CRITICAL INCIDENT-FORCED CHOICE MERIT RATINGS AS APPLIED TO PROFESSIONAL WORKERS USING AN AEROSPACE ENGINEERING DEPARTMENT AS A DATA SOURCE

DISSERTATION

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By

Herbert A. Helstrom, B.S.M.E., M.B.A.
Denton, Texas
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The objective of this investigation is to begin to develop an understandable, reasonably valid, and objective merit rating system for professional workers. It is recognized that all conventional merit rating systems have significant shortcomings. Therefore, by using a results-oriented approach which combines the best features of the critical incident technique with those of the forced choice method, it is hoped to accomplish this goal. The Engineering Department of the Vought Corporation, Dallas, Texas, is used as a data source for this study.

The dissertation is divided into six sections: (1) an introduction including key definitions; (2) a discussion on modern merit rating systems including their purposes, strengths, and drawbacks; (3) the plan for combining the critical incident technique with the forced choice method into a single merit rating system and gathering data for use therein; (4) the results, analysis, and comparison of the dual runs; (5) the operating managers' evaluations; and (6) a summary, conclusions, and recommendations.

Two departments of professional engineers were each rated twice. This was done once using the Vought regular method of consensus ranking on the basis of the engineer's overall value, and once using the critical incident-forced choice system. The Spearman rank correlation coefficient was used to measure the association between the resulting two ordered series, and this coefficient was tested for significance, assuming the null hypothesis.

These rank correlation coefficients were .57 and .67 respectively for the two departments tested and each coefficient is statistically significant below the .002 level. There was a widespread and almost uniform distribution of rating scores for each department ranging from a high of slightly over +400 for the No. 1 ranked engineer to approximately -300 for the lowest ranked engineer.

It may be concluded that supervisors of professional workers as well as the professional workers themselves would prefer a structured and objective merit rating system. It may also be concluded that, by combining the critical incident technique with the forced choice method, a new system evolves that offers promise of

1. Eliminating many of the criticisms directed at conventional merit ratings,

2. Eliminating many of the criticisms directed singly at either the forced choice technique or the critical incident method,

3. Being acceptable to professional engineers,

4. Being results-oriented,

5. Being objective,

6. Reasonable reliability, although the question of validity is sure to arise.

It is, however,

1. Moderately expensive to implement,

2. Probably costly to maintain,

3. Not yet proven or fully understood, and

4. Viewed with some degree of suspicion in that the rater cannot readily control the outcome.

Concerning the question of rating system validity, one should perhaps inquire as to what is validating what. Particularly when the subjective nature of the conventional merit rating is well-known and established, it must be concluded that departmental consensus ranking itself is imperfect. But while a criterion based on group consensus may not be fully valid, it is better than nothing. The important point lies in how the rank ordered series is to be used. Since, in the final analysis, each manager still must make his own subjective decision as to any proposed salary change, it seems that he has another decision making tool available. It is therefore recommended that this system be developed further using other groups of professional engineers and other forced choice formats of critical incidents.

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CHAPTER I

INTRODUCTION

Most people today accept as normal the idea that we all tend to evaluate those with whom we associate. We form intuitive impressions of others and are usually aware that we are also impressing them, one way or another, consciously or subconsciously. Therefore, in a business environment where things ought to be done systematically, it would seem to follow that this intuitive tendency be formalized. Bittner writes,

> Most certainly we are going to rate our people; we have no choice between rating and not rating. As long as two people are thrown together, each will make judgments about the other. . . . and forming judgments about people or things is all that we mean by rating.[1]

While the term "merit rating" probably originated in the pre-World War II days,[2] the basic concept no doubt originated with the military services and has been in existence in more or less a formalized fashion since 1813. Siegel displays "The First Recorded Efficiency Report in the Files of the War Department" wherein a General Cass formally (but

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[1]Reign Bittner, "Developing an Industrial Merit Rating Procedure," Personnel Psychology, I (January, 1948), 403-432.

