsed--completion date for program delivery minus start date for program design. At the time of program delivery the program is ready to be installed in the operational computer to begin system test. Coded in months.

4 Man Months, including man months expended on utility and executive programs developed specifically for the data point. Entered from questionnaire.

3 Man Months to design, code, and test the program and the utility programs used in production. Entered from questionnaire.

2 Man Months to develop utility programs used in program design, code, and test. Entered from questionnaire.

1 Man Months, not including man months to develop the utility programs used in program design, code, and test. Entered from questionnaire.

Sample Number

	5	6	7	8
1	5.000	18.000	0.	0.
2	6.000	2.000	1.000	35.000
3	4.000	5.000	0.	0.
4	5.000	40.000	0.	0.
5	5.000	12.000	0.	0.
6	7.000	30.000	0.	0.
7	6.000	15.000	0.	0.
8	11.000	15.000	0.	0.
9	4.000	7.000	0.	0.
10	5.000	75.000	0.	0.
11	5.000	25.000	0.	0.
12	5.000	12.000	1.000	1100.000
13	7.000	20.000	1.000	3800.000
14	7.000	20.000	1.000	3800.000
15	7.000	20.000	1.000	3800.000
16	6.000	20.000	0.	0.
17	3.000	2.000	0.	0.
18	5.000	38.000	0.	0.
19	3.000	70.000	0.	0.
20	12.000	25.000	0.	0.
21	8.000	32.000	0.	0.
22	7.000	20.000	1.000	3800.000
23	6.000	17.000	1.000	35.000
24	6.000	17.000	1.000	35.000
25	7.000	20.000	1.000	3800.000
26	5.000	160.000	1.000	6000.000
27	7.000	150.000	16.000	3800.000
28	17.000	200.000	0.	0.
29	4.000	42.000	5.000	900.000
30	6.000	27.000	1.000	35.000
31	5.000	47.000	0.	0.
32	5.000	120.000	5.000	2500.000
33	12.000	75.000	8.000	3800.000
34	5.000	60.000	8.000	3600.000
35	12.000	31.000	4.000	6000.000
36	18.000	500.000	55.000	120.000
37	12.000	150.000	16.000	3800.000
38	9.000	70.000	3.000	2000.000
39	12.000	150.000	16.000	3800.000
40	5.000	250.000	5.000	900.000
41	5.000	135.000	3.000	5000.000
42	13.000	275.000	275.000	105.000

	1	2	3	4
1	1.000	0.	0.	0.
2	2.000	0.	0.	0.
3	2.000	0.	0.	0.
4	3.000	0.	0.	0.
5	3.000	0.	0.	0.
6	3.000	0.	0.	0.
7	3.000	0.	0.	0.
8	3.000	0.	0.	0.
9	4.000	0.	0.	0.
10	4.000	0.	0.	0.
11	4.000	0.	0.	0.
12	5.000	0.	0.	0.
13	6.000	0.	0.	0.
14	6.000	0.	0.	0.
15	6.000	0.	0.	0.
16	6.000	0.	0.	0.
17	6.000	0.	0.	0.
18	6.000	0.	0.	0.
19	6.000	6.000	0.	0.
20	6.000	0.	0.	0.
21	7.000	0.	0.	0.
22	7.000	0.	0.	0.
23	7.000	0.	0.	0.
24	8.000	0.	0.	0.
25	8.000	0.	0.	0.
26	8.000	0.	0.	0.
27	10.000	0.	0.	0.
28	12.000	1.000	0.	0.
29	12.000	3.000	0.	0.
30	14.000	0.	0.	0.
31	14.000	0.	0.	0.
32	16.000	0.	0.	0.
33	16.000	0.	0.	0.
34	19.000	0.	0.	0.
35	19.000	0.	0.	0.
36	20.000	24.000	0.	0.
37	24.000	0.	0.	0.
38	25.000	2.000	0.	0.
39	25.000	0.	0.	0.
40	30.000	12.000	0.	0.
41	45.000	4.000	0.	0.
42	46.000	20.000	0.	0.

	1	2	3	4	5	6	7	8	
44	53.000	2.000	0.	0.	10.000	274.000	4.000	3000.000	44
45	60.000	0.	0.	0.	14.000	550.000	0.	0.	45
46	64.000	1.000	0.	0.	9.000	633.000	0.	0.	46
47	66.000	33.000	0.	0.	36.000	2100.000	3.000	4260.000	47
48	79.000	12.000	0.	0.	6.000	600.000	0.	0.	48
49	96.000	112.000	0.	0.	25.000	300.000	4.000	1100.000	49
50	110.000	23.000	0.	0.	6.000	600.000	20.000	250.000	50
52	121.000	0.	0.	0.	19.000	443.000	5.000	3000.000	52
53	130.000	12.000	0.	0.	18.000	880.000	16.000	2000.000	53
54	143.000	245.000	0.	0.	19.000	130.000	0.	0.	54
55	183.000	112.000	0.	0.	14.000	195.000	42.000	3100.000	55
56	183.000	9.000	0.	0.	12.000	581.000	25.000	3000.000	56
57	185.000	0.	0.	0.	23.000	427.000	0.	0.	57
58	190.000	3.000	0.	0.	29.000	1420.000	30.000	1000.000	58
59	201.000	112.000	0.	0.	16.000	320.000	0.	0.	59
60	207.000	168.000	0.	0.	25.000	990.000	30.000	3370.000	60
61	232.000	245.000	0.	0.	21.000	850.000	10.000	1000.000	61
62	256.000	2.000	0.	0.	14.000	1291.000	15.000	3000.000	62
63	260.000	5.000	0.	0.	20.000	1625.000	21.000	3000.000	63
64	300.000	1.000	0.	0.	16.000	1095.000	20.000	3000.000	64
71	53.000	1.000	0.	0.	9.000	274.000	4.000	3000.000	71
72	121.000	5.000	0.	0.	19.000	443.000	5.000	3000.000	72
80	27.000	0.	0.	0.	4.000	222.000	0.	0.	80
84	98.000	3.000	0.	0.	26.000	250.000	420.000	120.000	84
85	13.000	0.	0.	0.	8.000	91.000	2.000	1400.000	85
86	50.000	0.	0.	0.	4.000	100.000	0.	0.	86
100	0.	0.	4.000	3.000	2.000	43.000	12.000	5.000	100
101	0.	0.	3.000	2.000	5.000	8.000	15.000	1.000	101
102	0.	0.	4.000	0.	5.000	15.000	6.000	170.000	102
104	0.	0.	4.000	0.	3.000	6.000	0.	0.	104
105	0.	0.	1.000	0.	1.000	2.000	0.	0.	105
106	0.	0.	2.000	0.	10.000	4.000	0.	0.	106
107	0.	0.	13.000	5.000	3.000	32.000	3.000	1100.000	107
109	0.	0.	6.000	0.	5.000	26.000	0.	0.	109
110	0.	0.	10.000	0.	3.000	3.000	0.	0.	110
111	0.	0.	7.000	0.	5.000	19.000	35.000	2.000	111
112	0.	0.	5.000	1.000	3.000	3.000	11.000	2.000	112
113	0.	0.	2.000	0.	2.000	2.000	0.	0.	113
114	0.	0.	33.000	0.	11.000	53.000	7.000	16.000	114
115	0.	0.	5.000	0.	14.000	18.000	0.	0.	115
116	0.	0.	1.000	0.	4.000	4.000	0.	0.	116
117	0.	0.	3.000	0.	10.000	6.000	0.	0.	117

	1	2	3	4	5	6	7	8	
118	0.	0.	5.000	0.	5.000	5.000	0.	0.	118
119	0.	0.	1.000	0.	5.000	5.000	0.	0.	119
120	0.	0.	1.000	0.	4.000	3.000	0.	0.	120
121	0.	0.	82.000	0.	9.000	28.000	8.000	1100.000	121
122	0.	0.	6.000	0.	5.000	2.000	0.	0.	122
123	0.	0.	5.000	0.	15.000	6.000	0.	0.	123
124	0.	0.	3.000	0.	4.000	7.000	0.	0.	124
125	0.	0.	2.000	0.	2.000	3.000	0.	0.	125
126	0.	0.	1.000	0.	3.000	5.000	0.	0.	126
127	0.	0.	2.000	0.	4.000	11.000	0.	0.	127
128	0.	0.	3.000	1.000	2.000	6.000	6.000	-0.	128
129	0.	0.	1.000	0.	1.000	2.000	0.	0.	129
130	0.	0.	2.000	0.	2.000	1.000	0.	0.	130
131	0.	0.	4.000	0.	4.000	7.000	0.	0.	131
132	0.	0.	15.000	0.	21.000	63.000	0.	0.	132
133	0.	0.	2.000	1.000	1.000	34.000	1.000	2400.000	133
134	0.	0.	2.000	0.	3.000	5.000	0.	0.	134
135	0.	0.	3.000	0.	3.000	13.000	0.	0.	135
136	0.	0.	8.000	0.	8.000	5.000	0.	0.	136
137	0.	0.	1.000	0.	3.000	2.000	18.000	1178.000	137
138	0.	0.	2.000	0.	5.000	1.000	0.	0.	138
139	0.	0.	3.000	0.	3.000	1.000	0.	0.	139
140	0.	0.	2.000	0.	8.000	15.000	0.	0.	140
141	0.	0.	2.000	0.	3.000	4.000	2.000	280.000	141
142	0.	0.	21.000	0.	8.000	40.000	30.000	300.000	142
143	0.	0.	15.000	0.	5.000	100.000	0.	0.	143
144	0.	0.	5.000	0.	3.000	20.000	2.000	2500.000	144
145	0.	0.	63.000	9.000	26.000	100.000	30.000	950.000	145
146	0.	0.	9.000	0.	10.000	80.000	10.000	15.000	146
147	0.	0.	10.000	1.000	5.000	16.000	4.000	290.000	147
148	0.	0.	166.000	3.000	9.000	1918.000	104.000	100.000	148
149	0.	0.	4.000	0.	4.000	11.000	1.000	125.000	149
150	0.	0.	3.000	1.000	8.000	6.000	32.000	22.000	150
151	0.	0.	2.000	0.	4.000	10.000	0.	0.	151
152	0.	0.	2.000	0.	6.000	8.000	0.	0.	152
153	0.	0.	1.000	0.	1.000	4.000	0.	0.	153
154	0.	0.	4.000	0.	4.000	12.000	0.	0.	154
155	0.	0.	16.000	2.000	20.000	150.000	0.	0.	155
156	0.	0.	6.000	0.	14.000	30.000	0.	0.	156
157	0.	0.	2.000	0.	2.000	2.000	0.	0.	157
158	0.	0.	3.000	0.	3.000	10.000	0.	0.	158
159	0.	0.	5.000	0.	3.000	11.000	0.	0.	159

	1	2	3	4	5	6	7	8	
160	0.	0.	2.000	0.	3.000	3.000	0.	0.	160
161	0.	0.	1.000	0.	1.000	6.000	0.	0.	161
162	0.	0.	3.000	1.000	3.000	11.000	0.	0.	162
163	0.	0.	1.000	0.	1.000	7.000	0.	0.	163
164	0.	0.	2.000	0.	4.000	5.000	0.	0.	164
165	0.	0.	1.000	0.	3.000	15.000	0.	0.	165
166	0.	0.	30.000	0.	5.000	130.000	0.	0.	166
167	0.	0.	65.000	0.	18.000	420.000	2.000	1200.000	167
168	0.	0.	3.000	0.	3.000	7.000	0.	0.	168
169	0.	0.	1.000	0.	3.000	14.000	0.	0.	169
170	0.	0.	6.000	4.000	4.000	50.000	0.	0.	170
171	0.	0.	2.000	0.	3.000	5.000	0.	0.	171
173	0.	0.	4.000	0.	3.000	10.000	0.	0.	173
174	0.	0.	52.000	0.	27.000	700.000	0.	0.	174
175	0.	0.	109.000	0.	13.000	1000.000	10.000	400.000	175
176	0.	0.	58.000	1.000	9.000	400.000	2.000	360.000	176
177	0.	0.	95.000	4.000	20.000	930.000	10.000	350.000	177
179	0.	0.	79.000	0.	21.000	200.000	0.	0.	179
180	0.	0.	100.000	0.	21.000	200.000	0.	0.	180
181	0.	0.	152.000	17.000	25.000	1022.000	0.	0.	181
182	0.	0.	135.000	0.	13.000	450.000	20.000	400.000	182
184	0.	0.	7.000	0.	11.000	100.000	2.000	300.000	184
185	0.	0.	90.000	0.	22.000	900.000	50.000	160.000	185
186	0.	0.	130.000	0.	22.000	1300.000	25.000	160.000	186
187	0.	0.	115.000	0.	22.000	1325.000	50.000	160.000	187
188	0.	0.	140.000	0.	22.000	1300.000	25.000	160.000	188
189	0.	0.	105.000	12.000	22.000	2100.000	50.000	160.000	189
190	0.	0.	51.000	6.000	13.000	107.000	33.000	450.000	190
191	0.	0.	190.000	0.	23.000	2650.000	25.000	160.000	191
192	0.	0.	1.000	0.	3.000	15.000	0.	0.	192
193	0.	0.	2.000	0.	2.000	30.000	0.	0.	193
194	0.	0.	58.000	0.	25.000	100.000	42.000	100.000	194
195	0.	0.	8.000	0.	7.000	15.000	0.	0.	195
196	0.	0.	5.000	0.	6.000	13.000	0.	0.	196
197	0.	0.	4.000	0.	4.000	1.000	0.	0.	197
198	0.	0.	28.000	0.	22.000	115.000	0.	0.	198
199	0.	0.	30.000	6.000	15.000	80.000	0.	0.	199
200	0.	0.	4.000	0.	4.000	8.000	0.	0.	200
201	0.	0.	135.000	15.000	11.000	1600.000	50.000	200.000	201
202	0.	0.	4.000	0.	4.000	10.000	0.	0.	202
203	0.	0.	2.000	0.	3.000	8.000	5.000	10.000	203
204	0.	0.	6.000	0.	6.000	2.000	0.	0.	204
205	0.	0.	15.000	0.	14.000	30.000	0.	0.	205

Sample Number

16 Design Characteristics of the Program Data Point. Coded: direct translation of manual tasks to automatic functions = 0; relatively few, well defined functions to be automated = 1; many clear and well defined functions to be automated = 2; many undefined and unstructured functions to be automated = 3.

15 Operational Characteristics of the Program Data Point. Coded: no on-line, real-time operation = 0; mixture of on-line and off-line operations = 1; mainly on-line, real-time operation = 2.

14 Number of computer-based centers with which the Program Data Point must communicate. Entered from questionnaire.

13 Extent of response time requirements imposed by the organizational users. Coded: greater than 1 day = 0; 24 hours or less = 1; 1 hour or less = 2; real time = 3.

12 With how many Organizational Users (interfaces) must the Program Data Point communicate? Entered from questionnaire.

11 How well were the Program Data Point's operational requirements known and documented? Coded: in detail = 0; in outline = 1; vaguely = 2.

10 Participation of Programming Organization in the requirements analysis and/or operational design of the Program Data Point. The requirements analysis is conducted to specify the performance requirements of the information-processing system. These performance requirements are input to the operational design activity, which indicates how the information processing needs will be satisfied. Coded: extensive participation = 0; intermittent participation = 1; minimal participation = 2.

9 Need for innovation in the information processing system. Innovation means either a new data processing application of a known programming technique and/or a new technique for a known application. New means to the people involved. Coded: Yes = 1; No = 0.

Sample Number

Sample Number	16	15	14	13	12	11	10	9
1	1.000	0.	3.000	3.000	1.000	0.	2.000	0.
2	0.	0.	2.000	1.000	3.000	0.	0.	0.
3	1.000	0.	16.000	1.000	1.000	1.000	2.000	0.
4	0.	0.	16.000	0.	2.000	2.000	0.	2.000
5	0.	0.	1.000	1.000	1.000	1.000	0.	0.
6	1.000	0.	16.000	2.000	3.000	2.000	0.	0.
7	1.000	0.	16.000	2.000	3.000	0.	0.	1.000
8	2.000	0.	1.000	0.	100.000	2.000	0.	1.000
9	1.000	1.000	1.000	1.000	2.000	2.000	0.	1.000
10	2.000	0.	1.000	1.000	2.000	2.000	0.	1.000
11	2.000	0.	1.000	1.000	6.000	2.000	0.	0.
12	2.000	1.000	5.000	2.000	1.000	0.	0.	0.
13	2.000	0.	5.000	2.000	1.000	0.	0.	0.
14	2.000	0.	1.000	0.	1.000	0.	1.000	0.
15	2.000	0.	1.000	3.000	1.000	0.	0.	0.
16	2.000	0.	16.000	2.000	1.000	0.	0.	0.
17	2.000	0.	16.000	1.000	3.000	0.	1.000	1.000
18	2.000	0.	15.000	3.000	15.000	1.000	1.000	0.
19	2.000	0.	3.000	3.000	1.000	0.	0.	0.
20	2.000	0.	5.000	1.000	1.000	0.	0.	0.
21	1.000	0.	2.000	1.000	3.000	0.	0.	0.
22	1.000	0.	5.000	1.000	1.000	0.	0.	0.
23	1.000	0.	1.000	3.000	1.000	1.000	0.	0.
24	1.000	0.	5.000	3.000	1.000	0.	0.	0.
25	2.000	0.	1.000	0.	25.000	1.000	0.	0.
26	2.000	0.	1.000	1.000	3.000	0.	0.	0.
27	2.000	0.	2.000	2.000	1.000	1.000	1.000	1.000
28	2.000	0.	16.000	2.000	4.000	1.000	1.000	0.
29	2.000	0.	2.000	2.000	1.000	0.	0.	0.
30	2.000	0.	5.000	2.000	1.000	1.000	0.	0.
31	2.000	0.	1.000	1.000	4.000	1.000	1.000	0.
32	2.000	0.	5.000	2.000	1.000	0.	0.	0.
33	2.000	0.	5.000	2.000	1.000	1.000	0.	0.
34	2.000	1.000	1.000	2.000	1.000	0.	0.	0.
35	2.000	0.	1.000	3.000	1.000	0.	0.	0.
36	1.000	0.	1.000	3.000	1.000	1.000	1.000	0.
37	2.000	0.	5.000	2.000	4.000	0.	0.	0.
38	2.000	0.	16.000	2.000	1.000	1.000	0.	0.
39	2.000	2.000	5.000	3.000	3.000	0.	0.	0.
40	2.000	2.000	17.000	3.000	1.000	0.	0.	1.000
41	2.000	2.000	1.000	3.000	6.000	1.000	0.	1.000
42	2.000	0.	1.000	3.000	100.000	0.	1.000	1.000
Sample Number	16	15	14	13	12	11	10	9

	9	10	11	12	13	14	15	16	
44	2.000	2.000	0.	5.000	2.000	34.000	0.	1.000	44
45	1.000	0.	1.000	5.000	3.000	1.000	2.000	3.000	45
46	0.	1.000	0.	1.000	3.000	1.000	0.	0.	46
47	2.000	0.	1.000	6.000	3.000	1.000	2.000	2.000	47
48	1.000	0.	2.000	1.000	0.	1.000	0.	2.000	48
49	2.000	1.000	2.000	1.000	1.000	2.000	1.000	2.000	49
50	0.	1.000	2.000	7.000	2.000	1.000	0.	2.000	50
52	0.	0.	0.	5.000	3.000	34.000	0.	1.000	52
53	0.	0.	1.000	1.000	3.000	3.000	0.	2.000	53
54	1.000	1.000	1.000	2.000	1.000	2.000	0.	2.000	54
55	0.	2.000	2.000	2.000	0.	2.000	0.	1.000	55
56	2.000	2.000	0.	4.000	3.000	1.000	1.000	2.000	56
57	1.000	0.	2.000	1.000	0.	1.000	0.	3.000	57
58	0.	1.000	0.	2.000	3.000	20.000	0.	2.000	58
59	2.000	1.000	2.000	2.000	0.	2.000	0.	2.000	59
60	1.000	0.	1.000	1.000	0.	1.000	0.	2.000	60
61	0.	2.000	2.000	2.000	0.	2.000	1.000	2.000	61
62	1.000	1.000	0.	4.000	3.000	1.000	1.000	2.000	62
63	0.	2.000	1.000	1.000	3.000	34.000	0.	1.000	63
64	1.000	1.000	0.	4.000	3.000	1.000	1.000	2.000	64
71	0.	1.000	0.	5.000	1.000	34.000	0.	2.000	71
72	2.000	1.000	0.	5.000	3.000	34.000	0.	2.000	72
80	1.000	1.000	1.000	5.000	2.000	14.000	0.	2.000	80
84	1.000	0.	0.	1.000	2.000	1.000	0.	1.000	84
85	2.000	0.	0.	1.000	1.000	1.000	0.	0.	85
86	0.	1.000	2.000	10.000	2.000	2.000	1.000	3.000	86
100	2.000	0.	0.	6.000	0.	1.000	2.000	2.000	100
101	2.000	0.	1.000	2.000	1.000	1.000	1.000	0.	101
102	2.000	0.	0.	3.000	0.	0.	2.000	0.	102
104	1.000	1.000	1.000	7.000	0.	0.	0.	3.000	104
105	0.	1.000	1.000	2.000	0.	0.	2.000	1.000	105
106	2.000	0.	2.000	1.000	1.000	0.	2.000	0.	106
107	2.000	2.000	1.000	28.000	0.	0.	1.000	3.000	107
109	2.000	0.	1.000	6.000	0.	0.	0.	2.000	109
110	1.000	0.	1.000	53.000	1.000	1.000	0.	2.000	110
111	2.000	0.	2.000	60.000	0.	1.000	1.000	3.000	111
112	2.000	0.	1.000	20.000	0.	1.000	2.000	3.000	112
113	0.	0.	1.000	1.000	0.	0.	0.	0.	113
114	0.	0.	0.	1.000	2.000	0.	1.000	1.000	114
115	2.000	1.000	2.000	1.000	0.	0.	0.	2.000	115
116	2.000	1.000	1.000	1.000	0.	0.	0.	2.000	116
117	1.000	0.	1.000	1.000	0.	0.	0.	2.000	117

