Title: Case Study: Port of Portland Engineering Services - A Methodology for Improving Customer Satisfaction

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Author(s): A. Acar, D. Dittmer, P. Huebschman and C. Winton

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Abstract: This project suggests a methodology for identifying areas of concern within an engineering organization to achieve customer satisfaction. The paper implies continuing self-improvements through analysis of information obtained from clients. Factor analysis and Friedman tests revealed the problem areas for various projects. The results can aid the management to implement action plans to improve customer service.

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A. Acar, D. Dittmer, P. Huebschman, C. Winton

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CASE STUDY: PORT OF PORTLAND ENGINEERING SERVICES - A METHODOLOGY FOR IMPROVING CUSTOMER SATISFACTION

ALPER ACAR

DAVID DITTMER

PAUL HUEBSCHMAN

CRAIG WINTON

INSTRUCTOR: DR. HULYA YAZICI

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ABSTRACT:

Only satisfied customers provide repeat business; and for clients of the Engineering Service of the Port of Portland, this satisfaction is no different. Many intangible variables complicate the goal of achieving customer satisfaction, and the best approaches toward identifying these variables involve an investigation of the issues for each significant client. Only then can customized services be designed to meet the specific needs of a particular client.

This project will suggest a methodology for identifying areas of concern within an engineering organization. These concerns will be identified with respect to the customer viewpoint. Therefore, this paper will be of particular interest to engineering firms that want to maintain a core group of "valued" clients.

This paper implies continuing self-improvements through analysis of information obtained from clients. It involves a data gathering process which occurs at certain intervals, and involves quantifiable assessments of customer satisfaction.

The output of this project is an engineering management tool. It can only identify concerns. Only management can direct resources required to implement action plans that improve customer service.

LIST OF APPENDIX -

1. INTRODUCTION

At the Port of Portland (POP - Appendix 1), four main operating areas exist. These areas consist of Aviation, Marine, Ship Repair Yard, and Real Estate. They require the Engineering Services department to accomplish facility development, maintenance, planning, and construction support activities. The corporate mission of Engineering Services is to provide service and meet the various needs of the operating areas. In order to accomplish this, a client (operating manager) and engineer (engineering manager) must work together. The operating manager must clearly explain the scope and schedule expectations to the engineering manager. Engineering must then obtain and apply the resources as required to fulfill the customer expectations. The task of fulfilling customer expectations is complicated by:

1. State law governing contracting procedures - As the Port of Portland is a state organization, public bidding of most projects is required. This procedure is time consuming and therefore, slows project completion. In addition, the quality of the project can suffer when contractors are selected based on a low-cost bid and not on capability.
2. Extracting all required information from the customer - Effective communication of the scope of work prior to project completion has been identified by the engineering management as a problem on numerous occasions.

3. Thorough understanding of costs of performing activities for operating areas - Design engineers and project management are not professional estimators. In addition, difficulties arise in calculating budget estimates when the scope of work is not understood.

4. Obtaining the best possible resource for a task with minimal amounts of scheduling flexibility - a client wants the product now, and this remains the case even when the resources are not available.

5. No formal definition of engineering responsibility leaves no limit on the scope of operation area requests - Expertise covering a limitless expectation is not practically accomplished.

Therefore, customer satisfaction is related to many variables. Only after the operating managers have described a project as successful can an engineering manager declare that customer expectations have been met.

Therefore, when POP Engineering Management began to receive feedback from the operating groups regarding various concerns about Engineering Service, they decided to identify the issues and make changes where it was feasible. With this decision, Engineering management took the first step toward problem definition and self-improvement. This sent a message to corporate management that Engineering intended to pursue every avenue possible to meet the corporate mission. Not only does this step toward self-improvement

fulfill corporate expectation, but the operating areas view the process as a positive step toward fulfilling their expectations.

Engineering management initiated an effort in 1991 to define the operating area concerns by hiring a consultant, Terry O'Conner, to design and administer a survey to all of the individual clients representing the four operating areas. The survey was exploratory in function, and consisted of two parts (see exhibit B for survey). Part one provided rankings of all engineering subgroups on various descriptive independent variables. Part two provided a set of data similar to part one, except most of the subject matter deviated from association with the variables identified in part one. Part two was useful to stimulate discussion and explore areas not covered in part one.

The raw data was compiled for each operating area. The compiled data (both part one and part two) was presented to the Engineering director. The high (or positive) and low (negative) rankings were judgmatically assessed, and concerns were thereby identified. The Engineering department director wrote a letter (exhibit D) which summarized results on some of the many subjects explored in the original survey. In the letter, he stated "there are some very clear messages from individual departments. We intend to follow up on a department-by-department basis and develop specific action plans in the coming months."

Specific action plan development has been slow because the compiled data was not conclusive. The data was spread over too many topics, and was not easy to assess in present form. This project analyzed the original survey data from an operating area, and defines specific problems unique to this Engineering customer. Once condensed and clarified, the data from this case study will be of significance to the Engineering director pursuing specific action plans.

Aviation area was used in the case study. A factored set of variables identified by Aviation was compared against a set of "goal" factored variables derived from the statistically similar portion of the remaining client population. Individual engineering sub-group problems were identified. At this point, a second survey customized for each particular client (Aviation in this case) was recommended. It would be administered subsequent to the first survey, and would test the validity of the concerns identified from the original survey. A third survey would be issued subsequent to an action plan implementation, and would measure improvements. For this project, the analysis was performed on part one of the original survey. Recommendations were than made with respect to future work.

A. General Engineering Management Significance

This project will develop a methodology for identifying specific problem areas between an engineering organization and any

one client. This will facilitate design of client specific action plans. It will be useful in providing feedback from "steady", or "repeat" clients. These clients normally have long-term contracts with a consultant which can typically provide up to 50-60% of a consultant yearly revenue. Loss of this type of revenue would be devastating to most consultants, and could be avoided if fulfillment of customer expectations was improved.

2. THE REVIEW OF RELATED LITERATURE

Over the past 30 years, engineering managers have been looking for more effective ways to utilitize their engineers to increase productivity. Books and articles have been written on ways to increase the motivation, development, communication, and support of the engineers.(2) In recent years this has not been enough to ensure the productivity of the engineering organization. As J. W. Forrester wrote, the engineer manager needs to integrate technology, economics, management, human behavior, and marketing into his work.(2) As we have identified previously, we are looking at the Port of Portland Engineering Services' markets, or other departmental areas, and the engineering relationship with the operating departments.

Although we were not able to identify specific case studies of client evaluation of an engineering firm, We were able to identify a few books and articles which discussed the quality of a service firm and how it contributes to the success of projects. In recent

years of Total Quality Management, many articles and books have been written about customer's expectations, and how they have a contributing factor to the success of the projects and to the continued business relations between the client and the engineering firm.(6)

Two important articles were found to be very applicable to the Engineering Services identification of concerns. The first was titled " Defining Service Quality Is Difficult For Service And Manufacturing Firms "(Farsad and Elshennawy). The article described quality as " consistently meeting customer expectations and can be measured by how well the delivered service level is conforming to (the) customer's expectations."(6) The authors also noted that a service organization's quality is less predictable. Among such characteristics are:

- Intangibility of service.
- Consumer Involvement in the service process.
- Simultaneous production and consumption of service.
- Labor-insensitivity of service.

The article states that in the service industry, feedback is often difficult to predict or achieve, primarily because of the intangibility of service.

When setting standards for service quality, a set of predicted customer demands must first be defined. This should be followed by planning and establishing policies and rules for satisfying such demands. Finally, feedback should used to measure the level of achievement in customer's satisfaction.

The authors also stated that the level of service quality in general is affected by these four factors:

- physical factors - location, size, type.
- responsiveness - promptness to the customer.
- reliability - ability to perform accurately.
- consistency - quality over and over again.

Another article titled " How Firms Select Professional Services "(Day and Barksdale) contains applicable information. The authors of this article surveyed 17 client executives to develop factors contributing to satisfaction and dissatisfaction within the engineering services firms.(4) The authors found that interrelationships existed among the variables evaluated. Listed below are the factored variables discovered in this survey:

-Understanding Clients Needs and Interests
- Attitude
- Appears to want a long-term relationship
- Responsive
- Personnel attention

-Interaction, Relationship, Communications
- Receptive to client's questions and suggestions
- Pleasant to work with
- Project manager on top of the job
- Constant communication
- Attended to client's needs
- Continuous follow-up
- Involvement of project executive
- Well coordinated
- Talked to each other and to client

-Contractual/Administrative Conformance
- On time, on budget
- Extra work orders minimal
- Provided detailed schedule up front and stuck to it
- Informed clients of ... and explained ... deviations
- Met Schedule

-Performance/Outcome
- Did what they said they would do
- Consistency in quality
- Did what was required without being told
- Responded to client's needs
- Responded well to client on the job
- Functional thinking in early stage of projects matched with final design
- No turnover of staff, working with same people throughout
- Met or exceeded client's expectations

In comparing the factors of the original survey and the researched articles, some significant differences can be noted. The original survey did not include an investigation of understanding client needs and interests or the relationship of the physical factors.

The variables identified in the original survey were generated from discussions with the engineering management at the Port of Portland. It was not a valid assumption that engineering would be able to supply all potential areas of concern. It would be appropriate to supplement the variables established through engineering management interviews with variables identified by past research articles and client surveys.

3. RESEARCH METHODOLOGY

A. Problem Hypotheses-

The case study primary hypothesis is:

H_1: Within the Port of Portland, Aviation ratings of Engineering subgroups will vary significantly from a set of goal values established from an analysis of the remaining operation areas.

Ho (Null Hyp) :Aviation ratings of Engineering will not vary significantly.

B. Assumptions -

1. No reliability testing was performed on the data from the

original survey. The assumption here is that the data is reliable.

2. The operational areas will responsibly participate in the design of procedures to improve ratings of Engineering.

3. The original 12 variables adequately cover all possible problem areas given the differences among operations groups (as described in the first paragraph). If any variables are subsequently discovered, they will be investigated under future questionnaires.

4. The number of responses are representative of the operations group being studied, and data is not influenced by individual venting of frustration through the questionnaire.

The compiled original survey data consisted of a block matrix with 12 variables and 7 sub-groups of engineering (Appendix 4). Terry O'Conner, the administering consultant, compiled the data for each of the four operating areas and established the mean value rankings for each corresponding variable and for each engineering sub-group.

In this paper, the original survey data means from each department matrix were analyzed. The analysis determined if there was significant difference in the way each operating area ranked the various engineering subgroups with respect to these variables.

It was not assumed that the probability distributions of rankings from each surveyed department approximated a normal distribution. Therefore, the ANOVA and other parametric statistical comparison and correlation procedures were not deemed appropriate.

Nonparametric statistical analysis was the method acceptable for analysis of the data. The advantage of nonparametric analysis was that it required no assumptions about the probability distributions being analyzed. The only caveat was a sample size of at least N = 5.

C. Component Factor Analysis -

The first step in this study was to reduce the 12 variables of the part one data into a smaller, more manageable set of factors by performing a component factor analysis. The factors were formed by analysis of the Aviation rankings. The factor analysis determined which 12 variables of the original twelve by seven (84 member) data matrix were correlated significantly, and could be statistically combined into factors. By this process, a broad set of variables are simplified into a smaller set of factors. This was accomplished using the statistical software package Systat. This procedure clearly defined the constructs of the problem without losing completeness of the original information.

The hypotheses to be tested:

H_2: The original survey matrices can be reduced by using factor analysis.