[2]Joseph Tiffin, Industrial Psychology (New York, 1944), pp. 231-261.

quite subjectively and unsystematically) comments on each of his subordinate officers.[3] The first known merit rating form introduced to industry was developed by the Lord and Taylor Drygood Company in 1916. In 1917, this form was promptly disapproved by a group of personnel directors at a Columbia University luncheon because "no person could scientifically rate the complex human being."[4]

At any rate, it was from an inauspicious beginning such as one of these that the idea of a formal, systematized merit rating evolved. By 1939, approximately one-third of the industrial firms were merit rating[5] their people, generalities had been replaced with specifics, and the trait approach to merit rating was in full swing. Tiffen[6] reports on the Starr and Greenly survey[7] wherein firms rated their people on from a minimum of four to a maximum of twenty-one specified traits with the median being ten traits. Typical of such traits were (1) Quality of work, (2) Quantity of work, (3) Cooperation, (4) Dependability, (5) Knowledge, (6) Loyalty, (7) Appearance, and a host of others. Correlating an

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[3]Laurence Siegel, Industrial Psychology (Homewood, Ill., 1969), pp. 216-242.

[4]G. D. Halsey, Making and Using Industrial Service Ratings (New York, 1944), p. xvi.

[5]R. B. Starr and R. J. Greenly, "Merit Rating Survey Findings," Personnel Journal, XVII (April, 1939), 378-384.

[6]Tiffen, op. cit., p. 233.

[7]Starr and Greenly, op. cit.

individual's value to the firm at least to some extent with high scores on the selected traits, many firms enthusiastically embraced the trait approach to merit rating. Of course there were variations to the approaches used. Siegel[8] cites: (1) the ranking method wherein the rater placed each ratee in a ranked order, usually from best to worst, (2) the paired comparison method wherein each worker was compared to every other worker and the rater judges which member of each pair is the better, and (3) graphic rating scales wherein all degrees of each trait be defined as simply as possible and each worker is charted thereon. One modification that is sometimes applied to any approach is for the firms to weight each trait differently so that each will conform to what they feel to be the most important to them.

However, despite the profusion of merit rating forms, it began to be apparent that merit rating in general was not fulfilling the high expectations management had. Numerous shortcomings appeared[9] and in 1948, the U.S. Army adopted the Forced Choice Rating.[10] In 1954 Flanagan advocated the Critical Incident Technique.[11] In 1957, the much respected

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[8]Siegel, op. cit., pp. 223-230.

[9]See discussion in Chapter II.

[10]E. Donald Sisson, "Forced Choice--The New Army Rating," Personnel Psychology, I (Autumn, 1948), 365-381.

[11]John C. Flanagan, "The Critical Incident Technique," Psychological Bulletin, LI (July, 1954), 327-357.

Douglas McGregor challenged performance appraisals in general and opted for a more meaningful system[12] and in 1964 Meyer, Kay, and French reported[13] that the traditional merit rating programs were decidedly of questionable value because supervisory criticisms of worker performance disrupted rather than improved the situation. Nevertheless, merit rating by now had become a reasonably well-accepted way of life in American industry. At least, in 1972, Oberg comments[14] that "over three-fourths of U.S. companies now have performance appraisal programs."

Merit ratings therefore hopefully become a thoughtful and careful evaluation of an employee's performance and are made, recorded, and approved by the worker's supervisor. Tiffen comments,

> A merit rating thus becomes a permanent part of an employee's record with a given company, and at least in theory, is a part of the record that may be used by management in subsequent promotion, demotion, transfer, or layoff.[15]

Since merit reviews are (1) useful for a number of purposes, yet (2) controversial in many respects, and

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[12] D. McGregor, "An Uneasy Look at Performance Appraisal," Harvard Business Review, XXXV (May-June, 1957), 89-94.