	9	10	11	12	13	14	15	16	
118	1.000	1.000	2.000	1.000	0.	0.	0.	3.000	118
119	0.	0.	0.	1.000	0.	0.	2.000	0.	119
120	1.000	0.	1.000	1.000	0.	1.000	1.000	2.000	120
121	2.000	1.000	2.000	3.000	0.	6.000	2.000	0.	121
122	2.000	0.	1.000	3.000	0.	6.000	0.	2.000	122
123	2.000	1.000	1.000	3.000	0.	0.	0.	2.000	123
124	1.000	0.	1.000	2.000	0.	0.	1.000	0.	124
125	1.000	0.	1.000	1.000	0.	0.	2.000	1.000	125
126	0.	1.000	1.000	2.000	0.	0.	2.000	1.000	126
127	0.	1.000	0.	1.000	0.	0.	1.000	0.	127
128	1.000	1.000	1.000	1.000	0.	0.	2.000	0.	128
129	1.000	1.000	1.000	1.000	0.	0.	2.000	1.000	129
130	1.000	2.000	1.000	5.000	-0.	0.	2.000	1.000	130
131	2.000	0.	1.000	1.000	0.	0.	0.	0.	131
132	1.000	0.	1.000	1.000	1.000	1.000	1.000	3.000	132
133	2.000	0.	1.000	1.000	1.000	0.	2.000	0.	133
134	0.	0.	0.	1.000	1.000	0.	0.	0.	134
135	1.000	0.	1.000	1.000	-0.	0.	0.	3.000	135
136	1.000	0.	1.000	1.000	0.	1.000	2.000	0.	136
137	0.	0.	1.000	10.000	1.000	10.000	1.000	0.	137
138	0.	0.	1.000	1.000	-0.	1.000	2.000	1.000	138
139	1.000	0.	1.000	1.000	-0.	1.000	2.000	1.000	139
140	1.000	0.	0.	1.000	1.000	0.	0.	2.000	140
141	0.	2.000	1.000	1.000	0.	1.000	0.	0.	141
142	0.	0.	1.000	1.000	3.000	3.000	1.000	1.000	142
143	1.000	0.	1.000	1.000	1.000	2.000	2.000	2.000	143
144	1.000	1.000	0.	1.000	0.	1.000	0.	0.	144
145	1.000	0.	0.	1.000	0.	1.000	1.000	2.000	145
146	0.	0.	0.	6.000	0.	0.	0.	1.000	146
147	2.000	0.	1.000	4.000	3.000	-0.	0.	2.000	147
148	1.000	0.	2.000	1.000	3.000	0.	2.000	3.000	148
149	2.000	2.000	0.	2.000	0.	1.000	0.	1.000	149
150	0.	1.000	1.000	2.000	0.	1.000	0.	2.000	150
151	2.000	0.	1.000	2.000	0.	0.	0.	3.000	151
152	1.000	0.	1.000	2.000	0.	0.	0.	0.	152
153	0.	0.	0.	5.000	1.000	0.	0.	0.	153
154	1.000	0.	0.	2.000	0.	0.	0.	1.000	154
155	1.000	1.000	1.000	7.000	0.	0.	0.	2.000	155
156	0.	0.	0.	6.000	1.000	0.	0.	2.000	156
157	2.000	0.	0.	1.000	0.	1.000	0.	1.000	157
158	0.	0.	0.	12.000	1.000	0.	0.	2.000	158
159	1.000	0.	1.000	1.000	0.	1.000	0.	1.000	159

	9	10	11	12	13	14	15	16	
160	0.	1.000	0.	1.000	1.000	0.	0.	2.000	160
161	2.000	0.	0.	17.000	0.	1.000	0.	1.000	161
162	2.000	0.	2.000	5.000	0.	1.000	0.	1.000	162
163	2.000	0.	2.000	12.000	0.	1.000	0.	0.	163
164	2.000	0.	1.000	3.000	0.	0.	0.	0.	164
165	0.	0.	0.	1.000	0.	0.	1.000	2.000	165
166	1.000	0.	0.	8.000	1.000	0.	0.	2.000	166
167	2.000	0.	0.	70.000	1.000	1.000	0.	2.000	167
168	0.	0.	0.	2.000	1.000	0.	0.	2.000	168
169	0.	1.000	0.	2.000	1.000	0.	1.000	2.000	169
170	1.000	0.	0.	2.000	0.	0.	1.000	3.000	170
171	1.000	1.000	0.	1.000	0.	0.	0.	0.	171
173	0.	0.	0.	3.000	0.	0.	1.000	0.	173
174	1.000	0.	0.	95.000	3.000	1.000	1.000	3.000	174
175	1.000	2.000	0.	1.000	3.000	0.	0.	0.	175
176	2.000	0.	1.000	0.	3.000	0.	0.	2.000	176
177	2.000	1.000	1.000	1.000	2.000	1.000	2.000	0.	177
179	1.000	1.000	1.000	1.000	3.000	0.	0.	2.000	179
180	2.000	1.000	1.000	1.000	3.000	0.	0.	2.000	180
181	1.000	2.000	1.000	1.000	3.000	0.	0.	1.000	181
182	1.000	0.	0.	1.000	3.000	0.	0.	2.000	182
184	0.	1.000	1.000	3.000	3.000	0.	0.	1.000	184
185	1.000	0.	1.000	1.000	3.000	0.	0.	0.	185
186	1.000	0.	1.000	1.000	3.000	0.	0.	0.	186
187	1.000	0.	1.000	1.000	3.000	0.	0.	0.	187
188	1.000	0.	1.000	1.000	3.000	0.	0.	0.	188
189	1.000	0.	1.000	1.000	3.000	0.	0.	0.	189
190	2.000	0.	1.000	2.000	3.000	0.	0.	1.000	190
191	1.000	0.	1.000	1.000	3.000	0.	0.	0.	191
192	0.	0.	1.000	1.000	0.	1.000	0.	0.	192
193	0.	0.	2.000	8.000	0.	1.000	1.000	0.	193
194	2.000	0.	0.	6.000	0.	0.	0.	2.000	194
195	1.000	0.	0.	2.000	0.	0.	0.	2.000	195
196	0.	0.	1.000	1.000	0.	0.	0.	1.000	196
197	1.000	0.	1.000	2.000	0.	0.	0.	3.000	197
198	2.000	0.	1.000	10.000	1.000	3.000	0.	3.000	198
199	2.000	0.	1.000	10.000	1.000	3.000	0.	1.000	199
200	0.	0.	1.000	2.000	1.000	1.000	0.	1.000	200
201	2.000	0.	0.	1.000	2.000	1.000	0.	0.	201
202	1.000	0.	1.000	20.000	1.000	1.000	0.	2.000	202
203	1.000	1.000	1.000	2.000	1.000	1.000	0.	2.000	203
204	1.000	0.	1.000	3.000	0.	1.000	0.	2.000	204
205	2.000	0.	1.000	1.000	2.000	1.000	1.000	2.000	205

Sample Number

24 Number of Input Message Types. Message types could be unique displays or messages (these may be variations of data within their specific formats). Entered from questionnaire.

23 Number of Classes of Items in the Data Base. Classes means categories of types of items such as names, salaries, states, or any characteristics of information for which there are many items or entries. Entered from questionnaire.

22 Number of Words in the Data Base. Data Base is the subset of tables that describe the environment of the problem that the program is solving and/or files to be processed. Entered from questionnaire, in thousands.

21 Number of subroutines, i.e., a set of well defined instructions to carry out a mathematical or logical operation. Entered from questionnaire.

20 Percent delivered object instructions to total number of object instructions written or generated specifically for this Program Data Point. Derived from questionnaire. Coded in percent.

19 Number of source instructions written in procedure-oriented language (POL). Entered from questionnaire, in thousands.

18 Number of source instructions written in machine-oriented language (MOL). Entered from questionnaire, in thousands.

17 Total Number of object instructions written or generated specifically for this Program Data Point. Entered from questionnaire, in thousands.

Sample Number

	24	23	22	21	20	19	18	17
1	1.000	5.000	0.075	6.000	20.000	0.	0.265	0.265
2	0.	1.000	0.001	1.000	100.000	0.	0.150	0.150
3	2.000	4.000	0.095	3.000	12.000	0.	0.150	0.150
4	1.000	4.000	1.400	3.000	35.000	0.	0.310	0.310
5	1.000	13.000	5.200	47.000	84.000	0.	0.335	0.335
6	1.000	7.000	0.820	3.000	100.000	1.410	0.	4.580
7	1.000	7.000	0.012	2.000	87.000	0.310	0.143	0.715
8	4.000	50.000	0.935	1.000	87.000	0.	2.008	2.008
9	5.000	11.000	4.000	3.000	85.000	0.846	0.	2.683
10	1.000	6.000	4.000	3.000	87.000	0.650	0.	1.600
11	3.000	8.000	150.000	1.000	86.000	0.600	0.	1.500
12	10.000	125.000	400.000	6.000	70.000	0.581	0.	4.500
13	20.000	6.000	0.020	9.000	43.000	0.	1.500	1.500
14	20.000	6.000	0.020	12.000	64.000	0.	2.300	2.300
15	20.000	6.000	0.020	5.000	38.000	0.	1.500	1.500
16	1.000	75.000	50.000	1.000	83.000	0.	2.065	2.065
17	8.000	5.000	0.007	9.000	88.000	0.	2.200	2.200
18	2.000	23.000	0.163	2.000	25.000	0.	1.200	1.200
19	0.	5.000	1.600	76.000	83.000	0.	0.500	0.500
20	0.	2.000	0.500	4.000	100.000	0.	1.050	1.050
21	1.000	6.000	0.020	4.000	17.000	0.	0.685	0.685
22	20.000	30.000	0.020	16.000	41.000	0.	1.500	1.500
23	0.	20.000	1.200	5.000	91.000	0.	2.650	2.650
24	20.000	6.000	1.040	1.000	95.000	0.	2.682	2.682
25	8.000	7.000	0.400	11.000	100.000	0.	3.849	3.849
26	100.000	6.000	0.500	9.000	100.000	0.	2.000	2.000
27	50.000	10.000	0.400	19.000	44.000	0.	3.500	3.500
28	0.	47.000	0.050	14.000	100.000	0.	5.700	5.700
29	12.000	50.000	0.374	4.000	73.000	0.578	0.689	1.878
30	0.	3.000	1.280	1.000	87.000	0.	7.000	7.000
31	2.000	3.000	1.230	4.000	37.000	0.	4.500	4.500
32	100.000	6.000	0.800	19.000	73.000	0.	8.000	8.000
33	2.000	1000.000	0.100	46.000	79.000	0.	5.000	5.000
34	0.	25.000	2.000	3.000	75.000	0.	6.000	6.000
35	0.	5.000	3.053	54.000	50.000	0.	12.250	12.250
36	100.000	6.000	6.660	4.000	40.000	0.	40.000	40.000
37	2.000	120.000	0.100	13.000	75.000	0.	6.000	6.000
38	100.000	6.000	1.300	4.000	79.000	3.800	3.000	19.000
39	6.000	10.000	0.200	52.000	33.000	0.	5.400	5.400
40	150.000	200.000	0.015	19.000	87.000	0.	6.000	6.000
41	2.000	7.000	3.800	11.000	73.000	2.008	11.036	11.000
42				31.000	12.000		0.	11.000

	17	18	19	20	21	22	23	24	
44	10.000	10.000	0.	100.000	14.000	0.985	6.000	6.000	44
45	35.000	35.000	0.	100.000	16.000	100.000	255.000	8.000	45
46	14.100	14.100	0.	100.000	8.000	1.000	20.000	4.000	46
47	40.000	0.	30.000	31.000	12.000	20.000	2048.000	3.000	47
48	25.000	25.000	0.	65.000	1.000	0.010	1.000	8.000	48
49	16.900	16.900	0.	100.000	5.000	0.363	4.000	21.000	49
50	21.590	21.590	0.	97.000	17.000	4.000	30.000	2.000	50
52	19.000	19.000	0.	76.000	19.000	1.200	6.000	3.000	52
53	10.000	10.000	0.	38.000	35.000	3.400	12.000	16.000	53
54	26.900	26.900	0.	100.000	14.000	3.980	132.000	5.000	54
55	58.300	58.300	0.	100.000	1.000	10.000	10.000	0.	55
56	21.000	21.000	0.	60.000	36.000	1.990	7.000	3.000	56
57	25.000	0.	4.000	100.000	6.000	2.000	8.000	1.000	57
58	15.000	15.000	0.	50.000	71.000	5.000	25.000	31.000	58
59	31.500	31.500	0.	76.000	16.000	110.000	102.000	9.000	59
60	56.000	56.000	0.	30.000	98.000	2.200	24.000	25.000	60
61	45.400	45.400	0.	100.000	21.000	95.000	105.000	10.000	61
62	30.000	30.000	0.	77.000	36.000	2.090	7.000	3.000	62
63	50.000	50.000	0.	100.000	31.000	0.501	1.000	0.	63
64	17.000	17.000	0.	86.000	36.000	2.190	7.000	3.000	64
71	7.500	7.500	0.	100.000	10.000	0.400	5.000	4.000	71
72	16.000	16.000	0.	64.000	17.000	8.525	26.000	4.000	72
80	17.000	17.000	0.	11.000	3.000	0.800	1.000	0.	80
84	12.898	1.000	3.000	13.000	32.000	57.142	256.000	24.000	84
85	8.400	1.100	2.700	88.000	2.000	1.740	150.000	0.	85
86	3.000	3.000	0.	50.000	9.000	0.800	80.000	22.000	86
100	1.298	1.115	0.	100.000	34.000	0.068	5.000	8.000	100
101	1.064	0.630	0.	100.000	27.000	0.069	2.000	6.000	101
102	0.655	0.211	0.	100.000	8.000	240.000	16.000	9999.000	102
104	4.200	2.400	0.	100.000	4.000	1.200	21.000	10.000	104
105	1.634	1.105	0.	100.000	18.000	2200.000	60.000	4.000	105
106	0.658	0.287	0.	51.000	0.	0.370	29.000	1.000	106
107	30.072	9.750	0.	100.000	100.000	0.869	250.000	16.000	107
109	83.336	12.000	10.000	100.000	0.	15.000	20.000	7.000	109
110	8.280	4.200	0.	100.000	2.000	1.200	400.000	12.000	110
111	1.172	1.086	0.	100.000	45.000	0.020	10.000	13.000	111
112	1.893	1.655	0.	100.000	36.000	4.370	12.000	2.000	112
113	2.589	0.030	0.720	100.000	3.000	38.339	25.000	1500.000	113
114	0.850	0.850	0.	100.000	12.000	1400.000	50.000	6.000	114
115	1.242	0.447	0.214	17.000	2.000	-0.	4.000	1.000	115
116	0.648	0.281	0.029	18.000	4.000	34.560	13.000	13.000	116
117	1.941	0.026	0.154	25.000	0.	-0.	5.000	2.000	117

	17	18	19	20	21	22	23	24	
118	1.220	0.333	0.174	47.000	0.	180.000	23.000	1.000	118
119	2.055	0.025	0.275	32.000	1.000	7.479	105.000	1.000	119
120	2.509	1.744	0.	66.000	12.000	-0.	3.000	1.000	120
121	28.000	28.000	0.	100.000	100.000	229.600	111.000	10.000	121
122	43.500	8.000	0.	52.000	2.000	-0.	25.000	2.000	122
123	26.000	26.000	0.	100.000	2.000	53250.000	99999.000	2.000	123
124	0.316	0.030	0.070	2.000	3.000	0.165	12.000	7534.000	124
125	2.075	1.522	0.	6.000	2.000	17668.356	323.000	323.000	125
126	1.314	0.472	0.059	14.000	6.000	7438.859	57.000	9999.000	126
127	0.217	0.	0.052	1.000	32.000	42.000	155.000	9999.000	127
128	0.363	0.303	0.	25.000	1.000	12247.053	192.000	9999.000	128
129	2.105	0.395	0.328	45.000	3.000	1373.725	25.000	9999.000	129
130	0.800	0.800	0.	100.000	4.000	43.200	14.000	2.000	130
131	-0.	0.	1.321	100.000	4.000	60.000	60.000	18.000	131
132	19.462	0.178	4.163	66.000	45.000	0.329	145.000	32.000	132
133	0.980	0.980	0.	100.000	12.000	3.568	5.000	3.000	133
134	1.716	1.697	0.	100.000	4.000	0.527	29.000	7.000	134
135	4.850	0.003	1.300	97.000	60.000	0.152	45.000	6.000	135
136	1.748	1.748	0.	100.000	12.000	0.578	37.000	3.000	136
137	1.000	0.500	0.	100.000	10.000	0.012	12.000	2.000	137
138	0.264	0.145	0.	20.000	20.000	0.136	13.000	2.000	138
139	0.473	0.402	0.	32.000	65.000	0.260	24.000	6.000	139
140	2.150	1.150	0.	100.000	7.000	213.125	1.000	4.000	140
141	0.550	0.550	0.	100.000	1.000	40.000	16.000	5.000	141
142	15.000	15.000	0.	100.000	25.000	-0.	-0.	1.000	142
143	6.000	0.250	3.500	50.000	90.000	0.100	7.000	25.000	143
144	5.000	4.500	0.	100.000	36.000	1.000	50.000	10.000	144
145	35.000	25.000	1.500	88.000	180.000	5.000	1000.000	20.000	145
146	1.200	1.200	0.	100.000	35.000	50.000	24.000	21.000	146
147	3.875	3.300	0.	100.000	35.000	3.800	20.000	6.000	147
148	20.000	20.000	0.	25.000	160.000	100.000	120.000	4.000	148
149	0.725	0.725	0.	96.000	2.000	2.400	12.000	5.000	149
150	2.000	2.000	0.	100.000	14.000	0.148	37.000	3.000	150
151	5.875	5.875	0.	100.000	5.000	8.600	12.000	3.000	151
152	2.750	2.750	0.	62.000	2.000	97.700	30.000	2.000	152
153	2.150	2.150	0.	56.000	0.	228.000	19.000	6.000	153
154	8.000	8.000	0.	80.000	0.	300.000	150.000	4.000	154
155	7.076	7.076	0.	25.000	60.000	673.000	56.000	20.000	155
156	5.528	5.528	0.	55.000	70.000	200.000	112.000	15.000	156
157	6.500	0.	0.450	100.000	6.000	0.125	25.000	10.000	157
158	3.650	3.650	0.	68.000	21.000	855.000	19.000	20.000	158
159	14.300	0.	1.900	100.000	12.000	1900.000	50.000	6.000	159

	17	18	19	20	21	22	23	24	
160	10.050	0.	1.028	100.000	20.000	64.500	17.000	6.000	160
161	2.965	0.	0.740	100.000	0.	200.000	19.000	6.000	161
162	5.266	0.	1.464	100.000	0.	973.000	40.000	1.000	162
163	0.714	0.	0.216	100.000	0.	90.600	3.000	1.000	163
164	16.000	0.	0.790	100.000	18.000	0.600	3.000	3.000	164
165	6.500	6.500	0.	100.000	0.	0.150	40.000	8.000	165
166	82.000	69.000	0.	53.000	400.000	331.000	90.000	24.000	166
167	217.000	110.000	5.000	100.000	400.000	130.000	90.000	101.000	167
168	16.767	0.	2.646	100.000	14.000	415.000	15.000	9.000	168
169	8.040	0.	0.328	100.000	6.000	0.104	57.000	4.000	169
170	6.500	6.500	0.	80.000	1.000	1184.000	145.000	5.000	170
171	2.700	2.700	0.	57.000	16.000	1200.000	30.000	9999.000	171
173	7.000	0.	0.350	100.000	0.	430.000	43.000	14.000	173
174	18.000	18.000	0.	100.000	0.	-0.	-0.	-0.	174
175	12.000	12.000	0.	100.000	25.000	-0.	-0.	1.000	175
176	9.500	9.500	0.	100.000	-0.	-0.	-0.	-0.	176
177	30.000	30.000	0.	100.000	125.000	-0.	-0.	8.000	177
179	3.100	3.100	0.	100.000	100.000	-0.	-0.	-0.	179
180	1.000	1.000	0.	100.000	25.000	-0.	-0.	2.000	180
181	26.297	26.297	0.	100.000	47.000	-0.	-0.	2.000	181
182	12.000	12.000	0.	100.000	220.000	0.125	6.000	3.000	182
184	3.000	3.000	0.	100.000	10.000	0.300	40.000	50.000	184
185	10.000	7.000	0.	100.000	25.000	-0.	-0.	1.000	185
186	30.000	25.000	0.	100.000	20.000	-0.	-0.	2.000	186
187	4.500	4.000	0.	100.000	25.000	-0.	-0.	-0.	187
188	27.000	22.000	0.	100.000	25.000	-0.	-0.	1.000	188
189	18.000	15.000	0.	100.000	20.000	-0.	-0.	-0.	189
190	10.650	9.800	0.	93.000	52.000	2.100	40.000	15.000	190
191	48.000	40.000	0.	100.000	25.000	-0.	-0.	1.000	191
192	0.200	0.200	0.	60.000	27.000	153.000	45.000	2.000	192
193	1.906	1.630	0.	99.000	30.000	-0.	-0.	6.000	193
194	49.800	0.630	2.300	100.000	70.000	-0.	-0.	-0.	194
195	3.225	2.025	0.	100.000	80.000	-0.	-0.	3.000	195
196	2.603	0.	0.685	100.000	0.	0.058	58.000	4.000	196
197	0.920	0.900	0.	94.000	25.000	18.000	100.000	1.000	197
198	3.000	0.	1.000	65.000	140.000	200.000	300.000	8.000	198
199	25.850	25.000	0.	53.000	68.000	6058.000	78.000	60.000	199
200	0.979	0.695	0.	82.000	16.000	0.157	20.000	3.000	200
201	9.000	9.000	0.	100.000	10.000	5.000	5.000	-0.	201
202	6.342	0.	1.467	100.000	1.000	12.000	12.000	16.000	202
203	18.000	0.	1.500	100.000	2.000	4.900	20.000	5.000	203
204	5.035	0.	1.610	-0.	41.000	14.000	23.000	8.000	204
205	11.000	10.000	0.	100.000	57.000	3.500	9.000	4.000	205

Sample Number

32 Percent Input/Output Instructions to perform data acceptance and output formatting. Coded in percent.

31 Percent Mathematical Instructions devoted to evaluating and computing algebraic, mathematical, geometric, and trigonometric formulas. Coded in percent.

30 Percent Clerical Instructions, e.g., bookkeeping, sorting, searching, and file maintenance instructions. Coded in percent.

29 Complexity of Communication, referring to interprogram communications problems. Coded: less than 10% of the program design devoted to communication problems = 0; 10% to 50% of the program design devoted to communication problems = 1; more than 50% of the program design devoted to communication problems = 2.