Ho (null hypothesis): The matrices cannot be reduced.

Assumptions:

1. The variables used in the original survey define all areas of concern for the determination of satisfaction.

2. Clients have a clear understanding of the definitions for each variable.

The 12 original survey variables were input with respect to the 7 separate Engineering sub-groups rated. These variables were capable (CAP), collaborative (COL), accurate in estimates (ACCU), reliable regarding schedules (SCHE), flexible (FLEX), reliable regarding budgets (BUDG), cost effective (COST), forceful (FORC), communicative (COMM), accessible (ACCE), organized (ORG), and efficient (EFF). The sub-groups consisted of construction administration (CA), engineering and architectural project management and design (EA), environmental services (ES), facility maintenance engineering (FS), marketing support (MS), special projects (SP), and technical services (TS). Though factor analysis, the number of these 12 variables were reduced with one or more variables combined into factors. The mean rankings will be combined by averaging the means of the combined variables in their corresponding factor. With the reduction in the amount of variables, the data can be reduced into a more useable form.

D. FRIEDMAN TESTS -

After a set of factored data matrices was formed for all four operating areas, the Friedman test was used to compare the matrices. This was accomplished using the statistical software package Systat. The goal was to formulate a representative goal

matrix from the customer population by determining which individual operating areas are most statistically similar. Because the operating area, Real Estate, does not use the engineering subgroup, Facility Engineering, this subgroup was removed from the analysis. This reduced the factor matrix for each operating area from a four by seven to a four by six.

The Friedman test is a two-way nonparametric analysis between two or more probability distributions. The analysis compares: (1) if two or more probability distributions are statistically different by more than random occurrence, and (2) within group randomized block design analysis.

The hypotheses to be tested:

H_3: A "best fit" goal matrix can be determined for each factor from a Friedman test which compares all operation area matrices, and determines which are most similar.

Ho (null hypothesis) : Significant differences exist between all combinations of matrices such that no "best fit" matrix exists.

For each factor, a matrix was established which contained the six engineering subgroups, as cases, and the four operating areas as variables. We were then able to compare any combination of the four operating areas within a factor matrix. The best combination of operation area sets were determined by the lowest Friedman test scores. Then the best representative rankings were averaged to form the "goal" matrix.

The hypothesis checked in this area of analysis:

H_4: Using the Friedman test, there exists significant variation

between the aviation and goal matrices.

Ho (null): There is no significant differences.

Assumptions:

1. The combination of means did not alter the data significantly.

The significant problems were identified between the case study data (Aviation) and the goal matrix. These significant problems were ranked by the largest differences between the Aviation ranking and the Goal (for each factor). This allows resource allocation, for action plan implementation, based on a prioritized set of problems within the various engineering sub-groups. However, this is not as precise of an answer as would be achieved by comparing the individual rankings.

E. Statistics -

H_5: Using the statistics, there exists significant differences in the individual mean rankings within each matrix, and these differences can be identified and magnitude of variation can be found.

Ho (null): The differences cannot be determined.

From these statistical analysis we were able to determine if any variance existed between the aviation and goal matrices. Simple statistics were performed to compare each Aviation value against the goal matrix value. By identifying the variance between these two ranking values a prioritized list is determined whereby the highest variance indicated the most concern. The engineering management must then evaluate the statistical values, in

combination with resources available, to design action plans to reduce the magnitudes of the variation.

5. ANALYSIS OF THE DATA -

A. COMPONENT FACTOR ANALYSIS

The component factor analysis was performed by the PC version of Systat. The variables were grouped into factors by accounting for the largest amount of variance among the variables in the minimum number of factors. Once Systat determined the minimum number of factors, a rotation of the factors was performed to more clearly identify and separate the variables associated with the four factors. An orthagonal rotation was performed, and this maintained an independence among the factors. Oblique rotations were possible, but the interdependence among factors made identification less meaningful.

The output of Systat reduced the variables into the following four factors:

Factor 1 - **EFFICIENT MANAGEMENT**-Reliable regarding schedules, Accessible, Efficient, and Organized. Capable was closely associable, but to a smaller significance level. We chose to eliminate capable from further consideration because the remaining variables were associated with management style.

Capable relates more to a basic skill level. Arguably, it could be included, but since the analysis was somewhat objective, it was eliminated during this exercise.

Factor 2 - **MONEY MANAGEMENT**- Reliable regarding budgets and Cost-effective. This showed that client groups had a well defined interest in knowing project cost status at all times, and perceived that the balance between cost and quality (cost effectiveness) affected budgets.

Factor 3 - **INFORMATION DELIVERY**- Communicative, Collaborative, Flexible, and Forceful. Communicative, collaborative, and forceful all describe interactions from the perspective of the client. Flexible rankings would associate most obviously with collaborative because any change to a project, by a client, requires establishment of all new cost and schedule parameters for a project. Numerous redefinitions of this kind normally have an influence on the collaboration between client and engineer.

Factor 4 - **ACCURATE ESTIMATES**- Accurate in Estimates. A stand alone variable. Clients typically base the economic performance of a particular plan on the engineer's estimate. For this reason, the estimate was a factor in keeping the client successful in his business ventures.

With a rationale set of factors, the factor analysis was completed. A four by seven matrix was formulated for Aviation. The rankings in the four by seven matrix were the averages of the variables which formed the factors. The same four by seven matrices were formulated for the remaining client groups, and this formed the basis of comparing Aviation to the other operating areas. Instead of comparing the twelve variables with the six engineering sub-groups, the four factor rankings are compared to the engineering sub-groups and significantly reduced the amount of work needed to compare the matrices.

In establishment of the reduced matrix, it can be noted that Real Estate does not require Facility Maintenance Engineering services (a sub-group of Engineering). Therefore, for comparison purposes, this subgroup will be eliminated from further study to make consistent comparisons between all of the matrices.

B. FRIEDMAN TESTS -

To determine the factored matrices of each operational area, the data was reorganized so that each of the four factors were the grouping mechanism. The variables were the operating areas, and the cases were the engineering subgroups. The Friedman test then checked variance among combinations of all four operating areas with respect to the engineering subgroups. The following Friedman test results were performed to determine the differences existing among all four operating areas.

FACTOR TEST	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION MANAGEMENT	ACCURATE ESTIMATES
FRIEDMAN STATISTIC	9.400	.150	11.0	9.150
PROBABILITY	.024	.985	.012	.027
DEGREE F.	3	3	3	3

The above results indicated that rankings by all four operating areas were the same for the factor "money management". The other factors had significant differences in the responses. This was shown by the high Friedman statistic and low probability that the differences were caused by sampling error.

In the next comparison testing, the same test was used except that the aviation rankings were removed from the data. The hypothesis was again: No significant differences in the rankings by three groups. The results were:

FACTOR TEST	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION MANAGEMENT	ACCURATE ESTIMATES
FRIEDMAN STATISTIC	9.333	.333	9.333	5.083
PROBABILITY	.009	.846	.009	.079
DEGREE F.	2	2	2	2

The above tests continued to show the same significant differences as noted in the previous test.

After looking at the rank sum scores in the previous tests,

Real Estate rankings were removed from the previous test. Then PSRY and Marine were analyzed and these results followed:

FACTOR TEST	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION MANAGEMENT	ACCURATE ESTIMATES
FRIEDMAN STATISTIC	.667	.333	.667	.667
PROBABILITY	.414	.846	.414	.414
DEGREE F.	1	1	1	1

Based upon the above statistics, no significant differences were noted between the rankings of PSRY and Marine areas. Therefore, if the PSRY and Marine matrices were averaged, this would form the "goal" matrix.

The goal matrix was used to analyze the Aviation matrix. If significant differences were found, an area of concern within Aviation was identified. The following results were determined in the goal versus Aviation comparison:

FACTOR TEST	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION MANAGEMENT	ACCURATE ESTIMATES
FRIEDMAN STATISTIC	.667	0.00	2.667	6.00
PROBABILITY	.414	1.00	.102	.014
DEGREE F.	1	1	1	1

Based upon the above results, there was no significant difference

between the goal and aviation matrices with regard to money management or efficient management. However, information management and accurate estimates variables showed some variation based upon a low probability and high Friedman Statistic valve.

These results indicated the primary areas of concern as information management and accurate estimates. However, this information did not relate to the engineering subgroups and was not specific.

C. STATISTICS -

The analysis of Aviation rankings versus the goal matrix rankings was performed for each Engineering subgroup within each customer satisfaction factor. The mean, standard deviation, and variance between these rankings was performed, and the results were tabulated. A prioritization of customer service concerns was then made.

The following table shows the priority items and their area:

Engineering Subgroup	Factor	Aviation Value	Goal Value	Mean	Variance	Priority
Technical Services	Efficient Management	4.250	5.700	4.975	1.051	1
A&E Project Management	Information Delivery	3.400	5.125	4.263	1.488	1
Technical Services	Accurate Estimates	3.700	5.300	4.500	1.280	1
Construction Management	Information Delivery	4.200	5.463	4.832	.798	2
Technical Services	Information Delivery	4.550	5.675	5.113	.633	2
Marketing Support	Accurate Estimates	4.000	5.150	4.575	.661	2

Based upon the variance, the priority was established. If the variance was greater than or equal to 1.00, it had a priority of one, and if the variance was greater than .6 and less than 1.00, the priority of two. Therefore, the items receiving a priority one should be addressed first.

6. CONCLUSIONS -

The original form of the data indicated the engineering subgroup, Environmental Services, had low rankings. This study was designed to condense and clarify. Since no clarification was necessary for Environmental Services, our case study did not conclude any concern for them, but as a practical matter, the original data is clear that concerns exist in this area.

As shown on the output (Appendix 13), a priority one (1) was placed on the Engineering subgroup / customer satisfaction factor rankings with a variance greater than one. Although this evaluation was subjective, it did highlight the three largest concerns for Engineering with respect to the Aviation rankings. The result showed that Architectural and Engineering design did not meet the determined goal value with respect to factor 3 - **Information Delivery.** In addition, Technical Services did not meet the determined goal values with respect to factor 1 - **Efficient Management** and factor 4 - **Accurate Estimates.**

As a further interpretation, priority two (2) items were noted for those Engineering subgroup / customer satisfaction factor rankings with a variance greater than .60 and less than 1.00. The results showed Construction Administration and Technical Services were not meeting the determined goals with respect to factor 3 - **Information Delivery.** In addition, Marketing Support did not meet the determined goal with respect to factor 4 - **Accurate Estimates.**

The results of the formulation of the goal matrix (through Friedman testing iterations) showed that the Real Estate area had significantly lower rank sum scores than both Marine and PSRY. For factors one, two, and three, the rank sum scores were less than Aviation scores. This would indicate that comparisons of Real Estate values against a goal matrix would result in significant areas of concern. The first step in analysis of Real Estate would involve performing a factor analysis on their original 12 variable matrix. It is possible that they would group the variables differently, and this would affect the Friedman evaluations, and goal matrix formulation.

Both PSRY and Marine should be analyzed. Their rankings were significantly higher than the other areas when analyzed as a group, but individual Engineering subgroups / factor rankings may deviate from the determined goal.

A. Validity of Results

The computer generated results were assumed to be both accurate and precise. The only question to validity was the interpretation of the results. Because of the various types of tests used and similar results obtained, the results are considered valid.

However, the validity of the means of the data was assumed. The original 12 x 7 ranking matrix (part one of original survey) provided one assessment of each variable. Interpretations of variable definition, and momentary lapses in concentration could render an individual ranking invalid. Therefore, a phase II program should be initiated to verify the data and its conclusions.