[13] H. H. Meyer, E. Kay, and John R. P. French, Jr., "Split Roles in Performance Appraisal," Harvard Business Review, XLIII (1964), 124-129.

[14] Winston Oberg, "Make Performance Appraisal Relevant," Harvard Business Review, L (January-February, 1972), 61.

[15] Tiffen, op. cit., p. 231.

certainly (3) difficult to manage, many firms have chosen to discontinue any specific trait rating, electing instead to consider the man-as-a-whole and his relative overall value to the firm. Thus the trend is becoming more results oriented rather than being overly concerned with specific traits. As Davies and Francis[16] point out, achieving corporate objectives of satisfactory results in a timely fashion and within previously agreed to budgets are paramount considerations. This feeling is reenforced by Meyer, Kay, and French who conclude that

> . . . work-planning-and-review discussions between a man and his manager appeared to be a far more effective approach in improving job performance than was the concentrated annual performance appraisal program.
>
> For this reason, many General Electric managers adopted some form of the new WP&R program to motivate performance improvement in employees, especially those at the professional and administrative levels.[17]

Thus it is the purpose of this research to review conventional merit rating systems, particularly as applied to professional workers and to develop a new merit rating technique utilizing a completely independent results oriented approach. To accomplish this, best features of the critical incident technique will be combined with those of the forced choice method and applied to a large group of

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[16]Celia Davies and Arthur Francis, "There is More to Performance Than Profits or Growth," Organizational Dynamics, III (Winter, 1975), 51-65.

[17]Meyer, Kay, and French, op. cit., p. 127.

professional workers. In this study, the Vought Corporation's Engineering Department will be used as a data source. Hopefully, this will result in:

1. A merit rating system that becomes a much less time-consuming project.

2. An objective merit rating system where neither the direction nor magnitude of the rating can be predicted successfully.

3. Less bitterness and enmities at merit rating time.

4. A ranking system that discriminates finitely between good and poor engineering performance.

Key Definitions

Merit Rating

In this report, this term is used synonymously with "merit review," "performance review," and "performance rating." It is a regular and systematic way an employee is evaluated against a given set of job standards. Ruderman[18] refers to it as "part of a formal systematic technique under which an employee or an employee's performance is judged against some set of measurement standards."

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[18] George P. Ruderman, "Employee Merit Rating," *Handbook of Business Administration*, edited by H. B. Maynard (New York, 1970), pp. 11:144-11:156.

Critical Incident Technique

This is a systematized approach to merit rating using as its basis a series of significant events that actually took place in the firm where the workers are being rated. The idea is to compare the individual to the set of critical incidents either favorably or unfavorably. Flanagan defines it thusly:

> The critical incident technique consists of a set of procedures for collecting direct observations of human behavior in such a way as to facilitate their developing broad psychological principles. . . . By an incident is meant any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act.[19]

The incidents are grouped into categories which reflect job proficiency and the supervisor indicates his relative agreement with each incident as it applies to the person being rated.[20]

For the purposes of this report, to be critical, an incident must have been viewed by the cognizant supervisor as either:

1. Making a significant difference in either worker performance or morale.

2. Demonstrating an activity that would be seriously considered in a merit rating and which would necessitate a discussion with the worker personally.

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[19] Flannagan, op. cit., p. 327.

[20] Wayne K. Kirchner and Marvin D. Dunnette, "Identifying the Critical Factors in Successful Salesmanship," Personnel, XXXIV (1957), 54-59.

Forced Choice Technique

Developed for the U.S. Army in the early 1940's, the application of this technique forces the rater to consider the worker in terms of several sets of specific phrases from which choices must be made. Each of the phrases relates to some aspect of job qualification or performance on the job. Often grouped in sets of four with two favorable and two unfavorable elements, the rater indicates one phrase that best characterizes the worker and one phrase which is most unlike him. As Sisson explains it,

> Rather than indicating how much or how little of each characteristic an officer possesses, the rater is required to choose, from several sets of four adjectives or phrases, which best characterizes the officer and which is least descriptive. In other words, it calls for objective reporting and minimizes subjective judgment.[21]

Because of the way each group of four elements is constructed, the rater feels that he would just as soon apply either favorable element or either unfavorable element to the worker. Yet each of the elements has been previously determined to actually discriminate widely in what is effective or noneffective performance.