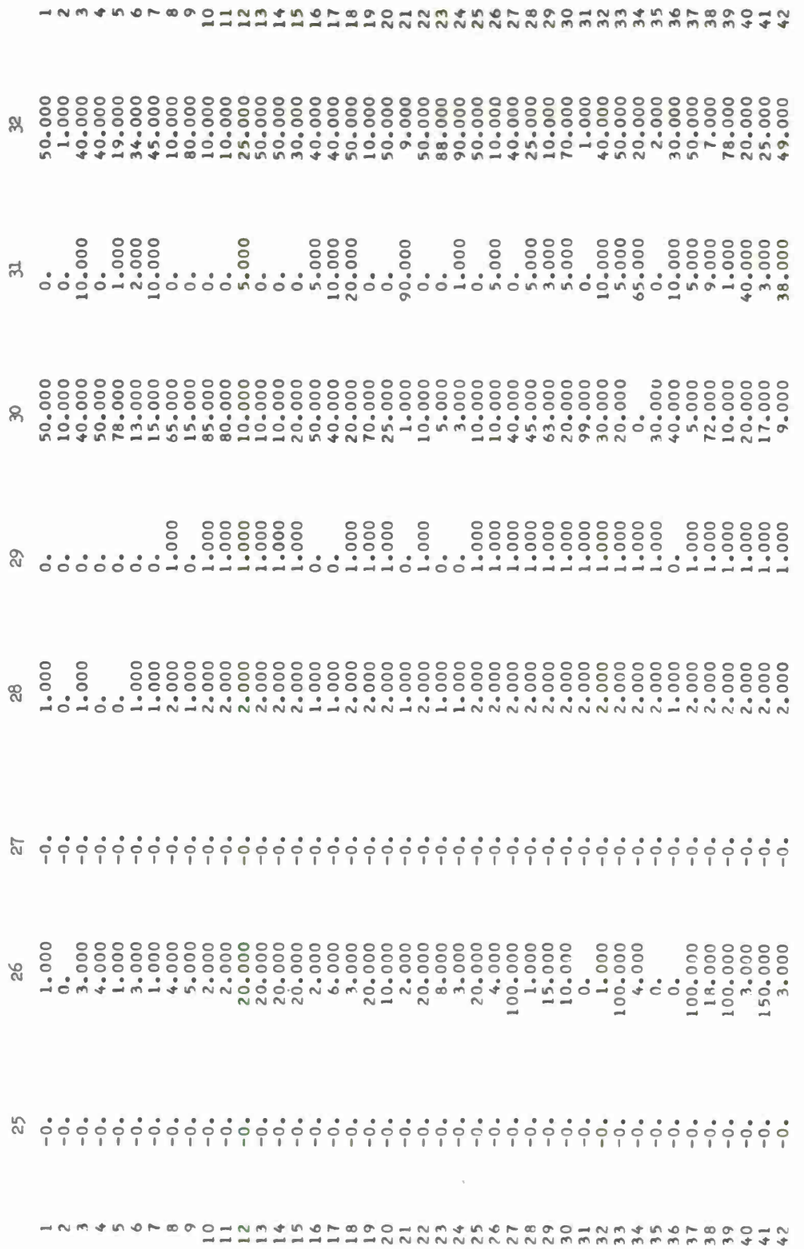
28 Stability of Program Design. Coded: initial design carried through without change = 0; few changes to initial program design = 1; frequent changes to program design = 2; initial program design almost completely revised = 3.

27 Average Number of Output Items per message type. Entered from questionnaire.

26 Number of Output Message Types. Entered from questionnaire.

25 Average Number of Input Items per input message type. Entered from questionnaire.

Sample Number



	25	26	27	28	29	30	31	32	
44	-0.	9.000	-0.	1.000	0.	30.000	0.	60.000	44
45	-0.	2.000	-0.	2.000	1.000	8.000	2.000	60.000	45
46	-0.	8.000	-0.	0.	0.	64.000	25.000	10.000	46
47	-0.	2.000	-0.	2.000	1.000	70.000	5.000	10.000	47
48	-0.	6.000	-0.	2.000	1.000	69.000	3.000	20.000	48
49	-0.	14.000	-0.	2.000	1.000	10.000	0.	60.000	49
50	-0.	3.000	-0.	2.000	1.000	17.000	18.000	45.000	50
52	-0.	0.	-0.	1.000	0.	25.000	0.	60.000	52
53	-0.	60.000	-0.	2.000	1.000	40.000	10.000	35.000	53
54	-0.	18.000	-0.	2.000	1.000	10.000	30.000	10.000	54
55	-0.	0.	-0.	1.000	0.	20.000	20.000	30.000	55
56	-0.	3.000	-0.	2.000	1.000	28.000	20.000	20.000	56
57	-0.	1.000	-0.	3.000	2.000	90.000	0.	5.000	57
58	-0.	31.000	-0.	2.000	1.000	10.000	5.000	75.000	58
59	-0.	22.000	-0.	2.000	1.000	60.000	15.000	5.000	59
60	-0.	57.000	-0.	2.000	1.000	15.000	15.000	15.000	60
61	-0.	50.000	-0.	2.000	1.000	10.000	40.000	40.000	61
62	-0.	6.000	-0.	2.000	1.000	20.000	28.000	20.000	62
63	-0.	0.	-0.	1.000	0.	50.000	0.	50.000	63
64	-0.	6.000	-0.	2.000	1.000	18.000	30.000	20.000	64
71	-0.	0.	-0.	2.000	1.000	30.000	30.000	20.000	71
72	-0.	0.	-0.	1.000	0.	10.000	20.000	55.000	72
80	-0.	0.	-0.	2.000	1.000	80.000	0.	20.000	80
84	-0.	33.000	-0.	1.000	0.	15.000	25.000	50.000	84
85	-0.	0.	-0.	0.	0.	0.	5.000	10.000	85
86	-0.	48.000	-0.	3.000	2.000	10.000	20.000	40.000	86
100	11.000	8.000	11.000	1.000	0.	5.000	10.000	25.000	100
101	12.000	6.000	12.000	1.000	1.000	69.000	4.000	22.000	101
102	24.000	5400.000	16.000	1.000	1.000	1.000	0.	99.000	102
104	8.000	19.000	10.000	2.000	0.	78.000	2.000	10.000	104
105	100.000	2.000	15.000	1.000	0.	21.000	1.000	25.000	105
106	15.000	2.000	12.000	2.000	0.	50.000	0.	20.000	106
107	26.000	13.000	26.000	1.000	1.000	20.000	5.000	30.000	107
109	17.000	6.000	18.000	2.000	0.	63.000	2.000	20.000	109
110	20.000	60.000	15.000	2.000	2.000	5.000	30.000	30.000	110
111	11.000	14.000	16.000	2.000	1.000	15.000	25.000	20.000	111
112	17.000	4.000	14.000	1.000	1.000	20.000	19.000	18.000	112
113	7.000	2000.000	9.000	1.000	2.000	60.000	5.000	25.000	113
114	43.000	2.000	38.000	1.000	2.000	5.000	5.000	70.000	114
115	4.000	1.000	5.000	3.000	1.000	0.	35.000	30.000	115
116	11.000	13.000	11.000	1.000	0.	80.000	0.	10.000	116
117	5.000	13.000	2.000	3.000	1.000	30.000	60.000	5.000	117

	25	26	27	28	29	30	31	32	
118	18.000	9.000	5.000	2.000	1.000	20.000	50.000	20.000	118
119	30.000	1.000	7.000	2.000	1.000	9.000	67.000	10.000	119
120	3.000	1.000	2.000	1.000	0.	5.000	70.000	3.000	120
121	56.000	6.000	25.000	2.000	1.000	17.000	2.000	30.000	121
122	9.000	6.000	158.000	1.000	0.	4.000	30.000	30.000	122
123	51.000	10.000	30.000	2.000	1.000	10.000	25.000	40.000	123
124	30.000	7534.000	23.000	3.000	1.000	3.000	0.	95.000	124
125	6.000	85.000	6.000	1.000	0.	63.000	0.	30.000	125
126	631.000	9999.000	28.000	1.000	1.000	10.000	30.000	60.000	126
127	145.000	9999.000	7.000	1.000	0.	60.000	20.000	10.000	127
128	192.000	9999.000	6.000	1.000	0.	55.000	0.	40.000	128
129	33.000	9999.000	6.000	1.000	0.	55.000	15.000	25.000	129
130	7.000	5.000	6.000	1.000	1.000	40.000	10.000	29.000	130
131	14.000	22.000	18.000	2.000	1.000	70.000	0.	10.000	131
132	14.000	26.000	9.000	2.000	1.000	36.000	26.000	5.000	132
133	5.000	6.000	3.000	1.000	0.	0.	20.000	80.000	133
134	13.000	8.000	14.000	1.000	0.	0.	0.	18.000	134
135	10.000	8.000	8.000	1.000	0.	50.000	0.	47.000	135
136	12.000	3.000	8.000	1.000	0.	10.000	40.000	20.000	136
137	12.000	5.000	14.000	1.000	1.000	55.000	5.000	30.000	137
138	6.000	4.000	5.000	0.	2.000	5.000	0.	35.000	138
139	6.000	1.000	10.000	0.	2.000	5.000	0.	25.000	139
140	2.000	1.000	4.000	3.000	1.000	61.000	0.	33.000	140
141	120.000	4.000	480.000	0.	2.000	10.000	10.000	30.000	141
142	1.000	1.000	1.000	1.000	2.000	8.000	2.000	30.000	142
143	5.000	5.000	5.000	1.000	2.000	60.000	0.	40.000	143
144	1.000	4.000	3.000	1.000	0.	55.000	20.000	20.000	144
145	5.000	20.000	20.000	1.000	1.000	50.000	0.	15.000	145
146	2.000	21.000	2.000	1.000	1.000	88.000	0.	10.000	146
147	6.000	7.000	4.000	1.000	0.	12.000	0.	8.000	147
148	6.000	4.000	26.000	1.000	1.000	12.000	0.	1.000	148
149	12.000	4.000	13.000	1.000	2.000	5.000	45.000	10.000	149
150	18.000	1.000	29.000	2.000	1.000	20.000	0.	50.000	150
151	15.000	1.000	54.000	2.000	0.	3.000	9.000	10.000	151
152	15.000	2.000	30.000	1.000	0.	44.000	3.000	3.000	152
153	13.000	3.000	14.000	1.000	0.	5.000	5.000	90.000	153
154	85.000	5.000	80.000	1.000	0.	0.	5.000	20.000	154
155	12.000	4.000	75.000	2.000	0.	60.000	2.000	36.000	155
156	40.000	16.000	20.000	1.000	1.000	45.000	5.000	35.000	156
157	12.000	2.000	40.000	1.000	2.000	0.	50.000	15.000	157
158	10.000	10.000	15.000	0.	1.000	20.000	40.000	10.000	158
159	10.000	8.000	10.000	2.000	1.000	50.000	5.000	20.000	159

	25	26	27	28	29	30	31	32	
160	10.000	6.000	10.000	1.000	1.000	25.000	10.000	45.000	160
161	6.000	10.000	13.000	1.000	2.000	30.000	0.	35.000	161
162	4.000	15.000	52.000	2.000	1.000	30.000	5.000	30.000	162
163	10.000	8.000	6.000	3.000	2.000	25.000	20.000	30.000	163
164	2.000	2.000	3.000	1.000	0.	46.000	1.000	49.000	164
165	3.000	18.000	15.000	3.000	0.	5.000	10.000	25.000	165
166	10.000	51.000	10.000	1.000	0.	75.000	5.000	10.000	166
167	9.000	51.000	20.000	1.000	0.	30.000	0.	20.000	167
168	10.000	10.000	10.000	1.000	0.	30.000	5.000	40.000	168
169	5.000	9.000	5.000	3.000	1.000	45.000	5.000	20.000	169
170	47.000	24.000	22.000	1.000	1.000	10.000	5.000	50.000	170
171	500.000	8500.000	35.000	1.000	1.000	25.000	5.000	40.000	171
173	8.000	1.000	8.000	1.000	1.000	35.000	5.000	30.000	173
174	-0.	-0.	-0.	1.000	1.000	5.000	0.	20.000	174
175	-0.	3.000	-0.	1.000	1.000	4.000	54.000	17.000	175
176	-0.	-0.	-0.	1.000	1.000	14.000	1.000	20.000	176
177	4.000	0.	0.	1.000	0.	50.000	2.000	30.000	177
179	-0.	-0.	-0.	2.000	2.000	10.000	0.	20.000	179
180	3.000	3.000	6.000	1.000	1.000	10.000	10.000	10.000	180
181	6.000	3.000	6.000	2.000	1.000	10.000	5.000	10.000	181
182	5.000	10.000	7.000	2.000	0.	5.000	15.000	10.000	182
184	20.000	60.000	30.000	1.000	1.000	25.000	0.	75.000	184
185	15.000	1.000	10.000	2.000	2.000	55.000	1.000	10.000	185
186	5.000	2.000	15.000	2.000	2.000	30.000	2.000	20.000	186
187	-0.	-0.	-0.	3.000	2.000	5.000	0.	45.000	187
188	2.000	2.000	5.000	1.000	1.000	25.000	15.000	15.000	188
189	-0.	-0.	-0.	1.000	1.000	74.000	1.000	15.000	189
190	40.000	25.000	15.000	2.000	1.000	15.000	20.000	15.000	190
191	2.000	2.000	5.000	3.000	1.000	25.000	15.000	15.000	191
192	3.000	4.000	5.000	1.000	1.000	30.000	10.000	30.000	192
193	125.000	6.000	125.000	1.000	1.000	50.000	1.000	25.000	193
194	-0.	-0.	-0.	2.000	0.	10.000	30.000	10.000	194
195	30.000	7.000	30.000	2.000	1.000	40.000	10.000	50.000	195
196	35.000	5.000	32.000	1.000	0.	20.000	5.000	35.000	196
197	10.000	1.000	4.000	1.000	1.000	40.000	10.000	20.000	197
198	21.000	3.000	21.000	2.000	1.000	20.000	20.000	20.000	198
199	8.000	12.000	20.000	1.000	1.000	70.000	1.000	20.000	199
200	102.000	2.000	47.000	3.000	1.000	70.000	15.000	10.000	200
201	-0.	-0.	-0.	3.000	2.000	30.000	0.	30.000	201
202	8.000	4.000	12.000	2.000	1.000	20.000	8.000	25.000	202
203	10.000	8.000	8.000	1.000	2.000	50.000	1.000	5.000	203
204	9999.000	4.000	9999.000	2.000	1.000	20.000	1.000	30.000	204
205	4.000	7.000	2.000	1.000	1.000	30.000	20.000	35.000	205

Sample Number

40 Percent Generation Functions to produce desired outputs. Coded in percent.

39 Percent Transformation and Reformatting Functions. Coded in percent.

38 Percent Decision Making Functions. Coded in percent.

37 Percent Control or Regulation Functions. Coded in percent.

36 Percent Data Acquisition and Display Functions. Coded in percent.

35 Percent Information Storage and Retrieval Functions. Coded in percent.

34 Percent Self-Checking - FIX Instructions, such as monitoring programs which detect, report, and in some cases, attempt to correct errors. Coded in percent.

33 Percent Logical Control Instructions, where the sequencing of operations according to orders, priorities, or timing requirements. Coded in percent.

Sample Number	40	39	38	37	36	35	34	33
1	0.	70.000	0.	0.	0.	30.000	0.	0.
2	0.	0.	0.	90.000	0.	10.000	0.	89.000
3	0.	40.000	0.	0.	30.000	30.000	0.	10.000
4	0.	10.000	10.000	10.000	30.000	40.000	0.	10.000
5	20.000	80.000	0.	0.	0.	0.	0.	2.000
6	15.000	5.000	10.000	10.000	0.	60.000	41.000	10.000
7	20.000	10.000	0.	0.	0.	30.000	0.	30.000
8	10.000	20.000	5.000	5.000	0.	60.000	0.	25.000
9	0.	50.000	0.	0.	0.	0.	0.	5.000
10	3.000	5.000	5.000	5.000	2.000	50.000	0.	5.000
11	6.000	5.000	4.000	5.000	10.000	80.000	0.	10.000
12	20.000	0.	15.000	10.000	50.000	70.000	10.000	50.000
13	0.	0.	0.	40.000	5.000	50.000	0.	40.000
14	0.	0.	0.	20.000	40.000	10.000	0.	40.000
15	0.	0.	20.000	20.000	30.000	30.000	20.000	30.000
16	0.	20.000	5.000	5.000	0.	70.000	0.	5.000
17	5.000	45.000	0.	10.000	0.	45.000	0.	10.000
18	5.000	50.000	5.000	5.000	0.	25.000	0.	10.000
19	20.000	0.	40.000	20.000	0.	20.000	0.	20.000
20	0.	0.	0.	0.	0.	1.000	0.	25.000
21	33.000	0.	0.	40.000	99.000	0.	0.	0.
22	0.	0.	0.	0.	67.000	10.000	2.000	40.000
23	30.000	25.000	0.	0.	50.000	25.000	1.000	5.000
24	40.000	20.000	10.000	10.000	20.000	10.000	10.000	5.000
25	0.	0.	10.000	0.	50.000	30.000	5.000	30.000
26	0.	10.000	0.	0.	70.000	0.	10.000	70.000
27	0.	20.000	0.	0.	20.000	50.000	0.	10.000
28	5.000	25.000	5.000	5.000	25.000	25.000	15.000	25.000
29	10.000	10.000	0.	0.	0.	80.000	20.000	5.000
30	5.000	60.000	20.000	5.000	1.000	10.000	0.	3.000
31	0.	0.	0.	99.000	0.	0.	0.	0.
32	0.	40.000	0.	0.	60.000	50.000	0.	20.000
33	20.000	25.000	0.	5.000	20.000	0.	0.	25.000
34	0.	0.	80.000	0.	0.	1.000	0.	15.000
35	20.000	99.000	0.	0.	0.	20.000	20.000	64.000
36	50.000	15.000	5.000	10.000	0.	5.000	5.000	20.000
37	0.	5.000	0.	30.000	0.	30.000	1.000	7.000
38	41.000	14.000	5.000	8.000	2.000	60.000	15.000	10.000
39	0.	20.000	0.	5.000	15.000	10.000	0.	5.000
40	30.000	5.000	30.000	5.000	95.000	35.000	1.000	55.000
41	5.000	5.000	5.000	45.000	5.000	0.	0.	3.000
42	5.000	0.	0.	0.	0.	0.	1.000	0.

	33	34	35	36	37	38	39	40	
44	10.000	0.	0.	0.	10.000	0.	60.000	30.000	44
45	30.000	0.	20.000	80.000	0.	0.	0.	0.	45
46	1.000	0.	50.000	0.	0.	0.	0.	50.000	46
47	10.000	5.000	70.000	15.000	5.000	3.000	7.000	0.	47
48	5.000	3.000	40.000	0.	0.	5.000	30.000	25.000	48
49	30.000	0.	0.	0.	99.000	1.000	0.	0.	49
50	16.000	4.000	10.000	56.000	16.000	0.	18.000	0.	50
52	15.000	0.	0.	0.	15.000	20.000	45.000	20.000	52
53	10.000	5.000	20.000	30.000	5.000	5.000	25.000	15.000	53
54	30.000	20.000	0.	20.000	10.000	40.000	0.	30.000	54
55	30.000	0.	60.000	0.	0.	20.000	0.	20.000	55
56	22.000	10.000	30.000	25.000	10.000	10.000	10.000	15.000	56
57	5.000	0.	99.000	1.000	0.	0.	0.	0.	57
58	10.000	0.	0.	0.	0.	0.	50.000	50.000	58
59	20.000	0.	99.000	1.000	0.	0.	0.	0.	59
60	45.000	10.000	10.000	5.000	5.000	5.000	25.000	50.000	60
61	10.000	0.	20.000	40.000	0.	20.000	20.000	0.	61
62	22.000	10.000	25.000	20.000	15.000	15.000	10.000	15.000	62
63	0.	0.	20.000	0.	0.	0.	50.000	30.000	63
64	22.000	10.000	20.000	20.000	15.000	20.000	10.000	15.000	64
71	20.000	0.	20.000	0.	20.000	10.000	30.000	20.000	71
72	15.000	0.	0.	0.	10.000	20.000	40.000	30.000	72
80	0.	0.	30.000	0.	0.	0.	50.000	20.000	80
84	10.000	0.	0.	67.000	0.	0.	0.	33.000	84
85	84.000	1.000	15.000	15.000	5.000	55.000	5.000	5.000	85
86	20.000	10.000	40.000	0.	20.000	0.	20.000	20.000	86
100	35.000	25.000	5.000	10.000	45.000	40.000	0.	0.	100
101	0.	5.000	20.000	15.000	5.000	15.000	20.000	25.000	101
102	0.	0.	70.000	0.	0.	10.000	5.000	15.000	102
104	5.000	5.000	15.000	15.000	5.000	30.000	30.000	5.000	104
105	48.000	5.000	10.000	40.000	20.000	2.000	15.000	13.000	105
106	20.000	10.000	2.000	2.000	2.000	90.000	0.	4.000	106
107	30.000	15.000	5.000	5.000	40.000	0.	30.000	20.000	107
109	5.000	10.000	0.	30.000	25.000	15.000	15.000	15.000	109
110	25.000	10.000	10.000	20.000	10.000	10.000	25.000	25.000	110
111	30.000	10.000	35.000	10.000	20.000	20.000	5.000	10.000	111
112	35.000	8.000	5.000	5.000	10.000	30.000	0.	50.000	112
113	9.000	1.000	0.	0.	0.	0.	30.000	70.000	113
114	15.000	5.000	20.000	0.	15.000	5.000	40.000	20.000	114
115	20.000	15.000	10.000	50.000	0.	10.000	0.	30.000	115
116	9.000	1.000	20.000	0.	10.000	0.	60.000	10.000	116
117	5.000	0.	5.000	0.	25.000	15.000	20.000	35.000	117