A. Phase Two

We believe that a phase two survey should be designed for each operating area which showed areas of specific concern. In the case of Aviation, we identified three priority (1) concerns, and three priority (2) concerns. The proposed phase two questionnaire would be a ranking matrix similar to the part one of the original survey except for the following changes:

1. Variables for factor 2 - **Money Management** - could be eliminated. There was no concerns determined from the

original data. But since this factor is comprised of only two variables, the variables should remain through future tests to determine if the ranking trend reverses.

2. A physical features variable should be added. This was discovered in our literature research, and deals with factors such as location, size, type, and accessibility of the engineering department.

3. Since no problems were discovered with Special Projects, and since Environmental Services rankings were consistently low with all operating areas, they could be eliminated from the phase two process. But since this ranking form would measure future change to rankings, these Engineering subgroups should remain.

4. Better variable definition needs to be performed. As an example, the variable Capable means ; "having attributes required for performance". The original survey definition is "achieves top quality product". We believe the true definition of the word should be used to study whether Aviation believes the basis skill level is present. Collaborative means ; "to work jointly with others in an endeavor". The original survey definition is "open and responsive to customer needs and desires". The definition in phase two would read "works well in teams".

5.The raw data for all 16 Aviation respondents needs to be analyzed. If raw data had been available from the original survey, statistical analysis of the data would show a level of

confidence with the mean scores.

A phase two ranking matrix for Aviation should be formulated. This should be issued to verify the conclusions derived from the original survey, address newly discovered variables, and clarify any ambiguous definition of variables.

C. Phase Three

If the conclusions of the original ranking matrix are verified by the phase two ranking matrix, the factored form of the variables (12 variables reduced to 4 factors) will be considered valid for use. Engineering management should allocate the resources and develop action plans to improve the identified low rankings. Subsequent to action item implementation for each operating area, the phase two matrix could be administered to gather data on all action plans implemented. Improvements in the rankings would not be attributable to any particular action plan, unless each action plan was investigated separately.

Since the goal of Engineering Management is to facilitate the improvement of customer service, the value of knowing which action plan improves customer service most significantly may not be worth the extra resource required. If specific action plan resultant rankings were desired, a new form of the phase three ranking matrix could be formulated. By reducing the original 12 variables to the factored form, various action plans can be assessed without overburdening the respondents.

In conclusion, this methodology allows data gathering and analysis that is relevant to any one customer of an engineering service organization. It could be useful for both identification of concerns, and measurement of action plan effects on customer service. Design of specific action plans for each customer remains the responsibility of Engineering Management.

6. BIBLIOGRAPHY -

1. Bryan, Jerry L., and Franklin C. Compton, "How Can You Get More Out Of The Relationship with Your Agency/Clint?", Business Marketing, Vol. 76, Iss. 1, January 1991, 6-15.

2. Cleland, David I., and Dundar F. Kocaoglu, Engineering Management, Mcgraw - Hill Book Company, New York.

3. Crane, F.G., "A Practical Guide to Professional Services Marketing", Journal of Professional Services Marketing, Vol. 5, Iss. 1, 1989, 3-15.

4. Day, Ellen, and Hiram C. Barksdale Jr., "How Firms Select Professional Services," Industrial Marketing Management, Vol. 21, Iss: 2, May 1992, 85-91.

5. Emory, C. W., Business Research Methods (3rd edition), Irwin, Homewood, IL, 1985.

6. Farsad, Behshid, and Ahmad K. Elshennawy, "Defining service quality is difficult for service and manufacturing Firms," Industrial Engineering, Vol: 21, No: 3, March 1989, p17.

7. Hair, Joseph F., Rolph E. Anderson, Ronald L. Tatham, Multivariate Data Analysis (2nd edition), Macmillan Publishing Company, 1987.

8. Kerlinger, Fred N., Foundations of Behavorial Research (2nd edition), Holt, Rinehart, and Winston, Inc., New York, 1973.

9. Kim, J. and C. Mueller, Introduction To Factor Analysis: Statistical Methods and Practical Issues, Sage Publications, Inc., Beverly Hills, CA, 1982.

10. Kvanli, Alan H., Statistics, A Computer Integrated Approach, West Publishing Company, New York, 1988.

11. McClave, J.T. and Frank H. Dietrich II, Statistics, Dellen Publishing Company, San Franciso, 1982.

12. Siegel, Gary, "Looking at the Firm Through Client's Eyes", Journal of Accountancy, Vol: 167, Iss: 3, March 1989, 7-75.

13. Smith, George L. Jr., "A model for designing," Industrial Engineering, Vol: 21 No: 11 November 1989, p35.

14. Tull, Donald S. and Del I. Hawkins, Marketing Research - Measurement and Method, Macmillan Publishing Co. Inc., New York, 1980.

15. Walpole, Ronald E., and Raymond H. Myers, Probability and Statistics for Engineers and Scientists (2nd edition), Macmillan Publishing Co., Inc., New York, 1978.

16. Wilkinson, Leland, SYSTAT: The system for Statistics, Systat Inc., Evanston, IL, 1989.

PORT OF PORTLAND
ORGANIZATION DESCRIPTION

The Port of Portland is a state agency with a primary business focus related to transportation system development. A secondary business involvement relates to development of lands both acquired and created through dredging of the navigable waterways. Estimates show the Port stimulates the regional economy to the tune of $6 million per day by providing facilities which support passenger and cargo movement, developing a real estate portfolio to support the core business, and lastly making financial resources available to other businesses which benefit the regional economy. The mission statement of "the Port" involves " promoting a strong economic base for the region via management of its assets".

The Port was created by the Oregon Legislature in 1891 to dredge and maintain a navigable channel from Portland to the Pacific Ocean. Over the years, the responsibilities have broadened to constitute the formation of three divisions. These are Maritime (Marine and Ship Repair Yard), Aviation, and Real Estate. The activities of these operating groups are coordinated by an executive director who implements policies and directives of a nine member commission appointed by the governor.

Service groups (including Engineering) support the efforts and goals of the operating groups. The service groups are in partnership to preserve and manage the assets of the operating groups. In this manner, the assets will continue to function and serve the citizens of the region for years to come.

Port of Portland

Organization Chart—February 1992

PORT OF PORTLAND COMMISSION

COMMISSION
Appointed by the Governor to direct the Port to meet responsibilities established by legislature.

Robert R. Ames	President
George M. Miller	Vice President
Robert S. Walsh	Secretary
Nancy Wilgenbusch	Treasurer
A. Victor Rosenfeld	Commissioner
Sho G. Dozono	Commissioner
Alfred M. Gleason	Commissioner
Darryl Tukufu	Commissioner
Elizabeth Flanagan	Commissioner

EXECUTIVE DIRECTOR
Mike Thorne

GEN. COUNSEL

EXECUTIVE ASSISTANT

EXEC. ADMIN. COOR.

OPERATIONS GROUPS

GENERAL SERVICE GROUPS

1 MARINE DIRECTOR
- GEN. MGR. MARINE PLANNING & DEV.
- ACTING GEN. MGR. MARINE TERMINALS
- GENERAL MGR. MARINE MARKETING

2 REAL ESTATE MGMT. & DEV. DIRECTOR
- GENERAL MGR. REAL ESTATE
- MANAGER PLANNING
- MANAGER LAND DEV.

3 SHIP YARD DIRECTOR
- MGR., FACILITIES/ MAINTENANCE
- MANAGER MARKETING
- MANAGER SERVICES
- MANAGER OPERATIONS
- CONTRACTS/ADMIN. MANAGER

4 AVIATION DIRECTOR
- AIRPORT MANAGER
- MANAGER MARKETING
- MGR., PLANNING & PROPERTIES DEV.
- T.E.N. AVIATION MGR.

ENGINEERING DIRECTOR
Kenneth N. Weber
- PROJECT DEV. MGR.
- CONSTRUCTION SERVICES MGR.
- ENVIRONMENTAL SERVICES MGR.
- FACILITY SERVICES MGR.
- DREDGE OREGON MANAGER

PROGRAM DEV. DIRECTOR
- MANAGER RISK MANAGEMENT
- MGR., EMP./LABOR RELATIONS
- MANAGER COMPENSATION

CHIEF FIN. OFFICER
DIR. OF FINANCE & ADMIN.
- CONTROLLER
- SENIOR MGR. FINANCE
- SENIOR MGR. INFORMATION TECH.
- SENIOR MGR. ADM. SERVICES
- SENIOR MGR. INTERNAL AUDIT
- SENIOR MGR. FINANCE—AVIATION
- SENIOR MGR. FINANCE—MARINE
- BUSINESS MANAGER REAL EST. MGMT. & DEV.
- MANAGER FINANCE—PSRY
- GENERAL MGR. SPECIAL PROJECTS

PUBLIC AFFAIRS DIRECTOR
- MANAGER MARKETING
- MANAGER GOVT. RELATIONS
- COMMUNITY RELATIONS

ENGINEERING PROVIDES SERVICE TO THE OPERATIONAL AREAS

2804

☐ AVIATION ☐ PSRY

☐ MARINE ☐ REAL ESTATE

☐ NAVIGATION

PORT OF PORTLAND

ENGINEERING SERVICES DEPARTMENT

CUSTOMER SURVEY

Your responses to this questionnaire will help us maintain and improve the services we provide to you.

The questionnaire is divided into two parts. The first part allows you to rate our primary services in relation to twelve key customer-service attributes. The second part contains a limited number of specific questions relating to many types of service.

Because the department provides many services in many ways (e.g., as part of large projects, as small "special" projects, as marketing support, and as independent, non-project-related activities), you are asked to review the definitions when you are not sure what a heading refers to.

Thank you for your contribution to this evaluation. You will receive information about the survey results this Fall.

PART 1

Part 1 Instructions

Please use the matrix on the next page to rate the services provided to you by the Engineering Services Department. Twelve attributes are listed on the left-hand axis, and seven types of service are listed on the top axis. To make your rating, place a number from 1 to 7 in each relevant cell. A 7 indicates that the attribute is provided in an excellent manner; a 1 means that it is handled terribly.

If you have no opinion, or if an attribute is not relevant to the service you are rating, leave the box blank. Please provide ratings only for services with which you have direct experience.

To ensure clarity, an expanded description of each service listed on the top axis is provided below.

Use the following scale when you write your evaluations of each attribute:

7: Excellent
6: Very Good
5: Good
4: Fair
3: Poor
2: Very Poor
1: Terrible

DESCRIPTIONS OF SERVICES (TOP AXIS)

ENGINEERING AND ARCHITECTURAL PROJECT MANAGEMENT AND DESIGN includes all activities, including those of outside firms, carried out to produce a final engineering or architectural design, *except projects under $50,000*, which are covered under the "Special Projects" function (below).

CONSTRUCTION ADMINISTRATION includes the management of construction contracts and related activities such as site inspection.

ENVIRONMENTAL SERVICES includes all activities carried out by that organization.

FACILITY MAINTENANCE ENGINEERING includes the activities carried out in support of maintenance/asset-presevation at operating facilities.

MARKETING SUPPORT includes all activities carried out in support of marketing activities.

SPECIAL PROJECTS is the group which to carries out expedited construction procedures for "small" projects – projects under $50,000.