Preference Index

This is an index of the tendency of raters to select one particular incident or element in the tetrad as typical

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[21] Sisson, op. cit., p. 365.

of performance in preference to the other available choices. Ideally, each incident in a set of critical incidents should have the same preference index. That is, each incident in the set should appear as an equally favorable (or unfavorable) way to describe the worker.

Discrimination Index

This is a measure of how well a specific critical incident truly distinguishes between effective and ineffective (engineering) performance. The basic idea is that, while each incident in the set should have the same preference index (probability of being selected) there will be a significant difference in discrimination indexes in each set of incidents. That is, the degree to which an incident is used to describe effective performance and vice versa.

Validation Index

As used herein, this term is used as a measure of how well the end results obtained match up with the consensus of who are the good and poor workers. While similar in nature to the discrimination index, the validation index is calculated after the fact while the discrimination index is calculated ahead of the merit rating. The Spearman rank correlation coefficient[22] will be used as the validation index for this research. Calculations of the coefficient and testing its significance are included in Chapter IV.

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[22] Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York, 1956), pp. 202-213.

CHAPTER II

MODERN MERIT RATING

Properly used, the modern merit review can perform several very useful functions or purposes. For example, the firm may well expect to

1. Improve worker performance and contribution to the firm based on measurement, evaluation, and subordinate acceptance.

2. Determine individual promotability, transfer, layoff, or termination.

3. Improve the supervisor's overall capabilities in employee relations by having them conduct the reviews.

4. Improve morale by satisfying the individual employee's human need for feedback on performance and open up communications between supervisor and subordinate.

Industry has come a long way in the application of merit rating procedures to accomplish these goals. Each of the approaches mentioned earlier[1] has its advantages and champions; disadvantages and detractors. An evaluation of each of these key approaches follows.

The Ranking Method

This method is used to measure the performance of one person against all of the others. The rater places each

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[1]See pages 3 and 4 of this report.

person in a ranked order of merit, either on an overall basis or on the basis of the sum of the ratings of a group of traits. These traits may or may not be individually weighted to arrive at an overall evaluation.

Ruderman describes[2] a variant of this procedure wherein the final ranking is required to conform to prespecified distribution. Thus, for example, the rater might be forced to identify his top 10 percent, his next 20 percent, the middle 40 percent, etc. To be meaningful, of course, the rater has to have an adequate number of workers.

There are a number of drawbacks to the ranking method. If the workers are considered on an overall basis, it is extremely easy to "rig" the system and place a worker in a rank commensurate with his salary (or proposed salary) rather than his performance. In addition, a ranked order tends to give a fallacious appearance of regularity. Siegel points out[3] that while only one rank separates any two employees, the magnitude of difference between employees ranked two and three is probably greatly different than the difference between employees ranked twenty-six and twenty-seven, "even though only one rank separates each of these pairs."

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[2]George P. Ruderman, "Employee Merit Rating," Handbook of Business Administration, edited by H. B. Maynard (New York, 1970), pp. 11:144-11:156.

[3]Laurence Siegel, Industrial Psychology (Homewood, Ill., 1969), pp. 216-242.

If the rankings are required to conform to some particular, distribution, the common supervisory complaint is that the upper distribution levels are always too limited. And this could be both true and unfair if a particular group had a higher than average number of outstanding performers.[4]

If the rater evaluates each of a set of traits for each worker, any number of well-known shortcomings can appear. These include knowledge that

1. The outcome is predictable and may be controlled by the rater.

2. Ratings lack validity in that some supervisors choose not to indicate their true opinions. They know what is going on but will not reveal their feelings. Therefore the ratings fail to agree with the person's known job effectiveness.