	33	34	35	36	37	38	39	40	
118	10.000	0.	5.000	0.	30.000	15.000	20.000	30.000	118
119	11.000	3.000	15.000	5.000	0.	80.000	0.	0.	119
120	20.000	2.000	0.	0.	5.000	60.000	10.000	25.000	120
121	50.000	1.000	25.000	10.000	15.000	20.000	20.000	10.000	121
122	35.000	1.000	1.000	2.000	0.	45.000	2.000	50.000	122
123	20.000	5.000	4.000	5.000	28.000	27.000	16.000	20.000	123
124	2.000	0.	20.000	10.000	10.000	5.000	30.000	25.000	124
125	0.	7.000	15.000	40.000	5.000	20.000	10.000	10.000	125
126	0.	0.	15.000	50.000	5.000	5.000	10.000	10.000	126
127	5.000	5.000	10.000	0.	0.	20.000	20.000	50.000	127
128	0.	5.000	20.000	10.000	5.000	20.000	30.000	15.000	128
129	0.	5.000	20.000	25.000	10.000	5.000	25.000	15.000	129
130	20.000	1.000	22.000	3.000	5.000	45.000	5.000	20.000	130
131	20.000	0.	0.	0.	30.000	50.000	20.000	0.	131
132	28.000	5.000	10.000	0.	0.	25.000	0.	65.000	132
133	0.	0.	10.000	0.	0.	0.	0.	90.000	133
134	40.000	42.000	9.000	9.000	40.000	42.000	0.	0.	134
135	0.	3.000	0.	0.	0.	0.	80.000	20.000	135
136	30.000	0.	10.000	10.000	20.000	35.000	0.	25.000	136
137	10.000	0.	0.	0.	20.000	60.000	0.	20.000	137
138	50.000	10.000	30.000	0.	0.	0.	60.000	10.000	138
139	50.000	20.000	10.000	0.	0.	0.	80.000	10.000	139
140	3.000	3.000	75.000	0.	0.	0.	0.	25.000	140
141	40.000	10.000	25.000	25.000	0.	0.	50.000	0.	141
142	30.000	30.000	10.000	50.000	15.000	15.000	10.000	0.	142
143	0.	0.	15.000	30.000	0.	15.000	30.000	10.000	143
144	0.	5.000	30.000	0.	0.	0.	50.000	20.000	144
145	15.000	20.000	35.000	10.000	20.000	15.000	10.000	10.000	145
146	0.	2.000	5.000	0.	15.000	75.000	0.	5.000	146
147	60.000	20.000	0.	0.	15.000	15.000	60.000	10.000	147
148	79.000	8.000	20.000	10.000	5.000	30.000	0.	35.000	148
149	20.000	20.000	0.	0.	10.000	0.	40.000	50.000	149
150	5.000	25.000	50.000	30.000	10.000	0.	0.	10.000	150
151	4.000	74.000	0.	0.	80.000	10.000	10.000	0.	151
152	46.000	4.000	0.	10.000	0.	0.	30.000	60.000	152
153	0.	0.	40.000	0.	20.000	0.	20.000	20.000	153
154	50.000	25.000	10.000	0.	10.000	0.	10.000	70.000	154
155	0.	2.000	0.	30.000	10.000	0.	50.000	10.000	155
156	10.000	5.000	0.	0.	0.	0.	30.000	70.000	156
157	35.000	0.	0.	0.	0.	0.	70.000	30.000	157
158	15.000	15.000	60.000	0.	10.000	0.	10.000	20.000	158
159	20.000	5.000	30.000	0.	10.000	20.000	30.000	10.000	159

	33	34	35	36	37	38	39	40	
160	20.000	0.	25.000	25.000	0.	10.000	10.000	30.000	160
161	30.000	5.000	0.	25.000	0.	0.	35.000	40.000	161
162	30.000	5.000	0.	20.000	10.000	0.	20.000	50.000	162
163	20.000	5.000	0.	25.000	0.	0.	25.000	50.000	163
164	3.000	1.000	0.	0.	0.	0.	0.	99.000	164
165	50.000	10.000	10.000	15.000	35.000	0.	35.000	5.000	165
166	5.000	5.000	10.000	5.000	10.000	5.000	50.000	20.000	166
167	48.000	2.000	65.000	0.	0.	0.	0.	35.000	167
168	25.000	0.	20.000	0.	20.000	0.	30.000	30.000	168
169	15.000	15.000	20.000	0.	0.	30.000	20.000	30.000	169
170	30.000	5.000	10.000	0.	0.	40.000	10.000	40.000	170
171	29.000	1.000	95.000	0.	2.000	3.000	0.	0.	171
173	10.000	20.000	10.000	0.	0.	30.000	40.000	20.000	173
174	70.000	5.000	50.000	0.	30.000	0.	15.000	5.000	174
175	0.	25.000	0.	0.	0.	0.	25.000	75.000	175
176	50.000	15.000	-0.	-0.	-0.	-0.	-0.	-0.	176
177	18.000	0.	45.000	0.	3.000	27.000	0.	25.000	177
179	60.000	10.000	10.000	50.000	10.000	10.000	10.000	10.000	179
180	40.000	30.000	20.000	10.000	10.000	10.000	25.000	25.000	180
181	73.000	2.000	0.	0.	5.000	5.000	0.	90.000	181
182	40.000	30.000	5.000	5.000	20.000	30.000	20.000	20.000	182
184	0.	0.	0.	50.000	0.	0.	50.000	0.	184
185	24.000	10.000	25.000	5.000	20.000	5.000	40.000	5.000	185
186	40.000	8.000	30.000	10.000	20.000	15.000	15.000	10.000	186
187	45.000	5.000	5.000	20.000	25.000	25.000	25.000	5.000	187
188	40.000	5.000	10.000	2.000	20.000	15.000	25.000	28.000	188
189	5.000	5.000	10.000	10.000	30.000	30.000	10.000	10.000	189
190	35.000	15.000	15.000	0.	10.000	15.000	20.000	40.000	190
191	40.000	5.000	10.000	2.000	20.000	15.000	25.000	28.000	191
192	30.000	0.	0.	0.	60.000	0.	0.	40.000	192
193	20.000	4.000	80.000	0.	0.	0.	20.000	0.	193
194	30.000	20.000	35.000	0.	25.000	25.000	10.000	5.000	194
195	0.	0.	0.	0.	5.000	15.000	50.000	30.000	195
196	40.000	0.	5.000	20.000	5.000	25.000	10.000	35.000	196
197	20.000	10.000	10.000	0.	0.	0.	10.000	80.000	197
198	35.000	5.000	0.	0.	0.	0.	0.	99.000	198
199	3.000	1.000	40.000	0.	15.000	0.	20.000	25.000	199
200	5.000	0.	10.000	10.000	10.000	50.000	10.000	10.000	200
201	30.000	10.000	40.000	0.	30.000	0.	20.000	10.000	201
202	42.000	5.000	10.000	0.	10.000	40.000	20.000	20.000	202
203	10.000	34.000	5.000	0.	60.000	20.000	5.000	10.000	203
204	30.000	19.000	0.	0.	0.	0.	25.000	75.000	204
205	5.000	10.000	0.	0.	0.	0.	25.000	75.000	205

Sample Number

48 Total Number of Pages of Internal Documentation = number of types of internal documentation x average number of pages/internal document.

47 Number of Types of Internal Documentation, i.e., distinct documents for use of programming organization. Entered from questionnaire.

46 MOL versus POL. Coded: MOL = 1; POL = 0. MOL uses machine-oriented assembly symbolic language source statements; POL uses procedure-oriented or compiler language for source statements.

45 Was <u>timing constraint</u> a factor in program design, code, and test? Coded: Yes = 1; No = 0.

44 Was <u>insufficient memory</u> a factor in program design, code, and test? Coded: Yes = 1; No = 0.

43 Average Frequency of Operation. Coded: not applicable = 0; less than 1/month = 1; weekly to monthly inclusive = 2; 24 hours to weekly inclusive = 3; daily = 4; utility or on-line (including compilers) = 5.

42 Average Operate Time of Program Data Point. Coded: not applicable = 3; less than 15 minutes = 2; 15 minutes to 1 hour = 1; greater than 1 hour = 3.

41 Number of Conditional Branches written specifically for this Program Data Point. Entered from questionnaire, in thousands.

Sample Number

	48	47	46	45	44	43	42	41
1	100.000	8.000	1.000	0.	0.	5.000	1.000	-0.
2	12.000	2.000	1.000	0.	0.	4.000	1.000	-0.
3	2.000	1.000	1.000	0.	0.	4.000	2.000	-0.
4	16.000	2.000	1.000	0.	0.	3.000	3.000	-0.
5	75.000	10.000	1.000	0.	0.	1.000	1.000	-0.
6	4.000	2.000	0.	1.000	1.000	3.000	1.000	-0.
7	40.000	2.000	0.	0.	0.	3.000	1.000	-0.
8	90.000	1.000	1.000	0.	1.000	1.000	2.000	-0.
9	24.000	1.000	0.	0.	0.	5.000	3.000	-0.
10	0.	0.	0.	0.	0.	3.000	3.000	-0.
11	0.	0.	0.	0.	0.	3.000	3.000	-0.
12	4.000	3.000	0.	1.000	1.000	4.000	2.000	-0.
13	40.000	3.000	1.000	1.000	1.000	4.000	2.000	-0.
14	60.000	3.000	1.000	1.000	1.000	4.000	2.000	-0.
15	47.000	3.000	1.000	0.	1.000	2.000	2.000	-0.
16	50.000	5.000	1.000	0.	1.000	4.000	3.000	-0.
17	25.000	5.000	1.000	0.	1.000	4.000	2.000	-0.
18	115.000	11.000	1.000	0.	1.000	3.000	2.000	-0.
19	0.	0.	1.000	1.000	1.000	5.000	1.000	-0.
20	75.000	3.000	1.000	1.000	1.000	5.000	1.000	-0.
21	210.000	8.000	1.000	0.	1.000	4.000	1.000	-0.
22	76.000	3.000	1.000	1.000	1.000	4.000	2.000	-0.
23	12.000	2.000	1.000	0.	1.000	4.000	1.000	-0.
24	12.000	2.000	1.000	0.	1.000	4.000	2.000	-0.
25	107.000	3.000	1.000	1.000	1.000	5.000	1.000	-0.
26	25.000	3.000	1.000	1.000	1.000	4.000	3.000	-0.
27	138.000	3.000	1.000	1.000	1.000	5.000	1.000	-0.
28	40.000	3.000	1.000	1.000	1.000	3.000	1.000	-0.
29	4.000	7.000	0.	0.	0.	4.000	2.000	-0.
30	12.000	2.000	1.000	0.	0.	5.000	1.000	-0.
31	200.000	3.000	1.000	1.000	1.000	5.000	1.000	-0.
32	0.	0.	1.000	0.	1.000	5.000	2.000	-0.
33	89.000	3.000	1.000	1.000	1.000	5.000	1.000	-0.
34	25.000	2.000	1.000	0.	0.	-0.	1.000	-0.
35	5.000	1.000	1.000	0.	0.	-0.	2.000	-0.
36	3.000	1.000	1.000	0.	0.	5.000	2.000	-0.
37	60.000	3.000	1.000	1.000	1.000	5.000	2.000	-0.
38	200.000	2.000	0.	0.	1.000	-0.	2.000	-0.
39	176.000	3.000	1.000	1.000	1.000	5.000	2.000	-0.
40	150.000	2.000	1.000	1.000	1.000	5.000	1.000	-0.
41	300.000	1.000	1.000	1.000	1.000	5.000	1.000	-0.
42	100.000	1.000	0.	1.000	1.000	5.000	1.000	-0.

	41	42	43	44	45	46	47	48	
44	-0.	1.000	4.000	1.000	0.	1.000	0.	0.	44
45	-0.	0.	5.000	1.000	0.	1.000	4.000	500.000	45
46	-0.	0.	5.000	1.000	1.000	1.000	0.	0.	46
47	-0.	2.000	4.000	0.	0.	0.	4.000	300.000	47
48	-0.	0.	2.000	0.	0.	1.000	4.000	2500.000	48
49	-0.	0.	5.000	0.	1.000	1.000	0.	0.	49
50	-0.	1.000	5.000	1.000	0.	1.000	11.000	40.000	50
52	-0.	1.000	5.000	1.000	1.000	1.000	1.000	600.000	52
53	-0.	1.000	5.000	1.000	1.000	1.000	26.000	13400.000	53
54	-0.	0.	5.000	0.	0.	1.000	5.000	22000.000	54
55	-0.	0.	5.000	0.	0.	1.000	4.000	190.000	55
56	-0.	2.000	5.000	0.	1.000	1.000	1.000	900.000	56
57	-0.	3.000	2.000	0.	0.	0.	1.000	4000.000	57
58	-0.	1.000	5.000	1.000	1.000	1.000	10.000	2000.000	58
59	-0.	0.	5.000	1.000	1.000	1.000	4.000	3500.000	59
60	-0.	3.000	3.000	1.000	0.	1.000	12.000	7700.000	60
61	-0.	0.	5.000	1.000	0.	1.000	3.000	400.000	61
62	-0.	2.000	5.000	0.	1.000	1.000	1.000	1000.000	62
63	-0.	1.000	5.000	0.	0.	1.000	6.000	650.000	63
64	-0.	2.000	5.000	0.	1.000	1.000	1.000	1200.000	64
71	-0.	1.000	5.000	1.000	0.	1.000	1.000	200.000	71
72	-0.	1.000	5.000	1.000	1.000	1.000	1.000	500.000	72
80	-0.	3.000	4.000	0.	0.	1.000	5.000	140.000	80
84	-0.	1.000	5.000	1.000	0.	0.	7.000	28.000	84
85	-0.	2.000	0.	0.	0.	0.	2.000	25.000	85
86	-0.	2.000	4.000	0.	0.	1.000	1.000	102.000	86
100	0.262	2.000	1.000	0.	0.	1.000	10.000	760.000	100
101	0.224	2.000	3.000	0.	0.	1.000	4.000	64.000	101
102	0.072	1.000	3.000	0.	0.	1.000	22.000	44.000	102
104	0.700	3.000	3.000	0.	0.	1.000	2.000	30.000	104
105	0.094	3.000	2.000	0.	0.	1.000	2.000	30.000	105
106	0.060	1.000	4.000	0.	1.000	1.000	1.000	1.000	106
107	2.342	3.000	3.000	0.	0.	1.000	1.000	100.000	107
109	17.000	3.000	3.000	0.	0.	0.	2.000	30.000	109
110	0.800	2.000	2.000	0.	0.	1.000	3.000	240.000	110
111	0.154	2.000	3.000	0.	1.000	1.000	3.000	9.000	111
112	0.440	2.000	2.000	0.	0.	1.000	5.000	55.000	112
113	0.290	1.000	3.000	1.000	0.	0.	1.000	0.	113
114	0.035	1.000	5.000	0.	1.000	1.000	24.000	240.000	114
115	0.541	1.000	2.000	0.	0.	0.	0.	0.	115
116	0.464	1.000	2.000	0.	1.000	0.	4.000	12.000	116
117	0.954	1.000	3.000	0.	1.000	0.	6.000	120.000	117

	41	42	43	44	45	46	47	48	
118	0.365	1.000	2.000	0.	0.	0.	6.000	30.000	118
119	0.600	1.000	2.000	0.	0.	0.	1.000	6.000	119
120	0.197	1.000	4.000	0.	0.	1.000	10.000	100.000	120
121	4.500	3.000	4.000	1.000	0.	1.000	0.	0.	121
122	20.000	3.000	2.000	1.000	0.	1.000	0.	0.	122
123	0.447	3.000	1.000	0.	0.	1.000	3.000	120.000	123
124	0.007	2.000	0.	0.	1.000	0.	5.000	2000.000	124
125	0.565	2.000	1.000	0.	0.	1.000	6.000	90.000	125
126	0.160	2.000	1.000	0.	0.	0.	6.000	2700.000	126
127	0.750	3.000	0.	0.	0.	0.	5.000	1020.000	127
128	0.040	3.000	0.	0.	0.	1.000	6.000	60.000	128
129	0.015	2.000	1.000	0.	1.000	0.	6.000	42.000	129
130	0.091	1.000	4.000	0.	1.000	1.000	3.000	27.000	130
131	-0.	1.000	3.000	0.	0.	0.	0.	0.	131
132	0.809	1.000	4.000	0.	1.000	0.	3.000	480.000	132
133	0.015	2.000	4.000	0.	0.	1.000	5.000	30.000	133
134	0.958	1.000	4.000	0.	0.	1.000	3.000	45.000	134
135	1.100	3.000	2.000	0.	0.	0.	10.000	320.000	135
136	0.330	2.000	2.000	0.	0.	1.000	1.000	35.000	136
137	0.149	1.000	4.000	0.	0.	1.000	1.000	-0.	137
138	0.041	3.000	2.000	0.	0.	1.000	4.000	-0.	138
139	0.116	2.000	2.000	0.	0.	1.000	5.000	35.000	139
140	0.141	3.000	1.000	0.	0.	1.000	1.000	25.000	140
141	0.025	2.000	1.000	0.	0.	1.000	3.000	30.000	141
142	1.500	0.	5.000	1.000	0.	1.000	11.000	242.000	142
143	1.000	2.000	5.000	0.	0.	0.	2.000	60.000	143
144	-0.	2.000	4.000	0.	0.	1.000	10.000	20.000	144
145	2.000	0.	0.	1.000	0.	0.	25.000	5000.000	145
146	0.140	0.	5.000	0.	0.	1.000	1.000	10.000	146
147	0.410	0.	5.000	0.	0.	1.000	2.000	8.000	147
148	2.000	0.	5.000	1.000	0.	1.000	50.000	500.000	148
149	0.270	2.000	3.000	0.	0.	1.000	3.000	180.000	149
150	0.087	3.000	2.000	0.	0.	1.000	7.000	84.000	150
151	0.324	2.000	3.000	0.	0.	1.000	3.000	90.000	151
152	0.110	2.000	2.000	0.	0.	1.000	8.000	40.000	152
153	0.088	2.000	3.000	0.	0.	1.000	4.000	88.000	153
154	1.400	2.000	3.000	1.000	0.	1.000	4.000	200.000	154
155	0.884	3.000	3.000	1.000	0.	1.000	14.000	280.000	155
156	0.930	3.000	4.000	1.000	0.	1.000	23.000	12.000	156
157	0.150	2.000	2.000	1.000	0.	0.	4.000	40.000	157
158	0.368	2.000	4.000	0.	0.	1.000	4.000	120.000	158
159	0.575	2.000	1.000	0.	0.	0.	2.000	120.000	159

	41	42	43	44	45	46	47	48	
160	0.350	2.000	4.000	0.	0.	0.	3.000	108.000	160
161	0.098	2.000	2.000	0.	0.	0.	1.000	70.000	161
162	0.087	2.000	3.000	0.	0.	0.	1.000	78.000	162
163	0.018	2.000	2.000	0.	0.	0.	1.000	22.000	163
164	0.075	2.000	2.000	1.000	0.	0.	0.	0.	164
165	0.350	2.000	3.000	0.	0.	1.000	4.000	60.000	165
166	15.400	3.000	2.000	1.000	0.	1.000	5.000	35500.000	166
167	12.000	3.000	4.000	1.000	0.	0.	5.000	750.000	167
168	0.850	2.000	3.000	0.	0.	0.	3.000	150.000	168
169	0.340	3.000	3.000	1.000	0.	0.	2.000	1.000	169
170	0.590	3.000	3.000	1.000	0.	1.000	4.000	160.000	170
171	0.500	3.000	2.000	0.	0.	1.000	6.000	18.000	171
173	0.300	3.000	4.000	1.000	0.	0.	4.000	20.000	173
174	1.000	0.	5.000	0.	1.000	1.000	2.000	6000.000	174
175	-0.	0.	5.000	0.	1.000	1.000	1.000	125.000	175
176	-0.	0.	4.000	0.	1.000	1.000	8.000	60.000	176
177	1.000	0.	5.000	1.000	1.000	1.000	2.000	80.000	177
179	0.800	0.	5.000	1.000	1.000	1.000	3.000	60.000	179
180	0.250	0.	5.000	1.000	1.000	1.000	2.000	60.000	180
181	6.000	0.	5.000	0.	1.000	1.000	1.000	200.000	181
182	0.800	0.	5.000	0.	1.000	1.000	20.000	1000.000	182
184	1.000	1.000	5.000	0.	1.000	1.000	1.000	50.000	184
185	2.000	0.	5.000	1.000	1.000	1.000	0.	0.	185
186	7.000	0.	5.000	1.000	1.000	1.000	0.	0.	186
187	1.000	0.	5.000	1.000	1.000	1.000	0.	0.	187
188	5.000	0.	5.000	1.000	1.000	1.000	0.	0.	188
189	5.000	0.	5.000	1.000	1.000	1.000	0.	0.	189
190	0.180	1.000	5.000	1.000	1.000	1.000	200.000	1000.000	190
191	10.000	0.	5.000	0.	1.000	1.000	0.	0.	191
192	0.015	1.000	2.000	0.	0.	1.000	7.000	1.000	192
193	0.104	2.000	2.000	0.	0.	1.000	3.000	90.000	193
194	-0.	2.000	5.000	0.	0.	0.	2.000	400.000	194
195	-0.	3.000	2.000	0.	0.	1.000	30.000	600.000	195
196	0.531	3.000	2.000	0.	0.	0.	5.000	10.000	196
197	0.287	3.000	2.000	0.	0.	1.000	3.000	18.000	197
198	0.800	2.000	4.000	0.	0.	0.	3.000	60.000	198
199	5.000	2.000	4.000	0.	0.	1.000	4.000	800.000	199
200	0.291	2.000	3.000	0.	0.	1.000	3.000	60.000	200
201	2.000	3.000	4.000	0.	1.000	1.000	3.000	300.000	201
202	0.312	1.000	3.000	0.	1.000	0.	1.000	15.000	202
203	0.750	2.000	2.000	0.	0.	0.	1.000	70.000	203
204	1.200	2.000	4.000	0.	0.	0.	0.	0.	204
205	1.100	1.000	5.000	0.	1.000	1.000	0.	0.	205

Sample Number

56 Average turnaround time experienced by programmers. Coded: less than 2 hours = 0; 2.1 to 11 hours = 1; 12 to 24 hours (or daily) = 2; greater than 24 hours = 3.

55 Was this Program Data Point the first program development on the developmental computer? Coded: Yes = 1; No = 0.

54 Was special display equipment used? Coded: Yes = 1; No = 0.

53 Was disc storage used? Coded: Yes = 1; No = 0.

52 Developmental Computer Core Size. Coded in thousands.

51 Developmental Computer Manufacturer. Coded: IBM = 1; others = 0.

50 Total Number of Pages of External Documentation = number of types of external documentation x average number of pages/external document.

49 Number of Types of External Documentation, i.e., distinct documents delivered to customer with the completed program. (Computer output is not considered documentation.) Entered from questionnaire.