TECHNICAL SERVICES includes the preparation or retrieval of drawings, plats, surveys, graphics, reports, and other information provided to customers *separate from a design project or a marketing-support project.*

Rating Scale

7: Excellent
6: Very Good
5: Good
4: Fair
3: Poor
2: Very Poor
1: Terrible

	CONSTRUCTION ADMINISTRATION	ENGINEERING AND ARCHITECTURAL PROJECT MANAGEMENT AND DESIGN	ENVIRONMENTAL SERVICES	FACILITY MAINTENANCE ENGINEERING	MARKETING SUPPORT	SPECIAL PROJECTS	TECHNICAL SERVICES (E.G., DRAWINGS AND REPORTS — NON-PROJECT RELATED	COMMENTS
Capable: achieves top quality product								
Collaborative: open and responsive to customer needs and desires								
Accurate in estimates: provides estimates that can be relied on								
Reliable regarding schedules: meets schedule commitments								
Flexibile: adapts to changes required during a project or activity								
Reliable regarding budgets: stays within budget								
Cost-effective: achieves a proper balance between quality and cost								
Forceful: represents customer's interests strongly with contractors, outside agencies, etc.								
Communicative: keeps customer informed								
Accessible: can be contacted within reasonable time frames								
Organized: operates without confusion regarding roles, responsibilities, authority, etc.								
Efficient: avoids unproductives uses of time; avoids unnecessary bureaucracy or "red tape"								

PART 2

Part 2 Instructions

The questions in this part of the survey relate to specific aspects of Engineering Services activities. As in Part 1, please answer only for those activities with which you have direct experience. Since you may not have experience with all the services provided by the Department, it may help to review the headings and answer only for those categories that pertain to you.

Please indicate your degree of satisfaction regarding each activity by circling the appropriate number on the 1-to-7 scale. A **7** means that you completely agree with the statement; **1** means that you completely disagree. **If you have no opinion, or is an item does not apply to you, please leave the item unanswered.**

There is some room for your comments at the end of each section. If you need more room, please use the back page or an additional sheet of paper.

Overall Management of the Engineering Services Department

	Completely Disagree ← → Completely Agree						
1. From my perspective, I believe that the department provides all the services that it should be providing	1	2	3	4	5	6	7
2. The services provided to operating departments are distributed appropriately among those departments	1	2	3	4	5	6	7
3. The department seems to be operated in a cost-effective manner	1	2	3	4	5	6	7
4. I know, or I can easily find out, the organization or person to contact within the department to obtain the service(s) I need	1	2	3	4	5	6	7
5. Overall, the department has highly competent people working in it	1	2	3	4	5	6	7
6. Overall, the department seems well organized	1	2	3	4	5	6	7
7. I am satisfied with the cost of work provided by the department	1	2	3	4	5	6	7
8. Overall, there is good communication between management of the Engineering Services Department and management of operating departments	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

Project Management

	Completely Disagree ←						→ Completel Agree
9. Project managers generally do their jobs very effectively	1	2	3	4	5	6	7
10. Project managers treat all customers fairly: they do not cater to some customers to the disadvantage of others	1	2	3	4	5	6	7
11. "Fast tracking" is used effectively when a project requires it	1	2	3	4	5	6	7
12. The project status documentation that I receive (e.g., tracking of costs) is very helpful	1	2	3	4	5	6	7
13. Working roles and relationships between the department's project personnel and the customer's personnel are clearly defined.	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

Specific Functions Within the Department

ENGINEERING AND ARCHITECTURAL DESIGN PROJECT MANAGEMENT

14. The selection process for engineering and architectural consultants typically results in the selection of the best candidate to do the job	1	2	3	4	5	6	7
15. The contracting process for engineering and architectural consultants results in a contract that appropriately satisfies the Port's requirements	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

CAD. This category refers to CAD drawings requested by a customer for a special purpose such as marketing support; it does not refer to retrieval of existing CAD products (see the heading "Information Retrieval," below) or to CAD products developed as part of an architectural/engineering project managed by the Department.

	Completely Disagree ← → Completely Agree						
16. The quality of CAD drawings I receive is excellent	1	2	3	4	5	6	7
17. The time period required to produce CAD drawings is appropriate for my requirements	1	2	3	4	5	6	7
18. The cost of CAD drawings is appropriate	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

CUSTOMER CONTACT

19. My calls to the Engineering Services Department are handled in a professional manner	1	2	3	4	5	6	7
20. When I visit the Engineering Services Department, I am treated in a professional manner	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

CONSTRUCTION SERVICES

21. The transition from completion of construction to use by operations (owner) is handled smoothly	1	2	3	4	5	6	7
22. Inspections of construction work conducted by the Department are effective .	1	2	3	4	5	6	7
23. The quality of communication during construction is high: there are rarely any "surprises"	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

DRAWINGS (NON-CAD). This categ[illegible] refers to non-CAD drawings requested by [illegible]ustomer for a special purpose such as marketing support; it does not refer to retrieval of existing products (see the heading "Information Retrieval," below) or to drawings developed as part of an architectural/engineering project managed by the Department.

	Completely Disagree ← → Completely Agree						
24. The quality of drawings I receive is excellent	1	2	3	4	5	6	7
25. The time period required to produce drawings is appropriate for my requirements	1	2	3	4	5	6	7
26. The cost of drawings is appropriate	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

ENVIRONMENTAL SERVICES

27. I am kept aware of environmental policies and regulations that affect my work	1	2	3	4	5	6	7
28. I receive excellent support from Environmental Services for [please rate each of the following items that applies to you]:							
A. Operational/business planning	1	2	3	4	5	6	7
B. Emergency response compliance	1	2	3	4	5	6	7
C. Permit acquisition	1	2	3	4	5	6	7
D. Budgeting (projections of environmental costs)	1	2	3	4	5	6	7
E. Damage control response	1	2	3	4	5	6	7
F. Development of Environmental Management Plan	1	2	3	4	5	6	7
G. Coordination with environmental agencies	1	2	3	4	5	6	7
H. Support to operational and project development needs	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

	Completely Disagree ← → Completely Agree						
29. I receive excellent assistance for facility maintenance engineering activities .	1	2	3	4	5	6	7
30. I receive excellent assistance in the development and implementation of policies and plans for long-term asset preservation	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

GRAPHICS. This category refers to **graphics** — not maps or drawings — requested by a customer for a special purpose such as marketing support; it does not refer to *retrieval of existing graphics* (see the heading "Information Retrieval," below) or to graphics developed as part of an architectural/engineering project managed by the Department.

31. The quality of graphics I receive is excellent	1	2	3	4	5	6	7
32. The time period required to produce graphics is appropriate for my requirements	1	2	3	4	5	6	7
33. The cost of graphics is appropriate	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

INFORMATION RETRIEVAL. This category deals with *retrieval of existing products and information*; not with the creation of new drawings, maps, reports, etc.

34. Existing maps, drawings and other design-related items that I request are provided in a timely manner	1	2	3	4	5	6	7
35. Existing reports and other general information that I request are provided in a timely manner	1	2	3	4	5	6	7

Comments (You may continue your comments on an additional sheet.)

INTERIORS

Completely Disagree ← → Complete Agree

36. The design of building interiors is satisfactory 1 2 3 4 5 6 7

Comments (You may continue your comments on the back page or on an additional sheet.)

LANDSCAPING

36. The design of landscaping is satisfactory 1 2 3 4 5 6 7

37. Landscaping is installed in a satisfactory manner 1 2 3 4 5 6 7

Comments (You may continue your comments on the back page or on an additional sheet.)

PERMITS -- BUILDING-RELATED

38. Building-related permits are obtained promptly 1 2 3 4 5 6 7

Comments (You may continue your comments on the back page or on an additional sheet.)

SPECIAL PROJECTS. Expedited procedure for construction projects under $50,000.

39. The creation of the special projects section has significantly improved the department's performance on small construction projects 1 2 3 4 5 6 7

40. The $50,000 limit for definition of a small project is appropriate 1 2 3 4 5 6 7

41. Scoping of small projects is handled effectively 1 2 3 4 5 6 7

Comments (You may continue your comments on the back page or on an additional sheet.)

SURVEYING — LAND. This category refers to property surveying support requested by a customer, separate from surveys carried out in support of projects managed by the Department.

	Completely Disagree ← → Completely Agree						
42. The quality of surveys and survey information I receive is excellent	1	2	3	4	5	6	7
43. The time period required to produce surveys is appropriate for my requirements	1	2	3	4	5	6	7
44. The cost of surveying is appropriate	1	2	3	4	5	6	7

Comments (You may continue your comments on the back page or on an additional sheet.)

This is the final page of the survey.
Thank you for providing this assistance to the Engineering Services Department.

A12

REAL ESTATE (n = 9)

	ARCHITECTURAL AND ENGINEERING DESIGN PROJECTS	CONSTRUCTION ADMINISTRATION	ENVIRONMENTAL SERVICES	FACILITY SERVICES (MAINTENANCE ENGINEERING)	MARKETING SUPPORT	SPECIAL PROJECTS	TECHNICAL SERVICES (E.G., DRAWINGS AND REPORTS — NON-PROJECT RELATED)
Capable: achieves top quality product	4.8	4.3	3.3	0	5.0	5.2	5.3
Collaborative: open and responsive to customer needs and desires	3.8	4.0	3.6	0	5.0	4.8	**5.6**
Accurate in estimates: provides estimates that can be relied on	3.3	3.3	3.4	0	3.7	4.5	5.0
Reliable regarding schedules: meets schedule commitments	4.0	2.8	**2.7**	0	4.8	4.7	5.1
Flexibile: adapts to changes required during a project or activity	4.5	3.8	4.0	0	4.8	5.2	5.0
Reliable regarding budgets: stays within budget	4.0	3.5	4.3	0	4.0	4.8	4.8
Cost-effective: achieves a proper balance between quality and cost	4.3	3.8	4.0	0	4.3	5.0	5.2
Forceful: represents customer's interests strongly with contractors, outside agencies, etc.	4.8	4.1	3.2	0	4.3	5.0	5.2
Communicative: keeps customer informed	3.4	3.7	**2.6**	0	4.3	4.8	5.0
Accessible: can be contacted within reasonable time frames	4.5	4.2	3.9	0	4.8	5.2	5.4
Organized: operates without confusion regarding roles, responsibilities, authority, etc.	**6.0**	3.6	**2.4**	0	4.3	5.5	**6.0**
Efficient: avoids unproductives uses of time; avoids unnecessary bureaucracy or "red tape"	5.0	3.0	**2.7**	A13 0	3.8	5.2	5.4

MARINE (n = 10)

	ARCHITECTURAL AND ENGINEERING DESIGN PROJECTS	CONSTRUCTION ADMINISTRATION	ENVIRONMENTAL SERVICES	FACILITY SERVICES (MAINTENANCE ENGINEERING)	MARKETING SUPPORT	SPECIAL PROJECTS	TECHNICAL SERVICES (E.G., DRAWINGS AND REPORTS — NON-PROJECT RELATED)
Capable: achieves top quality product	4.8	4.7	4.2	5.6	5.6	**6.0**	**6.0**
Collaborative: open and responsive to customer needs and desires	4.3	4.9	3.7	5.1	5.4	5.8	**6.5**
Accurate in estimates: provides estimates that can be relied on	4.0	4.0	3.8	4.7	4.8	5.0	5.6
Reliable regarding schedules: meets schedule commitments	4.8	4.3	**3.5**	5.2	5.4	5.4	5.7
Flexibile: adapts to changes required during a project or activity	4.5	5.3	5.0	5.0	5.3	5.3	5.8
Reliable regarding budgets: stays within budget	4.3	4.8	5.0	4.4	4.3	5.0	5.0
Cost-effective: achieves a proper balance between quality and cost	4.3	4.3	3.8	4.3	**3.6**	4.6	4.0
Forceful: represents customer's interests strongly with contractors, outside agencies, etc.	5.5	5.7	4.0	5.0	5.0	5.5	5.7
Communicative: keeps customer informed	4.7	4.4	4.2	5.3	4.8	**6.0**	5.4
Accessible: can be contacted within reasonable time frames	5.3	5.2	4.7	5.6	5.0	**6.0**	**6.0**
Organized: operates without confusion regarding roles, responsibilities, authority, etc.	5.2	4.6	4.2	5.0	5.7	5.8	5.8
Efficient: avoids unproductives uses of time; avoids unnecessary bureaucracy or "red tape"	4.5	5.0	**3.4**	4.4	3.7	5.7	**6.0**