3. Ratings fail to show a reasonable spread in scores so there really is no discrimination between people. Sisson reports[5] that most rating scores come out obviously too high. Citing efficiency reports of 4000 ground officers, "instead of showing the 150 best, showed . . . 2000 were superior and best."

4. Many professional supervisors only rate in degrees of "Excellent," while others seem unable to convince themselves

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[4]William F. Glueck, Personnel: A Diagnostic Approach (Dallas, Texas, 1974), p. 296.

[5]E. Donald Sisson, "Forced Choice--The New Army Rating," Personnel Psychology, I (Autumn, 1948), 365-381

that their very best professional worker rates higher than "Good." This is usually referred to as the leniency effect and reflects differences in standards as set by different supervisors.

5. The so-called halo effect may manifest itself in one or more of three ways.

   a. A person's good or bad performance really involving only one trait tends to influence the ratings in the other traits.

   b. A person's good or bad recent performance tends to overshadow many months of the opposite performance.

   c. The rater's previously formed opinion on the person clouds the rating in each trait.

6. In addition, Flanagan introduces a basic concept of unreliability because of the lack of agreement among supervisors rating the same person.[6]

The Paired Comparison Method

This method is supposed to make the ranking method more objective, systematic, easier, and scientific. Every person paired and compared with every person being rated and the number of times each person is preferred over another is tallied to determine each person's rank. Of course, this

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[6] John C. Flanagan, "A New Approach to Evaluating Personnel," Personnel, XXVI (July, 1949), 35-42.

can be done either on an overall basis, or by using a trait-by-trait approach. As Glueck points out,[7] individual scores may be "converted into standard scores by comparing the scores to the standard deviation and the average of all scores."

The appeal of this method lies in its simplicity. The supervisor has to judge only two workers at a time. Yet, this very simplicity leads to a complication in that for a large group, the number of comparisons becomes quite large and unwieldy. Thus, in a department of 30 workers, the supervisor would have to make 435 comparisons on an overall basis or 435 comparisons for each trait being rated.[8] In addition, most of the same shortcomings associated with the ranking method are apparent herein.

Graphic Rating Scales

Probably the most widely used rating method in existence,[9] this system was developed in the early 1920's. The rater is presented with a chart and asked to rate each worker on the basis of the characteristics listed thereon. Each characteristic or trait is defined as simply as possible and often in several steps each indicating progressively better performance and identified with a series of boxes. Each box or step is typically assigned points which are added to get the worker's computed score.

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[7] Glueck, op. cit., p. 295.

[8] Siegel, op. cit., p. 226, gives the general formula as $N(N-1)/2$ where N is the number of workers involved in the rating.

[9] Glueck, op. cit., p. 292.

While the graphic rating scales are usually easy to construct and use, it is again apparent that the same shortcomings of the ranking method apply. In fact, as Siegel points out,[10] graphic rating scales are unusually susceptive to the halo effect. This is probably due to the usual scale constructions where the better scores are ordinarily grouped on one side of the rating form.

In addition, the leniency effect previously mentioned is vividly demonstrated by Taylor and Wherry[11] wherein not only is the lower end of the graphic rating scale not used at all, but there is a large difference between the mean of a group of ratings collected for trial purposes as compared to those collected "for real." The mean "for real" is significantly higher than the mean "for fun."

Forced Choice Ratings

The forced choice method of performance evaluation was originally developed for measuring the effectiveness of officers of the U.S. Army.[12] The primary reasons for this development were two-fold: (1) other methods in use led to a preponderance of high ratings with little discrimination (which made promotion decisions difficult), and (2) other

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[10] Siegel, op. cit., p. 228.

[11] Erwin K. Taylor and Robert J. Wherry, "A Study of Leniency in Two Rating Systems," Personnel Psychology, IV (Spring, 1951), 40-41.