Sample Number

Sample Number	56	55	54	53	52	51	50	49
1	3.000	0.	1.000	0.	8.000	0.	6.000	3.000
2	2.000	0.	0.	0.	32.000	0.	25.000	2.000
3	3.000	1.000	0.	0.	69.000	0.	160.000	2.000
4	3.000	0.	0.	0.	65.000	0.	1.000	1.000
5	1.000	0.	0.	0.	12.000	1.000	0.	0.
6	2.000	0.	1.000	0.	69.000	0.	3.000	3.000
7	3.000	1.000	0.	0.	69.000	0.	40.000	3.000
8	2.000	0.	1.000	0.	65.000	0.	3.000	1.000
9	3.000	0.	1.000	0.	32.000	1.000	24.000	1.000
10	0.	0.	1.000	0.	65.000	0.	35.000	1.000
11	0.	0.	1.000	0.	65.000	0.	35.000	1.000
12	3.000	0.	0.	0.	32.000	1.000	15.000	3.000
13	0.	0.	0.	0.	16.000	0.	40.000	3.000
14	0.	0.	1.000	0.	16.000	0.	60.000	3.000
15	1.000	0.	1.000	0.	16.000	0.	47.000	3.000
16	2.000	0.	0.	1.000	12.000	1.000	0.	0.
17	3.000	0.	1.000	0.	65.000	0.	0.	2.000
18	3.000	0.	1.000	0.	69.000	0.	150.000	2.000
19	3.000	0.	1.000	0.	65.000	0.	0.	0.
20	3.000	0.	0.	0.	69.000	0.	25.000	5.000
21	2.000	0.	0.	0.	8.000	0.	6.000	3.000
22	2.000	0.	1.000	0.	16.000	0.	76.000	3.000
23	2.000	0.	1.000	1.000	32.000	0.	100.000	2.000
24	2.000	0.	1.000	0.	32.000	0.	75.000	2.000
25	3.000	0.	0.	0.	16.000	0.	107.000	3.000
26	0.	0.	0.	0.	4.000	0.	0.	0.
27	3.000	0.	0.	0.	16.000	0.	138.000	3.000
28	0.	0.	0.	0.	8.000	1.000	0.	0.
29	4.000	0.	0.	0.	32.000	1.000	23.000	4.000
30	2.000	0.	0.	0.	32.000	0.	170.000	2.000
31	0.	0.	0.	0.	69.000	0.	0.	0.
32	3.000	0.	0.	0.	16.000	0.	268.000	3.000
33	3.000	0.	1.000	0.	16.000	0.	89.000	3.000
34	5.000	0.	0.	0.	16.000	0.	50.000	5.000
35	1.000	0.	0.	0.	32.000	1.000	250.000	1.000
36	1.000	1.000	0.	0.	32.000	1.000	225.000	1.000
37	3.000	0.	1.000	0.	16.000	0.	60.000	3.000
38	2.000	0.	1.000	1.000	69.000	0.	100.000	3.000
39	0.	0.	1.000	0.	16.000	0.	176.000	3.000
40	3.000	0.	1.000	0.	69.000	0.	100.000	4.000
41	0.	0.	1.000	0.	65.000	0.	600.000	2.000
42	3.000	0.	1.000	0.	32.000	1.000	350.000	5.000

	49	50	51	52	53	54	55	56	
44	5.000	100.000	0.	24.000	2.000	1.000	1.000	0.	44
45	5.000	500.000	0.	65.000	0.	1.000	1.000	0.	45
46	2.000	300.000	1.000	16.000	1.000	0.	1.000	2.000	46
47	1.000	125.000	0.	65.000	0.	0.	0.	0.	47
48	3.000	700.000	0.	32.000	0.	0.	0.	2.000	48
49	6.000	600.000	0.	32.000	0.	0.	0.	3.000	49
50	2.000	612.000	0.	8.000	0.	1.000	1.000	2.000	50
52	3.000	400.000	0.	24.000	1.000	1.000	0.	0.	52
53	6.000	1070.000	0.	8.000	0.	1.000	0.	3.000	53
54	7.000	4500.000	0.	32.000	0.	0.	0.	3.000	54
55	5.000	190.000	0.	32.000	0.	0.	1.000	3.000	55
56	9.000	1000.000	0.	69.000	1.000	1.000	0.	3.000	56
57	5.000	500.000	0.	32.000	0.	0.	1.000	3.000	57
58	0.	0.	0.	69.000	0.	0.	0.	3.000	58
59	2.000	700.000	0.	32.000	0.	1.000	1.000	3.000	59
60	0.	0.	1.000	32.000	0.	1.000	1.000	1.000	60
61	5.000	672.000	0.	32.000	0.	1.000	0.	3.000	61
62	9.000	1500.000	0.	69.000	1.000	1.000	0.	3.000	62
63	3.000	940.000	0.	24.000	0.	1.000	1.000	0.	63
64	9.000	1800.000	0.	69.000	1.000	1.000	0.	3.000	64
71	5.000	200.000	0.	24.000	0.	0.	1.000	1.000	71
72	4.000	400.000	0.	24.000	1.000	0.	0.	1.000	72
80	3.000	300.000	0.	69.000	1.000	0.	0.	3.000	80
84	11.000	2700.000	1.000	32.000	0.	0.	0.	3.000	84
85	8.000	700.000	0.	65.000	0.	0.	1.000	2.000	85
86	1.000	102.000	0.	32.000	0.	0.	1.000	2.000	86
100	10.000	760.000	1.000	40.000	1.000	0.	1.000	2.000	100
101	1.000	44.000	1.000	40.000	1.000	0.	1.000	2.000	101
102	8.000	16.000	1.000	40.000	1.000	0.	1.000	2.000	102
104	0.	0.	1.000	160.000	0.	1.000	0.	2.000	104
105	0.	0.	1.000	40.000	1.000	0.	0.	2.000	105
106	1.000	1.000	0.	10.000	0.	0.	0.	2.000	106
107	1.000	200.000	1.000	160.000	0.	0.	0.	2.000	107
109	0.	0.	0.	65.000	0.	1.000	1.000	2.000	109
110	0.	0.	1.000	80.000	0.	0.	0.	2.000	110
111	3.000	600.000	1.000	8.000	0.	0.	0.	2.000	111
112	2.000	6.000	1.000	40.000	0.	0.	0.	2.000	112
113	1.000	0.	1.000	65.000	0.	0.	0.	2.000	113
114	4.000	100.000	1.000	16.000	1.000	0.	0.	2.000	114
115	0.	0.	0.	8.000	0.	1.000	0.	1.000	115
116	0.	0.	0.	8.000	0.	1.000	0.	1.000	116
117	0.	0.	0.	8.000	0.	1.000	0.	1.000	117

	49	50	51	52	53	54	55	56	
118	0.	0.	0.	8.000	0.	1.000	0.	1.000	118
119	0.	0.	0.	8.000	0.	1.000	0.	1.000	119
120	0.	0.	0.	8.000	0.	1.000	0.	1.000	120
121	2.000	680.000	1.000	80.000	0.	0.	1.000	2.000	121
122	2.000	100.000	1.000	160.000	0.	0.	0.	3.000	122
123	3.000	120.000	1.000	160.000	0.	0.	0.	2.000	123
124	1.000	2.000	1.000	16.000	0.	0.	0.	1.000	124
125	1.000	2.000	1.000	16.000	1.000	1.000	0.	1.000	125
126	1.000	2.000	1.000	16.000	1.000	1.000	0.	1.000	126
127	1.000	2.000	1.000	16.000	1.000	1.000	0.	1.000	127
128	1.000	2.000	1.000	16.000	1.000	1.000	0.	1.000	128
129	1.000	2.000	1.000	16.000	1.000	1.000	0.	1.000	129
130	0.	0.	0.	4.000	0.	0.	0.	1.000	130
131	3.000	60.000	0.	65.000	0.	0.	1.000	2.000	131
132	2.000	48.000	1.000	32.000	0.	0.	0.	1.000	132
133	0.	0.	0.	4.000	0.	0.	0.	1.000	133
134	0.	0.	1.000	12.000	1.000	1.000	0.	1.000	134
135	12.000	18.000	0.	49.000	0.	0.	0.	1.000	135
136	1.000	35.000	0.	10.000	0.	0.	0.	3.000	136
137	1.000	-0.	1.000	40.000	1.000	0.	0.	2.000	137
138	3.000	-0.	1.000	40.000	1.000	0.	0.	2.000	138
139	0.	0.	1.000	40.000	1.000	0.	0.	2.000	139
140	1.000	25.000	1.000	16.000	0.	0.	0.	0.	140
141	3.000	30.000	0.	16.000	0.	0.	0.	2.000	141
142	2.000	140.000	0.	16.000	0.	0.	0.	2.000	142
143	0.	0.	0.	65.000	1.000	1.000	0.	0.	143
144	1.000	214.000	0.	32.000	0.	0.	0.	1.000	144
145	10.000	1000.000	1.000	32.000	0.	0.	0.	2.000	145
146	3.000	30.000	0.	16.000	1.000	0.	0.	0.	146
147	3.000	600.000	0.	16.000	0.	0.	1.000	0.	147
148	2.000	800.000	0.	16.000	1.000	1.000	0.	0.	148
149	4.000	32.000	0.	20.000	0.	0.	0.	3.000	149
150	0.	0.	0.	20.000	0.	0.	0.	3.000	150
151	3.000	15.000	0.	20.000	0.	0.	0.	3.000	151
152	3.000	6.000	0.	8.000	0.	0.	1.000	3.000	152
153	0.	0.	0.	8.000	0.	0.	0.	2.000	153
154	1.000	23.000	0.	8.000	0.	0.	1.000	2.000	154
155	1.000	30.000	0.	8.000	1.000	0.	1.000	3.000	155
156	10.000	20.000	0.	8.000	0.	0.	0.	3.000	156
157	1.000	1.000	0.	8.000	0.	0.	0.	2.000	157
158	1.000	10.000	0.	8.000	0.	0.	0.	2.000	158
159	2.000	12.000	1.000	32.000	0.	0.	0.	1.000	159

	49	50	51	52	53	54	55	56	
160	1.000	1.000	1.000	32.000	0.	0.	0.	1.000	160
161	1.000	39.000	1.000	32.000	0.	0.	0.	1.000	161
162	1.000	9.000	1.000	32.000	0.	0.	0.	1.000	162
163	1.000	5.000	1.000	32.000	0.	0.	0.	1.000	163
164	1.000	8.000	0.	8.000	0.	0.	0.	1.000	164
165	2.000	16.000	0.	8.000	0.	0.	0.	3.000	165
166	1.000	50.000	0.	32.000	0.	0.	1.000	2.000	166
167	28.000	42.000	0.	32.000	0.	0.	1.000	2.000	167
168	1.000	4.000	1.000	32.000	0.	0.	0.	1.000	168
169	2.000	1.000	0.	8.000	0.	0.	0.	3.000	169
170	7.000	840.000	0.	8.000	0.	0.	1.000	2.000	170
171	2.000	6.000	0.	8.000	0.	0.	0.	3.000	171
173	1.000	4.000	0.	8.000	0.	0.	0.	2.000	173
174	5.000	1500.000	1.000	80.000	1.000	1.000	1.000	1.000	174
175	7.000	525.000	1.000	8.000	0.	0.	1.000	2.000	175
176	3.000	90.000	1.000	32.000	1.000	1.000	1.000	2.000	176
177	3.000	300.000	1.000	16.000	1.000	1.000	1.000	1.000	177
179	4.000	500.000	1.000	32.000	0.	0.	1.000	0.	179
180	4.000	100.000	1.000	32.000	0.	0.	1.000	0.	180
181	3.000	690.000	1.000	64.000	0.	0.	1.000	2.000	181
182	3.000	240.000	1.000	64.000	1.000	1.000	1.000	1.000	182
184	5.000	250.000	1.000	16.000	1.000	1.000	1.000	2.000	184
185	2.000	100.000	1.000	16.000	1.000	1.000	1.000	1.000	185
186	2.000	100.000	1.000	16.000	1.000	0.	1.000	1.000	186
187	3.000	150.000	1.000	16.000	1.000	1.000	1.000	1.000	187
188	2.000	100.000	1.000	16.000	1.000	1.000	1.000	1.000	188
189	3.000	150.000	1.000	16.000	1.000	1.000	1.000	1.000	189
190	20.000	1000.000	1.000	8.000	0.	0.	1.000	2.000	190
191	3.000	300.000	1.000	16.000	1.000	1.000	1.000	1.000	191
192	0.	0.	1.000	80.000	0.	0.	0.	2.000	192
193	3.000	90.000	1.000	16.000	0.	0.	0.	3.000	193
194	4.000	600.000	1.000	32.000	0.	0.	1.000	2.000	194
195	5.000	5.000	1.000	160.000	0.	1.000	0.	2.000	195
196	11.000	44.000	1.000	100.000	1.000	1.000	0.	2.000	196
197	1.000	8.000	1.000	16.000	0.	0.	0.	2.000	197
198	3.000	60.000	1.000	80.000	0.	1.000	1.000	2.000	198
199	1.000	60.000	1.000	160.000	0.	0.	0.	2.000	199
200	2.000	30.000	1.000	80.000	1.000	1.000	0.	3.000	200
201	0.	0.	1.000	60.000	1.000	1.000	1.000	0.	201
202	1.000	92.000	1.000	32.000	0.	0.	0.	1.000	202
203	1.000	70.000	1.000	32.000	0.	0.	0.	1.000	203
204	1.000	20.000	0.	65.000	0.	0.	1.000	3.000	204
205	4.000	180.000	1.000	32.000	0.	0.	0.	2.000	205

Sample Number

64 Average Type III programmer experience with production language used in developing the Program Data Point. Coded in months.

63 Average Type II programmer experience with production language used in developing the Program Data Point. Coded in months.

62 Average Type I programmer experience with production language used in developing the Program Data Point. Coded in months.

61 Maximum Number of Type IV Programmers assigned at one time; a type IV programmer formulates and plans new program system applications, is highly creative in designing and developing major computer program systems. Entered from questionnaire.

60 Maximum Number of Type III Programmers assigned at one time; a type III programmer conceives, develops and improves large, complex computer programs. Entered from questionnaire.

59 Maximum Number of Type II Programmers assigned at one time; a type II programmer develops programs to solve well defined problems; prepares flow charts, writes instructions, tests programs, modifies established computer programs. Entered from questionnaire.

58 Maximum Number of Type I Programmers assigned at one time; a Type I programmer writes machine language instructions from flow charts, helps prepare flow charts and test programs. Entered from questionnaire.

57 Were there any data processing components to be used by the Program Data Point being developed concurrently with the program? Coded: Yes = 1; No = 0.

Sample Number

Sample Number	64	63	62	61	60	59	58	57
1	36.000	24.000	0.	6.000	2.000	4.000	0.	0.
2	0.	12.000	0.	1.000	0.	2.000	0.	0.
3	0.	24.000	0.	0.	0.	1.000	1.000	0.
4	0.	3.000	6.000	0.	0.	2.000	0.	0.
5	0.	30.000	0.	0.	0.	1.000	0.	0.
6	0.	30.000	0.	0.	0.	1.000	0.	0.
7	0.	6.000	0.	0.	0.	1.000	0.	0.
8	0.	60.000	0.	0.	0.	0.	0.	0.
9	12.000	0.	0.	0.	1.000	0.	0.	0.
10	36.000	0.	0.	0.	1.000	0.	0.	0.
11	36.000	0.	0.	0.	1.000	0.	0.	0.
12	24.000	0.	0.	0.	1.000	0.	0.	0.
13	48.000	0.	0.	0.	1.000	0.	0.	0.
14	48.000	0.	0.	0.	1.000	0.	0.	0.
15	48.000	48.000	0.	0.	1.000	1.000	0.	0.
16	36.000	0.	0.	0.	2.000	0.	0.	0.
17	36.000	24.000	0.	0.	1.000	1.000	0.	0.
18	96.000	36.000	0.	0.	2.000	2.000	2.000	0.
19	0.	24.000	12.000	0.	0.	11.000	0.	0.
20	36.000	24.000	0.	6.000	3.000	7.000	0.	0.
21	36.000	36.000	0.	0.	2.000	0.	0.	0.
22	48.000	0.	0.	1.000	0.	2.000	0.	0.
23	0.	12.000	0.	1.000	0.	0.	0.	0.
24	48.000	0.	0.	0.	2.000	0.	0.	0.
25	0.	0.	0.	1.000	1.000	0.	0.	0.
26	48.000	12.000	0.	0.	1.000	2.000	0.	0.
27	0.	0.	0.	1.000	0.	0.	0.	0.
28	12.000	0.	0.	0.	3.000	0.	0.	0.
29	0.	12.000	0.	1.000	0.	2.000	1.000	1.000
30	96.000	60.000	6.000	0.	1.000	2.000	1.000	0.
31	24.000	12.000	12.000	0.	1.000	4.000	1.000	0.
32	48.000	12.000	0.	1.000	1.000	1.000	0.	0.
33	24.000	12.000	0.	1.000	1.000	2.000	0.	0.
34	48.000	0.	0.	0.	2.000	0.	0.	0.
35	0.	0.	0.	0.	1.000	1.000	0.	0.
36	48.000	12.000	0.	0.	2.000	2.000	0.	0.
37	30.000	0.	0.	0.	4.000	0.	0.	0.
38	48.000	12.000	0.	0.	1.000	2.000	0.	0.
39	36.000	24.000	0.	1.000	2.000	4.000	0.	0.
40	24.000	24.000	24.000	3.000	3.000	2.000	1.000	1.000
41	24.000	24.000	0.	1.000	3.000	2.000	0.	1.000
42	30.000	12.000	0.	1.000	3.000	2.000	0.	1.000

	57	58	59	60	61	62	63	64	
44	0.	2.000	4.000	1.000	0.	0.	0.	0.	44
45	1.000	0.	0.	2.000	3.000	0.	0.	48.000	45
46	0.	0.	5.000	2.000	1.000	0.	12.000	12.000	46
47	0.	0.	1.000	2.000	1.000	0.	0.	0.	47
48	0.	2.000	4.000	3.000	2.000	6.000	12.000	24.000	48
49	1.000	2.000	2.000	2.000	0.	0.	0.	0.	49
50	1.000	2.000	6.000	7.000	2.000	0.	0.	0.	50
52	0.	1.000	4.000	2.000	1.000	9.000	9.000	9.000	52
53	0.	0.	6.000	4.000	4.000	0.	12.000	36.000	53
54	1.000	0.	5.000	3.000	2.000	0.	24.000	36.000	54
55	0.	0.	8.000	3.000	1.000	0.	30.000	48.000	55
56	1.000	7.000	10.000	6.000	2.000	0.	12.000	24.000	56
57	0.	2.000	3.000	2.000	1.000	12.000	24.000	36.000	57
58	0.	10.000	50.000	15.000	15.000	6.000	24.000	36.000	58
59	1.000	0.	18.000	2.000	0.	0.	0.	0.	59
60	0.	4.000	10.000	4.000	0.	12.000	36.000	60.000	60
61	1.000	2.000	10.000	0.	0.	4.000	24.000	0.	61
62	1.000	5.000	13.000	12.000	2.000	0.	24.000	72.000	62
63	0.	1.000	6.000	4.000	1.000	0.	0.	0.	63
64	1.000	3.000	15.000	15.000	3.000	0.	36.000	84.000	64
71	0.	2.000	4.000	1.000	0.	0.	0.	0.	71
72	0.	1.000	4.000	2.000	1.000	9.000	9.000	9.000	72
80	0.	0.	6.000	3.000	0.	0.	12.000	48.000	80
84	0.	1.000	2.000	5.000	2.000	24.000	30.000	38.000	84
85	0.	0.	1.000	1.000	0.	0.	0.	60.000	85
86	0.	0.	3.000	4.000	0.	0.	12.000	24.000	86
100	0.	0.	2.000	1.000	0.	6.000	0.	24.000	100
101	0.	0.	1.000	1.000	0.	0.	6.000	36.000	101
102	0.	0.	1.000	0.	0.	0.	12.000	0.	102
104	0.	0.	2.000	0.	2.000	0.	24.000	0.	104
105	0.	0.	0.	1.000	1.000	0.	0.	72.000	105
106	0.	0.	1.000	0.	0.	0.	18.000	0.	106
107	0.	4.000	4.000	1.000	1.000	12.000	24.000	48.000	107
109	1.000	1.000	3.000	1.000	1.000	12.000	24.000	24.000	109
110	0.	0.	5.000	0.	1.000	0.	48.000	0.	110
111	0.	1.000	1.000	1.000	1.000	12.000	12.000	24.000	111
112	0.	0.	1.000	0.	1.000	0.	12.000	0.	112
113	0.	0.	1.000	0.	0.	0.	12.000	0.	113
114	0.	0.	1.000	0.	1.000	0.	12.000	0.	114
115	0.	0.	1.000	0.	0.	0.	33.000	0.	115
116	0.	0.	0.	1.000	0.	0.	0.	48.000	116
117	0.	0.	1.000	0.	0.	0.	36.000	0.	117

	57	58	59	60	61	62	63	64	
118	0.	0.	0.	2.000	2.000	0.	0.	2.000	118
119	0.	0.	1.000	0.	1.000	0.	12.000	0.	119
120	0.	0.	0.	2.000	1.000	0.	0.	24.000	120
121	0.	1.000	5.000	1.000	0.	0.	0.	0.	121
122	0.	0.	1.000	0.	1.000	0.	24.000	0.	122
123	1.000	0.	2.000	0.	1.000	0.	36.000	0.	123
124	0.	0.	5.000	2.000	3.000	0.	36.000	36.000	124
125	0.	0.	2.000	1.000	1.000	0.	12.000	24.000	125
126	0.	0.	0.	1.000	0.	0.	0.	24.000	126
127	0.	0.	0.	1.000	0.	0.	0.	12.000	127
128	0.	0.	2.000	0.	2.000	0.	30.000	0.	128
129	0.	0.	1.000	1.000	0.	0.	12.000	24.000	129
130	0.	0.	0.	0.	1.000	0.	0.	0.	130
131	0.	0.	1.000	0.	0.	0.	0.	0.	131
132	0.	0.	1.000	1.000	0.	0.	24.000	84.000	132
133	0.	0.	1.000	1.000	0.	0.	24.000	60.000	133
134	0.	0.	1.000	1.000	0.	0.	8.000	8.000	134
135	0.	0.	0.	1.000	1.000	0.	0.	36.000	135
136	1.000	1.000	1.000	1.000	1.000	0.	12.000	60.000	136
137	0.	0.	1.000	0.	0.	0.	24.000	0.	137
138	0.	0.	0.	1.000	0.	0.	0.	99.000	138
139	0.	0.	0.	1.000	0.	0.	0.	99.000	139
140	0.	0.	0.	0.	1.000	0.	0.	0.	140
141	0.	0.	0.	0.	1.000	0.	0.	0.	141
142	0.	1.000	1.000	2.000	0.	0.	0.	12.000	142
143	0.	0.	1.000	1.000	0.	0.	24.000	48.000	143
144	0.	0.	1.000	1.000	0.	0.	0.	0.	144
145	0.	2.000	2.000	2.000	2.000	24.000	48.000	72.000	145
146	0.	0.	1.000	1.000	0.	0.	36.000	3.000	146
147	0.	0.	0.	1.000	0.	0.	0.	12.000	147
148	0.	4.000	5.000	5.000	3.000	12.000	24.000	24.000	148
149	0.	0.	4.000	0.	0.	0.	2.000	0.	149
150	0.	0.	0.	1.000	1.000	0.	0.	36.000	150
151	0.	0.	0.	0.	1.000	0.	0.	0.	151
152	0.	0.	1.000	0.	1.000	0.	0.	0.	152
153	0.	0.	1.000	0.	0.	0.	24.000	0.	153
154	0.	0.	1.000	0.	0.	0.	24.000	0.	154
155	0.	0.	0.	1.000	1.000	0.	0.	36.000	155
156	0.	0.	0.	0.	1.000	0.	0.	0.	156
157	0.	0.	0.	0.	1.000	0.	0.	0.	157
158	0.	0.	1.000	0.	0.	0.	24.000	0.	158
159	0.	0.	2.000	1.000	0.	0.	12.000	12.000	159