PSRY (n = 8)

	ARCHITECTURAL AND ENGINEERING DESIGN PROJECTS	CONSTRUCTION ADMINISTRATION	ENVIRONMENTAL SERVICES	FACILITY SERVICES (MAINTENANCE ENGINEERING)	MARKETING SUPPORT	SPECIAL PROJECTS	TECHNICAL SERVICES (E.G., DRAWINGS AND REPORTS — NON-PROJECT RELATED)
Capable: achieves top quality product	5.8	5.6	4.2	5.6	5.5	5.1	5.8
Collaborative: open and responsive to customer needs and desires	5.5	5.6	4.0	5.8	6.0	5.2	5.5
Accurate in estimates: provides estimates that can be relied on	5.0	5.0	4.3	5.3	5.5	4.4	5.0
Reliable regarding schedules: meets schedule commitments	5.3	5.3	3.8	5.0	5.5	4.6	5.4
Flexibile: adapts to changes required during a project or activity	5.5	6.0	4.7	5.6	6.0	5.2	6.0
Reliable regarding budgets: stays within budget	4.8	4.3	**3.0**	5.0	5.0	3.3	**3.0**
Cost-effective: achieves a proper balance between quality and cost	5.0	4.7	4.3	5.5	4.0	4.0	**3.0**
Forceful: represents customer's interests strongly with contractors, outside agencies, etc.	5.5	6.0	5.0	5.3	5.5	5.4	5.0
Communicative: keeps customer informed	5.5	5.8	4.2	5.5	5.5	5.2	5.5
Accessible: can be contacted within reasonable time frames	5.8	6.0	5.2	5.8	5.0	5.5	**6.2**
Organized: operates without confusion regarding roles, responsibilities, authority, etc.	6.0	**6.3**	3.5	6.0	5.5	5.8	5.8
Efficient: avoids unproductives uses of time; avoids unnecessary bureaucracy or "red tape"	5.0	5.3	4.2	6.0	5.5	5.0	4.7

AVIATION -- ALL(n = 15)

	ARCHITECTURAL AND ENGINEERING DESIGN PROJECTS	CONSTRUCTION ADMINISTRATION	ENVIRONMENTAL SERVICES	FACILITY SERVICES (MAINTENANCE ENGINEERING)	MARKETING SUPPORT	SPECIAL PROJECTS	TECHNICAL SERVICES (E.G., DRAWINGS AND REPORTS — NON-PROJECT RELATED)
Capable: achieves top quality product	4.2	5.3	**2.4**	5.9	**6.3**	5.8	4.6
Collaborative: open and responsive to customer needs and desires	3.7	4.8	3.4	5.7	**6.3**	5.8	4.6
Accurate in estimates: provides estimates that can be relied on	3.9	4.1	3.0	4.9	4.0	4.2	3.7
Reliable regarding schedules: meets schedule commitments	4.9	4.6	**2.7**	4.6	5.5	4.8	4.2
Flexibile: adapts to changes required during a project or activity	3.6	4.1	4.0	5.8	5.5	5.9	**6.0**
Reliable regarding budgets: stays within budget	4.7	4.3	3.5	4.9	4.7	4.9	5.4
Cost-effective: achieves a proper balance between quality and cost	4.0	4.0	3.0	4.8	4.0	4.7	4.7
Forceful: represents customer's interests strongly with contractors, outside agencies, etc.	**2.9**	3.7	3.7	4.6	4.5	4.3	3.6
Communicative: keeps customer informed	3.4	4.2	3.4	4.7	**6.0**	5.3	4.0
Accessible: can be contacted within reasonable time frames	5.1	5.1	4.3	5.3	5.5	5.7	4.2
Organized: operates without confusion regarding roles, responsibilities, authority, etc.	4.5	4.3	3.1	5.3	**6.0**	**6.0**	4.6
Efficient: avoids unproductives uses of time; avoids unnecessary bureaucracy or "red tape"	4.4	3.9	**2.8**	5.1	**6.3**	5.5	4.0

COMMENTS

DATE: DECEMBER 16, 1991

TO: CLIENT PARTICIPANTS IN OCTOBER SURVEY

FROM: KEN WEBER

COPIES: DARREL BUTTICE
ED GALLIGAN
BOB HRDLICKA
ROBERTA McENIRY
CARTER MACNICHOL
KEITH PHILDIUS
BRUCE ROBESON
SUSAN SCHREIBER
CORY STREISINGER
MIKE THORNE

SUBJECT: ENGINEERING DEPARTMENT PERFORMANCE SURVEY - RESULTS OF CLIENT INPUT

I'm sure you have been "anxiously awaiting" the results of the performance survey we conducted in late October and to hear what we plan to do about what was learned.

Let me start by thanking the 60 of you who participated by completing the questionnaire and providing your opinions and perceptions about the quality, responsiveness, and cost effectiveness of the services we currently provide.

We have had considerable data to sort through and analyze. I will summarize the results as we understand them to date. As you will recall from completing the survey, a 1-to-7 scale was available for response with one representing "completely disagree" and seven representing "completely agree." In tabulating the results, we considered 1-2 to be strong negatives and 6-7 to be strong positives. In this way, we identified the issues about which feelings were most intense.

Let's start with the good news. The Management Team and I were gratified (though I still see room for improvement) to see that a high percentage of you feel that:

- Customers know who to contact in Engineering for various services and responses are generally effective.
- Department is staffed with highly competent people who treat their customers in a very professional manner.
- Project Managers generally do their job well and treat customers fairly.

- Technical Services "non-CAD" drafting and graphics services are producing excellent quality and cost effective products.
- The handling of small projects is very effective and has significantly improved since the creation of the "Special Projects" team.
- "Fast Tracking" is used effectively when a project requires its use.
- Engineering support to maintenance activities and programs are effective services.

The opportunities for improvement across all five client groups within the Port were more difficult to discern. There are some very clear messages from individual departments. We intend to follow up on those on a department-by-department basis and develop specific action plans in the coming months.

There are several noteworthy trends among the negative responses:

- Adequate documentation of project status led the list from three client groups. Thirty-seven percent feel a strong need for improvement.
- The department's ability to be cost effective came second, with 32 percent responding negatively from the same three client groups.
- The need for clearly defined working relationships was the third highest negative, and CAD operations were identified consistently as areas for improvement.

In addition, during your discussions with Terry O'Connor, two additional service areas were identified for desired improvement: communications during construction and the building permit process. Environmental Services support has also been identified by many of you as an area for action.

The department's Management Team spent a day intensely reviewing and interpreting the data. Our planning for action is incomplete, but we have decided to begin several initiatives early in 1992.

First, we are refocusing on client relationships as a high priority within the department--as high as any of our projects. To support this commitment, we will invest in training of the staff. In addition, we are establishing a "committee"

to continually monitor client service and make recommendations for improvements responding to the needs of our different client groups.

Secondly, the reinstallation of post-project reviews to evaluate successes/failures in project development are essential for insuring that you, the client, have received a quality service and product in a timely manner. We will have a policy and procedure for post-project review out for your comments during January.

Thirdly, we have scheduled a December review of our lines of business. You have suggested that in the spirit of responding to all engineering-related needs, we may not be providing the desired quality in key service areas. It may be time to restructure how we are organized to provide some services or stop providing some of our existing business/services.

Finally, I am pleased with your strong endorsement of the special projects function which we established only two years ago in response to a similar survey. We have yet to finalize its shape and definition, but some restructuring to provide a similar service more tailored to the individual needs of departments will be considered and evaluated. Something we tagged as a "Son of Special Projects" seems appropriate as a 1992 innovation.

Thank you for your time, energy, and interest in working with us to better understand the strengths and the opportunities of the department. We have significant work yet to be done on issues of cost effectiveness and with our environmental program. In addition, there is considerable more detail to be developed on the initiatives stated above.

During the first quarter of 1992, I will again share with you more specific actions and progress with Engineering's response and initiatives.

i:\nmk\wp\knw\client.mem

		CAP BUDG ORG	COL COST EFF	ACCU FORC	SCHE COMM	FLEX ACCE
CASE	1	4.200	3.700	3.900	4.900	3.600
CASE	1	4.700	4.000	2.900	3.400	5.100
CASE	1	4.500	4.400			
CASE	2	5.300	4.800	4.100	4.600	4.100
CASE	2	4.300	4.000	3.700	4.200	5.100
CASE	2	4.300	3.900			
CASE	3	2.400	3.400	3.000	2.700	4.000
CASE	3	3.500	3.000	3.700	3.400	4.300
CASE	3	3.100	2.800			
CASE	4	5.900	5.700	4.900	4.600	5.800
CASE	4	4.900	4.800	4.600	4.700	5.300
CASE	4	5.300	5.100			
CASE	5	6.300	6.300	4.000	5.500	5.500
CASE	5	4.700	4.000	4.500	6.000	5.500
CASE	5	6.000	6.300			
CASE	6	5.800	5.800	4.200	4.800	5.900
CASE	6	4.900	4.700	4.300	5.300	5.700
CASE	6	6.000	5.500			
CASE	7	4.600	4.600	3.700	4.200	6.000
CASE	7	5.400	4.700	3.600	4.000	4.200
CASE	7	4.600	4.000			

N = 5

MATRIX TO BE FACTORED

	CAP	COL	ACCU	SCHE	FLEX
CAP	1.000				
COL	0.933	1.000			
ACCU	0.826	0.693	1.000		
SCHE	0.871	0.704	0.669	1.000	
FLEX	0.615	0.750	0.463	0.311	1.000
BUDG	0.631	0.503	0.566	0.631	0.698
COST	0.723	0.614	0.775	0.575	0.756
FORC	0.642	0.851	0.523	0.259	0.719
COMM	0.844	0.961	0.498	0.668	0.667
ACCE	0.778	0.724	0.690	0.762	0.222
ORG	0.913	0.911	0.689	0.842	0.692
EFF	0.884	0.889	0.643	0.868	0.577

	BUDG	COST	FORC	COMM	ACCE
BUDG	1.000				
COST	0.914	1.000			
FORC	0.153	0.362	1.000		
COMM	0.361	0.421	0.823	1.000	
ACCE	0.221	0.383	0.506	0.723	1.000
ORG	0.664	0.704	0.629	0.885	0.803
EFF	0.551	0.554	0.622	0.898	0.823

	ORG	EFF
ORG	1.000	
EFF	0.969	1.000

LATENT ROOTS (EIGENVALUES)

1	2	3	4	5
8.452	1.505	1.223	0.578	0.171
6	7	8	9	10
0.071	0.000	0.000	0.000	-0.000
11	12			
-0.000	-0.000			