[12] E. Donald Sisson, "Forced Choice--The New Army Rating," Personnel Psychology, I (Autumn, 1948), 365-381.

methods were thought to be too subjective and inordinately subject to personal bias.

Using this technique members of the evaluating group are first asked to prepare two brief essays: (1) describing successful performance, and (2) describing unsuccessful or poor performance. From these essays a series of tetrads is prepared. The usual version includes two positive statements and two negative statements. The evaluator is asked to select which of the four statements is most like the officer and which is least descriptive of him. Each tetrad is developed in a manner such that, while each pair of statements appears to be equally laudatory or derogatory, actually one statement of each pair discriminates between effective and ineffective personnel.

According to Sisson,

> Rather than indicating how much or how little of each characteristic an officer possesses, the rater is required to choose, from several sets of four adjectives or phrases, which best characterizes the officer and which is least descriptive. In other words, it calls for objective reporting and minimizes subjective judgment. And because of the way in which the tetrads--sets of four rating elements--are constructed, it reduces the rater's ability to produce any desired outcome by the choice of obviously good or obviously bad traits. It thus diminishes the effects of favoritism and personal bias.[13]

The theory is that if an evaluating superior is forced to select one of two equally good (or bad) things as most

[13] Ibid., p. 365.

descriptive of a subordinate, he will choose the one most accurately describing the subordinate.[14]

The construction of these tetrads is crucial to the usefulness of the forced choice technique. Rundquist gives the following six steps for the process.

1. Collection of brief essay descriptions of successful and unsuccessful officers.

2. Preparation of a complete list of descriptive phrases or adjectives culled from these essays, and the administration of this list to a representative group of officers.

3. Determination of two indices for each descriptive phrase or adjective--a preference index and a discrimination index.

4. Selecting pairs of phrases or adjectives such that they appear of equal value to the rater (preference index) but differ in their significance for success as an officer (discrimination index).

5. Assembling of pairs so selected into tetrads.

6. Item selection against an external criterion and cross-validation of the selected items.[15]

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[14]Of course, a clever superior can still force the system to confirm his selections by thinking of and evaluating one of his top people, for example, when he is, _in fact_, evaluating a rather mediocre individual, or vice versa. This, of course, merely confirms the fact that any "system" can probably be beaten if there is sufficient desire to do so.

[15]Sisson, op. cit., p. 368.

While these instructions are highly specific and apply strictly to Army officers, it is apparent that, with minor revisions to the phraseology, they could be made generally applicable to professional workers.

The literature abounds with evaluations of the forced choice technique. Since it was developed to reduce rater bias and halo effect and, at the same time, to spread the scores, much has been done to measure whether these purposes have been achieved.

Cozan reports that the forced choice technique has greater objectivity but that early claims for higher validity have not yet been proven.[16] On the other hand, Zavala suggests[17] that Cozan's criticism was based on a limited sample and cites several other investigators who have confirmed higher validities when comparing forced choice ratings with other techniques. Zavala also develops the thought that many users do not consider forced choice ratings as a panacea and have found it useful to use a forced choice rating in combination with some other conventional scale.[18] Taylor and Wherry establish that while there is some leniency effect in the forced choice method when using it "for real"

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[16]Lee W. Cozan, "Forced Choice: Better than Other Rating Methods?" Personnel, XXXVI (May-June, 1955), 80-83.

[17]Albert Zavala, "Development of the Forced-Choice Rating Scale Technique," Psychological Bulletin, LXIII, No. 2 (1965), 117-124.

[18]Ibid., p. 117.

compared to an experimental rating the shift of the mean upwards is not nearly as large as that demonstrated by using graphic rating scales.[19] It is also apparent that the forced choice ratings do use the lower end of the scales to some extent. Patton and Littlefield conclude[20] that a major limitation is in "the unsuitability of the form as a counseling guide for employees, where that is one of the purposes to be served."