	57	58	59	60	61	62	63	64	
160	0.	0.	1.000	0.	0.	0.	36.000	0.	160
161	0.	0.	0.	1.000	0.	0.	0.	7.000	161
162	0.	0.	1.000	0.	0.	0.	24.000	0.	162
163	0.	0.	0.	1.000	0.	0.	0.	18.000	163
164	0.	0.	0.	0.	1.000	0.	0.	0.	164
165	0.	0.	0.	0.	1.000	0.	0.	0.	165
166	0.	6.000	2.000	0.	1.000	0.	0.	0.	166
167	0.	0.	2.000	2.000	1.000	0.	0.	0.	167
168	0.	0.	0.	1.000	0.	0.	0.	36.000	168
169	0.	0.	0.	0.	1.000	0.	0.	0.	169
170	0.	0.	1.000	0.	1.000	0.	12.000	0.	170
171	0.	0.	1.000	0.	1.000	0.	36.000	0.	171
173	0.	0.	1.000	0.	1.000	0.	12.000	0.	173
174	0.	0.	2.000	1.000	3.000	0.	12.000	24.000	174
175	0.	1.000	2.000	6.000	0.	14.000	36.000	60.000	175
176	1.000	0.	4.000	2.000	1.000	0.	6.000	12.000	176
177	0.	5.000	2.000	0.	0.	12.000	12.000	0.	177
179	1.000	0.	0.	4.000	1.000	0.	0.	0.	179
180	1.000	2.000	2.000	2.000	1.000	0.	0.	0.	180
181	1.000	1.000	8.000	1.000	1.000	0.	24.000	60.000	181
182	0.	3.000	6.000	3.000	0.	3.000	3.000	3.000	182
184	0.	0.	3.000	1.000	0.	0.	0.	0.	184
185	0.	0.	5.000	1.000	0.	0.	12.000	24.000	185
186	0.	0.	6.000	2.000	0.	0.	12.000	24.000	186
187	0.	0.	5.000	2.000	0.	0.	12.000	24.000	187
188	0.	0.	5.000	2.000	0.	0.	12.000	24.000	188
189	0.	0.	5.000	2.000	0.	0.	12.000	24.000	189
190	1.000	0.	3.000	1.000	0.	0.	12.000	48.000	190
191	0.	0.	6.000	3.000	0.	0.	12.000	24.000	191
192	0.	0.	0.	1.000	0.	0.	0.	12.000	192
193	0.	0.	0.	1.000	0.	0.	0.	18.000	193
194	0.	3.000	0.	0.	1.000	36.000	0.	0.	194
195	0.	0.	2.000	0.	0.	0.	24.000	0.	195
196	0.	0.	0.	0.	1.000	0.	0.	0.	196
197	0.	0.	1.000	0.	1.000	0.	18.000	0.	197
198	0.	0.	2.000	1.000	1.000	0.	24.000	60.000	198
199	0.	0.	0.	0.	2.000	0.	0.	0.	199
200	0.	0.	1.000	0.	0.	0.	42.000	0.	200
201	0.	0.	5.000	3.000	1.000	0.	12.000	48.000	201
202	0.	0.	0.	1.000	1.000	0.	0.	24.000	202
203	0.	0.	0.	1.000	0.	0.	0.	12.000	203
204	0.	0.	1.000	2.000	0.	0.	36.000	48.000	204
205	0.	0.	0.	0.	3.000	0.	0.	0.	205

Sample Number

72 Maximum number of programmers assigned to the project at one time. Entered from questionnaire.

71 Total number of programmers who worked for the duration of the project. Entered from questionnaire.

70 Total number of programmers who participated in program design. Coded in months.

69 Average Type IV programmer experience with the application represented by the Program Data Point. Coded in months.

68 Average Type III programmer experience with the application represented by the Program Data Point. Coded in months.

67 Average Type II programmer experience with the application represented by the Program Data Point. Coded in months.

66 Average Type I programmer experience with the application represented by the Program Data Point. Coded in months.

65 Average Type IV programmer experience with production language used in developing the Program Data Point. Coded in months.

Sample Number	72	71	70	69	68	67	66	65
1	12.000	0.	2.000	60.000	36.000	24.000	0.	60.000
2	1.000	0.	3.000	0.	0.	0.	0.	12.000
3	1.000	1.000	1.000	0.	0.	24.000	0.	0.
4	3.000	3.000	2.000	0.	0.	3.000	6.000	0.
5	2.000	1.000	1.000	0.	0.	0.	1.000	0.
6	1.000	1.000	1.000	0.	0.	6.000	0.	0.
7	1.000	1.000	1.000	0.	0.	0.	0.	0.
8	1.000	1.000	1.000	0.	0.	0.	0.	0.
9	1.000	1.000	1.000	0.	12.000	0.	0.	0.
10	1.000	1.000	1.000	0.	24.000	0.	0.	0.
11	1.000	1.000	1.000	0.	24.000	0.	0.	0.
12	1.000	1.000	1.000	0.	0.	0.	0.	0.
13	1.000	1.000	1.000	0.	48.000	0.	0.	0.
14	1.000	1.000	1.000	0.	48.000	0.	0.	0.
15	1.000	1.000	1.000	0.	48.000	0.	0.	0.
16	2.000	2.000	1.000	0.	24.000	0.	0.	0.
17	2.000	1.000	2.000	0.	0.	0.	0.	0.
18	2.000	2.000	2.000	0.	24.000	24.000	0.	0.
19	2.000	2.000	2.000	0.	0.	24.000	0.	0.
20	14.000	0.	3.000	60.000	12.000	12.000	12.000	0.
21	16.000	1.000	4.000	0.	36.000	24.000	0.	60.000
22	2.000	0.	2.000	0.	48.000	0.	0.	0.
23	1.000	1.000	3.000	0.	0.	0.	0.	12.000
24	1.000	0.	2.000	0.	0.	0.	0.	12.000
25	2.000	1.000	2.000	0.	48.000	0.	0.	0.
26	2.000	2.000	2.000	0.	0.	0.	0.	0.
27	3.000	2.000	2.000	24.000	48.000	12.000	0.	0.
28	1.000	1.000	1.000	0.	0.	0.	0.	0.
29	3.000	3.000	3.000	0.	0.	0.	0.	36.000
30	1.000	0.	3.000	0.	0.	0.	0.	0.
31	7.000	2.000	2.000	0.	24.000	36.000	3.000	12.000
32	6.000	1.000	2.000	0.	24.000	6.000	0.	0.
33	2.000	1.000	2.000	0.	48.000	12.000	0.	0.
34	4.000	3.000	2.000	48.000	72.000	12.000	0.	36.000
35	2.000	2.000	2.000	24.000	48.000	0.	0.	24.000
36	5.000	1.000	3.000	0.	48.000	12.000	0.	0.
37	3.000	2.000	2.000	0.	0.	12.000	0.	0.
38	4.000	2.000	3.000	0.	0.	0.	0.	0.
39	3.000	2.000	2.000	48.000	48.000	12.000	0.	48.000
40	12.000	6.000	4.000	12.000	36.000	24.000	0.	36.000
41	8.000	9.000	7.000	66.000	12.000	12.000	12.000	36.000
42	10.000	3.000	4.000		30.000	12.000	0.	
Sample Number	72	71	70	69	68	67	66	65

	65	66	67	68	69	70	71	72	
44	0.	0.	0.	0.	0.	7.000	4.000	8.000	44
45	48.000	0.	0.	0.	0.	4.000	3.000	5.000	45
46	12.000	0.	12.000	12.000	12.000	5.000	2.000	10.000	46
47	0.	0.	0.	0.	0.	2.000	2.000	4.000	47
48	36.000	0.	0.	12.000	12.000	7.000	8.000	10.000	48
49	0.	0.	0.	0.	0.	6.000	1.000	8.000	49
50	0.	24.000	36.000	48.000	60.000	6.000	15.000	24.000	50
52	9.000	9.000	9.000	9.000	9.000	8.000	8.000	7.000	52
53	60.000	0.	24.000	30.000	36.000	10.000	2.000	29.000	53
54	48.000	0.	0.	0.	0.	6.000	10.000	15.000	54
55	60.000	0.	0.	0.	0.	0.	10.000	15.000	55
56	24.000	0.	0.	6.000	0.	13.000	21.000	28.000	56
57	48.000	0.	0.	0.	0.	8.000	3.000	10.000	57
58	48.000	6.000	24.000	36.000	48.000	30.000	20.000	90.000	58
59	0.	0.	0.	0.	0.	10.000	10.000	20.000	59
60	0.	12.000	36.000	48.000	0.	18.000	18.000	22.000	60
61	0.	7.000	36.000	0.	0.	12.000	1.000	20.000	61
62	96.000	0.	24.000	72.000	96.000	14.000	20.000	32.000	62
63	0.	0.	0.	0.	0.	10.000	6.000	14.000	63
64	96.000	0.	36.000	84.000	96.000	17.000	17.000	36.000	64
71	0.	0.	0.	36.000	0.	6.000	5.000	6.000	71
72	9.000	9.000	9.000	9.000	9.000	8.000	8.000	7.000	72
80	0.	0.	12.000	60.000	0.	9.000	5.000	10.000	80
84	42.000	24.000	28.000	34.000	42.000	9.000	8.000	10.000	84
85	0.	0.	0.	0.	0.	2.000	2.000	2.000	85
86	0.	0.	12.000	24.000	0.	2.000	1.000	6.000	86
100	0.	12.000	0.	24.000	0.	2.000	3.000	3.000	100
101	0.	0.	0.	0.	0.	1.000	2.000	2.000	101
102	0.	0.	0.	0.	0.	1.000	1.000	1.000	102
104	48.000	0.	12.000	0.	60.000	2.000	2.000	4.000	104
105	72.000	0.	0.	24.000	99.000	1.000	1.000	2.000	105
106	0.	0.	72.000	0.	0.	1.000	1.000	1.000	106
107	72.000	0.	0.	0.	0.	2.000	2.000	10.000	107
109	36.000	0.	12.000	24.000	60.000	6.000	4.000	6.000	109
110	84.000	0.	12.000	0.	60.000	6.000	3.000	6.000	110
111	96.000	0.	0.	12.000	60.000	1.000	1.000	4.000	111
112	12.000	0.	12.000	0.	12.000	1.000	1.000	2.000	112
113	0.	0.	12.000	0.	0.	1.000	1.000	1.000	113
114	99.000	0.	12.000	0.	99.000	2.000	2.000	2.000	114
115	0.	0.	15.000	0.	0.	1.000	1.000	1.000	115
116	0.	0.	0.	24.000	0.	1.000	1.000	1.000	116
117	0.	0.	12.000	0.	0.	1.000	1.000	1.000	117

	65	66	67	68	69	70	71	72	
118	2.000	0.	0.	0.	0.	4.000	4.000	4.000	118
119	36.000	0.	6.000	0.	60.000	2.000	2.000	2.000	119
120	24.000	0.	0.	2.000	0.	2.000	3.000	3.000	120
121	0.	0.	0.	0.	0.	3.000	6.000	7.000	121
122	72.000	0.	0.	0.	0.	2.000	2.000	2.000	122
123	60.000	0.	24.000	0.	36.000	1.000	2.000	3.000	123
124	36.000	0.	36.000	48.000	60.000	5.000	3.000	10.000	124
125	24.000	0.	12.000	12.000	24.000	4.000	1.000	4.000	125
126	0.	0.	0.	12.000	0.	1.000	1.000	1.000	126
127	0.	0.	0.	0.	0.	1.000	1.000	1.000	127
128	30.000	0.	6.000	0.	48.000	2.000	2.000	4.000	128
129	0.	0.	6.000	36.000	0.	2.000	2.000	2.000	129
130	72.000	0.	0.	0.	24.000	1.000	1.000	1.000	130
131	0.	0.	12.000	0.	0.	0.	1.000	1.000	131
132	0.	0.	12.000	72.000	0.	2.000	1.000	2.000	132
133	0.	0.	99.000	0.	0.	2.000	2.000	2.000	133
134	0.	0.	4.000	4.000	0.	1.000	2.000	2.000	134
135	18.000	0.	0.	36.000	18.000	2.000	2.000	2.000	135
136	12.000	0.	0.	6.000	12.000	1.000	1.000	4.000	136
137	0.	0.	0.	0.	0.	1.000	1.000	1.000	137
138	0.	0.	0.	72.000	0.	1.000	1.000	1.000	138
139	0.	0.	0.	72.000	0.	1.000	1.000	1.000	139
140	48.000	0.	0.	0.	36.000	1.000	1.000	1.000	140
141	24.000	0.	0.	0.	99.000	1.000	1.000	1.000	141
142	0.	0.	0.	12.000	0.	1.000	2.000	4.000	142
143	0.	0.	12.000	24.000	0.	2.000	2.000	2.000	143
144	0.	0.	0.	0.	0.	1.000	2.000	2.000	144
145	96.000	0.	24.000	48.000	72.000	6.000	1.000	8.000	145
146	0.	0.	3.000	3.000	0.	2.000	1.000	2.000	146
147	0.	0.	0.	12.000	0.	1.000	1.000	1.000	147
148	24.000	12.000	12.000	24.000	36.000	10.000	17.000	17.000	148
149	0.	0.	0.	0.	0.	1.000	1.000	4.000	149
150	48.000	0.	0.	0.	12.000	2.000	2.000	2.000	150
151	12.000	0.	0.	0.	24.000	1.000	1.000	1.000	151
152	90.000	0.	0.	0.	90.000	1.000	1.000	2.000	152
153	0.	0.	60.000	0.	0.	1.000	1.000	1.000	153
154	0.	0.	3.000	0.	0.	1.000	1.000	1.000	154
155	6.000	0.	0.	12.000	84.000	2.000	2.000	2.000	155
156	48.000	0.	0.	0.	24.000	1.000	1.000	1.000	156
157	6.000	0.	0.	0.	0.	1.000	1.000	1.000	157
158	0.	0.	36.000	0.	0.	1.000	1.000	1.000	158
159	0.	0.	0.	0.	0.	2.000	3.000	3.000	159

	65	66	67	68	69	70	71	72	
160	0.	0.	0.	0.	0.	1.000	1.000	1.000	160
161	0.	0.	0.	7.000	0.	1.000	1.000	1.000	161
162	0.	0.	3.000	0.	0.	2.000	2.000	2.000	162
163	0.	0.	0.	12.000	0.	1.000	1.000	1.000	163
164	30.000	0.	0.	0.	48.000	1.000	1.000	1.000	164
165	24.000	0.	0.	0.	24.000	1.000	1.000	1.000	165
166	0.	12.000	36.000	0.	36.000	3.000	3.000	9.000	166
167	0.	0.	12.000	60.000	84.000	5.000	4.000	5.000	167
168	0.	0.	0.	0.	0.	1.000	1.000	1.000	168
169	48.000	0.	0.	0.	0.	1.000	1.000	1.000	169
170	12.000	0.	0.	0.	24.000	1.000	2.000	2.000	170
171	48.000	0.	0.	0.	0.	1.000	2.000	2.000	171
173	36.000	0.	12.000	0.	12.000	1.000	1.000	2.000	173
174	48.000	0.	0.	0.	6.000	6.000	4.000	5.000	174
175	0.	0.	0.	0.	0.	3.000	8.000	9.000	175
176	12.000	0.	0.	6.000	6.000	3.000	2.000	7.000	176
177	0.	12.000	36.000	0.	0.	3.000	7.000	7.000	177
179	0.	0.	0.	0.	0.	5.000	2.000	5.000	179
180	0.	0.	0.	0.	0.	5.000	3.000	7.000	180
181	60.000	0.	0.	24.000	36.000	2.000	2.000	11.000	181
182	0.	0.	0.	0.	0.	9.000	12.000	12.000	182
184	0.	0.	0.	0.	0.	1.000	4.000	4.000	184
185	0.	0.	12.000	24.000	0.	2.000	2.000	6.000	185
186	0.	0.	12.000	36.000	0.	2.000	1.000	8.000	186
187	0.	0.	12.000	48.000	0.	2.000	3.000	7.000	187
188	0.	0.	12.000	60.000	0.	2.000	2.000	7.000	188
189	0.	0.	12.000	36.000	0.	2.000	3.000	7.000	189
190	0.	0.	0.	0.	0.	2.000	4.000	4.000	190
191	0.	0.	12.000	48.000	0.	5.000	0.	9.000	191
192	0.	0.	0.	1.000	0.	1.000	1.000	1.000	192
193	0.	0.	0.	12.000	0.	1.000	1.000	1.000	193
194	36.000	0.	0.	0.	0.	4.000	2.000	4.000	194
195	0.	0.	0.	0.	0.	2.000	2.000	2.000	195
196	12.000	0.	0.	0.	12.000	1.000	1.000	1.000	196
197	18.000	0.	0.	0.	0.	2.000	1.000	2.000	197
198	0.	0.	12.000	36.000	60.000	4.000	2.000	4.000	198
199	16.000	0.	0.	0.	12.000	2.000	2.000	2.000	199
200	0.	0.	0.	0.	0.	1.000	1.000	1.000	200
201	72.000	0.	0.	0.	0.	2.000	5.000	9.000	201
202	36.000	0.	0.	36.000	24.000	2.000	2.000	2.000	202
203	0.	0.	0.	12.000	0.	1.000	1.000	1.000	203
204	0.	0.	36.000	36.000	0.	3.000	3.000	3.000	204
205	72.000	0.	0.	0.	36.000	2.000	2.000	3.000	205

Sample Number

80 Was the Program Data Point developed at a site other than the operational location? Coded: Yes = 1; No = 0.

79 Was time-sharing implemented in program production? Coded: Yes = 1; No = 0.

78 Was the production computer facility operated on the basis of an open shop or a closed shop? Coded: open shop = 0; closed shop = 1.

77 Was the production computer operated by an organization other than the Program Data Point developer? Coded: Yes = 1; No = 0.

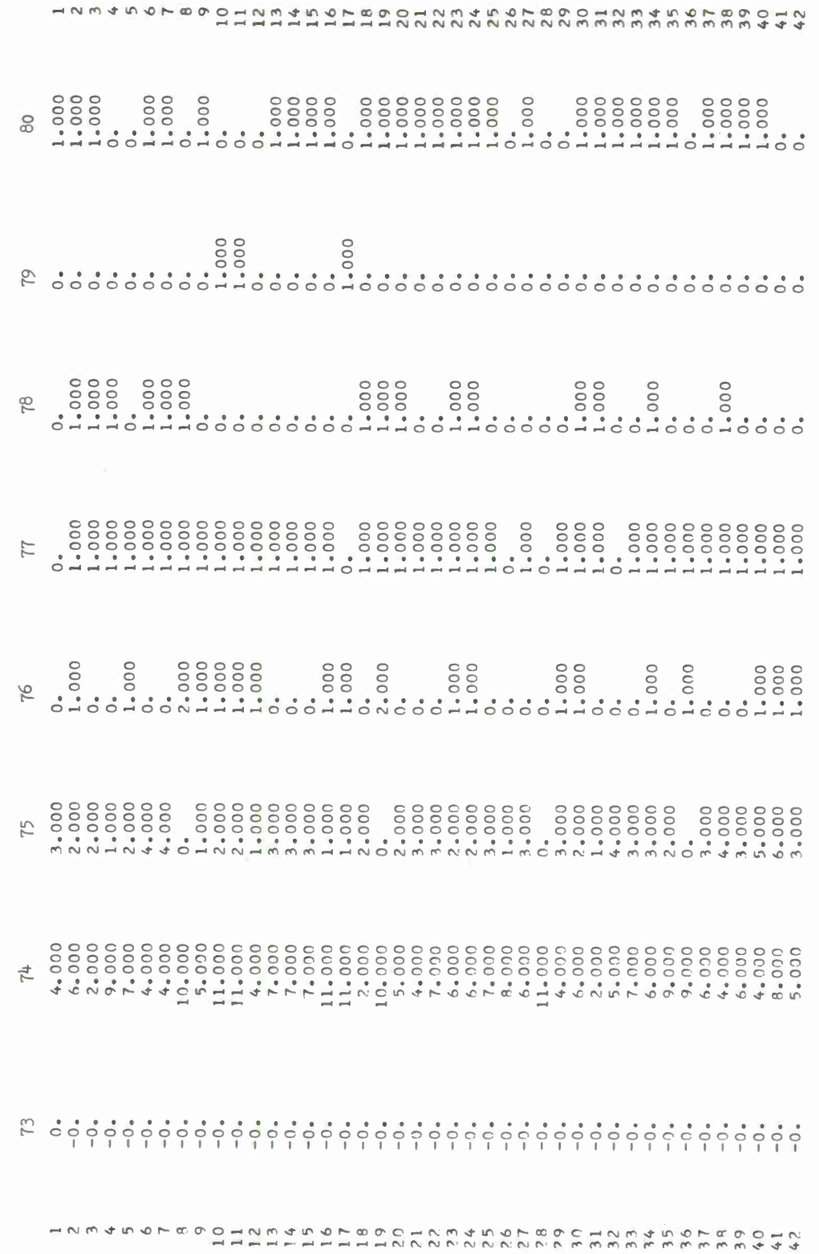
76 Estimated customer experience and knowledge concerning the development of automatic data processing systems. Coded: extensive = 0; limited = 1; none = 2.