	36.264	24.307	26.342	10.893	1.599

MATRIX OF RESIDUALS

	SCHE	ACCE	EFF	ORG	CAP
SCHE	0.000				
ACCE	0.005	0.000			
EFF	-0.009	-0.005	0.000		
ORG	-0.003	-0.001	0.003	0.000	
CAP	0.000	0.000	-0.000	-0.000	0.000
COMM	-0.003	-0.002	0.003	0.001	-0.000
COL	0.008	0.005	-0.008	-0.002	0.000
BUDG	-0.006	-0.004	0.007	0.002	-0.000
COST	0.005	0.003	-0.005	-0.002	0.000
FLEX	0.008	0.004	-0.008	-0.002	0.000
FORC	-0.000	-0.000	0.000	0.000	-0.000
ACCU	-0.015	-0.009	0.015	0.004	-0.000

	COMM	COL	BUDG	COST	FLEX
COMM	0.000				
COL	-0.003	0.000			
BUDG	0.002	-0.006	0.000		
COST	-0.002	0.005	-0.004	0.000	
FLEX	-0.003	0.007	-0.006	0.005	0.000
FORC	0.000	-0.000	0.000	-0.000	-0.000
ACCU	0.006	-0.014	0.011	-0.009	-0.013

	FORC	ACCU
FORC	0.000	
ACCU	0.001	0.000

FACTOR SCORE COEFFICIENTS

	1	2	3	4	5
SCHE	0.348	-0.014	-0.239	-0.072	0.929
ACCE	0.337	-0.149	-0.180	0.189	-1.406
EFF	0.327	0.029	-0.034	-0.318	-0.368
ORG	0.266	0.148	-0.049	-0.298	-0.805
CAP	0.026	-0.083	0.071	0.266	1.062
COMM	0.164	-0.114	0.262	-0.312	0.328
COL	-0.006	-0.091	0.264	0.040	0.598
BUDG	0.016	0.490	-0.175	-0.227	0.120
COST	-0.160	0.392	-0.094	0.254	-0.516
FLEX	-0.203	0.333	0.311	-0.281	-0.424
FORC	-0.253	-0.198	0.517	0.253	0.075
ACCU	-0.219	-0.065	-0.035	0.956	0.191

SCORES HAVE BEEN SAVED

COMPONENT LOADINGS

	1	2	3	4	5
ORG	0.973	0.036	0.064	0.161	-0.147
CAP	0.969	0.022	0.117	-0.062	0.186
COL	0.956	0.189	-0.188	0.008	0.106
EFF	0.935	0.185	0.133	0.206	-0.072
COMM	0.884	0.369	-0.191	0.202	0.053
SCHE	0.824	-0.017	0.513	0.186	0.149
ACCU	0.798	-0.159	0.192	-0.538	0.052
ACCE	0.775	0.406	0.383	-0.154	-0.238
COST	0.762	-0.613	-0.034	-0.165	-0.088
FLEX	0.734	-0.302	-0.596	0.097	-0.076
FORC	0.710	0.367	-0.557	-0.213	0.029
BUDG	0.675	-0.711	0.050	0.186	0.007

VARIANCE EXPLAINED BY COMPONENTS

1	2	3	4	5
8.452	1.505	1.223	0.578	0.171

PERCENT OF TOTAL VARIANCE EXPLAINED

1	2	3	4	5
70.434	12.538	10.192	4.814	1.427

ROTATED LOADINGS

	1	2	3	4	5
SCHE	0.883	0.352	0.019	0.217	0.219
ACCE	0.837	-0.043	0.238	0.416	-0.248
EFF	0.834	0.294	0.425	0.102	-0.030
ORG	0.757	0.447	0.443	0.139	-0.103
CAP	0.682	0.385	0.431	0.390	0.198
COMM	0.671	0.136	0.724	0.012	0.060
COL	0.588	0.287	0.711	0.229	0.100
BUDG	0.289	0.947	0.046	0.088	0.098
COST	0.221	0.861	0.205	0.398	-0.054
FLEX	0.081	0.685	0.722	-0.007	-0.060
FORC	0.209	0.031	0.942	0.248	-0.045
ACCU	0.397	0.387	0.240	0.791	0.015

VARIANCE EXPLAINED BY ROTATED COMPONENTS

1	2	3	4	5
4.352	2.917	3.161	1.307	0.192

PERCENT OF TOTAL VARIANCE EXPLAINED

1	2	3	4	5

Utilities Files Data Graph Statistics

SYSTAT Editor FACTOR1.SYSW

Case	PSRY1	REAL1	MARINE1	AVIAT1	GOAL1
1	5.525	4.875	4.950	4.725	5.237
2	5.725	3.400	4.775	4.475	5.250
3	4.175	2.925	3.950	3.700	4.062
4	5.375	4.425	4.950	5.825	5.162
5	5.225	5.150	5.725	5.500	5.475
6	5.525	5.475	5.875	4.250	5.700
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Utilities Files Data Graph Statistics

SYSTAT Editor FACTOR2.SYS

Case	PSRY2	REAL2	MARINE2	AVAIT2	GOAL2
1	4.900	4.150	4.300	4.350	4.600
2	4.500	3.650	4.550	4.150	4.525
3	3.650	4.150	4.400	3.250	4.025
4	4.500	4.150	3.950	4.350	4.225
5	3.650	4.900	4.800	4.800	4.225
6	3.000	5.000	4.500	5.050	3.750
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Utilities Files Data Graph Statistics

SYSTAT Editor FACTOR3.SYS

Case	PSRY3	REAL3	MARINE3	AVAIT3	GOAL3
1	5.500	4.125	4.750	3.400	5.125
2	5.850	3.900	5.075	4.200	5.463
3	4.475	3.350	4.225	3.625	4.350
4	5.750	4.600	5.125	5.575	5.437
5	5.250	4.950	5.650	5.325	5.450
6	5.500	5.200	5.850	4.550	5.675
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Utilities Files Data Graph Statistics

SYSTAT Editor FACTOR4.SYS

Case	PSRY4	REAL4	MARINE4	AVAIT4	GOAL4
1	5.000	3.300	4.000	3.900	4.500
2	5.000	3.300	4.000	4.100	4.500
3	4.300	3.400	3.800	3.000	4.050
4	5.500	3.700	4.800	4.000	5.150
5	4.400	4.500	5.000	4.200	4.700
6	5.000	5.000	5.600	3.700	5.300
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Type SAVE to save data, Esc to change data, QUIT when done

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY1	20.000
REAL1	8.000
MARINE1	19.000
AVIAT1	13.000

FRIEDMAN TEST STATISTIC = 9.400
KENDALL COEFFICIENT OF CONCORDANCE = 0.522

PROBABILITY IS 0.024 ASSUMING CHI-SQUARE DISTRIBUTION WITH 3 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY1	16.000
REAL1	6.000
MARINE1	14.000

FRIEDMAN TEST STATISTIC = 9.333
KENDALL COEFFICIENT OF CONCORDANCE = 0.778

PROBABILITY IS 0.009 ASSUMING CHI-SQUARE DISTRIBUTION WITH 2 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY1	10.000
MARINE1	8.000

FRIEDMAN TEST STATISTIC = 0.667
KENDALL COEFFICIENT OF CONCORDANCE = 0.111

PROBABILITY IS 0.414 ASSUMING CHI-SQUARE DISTRIBUTION WITH 1 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY2	15.000
REAL2	14.000
MARINE2	15.500
AVAIT2	15.500

FRIEDMAN TEST STATISTIC = 0.150
KENDALL COEFFICIENT OF CONCORDANCE = 0.008

PROBABILITY IS 0.985 ASSUMING CHI-SQUARE DISTRIBUTION WITH 3 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY3	21.000
REAL3	8.000
MARINE3	19.000
AVAIT3	12.000

FRIEDMAN TEST STATISTIC = 11.000
KENDALL COEFFICIENT OF CONCORDANCE = 0.611

PROBABILITY IS 0.012 ASSUMING CHI-SQUARE DISTRIBUTION WITH 3 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY3	16.000
REAL3	6.000
MARINE3	14.000

FRIEDMAN TEST STATISTIC = 9.333
KENDALL COEFFICIENT OF CONCORDANCE = 0.778

PROBABILITY IS 0.009 ASSUMING CHI-SQUARE DISTRIBUTION WITH 2 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY3	10.000
MARINE3	8.000

FRIEDMAN TEST STATISTIC = 0.667
KENDALL COEFFICIENT OF CONCORDANCE = 0.111

PROBABILITY IS 0.414 ASSUMING CHI-SQUARE DISTRIBUTION WITH 1 DF

PSRY3	10.000
MARINE3	8.000

FRIEDMAN TEST STATISTIC = 0.667
KENDALL COEFFICIENT OF CONCORDANCE = 0.111

PROBABILITY IS 0.414 ASSUMING CHI-SQUARE DISTRIBUTION WITH 1 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY4	20.500
REAL4	10.500
MARINE4	19.000
AVAIT4	10.000

FRIEDMAN TEST STATISTIC = 9.150
KENDALL COEFFICIENT OF CONCORDANCE = 0.508

PROBABILITY IS 0.027 ASSUMING CHI-SQUARE DISTRIBUTION WITH 3 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY4	14.500
REAL4	7.500
MARINE4	14.000

FRIEDMAN TEST STATISTIC = 5.083
KENDALL COEFFICIENT OF CONCORDANCE = 0.424

PROBABILITY IS 0.079 ASSUMING CHI-SQUARE DISTRIBUTION WITH 2 DF

FRIEDMAN TWO-WAY ANALYSIS OF VARIANCE RESULTS FOR 6 CASES

VARIABLE	RANK SUM
PSRY4	10.000
MARINE4	8.000

FRIEDMAN TEST STATISTIC = 0.667
KENDALL COEFFICIENT OF CONCORDANCE = 0.111

PROBABILITY IS 0.414 ASSUMING CHI-SQUARE DISTRIBUTION WITH 1 DF

Utilities Files Data Graph Statistics

SYSTAT Editor AVGOAL1.SYS

Case	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ	TECHSERV
GOAL 1	1 5.237	5.250	4.062	5.162	5.475	5.700
AVIAT 1	2 4.725	4.475	3.700	5.825	5.500	4.250
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Utilities Files Data Graph Statistics

SYSTAT Editor AVGOAL2.SYS

Case	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ	TECHSERV
GOAL 2 1	4.600	4.525	4.025	4.225	4.225	3.750
AVIAT 2 2	4.350	4.150	3.250	4.350	4.800	5.050
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Utilities Files Data Graph Statistics

SYSTAT Editor AVGOAL3.SYS

Case	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ	TECHSERV
GOAL 3 1	5.125	5.463	4.350	5.437	5.450	5.675
AVIAT 3 2	3.400	4.200	3.625	5.575	5.325	4.550
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hen done

Utilities Files Data Graph Statistics

SYSTAT Editor AVGOAL4.SYS

Case	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ	TECHSERV
GOAL 4 1	4.500	4.500	4.050	5.150	4.700	5.300
AVIAT 4 2	3.900	4.100	3.000	4.000	4.200	3.700
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Type SAVE to save data, Esc to change data, QUIT when done

A4GOAL1.SYS

TOTAL OBSERVATIONS: 2

	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ
N OF CASES	2	2	2	2	2
MINIMUM	4.725	4.475	3.700	5.162	5.475
MAXIMUM	5.237	5.250	4.062	5.825	5.500
RANGE	0.512	0.775	0.362	0.663	0.025
MEAN	4.981	4.863	3.881	5.494	5.488
VARIANCE	0.131	0.300	0.066	0.220	0.000
STANDARD DEV	0.362	0.548	0.256	0.469	0.018

	TECHSERV
N OF CASES	2
MINIMUM	4.250
MAXIMUM	5.700
RANGE	1.450
MEAN	4.975
VARIANCE	1.051 (1)
STANDARD DEV	1.025

AVGOAL2.SYS

	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ
N OF CASES	2	2	2	2	2
MINIMUM	4.350	4.150	3.250	4.225	4.225
MAXIMUM	4.600	4.525	4.025	4.350	4.800
RANGE	0.250	0.375	0.775	0.125	0.575
MEAN	4.475	4.338	3.638	4.288	4.513
VARIANCE	0.031	0.070	0.300	0.008	0.165
STANDARD DEV	0.177	0.265	0.548	0.088	0.407

	TECHSERV
N OF CASES	2
MINIMUM	3.750
MAXIMUM	5.050
RANGE	1.300
MEAN	4.400
VARIANCE	0.845 (2)
STANDARD DEV	0.919

} exceeded goal

TOTAL OBSERVATIONS: 2

	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ
N OF CASES	2	2	2	2	2
MINIMUM	3.400	4.200	3.625	5.437	5.325
MAXIMUM	5.125	5.463	4.350	5.575	5.450
RANGE	1.725	1.263	0.725	0.138	0.125
MEAN	4.263	4.832	3.988	5.506	5.388
VARIANCE	1.488 (1)	0.798 (2)	0.263	0.010	0.008
STANDARD DEV	1.220	0.893	0.513	0.098	0.088

	TECHSERV
N OF CASES	2
MINIMUM	4.550
MAXIMUM	5.675
RANGE	1.125
MEAN	5.113
VARIANCE	0.633 (2)
STANDARD DEV	0.795

AVGOAL 4.SYS

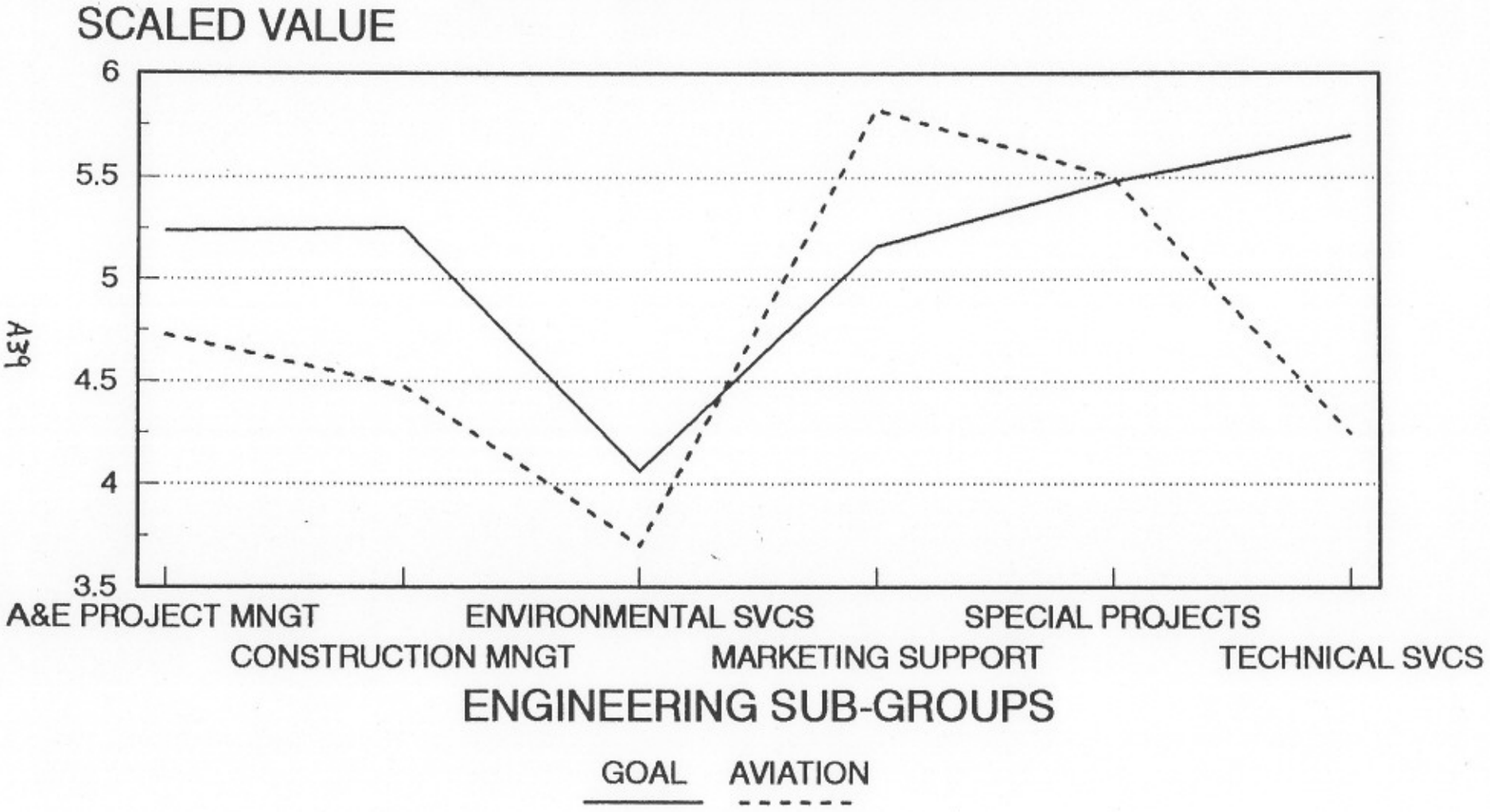
TOTAL OBSERVATIONS: 2

	ARCHENG	CONADMIN	ENVIRON	MARKETIN	SPECPROJ
N OF CASES	2	2	2	2	2
MINIMUM	3.900	4.100	3.000	4.000	4.200
MAXIMUM	4.500	4.500	4.050	5.150	4.700
RANGE	0.600	0.400	1.050	1.150	0.500
MEAN	4.200	4.300	3.525	4.575	4.450
VARIANCE	0.180	0.080	0.551	0.661 (2)	0.125
STANDARD DEV	0.424	0.283	0.742	0.813	0.354

	TECHSERV
N OF CASES	2
MINIMUM	3.700
MAXIMUM	5.300
RANGE	1.600
MEAN	4.500
VARIANCE	1.280 (1)
STANDARD DEV	1.131

EFFICIENT MANAGEMENT

GOAL VERSUS AVIATION



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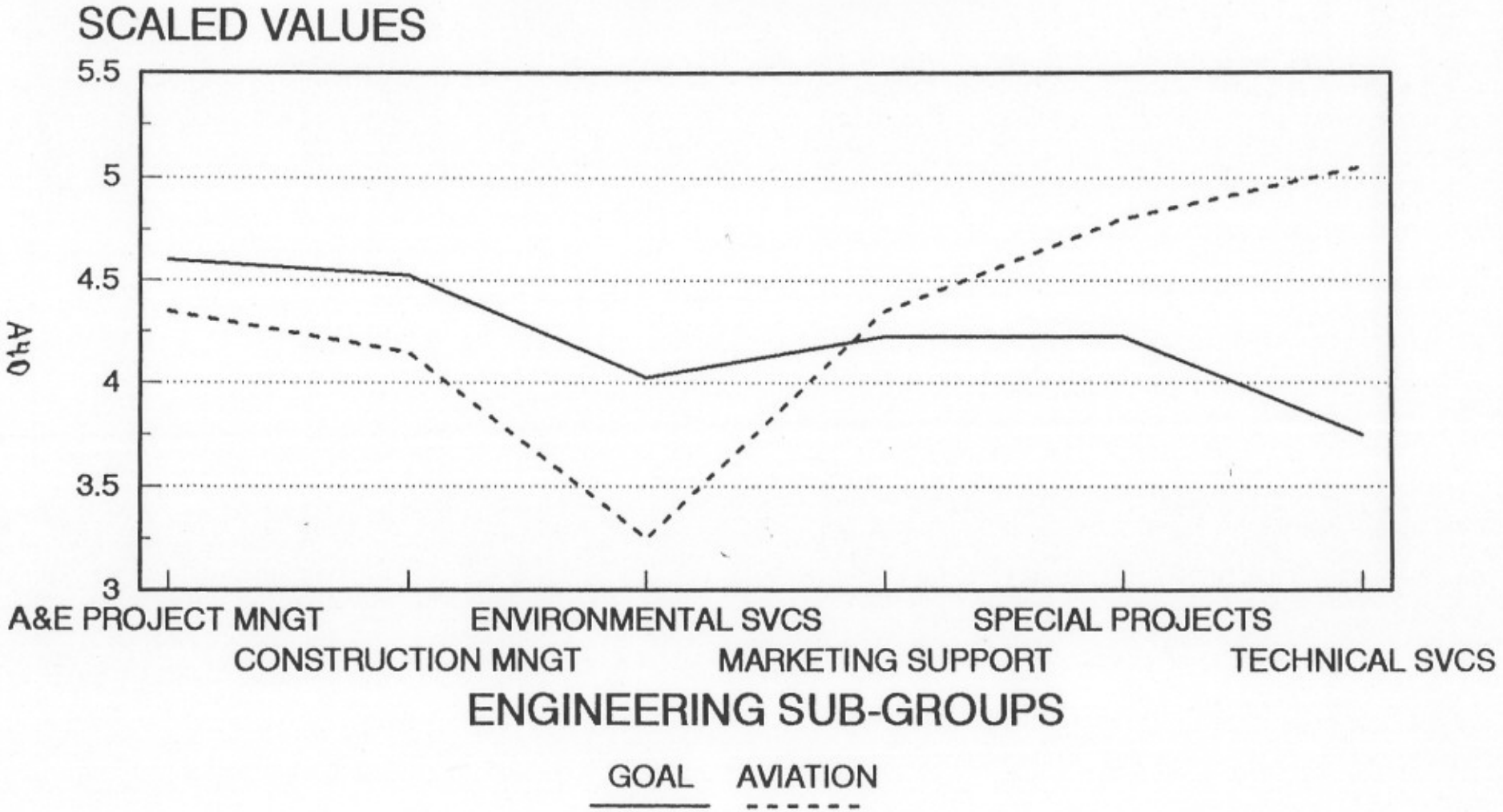
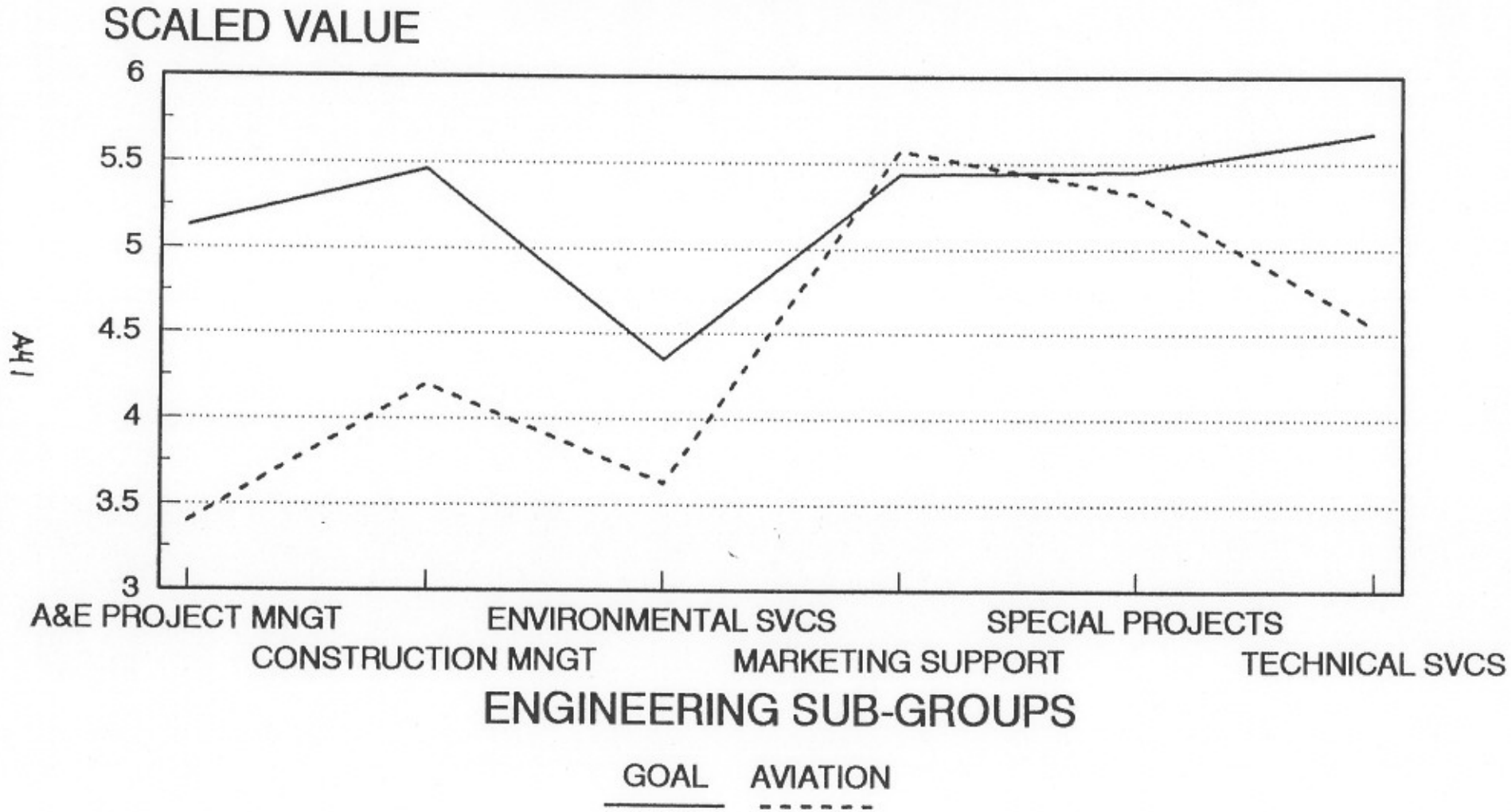
MONEY MANAGEMENT