75 Number of agencies whose concurrence was required on operational design specifications. Entered from questionnaire.

74 Implementation of Management Procedures. Coded in number of no replies.

73

Sample Number



	73	74	75	76	77	78	79	80	
44	-0.	3.000	4.000	1.000	0.	0.	0.	1.000	44
45	-0.	9.000	1.000	0.	0.	0.	1.000	0.	45
46	-0.	9.000	1.000	1.000	1.000	0.	0.	1.000	46
47	-0.	6.000	1.000	0.	0.	1.000	0.	0.	47
48	-0.	5.000	2.000	1.000	1.000	0.	0.	1.000	48
49	-0.	8.000	1.000	1.000	1.000	1.000	0.	0.	49
50	-0.	5.000	2.000	1.000	1.000	0.	0.	1.000	50
52	-0.	3.000	4.000	1.000	0.	0.	0.	1.000	52
53	-0.	4.000	3.000	0.	0.	0.	0.	1.000	53
54	-0.	2.000	1.000	1.000	1.000	0.	0.	1.000	54
55	-0.	6.000	2.000	1.000	1.000	0.	0.	1.000	55
56	-0.	9.000	0.	0.	1.000	1.000	0.	1.000	56
57	-0.	5.000	1.000	1.000	1.000	0.	0.	1.000	57
58	-0.	2.000	2.000	0.	1.000	1.000	0.	1.000	58
59	-0.	5.000	2.000	2.000	1.000	1.000	0.	1.000	59
60	-0.	1.000	4.000	0.	0.	1.000	0.	0.	60
61	-0.	8.000	1.000	1.000	1.000	0.	0.	1.000	61
62	-0.	7.000	0.	0.	1.000	1.000	0.	0.	62
63	-0.	5.000	0.	1.000	0.	0.	0.	1.000	63
64	-0.	7.000	0.	0.	1.000	1.000	0.	0.	64
71	-0.	3.000	5.000	1.000	0.	0.	0.	1.000	71
72	-0.	3.000	5.000	1.000	0.	0.	0.	1.000	72
80	-0.	3.000	5.000	0.	1.000	1.000	0.	0.	80
84	-0.	1.000	3.000	1.000	1.000	0.	0.	0.	84
85	-0.	11.000	1.000	0.	0.	0.	0.	0.	85
86	-0.	6.000	3.000	1.000	1.000	0.	0.	1.000	86
100	-0.	2.000	3.000	1.000	0.	1.000	0.	1.000	100
101	-0.	1.000	1.000	1.000	0.	1.000	0.	1.000	101
102	-0.	1.000	2.000	1.000	0.	1.000	0.	1.000	102
104	-0.	3.000	1.000	1.000	1.000	0.	0.	1.000	104
105	-0.	5.000	3.000	1.000	0.	1.000	0.	1.000	105
106	-0.	6.000	1.000	1.000	1.000	1.000	0.	0.	106
107	-0.	3.000	1.000	2.000	1.000	1.000	0.	0.	107
109	-0.	3.000	1.000	1.000	1.000	0.	0.	1.000	109
110	-0.	1.000	4.000	0.	0.	0.	0.	0.	110
111	-0.	3.000	2.000	1.000	1.000	0.	0.	1.000	111
112	-0.	3.000	2.000	1.000	0.	1.000	0.	1.000	112
113	-0.	6.000	1.000	1.000	1.000	0.	0.	1.000	113
114	-0.	0.	2.000	0.	1.000	0.	1.000	1.000	114
115	-0.	7.000	1.000	2.000	0.	1.000	0.	1.000	115
116	-0.	8.000	1.000	1.000	0.	1.000	0.	1.000	116
117	-0.	7.000	0.	1.000	0.	1.000	0.	1.000	117

	73	74	75	76	77	78	79	80	
118	-0.	7.000	0.	2.000	1.000	1.000	0.	1.000	118
119	-0.	10.000	1.000	0.	0.	1.000	0.	1.000	119
120	-0.	8.000	0.	1.000	1.000	1.000	0.	1.000	120
121	-0.	5.000	2.000	1.000	0.	0.	0.	0.	121
122	-0.	6.000	1.000	2.000	0.	1.000	0.	0.	122
123	-0.	2.000	1.000	0.	1.000	0.	1.000	0.	123
124	-0.	5.000	2.000	1.000	0.	1.000	0.	1.000	124
125	-0.	2.000	2.000	0.	0.	1.000	0.	1.000	125
126	-0.	2.000	2.000	0.	0.	1.000	0.	1.000	126
127	-0.	3.000	2.000	1.000	0.	1.000	0.	1.000	127
128	-0.	5.000	1.000	1.000	0.	1.000	0.	1.000	128
129	-0.	5.000	1.000	1.000	0.	1.000	0.	1.000	129
130	-0.	2.000	1.000	0.	0.	1.000	0.	1.000	130
131	-0.	6.000	1.000	2.000	1.000	0.	1.000	1.000	131
132	-0.	5.000	0.	0.	1.000	1.000	0.	1.000	132
133	-0.	10.000	1.000	2.000	0.	1.000	0.	1.000	133
134	-0.	10.000	1.000	1.000	0.	1.000	0.	1.000	134
135	-0.	2.000	2.000	1.000	0.	1.000	0.	1.000	135
136	-0.	9.000	1.000	2.000	1.000	0.	0.	1.000	136
137	-0.	2.000	1.000	0.	0.	1.000	0.	1.000	137
138	-0.	4.000	1.000	2.000	0.	1.000	0.	1.000	138
139	-0.	4.000	1.000	2.000	0.	1.000	0.	1.000	139
140	-0.	7.000	1.000	1.000	0.	0.	0.	1.000	140
141	-0.	5.000	1.000	0.	1.000	1.000	0.	1.000	141
142	-0.	8.000	1.000	0.	1.000	0.	0.	0.	142
143	-0.	10.000	1.000	1.000	0.	0.	1.000	1.000	143
144	-0.	3.000	1.000	0.	1.000	0.	0.	1.000	144
145	-0.	3.000	1.000	1.000	1.000	1.000	0.	1.000	145
146	-0.	9.000	1.000	1.000	1.000	0.	0.	1.000	146
147	-0.	6.000	1.000	0.	1.000	0.	0.	1.000	147
148	-0.	9.000	3.000	1.000	1.000	0.	0.	1.000	148
149	-0.	4.000	2.000	0.	0.	1.000	0.	1.000	149
150	-0.	2.000	3.000	2.000	1.000	1.000	0.	1.000	150
151	-0.	3.000	2.000	0.	1.000	1.000	0.	1.000	151
152	-0.	7.000	2.000	2.000	0.	1.000	0.	1.000	152
153	-0.	6.000	3.000	1.000	0.	1.000	0.	1.000	153
154	-0.	6.000	2.000	1.000	0.	1.000	0.	1.000	154
155	-0.	8.000	8.000	2.000	0.	1.000	0.	1.000	155
156	-0.	6.000	7.000	1.000	0.	1.000	0.	1.000	156
157	-0.	8.000	1.000	1.000	0.	1.000	0.	1.000	157
158	-0.	6.000	12.000	1.000	0.	1.000	0.	1.000	158
159	-0.	5.000	1.000	2.000	1.000	0.	0.	1.000	159

	73	74	75	76	77	78	79	80	
160	-0.	4.000	2.000	2.000	1.000	0.	0.	1.000	160
161	-0.	3.000	5.000	1.000	0.	0.	0.	1.000	161
162	-0.	3.000	4.000	1.000	0.	0.	0.	1.000	162
163	-0.	3.000	3.000	1.000	0.	0.	0.	1.000	163
164	-0.	5.000	1.000	1.000	1.000	0.	0.	1.000	164
165	-0.	7.000	2.000	2.000	0.	0.	0.	1.000	165
166	-0.	1.000	8.000	1.000	1.000	1.000	0.	1.000	166
167	-0.	2.000	5.000	0.	1.000	1.000	0.	1.000	167
168	-0.	2.000	2.000	1.000	1.000	0.	0.	1.000	168
169	-0.	5.000	2.000	1.000	1.000	1.000	0.	1.000	169
170	-0.	9.000	1.000	1.000	1.000	1.000	0.	1.000	170
171	-0.	6.000	1.000	1.000	1.000	1.000	0.	1.000	171
173	-0.	4.000	3.000	1.000	1.000	1.000	0.	1.000	173
174	-0.	11.000	1.000	1.000	0.	1.000	0.	1.000	174
175	-0.	3.000	1.000	0.	0.	0.	0.	0.	175
176	-0.	2.000	1.000	0.	0.	0.	0.	1.000	176
177	-0.	7.000	4.000	1.000	0.	0.	0.	0.	177
179	-0.	7.000	7.000	1.000	1.000	0.	0.	1.000	179
180	-0.	7.000	7.000	1.000	1.000	0.	0.	1.000	180
181	-0.	1.000	8.000	1.000	0.	0.	0.	0.	181
182	-0.	3.000	2.000	0.	0.	1.000	0.	1.000	182
184	-0.	4.000	3.000	0.	1.000	0.	0.	0.	184
185	-0.	4.000	3.000	1.000	1.000	0.	0.	0.	185
186	-0.	4.000	3.000	1.000	1.000	0.	0.	0.	186
187	-0.	4.000	3.000	1.000	1.000	0.	0.	0.	187
188	-0.	4.000	3.000	1.000	1.000	0.	0.	0.	188
189	-0.	4.000	3.000	1.000	1.000	0.	0.	0.	189
190	-0.	5.000	3.000	0.	1.000	1.000	0.	0.	190
191	-0.	4.000	3.000	1.000	1.000	0.	0.	0.	191
192	-0.	4.000	0.	0.	0.	0.	0.	1.000	192
193	-0.	8.000	3.000	1.000	0.	1.000	0.	1.000	193
194	-0.	6.000	0.	0.	1.000	0.	0.	1.000	194
195	-0.	3.000	2.000	1.000	0.	0.	0.	1.000	195
196	-0.	6.000	0.	1.000	1.000	1.000	0.	1.000	196
197	-0.	1.000	0.	1.000	0.	0.	0.	1.000	197
198	-0.	9.000	0.	0.	1.000	0.	0.	1.000	198
199	-0.	5.000	1.000	1.000	1.000	1.000	0.	1.000	199
200	-0.	3.000	2.000	1.000	1.000	1.000	0.	1.000	200
201	-0.	4.000	2.000	1.000	0.	0.	0.	1.000	201
202	-0.	1.000	1.000	1.000	1.000	0.	0.	1.000	202
203	-0.	5.000	2.000	2.000	0.	0.	0.	1.000	203
204	-0.	9.000	1.000	1.000	1.000	1.000	0.	1.000	204
205	-0.	4.000	4.000	1.000	1.000	1.000	0.	0.	205

Sample Number

88 Does the Program Data Point represent a utility or software application?
Coded: Yes = 1; No = 0.

87 Does the Program Data Point represent a scientific application? Coded:
Yes = 1; No = 0.

86 Does the Program Data Point represent a business application? Coded:
Yes = 1; No = 0.

85 Add time of developmental computer. Coded in microseconds.

84 Memory access time of developmental computer. Coded in microseconds x 10.

83 Number of bits in a memory word of the developmental computer.

82 Number of locations at which Program Data Point was developed. Entered
from questionnaire; minimum value = 1.

81 Was the developmental computer different from the operational computer?
Coded: Yes = 1; No = 0.

Sample Number

	88	87	86	85	84	83	82	81
1	0.	0.	0.	12.000	60.000	32.000	1.000	0.
2	0.	0.	0.	2.000	7.000	48.000	1.000	0.
3	0.	0.	0.	12.000	60.000	32.000	1.000	0.
4	0.	0.	1.000	12.000	60.000	32.000	1.000	0.
5	0.	0.	0.	230.000	115.000	6.000	1.000	0.
6	0.	0.	0.	12.000	60.000	32.000	1.000	0.
7	0.	0.	0.	12.000	60.000	32.000	1.000	1.000
8	0.	0.	1.000	3.000	14.000	36.000	1.000	0.
9	0.	0.	1.000	5.000	25.000	48.000	1.000	1.000
10	0.	0.	1.000	5.000	25.000	48.000	1.000	0.
11	0.	0.	0.	3.000	14.000	36.000	.000	0.
12	0.	0.	0.	6.000	64.000	12.000	1.000	0.
13	0.	0.	0.	6.000	64.000	12.000	3.000	0.
14	0.	0.	0.	6.000	64.000	12.000	2.000	0.
15	0.	0.	0.	230.000	115.000	6.000	1.000	0.
16	0.	0.	1.000	5.000	25.000	48.000	1.000	0.
17	0.	0.	1.000	12.000	60.000	32.000	1.000	0.
18	0.	1.000	0.	12.000	60.000	32.000	1.000	0.
19	0.	1.000	0.	12.000	60.000	32.000	2.000	0.
20	0.	0.	0.	6.000	64.000	12.000	1.000	0.
21	0.	0.	0.	2.000	7.000	48.000	3.000	0.
22	0.	0.	0.	2.000	64.000	12.000	1.000	0.
23	0.	0.	0.	6.000	7.000	48.000	3.000	0.
24	0.	0.	0.	1.000	64.000	12.000	1.000	0.
25	0.	0.	1.000	6.000	50.000	18.000	1.000	0.
26	0.	0.	0.	230.000	64.000	12.000	3.000	0.
27	0.	0.	1.000	5.000	115.000	6.000	1.000	0.
28	0.	0.	1.000	2.000	22.000	36.000	1.000	0.
29	0.	0.	0.	12.000	7.000	48.000	1.000	0.
30	0.	0.	0.	6.000	60.000	32.000	1.000	0.
31	0.	0.	0.	6.000	64.000	12.000	1.000	0.
32	0.	0.	0.	6.000	64.000	12.000	3.000	0.
33	0.	0.	0.	1.000	64.000	12.000	3.000	0.
34	0.	0.	0.	3.000	70.000	48.000	3.000	0.
35	1.000	0.	0.	5.000	14.000	36.000	2.000	0.
36	1.000	0.	0.	6.000	22.000	36.000	1.000	0.
37	0.	0.	0.	12.000	64.000	12.000	3.000	0.
38	0.	1.000	0.	6.000	60.000	32.000	1.000	0.
39	0.	0.	0.	6.000	64.000	12.000	3.000	0.
40	0.	0.	0.	12.000	60.000	32.000	1.000	0.
41	0.	0.	1.000	5.000	25.000	48.000	1.000	0.
42	0.	1.000	0.	5.000	22.000	36.000	1.000	0.

	81	82	83	84	85	86	87	88	
44	1.000	1.000	48.000	20.000	4.000	0.	0.	0.	44
45	0.	1.000	48.000	25.000	5.000	1.000	0.	0.	45
46	0.	2.000	6.000	115.000	230.000	0.	1.000	0.	46
47	0.	1.000	32.000	25.000	5.000	1.000	0.	0.	47
48	0.	2.000	48.000	48.000	7.000	0.	1.000	0.	48
49	0.	2.000	48.000	48.000	7.000	0.	0.	1.000	49
50	0.	2.000	48.000	70.000	1.000	0.	0.	1.000	50
52	1.000	4.000	48.000	60.000	10.000	0.	0.	0.	52
53	0.	1.000	32.000	60.000	12.000	0.	0.	0.	53
54	0.	2.000	48.000	48.000	7.000	0.	1.000	0.	54
55	0.	2.000	48.000	48.000	7.000	0.	1.000	0.	55
56	0.	2.000	32.000	60.000	12.000	0.	0.	0.	56
57	0.	2.000	48.000	48.000	7.000	1.000	0.	0.	57
58	0.	1.000	32.000	60.000	12.000	0.	0.	0.	58
59	0.	1.000	48.000	48.000	7.000	0.	1.000	0.	59
60	0.	1.000	36.000	14.000	3.000	0.	0.	0.	60
61	0.	1.000	48.000	48.000	7.000	0.	1.000	0.	61
62	0.	2.000	32.000	60.000	12.000	0.	0.	0.	62
63	1.000	2.000	48.000	60.000	10.000	0.	0.	1.000	63
64	0.	2.000	32.000	60.000	12.000	0.	0.	0.	64
71	1.000	1.000	48.000	60.000	10.000	0.	1.000	0.	71
72	1.000	3.000	48.000	60.000	10.000	0.	0.	0.	72
80	0.	1.000	32.000	60.000	12.000	0.	0.	0.	80
84	0.	1.000	36.000	22.000	5.000	0.	0.	0.	84
85	0.	1.000	32.000	60.000	12.000	1.000	0.	0.	85
86	0.	1.000	48.000	48.000	7.000	1.000	0.	0.	86
100	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	100
101	0.	2.000	6.000	45.000	110.000	1.000	0.	0.	101
102	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	102
104	0.	1.000	6.000	10.000	11.000	1.000	0.	0.	104
105	0.	0.	6.000	45.000	110.000	1.000	0.	0.	105
106	0.	1.000	6.000	70.000	189.000	1.000	0.	0.	106
107	0.	1.000	6.000	10.000	11.000	0.	0.	1.000	107
109	0.	1.000	36.000	18.000	4.000	1.000	0.	0.	109
110	0.	2.000	6.000	10.000	11.000	1.000	0.	0.	110
111	0.	1.000	6.000	115.000	230.000	1.000	0.	0.	111
112	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	112
113	0.	1.000	36.000	22.000	5.000	0.	1.000	0.	113
114	1.000	2.000	6.000	115.000	230.000	1.000	0.	0.	114
115	0.	1.000	48.000	40.000	15.000	0.	1.000	0.	115
116	0.	1.000	48.000	40.000	15.000	1.000	0.	0.	116
117	0.	1.000	48.000	40.000	15.000	0.	1.000	0.	117

	81	82	83	84	85	86	87	88	
118	0.	1.000	48.000	40.000	15.000	0.	1.000	0.	118
119	0.	1.000	48.000	40.000	15.000	0.	0.	1.000	119
120	0.	1.000	48.000	40.000	15.000	0.	1.000	0.	120
121	1.000	1.000	6.000	10.000	11.000	1.000	0.	0.	121
122	0.	1.000	6.000	10.000	11.000	0.	1.000	0.	122
123	0.	1.000	6.000	10.000	11.000	1.000	0.	0.	123
124	0.	1.000	36.000	80.000	16.000	1.000	0.	0.	124
125	0.	1.000	36.000	80.000	16.000	1.000	0.	0.	125
126	0.	1.000	36.000	80.000	16.000	1.000	0.	0.	126
127	0.	1.000	36.000	80.000	16.000	0.	1.000	0.	127
128	0.	1.000	36.000	80.000	16.000	1.000	0.	0.	128
129	0.	1.000	36.000	80.000	16.000	1.000	0.	0.	129
130	0.	1.000	6.000	70.000	189.000	0.	1.000	0.	130
131	0.	1.000	36.000	18.000	4.000	1.000	0.	0.	131
132	0.	1.000	36.000	14.000	3.000	0.	1.000	0.	132
133	0.	1.000	40.000	950.000	999.000	0.	1.000	0.	133
134	0.	1.000	6.000	115.000	100.000	1.000	0.	0.	134
135	0.	1.000	6.000	120.000	360.000	1.000	0.	0.	135
136	0.	1.000	6.000	100.000	185.000	1.000	0.	0.	136
137	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	137
138	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	138
139	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	139
140	0.	1.000	6.000	115.000	230.000	1.000	0.	0.	140
141	0.	1.000	12.000	64.000	6.000	1.000	0.	0.	141
142	0.	2.000	12.000	64.000	6.000	0.	0.	1.000	142
143	0.	1.000	32.000	25.000	5.000	1.000	0.	0.	143
144	0.	2.000	48.000	48.000	7.000	1.000	0.	0.	144
145	0.	1.000	36.000	14.000	3.000	0.	0.	1.000	145
146	0.	2.000	12.000	64.000	6.000	1.000	0.	0.	146
147	0.	2.000	12.000	64.000	6.000	0.	0.	1.000	147
148	0.	2.000	12.000	64.000	6.000	0.	0.	1.000	148
149	0.	1.000	6.000	70.000	189.000	0.	1.000	0.	149
150	0.	1.000	6.000	70.000	189.000	1.000	0.	0.	150
151	0.	1.000	6.000	70.000	189.000	1.000	0.	0.	151
152	0.	1.000	20.000	180.000	36.000	0.	1.000	0.	152
153	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	153
154	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	154
155	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	155
156	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	156
157	0.	1.000	20.000	180.000	36.000	0.	1.000	0.	157
158	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	158
159	0.	1.000	36.000	14.000	3.000	1.000	0.	0.	159

	81	82	83	84	85	86	87	88	
160	0.	1.000	36.000	14.000	3.000	1.000	0.	0.	160
161	0.	1.000	36.000	25.000	5.000	1.000	0.	0.	161
162	0.	1.000	36.000	25.000	5.000	1.000	0.	0.	162
163	0.	1.000	36.000	25.000	5.000	1.000	0.	0.	163
164	0.	1.000	20.000	60.000	12.000	1.000	0.	0.	164
165	0.	1.000	20.000	60.000	12.000	1.000	0.	0.	165
156	0.	1.000	24.000	51.000	16.000	1.000	0.	0.	166
167	0.	1.000	24.000	51.000	16.000	1.000	0.	0.	167
168	0.	1.000	36.000	14.000	3.000	1.000	0.	0.	168
169	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	169
170	0.	2.000	20.000	180.000	36.000	1.000	0.	0.	170
171	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	171
173	0.	1.000	20.000	180.000	36.000	1.000	0.	0.	173
174	0.	1.000	6.000	45.000	110.000	0.	0.	1.000	174
175	0.	3.000	36.000	80.000	16.000	0.	0.	1.000	175
176	0.	1.000	32.000	20.000	39.000	0.	0.	1.000	176
177	1.000	4.000	32.000	20.000	39.000	0.	0.	1.000	177
179	0.	1.000	32.000	20.000	39.000	0.	0.	1.000	179
180	0.	1.000	32.000	20.000	39.000	0.	0.	1.000	180
181	1.000	2.000	32.000	20.000	39.000	0.	0.	1.000	181
182	0.	3.000	32.000	20.000	39.000	0.	0.	1.000	182
184	0.	3.000	32.000	20.000	39.000	0.	0.	1.000	184
185	1.000	1.000	36.000	40.000	12.000	0.	0.	1.000	185
186	1.000	2.000	36.000	40.000	12.000	0.	0.	1.000	186
187	1.000	2.000	36.000	40.000	12.000	0.	0.	1.000	187
188	1.000	1.000	36.000	40.000	12.000	0.	0.	1.000	188
189	1.000	1.000	36.000	40.000	12.000	0.	0.	1.000	189
190	1.000	3.000	36.000	40.000	12.000	0.	0.	1.000	190
191	1.000	1.000	36.000	40.000	12.000	0.	0.	1.000	191
192	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	192
193	0.	1.000	6.000	115.000	230.000	1.000	0.	0.	193
194	0.	1.000	36.000	18.000	4.000	1.000	0.	0.	194
195	0.	1.000	6.000	10.000	11.000	1.000	0.	0.	195
196	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	196
197	0.	1.000	6.000	115.000	230.000	1.000	0.	0.	197
198	0.	1.000	6.000	45.000	110.000	1.000	0.	0.	198
199	0.	1.000	6.000	10.000	11.000	1.000	0.	0.	199
200	0.	1.000	6.000	24.000	35.000	1.000	0.	0.	200
201	0.	1.000	6.000	45.000	110.000	0.	0.	1.000	201
202	0.	1.000	36.000	22.000	5.000	1.000	0.	0.	202
203	0.	1.000	36.000	22.000	5.000	1.000	0.	0.	203
204	0.	1.000	36.000	18.000	4.000	0.	1.000	0.	204
205	1.000	2.000	36.000	14.000	3.000	0.	1.000	0.	205

94 Was the Program Data Point an independent program in which there are no interfaces with other programs? Coded: Yes = 1; No = 0.