GOAL VERSUS AVIATION



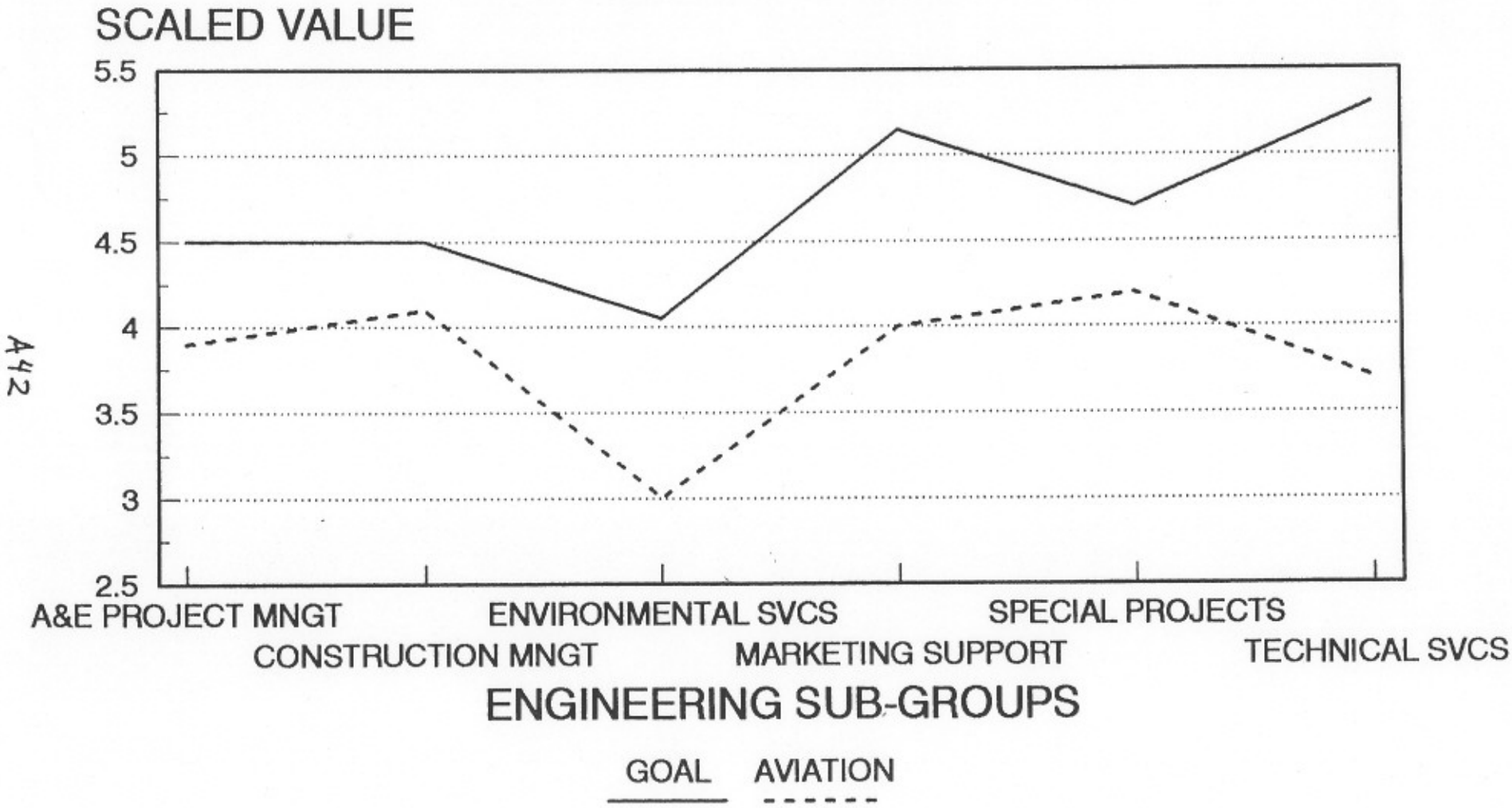
INFORMATION DELIVERY

GOAL VERSUS AVIATION



ACCURATE ESTIMATES

GOAL VERSUS AVIATION



A42

Exhibit x. Statistical Methodology using raw data

The raw data would have allowed use of a number of methods to support our identification of concerns. First use regression analysis to eliminate the outliers. In this way, we would compute a more representative mean. Then we would compute the sample standard deviation. Using the sample standard deviation we would see the distribution of the rankings and plot the means with their standard deviations. This descriptive way would enable us to better compare different operating areas within the Port of Portland and finding out the specific areas of concern.

The sample standard deviation would also serve for calculating a confidence interval estimate using the t-distribution. Then we could conclude with a specific confidence level (for example: 95%) that the population mean lies between the upper and lower limits of the confidence interval. We could also set a target or a goal mean, then compute both the lower and the upper limits, and compare the sample mean to these goal limits.

We could also find the frequency of the rankings. This would tell us more about the understanding of the particular question. We could also utilize the frequency distributions in chi-square test for goodness of fit to see whether the data come from a certain probability distribution.

The raw data would also have helped locate the areas of concern through use of the Mann-Whitney Test. The Mann-Whitney one way analysis of variance is an ANOVA of ranked data. We could apply this test between Aviation and the goal matrix at each cell. By this way, we would have been able to identify the cells of concern,

thus, the concern areas associated with the specific factor and the specific Engineering Service subgroup. This test recognizes the significance of difference between two groups of data. One can statistically measure if the two groups belong to the same population or they are different. For our case, if the raw data of one cell shows a significant difference, then one can conclude that we realize a problem in that cell. We recommend this test to be used for the follow up surveys.

Another highly recommended test for the follow up survey would be the Sign Test to measure whether the implemented programs have worked or not. The sign test measures differences in situations where the researcher wishes to test the hypothesis that the population means are equal and knows the samples are not independent. A common situation is the "before-after" experiment or survey, where the same subjects are measured twice. Then, one can conclude if the action plans have had any impact on rankings.

AVIATION

FACTORS SUB-GROUPS	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION DELIVERY	ACCURATE ESTIMATES
A&E PROJECT MANAGEMENT	4.725	4.350	3.400	3.900
CONSTRUCTION MANAGEMENT	4.475	4.150	4.200	4.100
ENVIRONMENTAL SERVICES	3.700	3.250	3.625	3.000
FACILITY MAINTENANCE	N\A	N\A	N\A	N\A
MARKETING SUPPORT	5.825	4.350	5.575	4.000
SPECIAL PROJECTS	5.500	4.800	5.325	4.200
TECHNICAL SERVICES	4.250	5.050	4.550	3.700

PSRY

FACTORS SUB-GROUPS	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION DELIVERY	ACCURATE ESTIMATES
CONSTRUCTION MANAGEMENT	5.525	4.900	5.500	5.000
A&E PROJECT MANAGEMENT	5.725	4.500	5.850	5.000
ENVIRONMENTAL SERVICES	4.175	3.650	4.475	4.300
FACILITY MAINTENANCE	N\A	N\A	N\A	N\A
MARKETING SUPPORT	5.375	4.500	5.750	5.500
SPECIAL PROJECTS	5.225	3.650	5.250	4.400
TECHNICAL SERVICES	5.525	3.000	5.500	5.000

REAL ESTATE

FACTORS / SUB-GROUPS	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION DELIVERY	ACCURATE ESTIMATES
A&E PROJECT MANAGEMENT	4.875	4.150	4.125	3.300
CONSTRUCTION MANAGEMENT	3.400	3.650	3.900	3.300
ENVIRONMENTAL SERVICES	2.925	4.150	3.350	3.400
FACILITY MAINTENANCE	N\A	N\A	N\A	N\A
MARKETING SUPPORT	4.425	4.150	4.600	3.700
SPECIAL PROJECTS	5.150	4.900	4.950	4.500
TECHNICAL SERVICES	5.475	5.000	5.200	5.000

MARINE

FACTORS / SUB-GROUPS	EFFICIENT MANAGEMENT	MONEY MANAGEMENT	INFORMATION DELIVERY	ACCURATE ESTIMATES
A&E PROJECT MANAGEMENT	4.900	4.300	4.750	4.000
CONSTRUCTION MANAGEMENT	4.775	4.550	5.075	4.000
ENVIRONMENTAL SERVICES	3.950	4.400	4.225	3.800
FACILITY MAINTENANCE	N\A	N\A	N\A	N\A
MARKETING SUPPORT	4.950	3.950	5.125	4.800
SPECIAL PROJECTS	5.725	4.800	5.650	5.000
TECHNICAL SERVICES	5.875	4.500	5.850	5.600