93 Total object instructions generated from procedure-oriented source statements. Entered from questionnaire, in thousands.

92 Cost of developmental computer, based on equivalent purchase cost. Coded: large-scale ($750,000 and up) = 0; medium-scale ($100,000 to $749,000) = 1; small-scale (less than $100,000) = 2.

91 Was the Program Data Point produced at a military installation? Coded: Yes = 1; No = 0.

90 Was the Program Data Point written at SDC? Coded: Yes = 1; No = 0.

89 Does the Program Data Point represent a command and control application? Coded: Yes = 1; No = 0.

Sample Number

Sample Number	89	90	91	92	93	94
1	1.000	1.000	0.	0.	0.	1.000
2	1.000	1.000	0.	0.	0.	1.000
3	1.000	1.000	0.	0.	0.	1.000
4	1.000	1.000	0.	2.000	0.	0.
5	0.	1.000	0.	0.	4.580	1.000
6	1.000	1.000	0.	0.	0.715	1.000
7	1.000	1.000	0.	0.	0.	1.000
8	0.	1.000	0.	0.	2.683	0.
9	0.	1.000	0.	0.	1.600	0.
10	0.	1.000	0.	0.	1.500	0.
11	0.	1.000	0.	0.	4.500	0.
12	0.	1.000	0.	1.000	0.	1.000
13	1.000	1.000	0.	1.000	0.	1.000
14	1.000	1.000	0.	2.000	0.	1.000
15	1.000	1.000	0.	0.	0.	0.
16	0.	1.000	0.	0.	0.	1.000
17	0.	1.000	0.	0.	0.	1.000
18	1.000	1.000	0.	0.	0.	1.000
19	0.	1.000	0.	0.	0.	1.000
20	0.	1.000	0.	0.	0.	1.000
21	1.000	1.000	0.	1.000	0.	1.000
22	1.000	1.000	0.	0.	0.	1.000
23	1.000	1.000	0.	1.000	0.	1.000
24	1.000	1.000	0.	2.000	0.	1.000
25	0.	1.000	0.	1.000	0.	0.
26	1.000	1.000	0.	2.000	1.878	0.
27	0.	1.000	0.	0.	0.	1.000
28	0.	1.000	0.	0.	0.	1.000
29	1.000	1.000	0.	0.	0.	1.000
30	0.	1.000	0.	1.000	0.	1.000
31	1.000	1.000	0.	1.000	0.	1.000
32	1.000	1.000	0.	0.	0.	1.000
33	1.000	1.000	0.	0.	0.	1.000
34	1.000	1.000	0.	0.	0.	1.000
35	0.	1.000	0.	0.	0.	1.000
36	1.000	1.000	0.	0.	0.	1.000
37	0.	1.000	0.	0.	19.000	1.000
38	1.000	1.000	0.	1.000	0.	1.000
39	1.000	1.000	0.	0.	0.	1.000
40	0.	1.000	0.	0.	0.	0.
41	0.	1.000	0.	0.	11.036	1.000
42	0.	1.000	0.	0.	0.	1.000

	89	90	91	92	93	94
44	1.000	1.000	0.	0.	0.	1.000
45	0.	1.000	0.	0.	0.	0.
46	0.	1.000	0.	2.000	0.	1.000
47	0.	1.000	0.	0.	40.000	0.
48	0.	1.000	0.	0.	0.	1.000
49	0.	1.000	0.	0.	0.	1.000
50	0.	1.000	0.	0.	0.	1.000
52	1.000	1.000	0.	0.	0.	1.000
53	1.000	1.000	0.	0.	0.	1.000
54	0.	1.000	0.	0.	0.	1.000
55	0.	1.000	0.	0.	0.	1.000
56	1.000	1.000	0.	0.	0.	1.000
57	0.	1.000	0.	0.	25.000	1.000
58	1.000	1.000	0.	0.	0.	1.000
59	0.	1.000	0.	0.	0.	1.000
60	1.000	1.000	0.	0.	0.	1.000
61	0.	1.000	0.	0.	0.	1.000
62	1.000	1.000	0.	0.	0.	1.000
63	0.	1.000	0.	0.	0.	1.000
64	1.000	1.000	0.	0.	0.	1.000
71	0.	1.000	0.	0.	0.	1.000
72	1.000	1.000	0.	0.	0.	1.000
80	1.000	1.000	0.	0.	0.	1.000
84	1.000	1.000	0.	0.	12.898	1.000
85	0.	1.000	0.	0.	8.400	0.
86	0.	1.000	0.	0.	0.	0.
100	0.	0.	1.000	1.000	0.	1.000
101	0.	0.	1.000	1.000	0.	1.000
102	0.	0.	1.000	1.000	0.	1.000
104	0.	0.	1.000	0.	0.	1.000
105	0.	0.	1.000	1.000	0.	1.000
106	0.	0.	1.000	1.000	0.	1.000
107	0.	0.	1.000	0.	0.	1.000
109	0.	0.	1.000	0.	46.496	1.000
110	0.	0.	1.000	0.	0.	1.000
111	0.	0.	1.000	2.000	0.	1.000
112	0.	0.	1.000	1.000	0.	1.000
113	0.	0.	1.000	0.	2.559	1.000
114	0.	0.	1.000	2.000	0.	1.000
115	0.	0.	1.000	0.	0.795	0.
116	0.	0.	1.000	0.	0.145	1.000
117	0.	0.	1.000	0.	1.907	0.

	89	90	91	92	93	94
118	0.	0.	1.000	0.	0.887	0.
119	0.	0.	1.000	0.	2.028	0.
120	0.	0.	1.000	0.	0.	0.
121	0.	0.	1.000	0.	0.	1.000
122	0.	0.	1.000	0.	0.	0.
123	0.	0.	1.000	0.	0.	1.000
124	0.	0.	1.000	0.	0.276	0.
125	0.	0.	1.000	0.	0.	0.
126	0.	0.	1.000	0.	0.732	1.000
127	0.	0.	1.000	0.	0.217	1.000
128	0.	0.	1.000	0.	0.	1.000
129	0.	0.	1.000	0.	1.224	1.000
130	0.	0.	1.000	1.000	0.	1.000
131	0.	0.	1.000	0.	0.	1.000
132	0.	0.	1.000	0.	19.282	0.
133	0.	0.	1.000	2.000	0.	0.
134	0.	0.	1.000	1.000	0.	0.
135	0.	0.	1.000	1.000	4.847	1.000
136	0.	0.	1.000	1.000	0.	1.000
137	0.	0.	1.000	1.000	0.	1.000
138	0.	0.	1.000	1.000	0.	1.000
139	0.	0.	1.000	1.000	0.	1.000
140	0.	0.	0.	2.000	0.	1.000
141	0.	0.	0.	1.000	0.	1.000
142	0.	0.	0.	1.000	0.	1.000
143	0.	1.000	0.	0.	5.750	0.
144	0.	0.	0.	0.	0.	0.
145	0.	0.	0.	0.	8.000	0.
146	0.	0.	0.	1.000	0.	1.000
147	0.	0.	0.	1.000	0.	1.000
148	0.	0.	0.	1.000	0.	1.000
149	0.	0.	0.	1.000	0.	0.
150	0.	0.	0.	1.000	0.	0.
151	0.	0.	0.	1.000	0.	1.000
152	0.	0.	0.	1.000	0.	1.000
153	0.	0.	0.	1.000	0.	1.000
154	0.	0.	0.	1.000	0.	1.000
155	0.	0.	0.	1.000	0.	1.000
156	0.	0.	0.	1.000	0.	1.000
157	0.	0.	0.	1.000	6.500	0.
158	0.	0.	0.	1.000	0.	1.000
159	0.	0.	0.	0.	14.300	1.000

	89	90	91	92	93	94
160	0.	0.	0.	0.	10.050	0.
161	0.	0.	0.	0.	2.965	1.000
162	0.	0.	0.	0.	5.266	1.000
163	0.	0.	0.	0.	0.714	1.000
164	0.	0.	0.	1.000	16.000	1.000
165	0.	0.	0.	1.000	0.	0.
166	0.	0.	0.	1.000	0.	1.000
167	0.	0.	0.	1.000	107.000	1.000
168	0.	0.	0.	0.	16.767	1.000
169	0.	0.	0.	1.000	8.040	1.000
170	0.	0.	0.	1.000	0.	1.000
171	0.	0.	0.	1.000	0.	1.000
173	0.	0.	0.	1.000	7.000	0.
174	0.	0.	0.	1.000	0.	0.
175	0.	0.	0.	0.	0.	1.000
176	0.	0.	0.	1.000	0.	1.000
177	0.	0.	0.	0.	0.	0.
179	0.	0.	0.	0.	0.	0.
180	0.	0.	0.	0.	0.	0.
181	0.	0.	0.	0.	0.	0.
182	0.	0.	0.	0.	0.	1.000
184	0.	0.	0.	1.000	0.	1.000
185	0.	0.	0.	0.	0.	1.000
186	0.	0.	0.	0.	0.	1.000
187	0.	0.	0.	0.	0.	1.000
188	0.	0.	0.	0.	0.	1.000
189	0.	0.	0.	0.	0.	1.000
190	0.	0.	0.	0.	0.	0.
191	0.	0.	0.	0.	0.	1.000
192	0.	0.	0.	1.000	0.	0.
193	0.	0.	0.	2.000	0.	0.
194	0.	0.	0.	0.	49.170	0.
195	0.	0.	0.	0.	0.	0.
196	0.	0.	0.	1.000	2.603	0.
197	0.	0.	0.	2.000	0.	0.
198	0.	0.	0.	1.000	3.000	1.000
199	0.	0.	0.	0.	0.	1.000
200	0.	0.	0.	0.	0.	0.
201	0.	0.	0.	1.000	0.	0.
202	0.	0.	0.	0.	6.342	1.000
203	0.	0.	0.	0.	18.000	1.000
204	0.	0.	0.	0.	4.970	1.000
205	0.	0.	0.	0.	0.	1.000

APPENDIX E

LIST OF FORMED VARIABLES

Two types of variables were used as input to the statistical analysis: (a) those obtained directly from the questionnaire, and (b) those that were formed by various combinations of the variables in the collection form.

This Appendix contains the list of formed variables used in the analysis. The variables are of several forms, e.g., logarithmic transformations, ratios, machine capability, etc., all created in an effort to evaluate their effects on programming cost.

Several of these variables were found to influence costs and are included in the winnowed (reduced) list of variables in Appendix F. The variables that appeared in the questionnaire are listed, with the corresponding data, in Appendix D.

Name of Formed Variable		Formation
Fernbach's Ranking of Machine Capability	=	Log_{10} [50 (number of bits in work + 10 x machine add time)]
Shaw's Ranking of Machine Capability*	=	$\frac{\text{Bits/Memory Word}}{\text{Time/Cycle}}$ [$\log_2$ (bits in memory)]
Total Man Months (not including man months to develop utility programs used in production)	=	Man Months, exclusive of utility programs + Man Months including utility programs + Man Months for executive and utility programs developed specifically for data point.
Total Pages of Documentation	=	Number of pages of internal documentation + number of pages of external documentation.
Number of Different Types of Documents	=	Number of types of internal documents + number of types of external documents.
Object Documentation Rate	=	Total pages of documentation/total object instructions generated for specific data point.
Source Documentation Rate	=	Total pages of documentation/(total MOL source instructions written + total POL source instructions written)
Production Rate (Object)	=	$\frac{\text{Number of Object Instructions Generated for Specific Data Point}}{\text{Total Man Months}}$
Production Rate (Source)	=	$\frac{\text{Total MOL Source Instr. Written + Total POL Source Instr. Written}}{\text{Total Man Months}}$
POL Usage Rate		$\frac{\text{Total POL Source Instr. Written}}{\text{Total MOL Source Instr. Written + Total POL Source Instr. Written}}$
Computer Usage Rate (Object)	=	$\frac{\text{Total Computer Hours}}{\text{Number of Object Instructions Generated for Specific Data Point}}$
Computer Usage Rate (Source)	=	$\frac{\text{Total Computer Hours}}{\text{Total MOL Source Instr. Written + Total POL Source Instr. Written}}$
POL Expansion Ratio	=	$\frac{\text{Number of Object Instructions Generated from POL Source Statements}}{\text{Total POL Source Instructions Written}}$
MOL Expansion Ratio	=	$\frac{\text{(Number Object Instr. Generated for Specific Data Point) - (Number Object Instr. Generated from POL Source Instructions)}}{\text{Total MOL Source Instructions Written}}$

*For a full discussion of this ranking scheme, see SP-2418/000/00, Cost Estimation for Computer Program Development: A Progress Report and an Evaluation, G. F. Weinwurm.

Name of Formed Variable		Formation
Proportion of Senior Programmers	=	$\frac{\text{Maximum Number of Type III and Type IV Programmers Assigned}}{\text{Maximum Number of Types I, II, III, and IV Programmers Assigned}}$
Average Programmer Experience with Development Language	=	$\frac{\text{(Maximum Number of Type I Programmers x Average Months Experience with Development Language) + (Maximum Number of Type II Programmers x Average Months Experience with Development Language) + (Maximum Number of Type III Programmers x Average Months Experience with Development Language) + (Maximum Number of Type IV Programmers x Average Months Experience with Development Language)}}{\text{Maximum Number of Programmers Assigned}}$
Average Programmer Experience with Program Application	=	$\frac{\text{(Maximum Number of Type I Programmers x Average Months Experience with Program Application) + (Maximum Number of Type II Programmers x Average Months Experience with Program Application) + (Maximum Number of Type III Programmers x Average Months Experience with Program Application) + (Maximum Number of Type IV Programmers x Average Months Experience with Program Application}}{\text{Maximum Number of Programmers Assigned}}$
Proportion of Programmers Participating in Design	=	$\frac{\text{Number of Programmers Participating in Design}}{\text{Maximum Number of Programmers Assigned}}$
Naperian Logarithm of Average Round Trip Distance/Trip	=	ln (Average Round-Trip Distance)
Logarithm of Number of Words in Data Base	=	Log_{10} (Number of Words in Data Base)
Logarithm of Number of Classes of Items in the Data Base	=	Log_{10} (Number of Classes of Items in the Data Base)
Square Root of Number of Classes of Items in the Data Base	=	$\sqrt{\text{Number of Items in Data}}$
Total Message Types	=	Number of Input Message Types + Number of Output Message Types
Square Root of Total Pages of External Documentation	=	$\sqrt{\text{Total Pages of External Documentation}}$
Average Programmers per Month	=	Total Man Months/Months Elapsed
Programmer Continuity	=	$\frac{\text{Number of Programmers for Duration of Project}}{\text{Maximum Number of Programmers Assigned at One Time}}$
Index of Programmer Continuity	=	Average Men per Month/Maximum Number of Programmers Assigned at One Time

Name of Formed Variable		Formation
Estimated Elapsed Time at Maximum Staffing	=	Total Man Months/Maximum Number of Programmers Assigned at One Time
Number of Input Variables to Memory	=	$\frac{\text{Number of Classes of Items in Data Base}}{\text{Core Size of Developmental Computer}}$
Object Instructions to Memory	=	$\frac{\text{Number of Object Instructions Generated for Specific Data Point}}{\text{Core Size of Developmental Computer}}$
Correction Factor for Effective Number of Programmers	=	Maximum Number of Programmers Assigned at One Time $[.4 + .6 (\text{Continuity of Programmers})^2]$
Total Number of Input Variables	=	Number of Input Message Types x Average Number of Input Items per Type
Total Number of Output Variables	=	Number of Output Message Types x Average Number of Output Items per Type
Logarithm of Number of Subroutines	=	Log_{10} (Number of Subroutines)
Logarithm of Input Message Types	=	Log_{10} (Input Message Types)
Logarithm of Output Message Types	=	Log_{10} (Output Message Types)
Total Source Instructions	=	Number of MOL Source Instructions + Number of POL Source Instructions
Source MOL Production Rate	=	Number of MOL Source Instructions/Total Man Months

APPENDIX F

CORRELATION OF SELECTED PREDICTORS WITH COST MEASURES, OBJECT PRODUCTION RATE, AND OBJECT COMPUTER USAGE RATE

This Appendix contains the correlation coefficients of selected predictors, resulting from the first winnowing phase, with the major cost measures, object production rate and object computer usage rate (computer hours/1000 object instructions). The cost variables are identified in column headings; the selected independent variables (i.e., cost factors) are noted by titles.

The variables in this Appendix were selected on the basis of intuitive judgment, previous experience and correlation with the cost measures.

The correlation coefficient is a measure of the statistical relationship between variables. For a sample size of 169, the null correlation, i.e., the correlation that could occur by chance two thirds of the time without any relationship between two variables, is equal to $\pm.076$. This means that if we conclude that a statistical relationship exists between variables with a correlation coefficient of $\pm.15$ or greater, our conclusions will be incorrect only 5 percent of the time.

Selected Predictors	Months Elapsed	Computer Hours	Number of Object Instructions	Man Months	Object Production Rate	Object Computer Usage Rate
Number of Man Trips	29	21	7	23	-10	14
Innovation	13	6	19	6	9	5
Operational Requirements Known	0	5	0	8	-7	2
Number of Organizational Users	2	-3	24	-5	1	-8
Response Time Requirements	44	52	7	42	-26	43
Number of ADP Centers	11	8	0	15	-14	9
Operational Characteristics	11	0	-9	-4	-8	-8
Design Characteristics	13	-8	11	6	7	-13
Source Instructions (MOL)	44	44	85	58	1	1
Source Instructions (POL)	27	23	28	0	22	-3
Number of Subroutines	26	14	62	20	-1	1
Number of Classes of Items in the Data Base	7	-3	5	-4	18	-5
Stability of Design	22	18	0	20	0	13
Complexity of Design	10	14	-14	11	-14	20
Percent Clerical Instructions	-4	2	7	-6	6	-1
Percent Mathematical Instructions	0	-2	-2	7	-1	-8
Percent Input/Output Instructions	-7	-11	-15	-9	-7	-1
Percent Logical Control Instructions	14	13	10	13	-6	9
Percent Self-Checking - FIX Instructions	-4	-4	-3	-1	12	-1

Selected Predictors	Months Elapsed	Computer Hours	Number of Object Instructions	Man Months	Object Production Rate	Object Computer Usage Rate
Percent Information Storage and Retrieval	6	5	14	9	-12	-2
Percent Transformation Instructions	-11	-3	-8	-7	-3	-2
Percent Generation to Produce Desired Output	5	3	9	2	14	-7
Number of Conditional Branches	12	21	61	10	45	-1
Average Frequency of Operation	44	40	14	44	-22	32
Insufficient Memory	32	19	20	22	-2	14
Stringent Timing	35	34	-3	32	-24	37
MOL versus POL	10	19	5	23	-31	23
Total Pages of External Documentation	39	24	16	51	-16	5
Production Computer Core Capacity	2	-3	11	2	9	-4
Use of Disc Storage	9	32	-4	22	-19	25
Use of Special Display Equipment	14	29	-2	26	-15	22
First Programming Effort	36	35	32	34	-9	30
Average Turnaround Time	-3	-15	6	5	6	-17
ADP Components Developed Concurrently with Program Production	25	14	15	41	3	9
Management Procedures	1	-4	-15	-7	-9	5
Number of Agencies Concurring in Design	10	6	11	5	-6	11
Estimated Customer Experience	-13	-8	-4	-8	20	-10

Selected Predictors	Months Elapsed	Computer Hours	Number of Object Instructions	Man Months	Object Production Rate	Object Computer Usage Rate
Computer Operated by Agencies Other than Program Developer	13	2	13	9	0	5
Open/Closed Shop Operation	-15	-19	-2	-16	-1	-21
Time-Sharing	-4	-7	-6	-8	-1	-1
Developed at Other than Operational Site	-33	-34	-12	-23	9	-21
Production Computer Different than Development Computer	35	42	10	33	-14	25
Number of Locations at which Program was Developed	22	16	3	27	-20	8
Number of Bits per Memory Word	21	18	13	31	-4	6
Memory Access Time	-18	-9	-12	-12	-1	-2
Machine Add Time	-16	-11	-14	-16	-8	-1
Business Application	-36	-33	-5	-40	27	-29
Scientific Application	-3	-10	3	2	-2	-8
Software Application	43	51	13	38	-14	39
Other Application	8	3	-9	13	-19	8
Military Developer	-29	-26	-12	-28	11	-22
Computer Cost	-23	-18	-12	-29	-1	-6
Stand-Alone Program	0	8	11	15	1	0

Selected Predictors	Months Elapsed	Computer Hours	Number of Object Instructions	Man Months	Object Production Rate	Object Computer Usage Rate
Total Pages of Documentation	19	9	29	25	-2	-1
Total Number of Document Types	11	4	8	10	-8	0
Documentation Rate (Source)	-7	-6	-7	-5	-7	3
Computer Usage Rate (Source)	35	46	-8	32	-24	90
Percent Senior Programmers	-15	-16	-12	-23	14	-13
POL Expansion Ratio	-4	-14	30	-13	46	-20
Percent Programmers Participating in Design	-19	-30	-13	-31	10	-23
Log_{10} Number of Words in Data Base	-23	-23	5	-13	15	-26
Log_{10} Number of Classes of Items in Data Base	-9	-22	9	-16	17	-30
Total Message Types	-18	-11	-11	-12	-2	-4
Square Root of External Pages of Documentation	49	36	23	61	-22	10
Programmer Continuity	-36	-31	-15	-30	18	-20
Programmer Continuity Index	-35	-32	-17	-32	-15	8
Number of Input Variables	-12	-7	-7	-9	0	-6
Number of Output Variables	-15	-9	-9	-11	0	-6
Total Number of Source Instructions	48	48	89	58	5	0
Log_{10} Number of Subroutines	41	28	29	35	-11	13
Log_{10} Output Message Types	-19	-19	-1	-12	-2	-7

Selected Predictors	Months Elapsed	Computer Hours	Number of Object Instructions	Man Months	Object Production Rate	Object Computer Usage Rate
Log_{10} Input Message Types	-15	-18	0	-15	-2	-12
Average Programmer Experience with Production Language	-10	-18	-18	-17	3	-17
Average Programmer Experience with Program Application	-3	-4	0	-6	-1	-5

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