As perhaps would be supposed, there are many variations to the forced choice technique. Berkshire and Highland made a detailed study[21] of the various types of forced choice formats. They came to the conclusion that the best-liked format had four statements per set, all favorable, and the rater was to choose the two most descriptive forms. While they did not test a format with four statements per set, all unfavorable, apparently they felt that raters would be quite hesitant to apply statements of negative emotional tone as descriptive of anyone.

It should be readily apparent that if each tetrad was comprised of both favorable and unfavorable statements, the rater could easily determine the direction (but not the magnitude) of the rating and this should be avoided.

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[19]Taylor and Wherry, op. cit., pp. 44-47.

[20]John A. Patton and C. L. Littlefield, Job Evaluation (Homewood, Ill., 1957), p. 306.

[21]James R. Berkshire and Richard W. Highland, "Forced Choice Performance Rating--A Methodological Study," Personnel Psychology, VI (Autumn, 1953), 355-358.

In summary, in theory the rationale behind the forced choice rating system is sound. In practice, however, there are several limitations to the system. Probably the two largest weaknesses lie (1) in its being so complex and involved, and (2) the idea that raters dislike using any system wherein they feel that they are being denied exact knowledge of how it works.

Critical Incident Method

The critical incident technique was developed at the University of Pittsburgh by Flanagan[22] and his associates as an outgrowth of studies in the Aviation Psychology Program of the Army Air Forces in World War II. Beginning with psychophysical methods of Sir Francis Galton just before the turn of the century and including later developments in time sampling, controlled observation tests and brief anecdotal records, Flanagan and his associates developed a method for analyzing specific reasons for pilot candidates' failure in flight training schools. It was found that many of the reasons given were cliches such as "lack of inherent flying ability," "poor judgment," or "insufficient progress." By insisting that specific facts be given in each instance instead of generalities, it was found that critical incidents

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[22] John C. Flanagan, "The Critical Incident Technique," Psychological Bulletin, LI (July, 1954), 327-357.

could be identified to predict successful performance in a given activity.

In 1950, Flanagan reports[23] on a natural extension of this work wherein this technique was used to determine the critical job requirements of hourly wage employees in the Delco-Remy Division of the General Motors Corporation. The performance of these employees was evaluted by hundreds of foremen who reported over 2500 incidents which they judged to be good examples of either effective or ineffective performance.

Thus the critical incident technique relies upon specific recorded actions obtained from those best qualified to make the necessary observations and judgments in the specific fields wherein the employees are being evaluated.

To be considered critical, an incident must not only be observed and noted, but must actually have resulted in a deviation from what would be considered normal performance. For example, there are three main aspects of an engineer's job.

1. Demonstrating technical proficiency.

2. Accepting responsibility for the satisfactory completion of the assigned task(s) on time, and within the established budget.

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[23] R. B. Miller and John C. Flanagan, "The Performance Record: An Objective Merit Rating Procedure for Industry," <u>American Psychologist</u>, V (1950), 331-332.

3. Handling the interdepartmental and intradepartmental working relationships satisfactorily.

Therefore, it would be expected to obtain critical incidents from the engineering supervisors as being those best qualified to evaluate such incidents.

Flanagan later reports[24] that, almost unanimously, foremen in the Delco-Remy Division have found that using the critical incident technique usually (1) Helps them anticipate job needs, (2) Leads to improved performance, (3) Helps change worker job attitudes, (4) Improves production methods, (5) Increases worker interest in the job, (6) Establishes better communications.

Most of these are usually thought of as desirable end results of a merit rating. Therefore, the critical incident method should prove to be an excellent approach to performance evaluation, particularly when applied in a professional worker environment.

Probably the major advantage of the critical incident method lies in the fact that it is "tailor-made" for one firm. By using job related critical incidents that really took place in the firm, the method has an authenticity that materially adds to its acceptability.[25] Also,as Oberg points

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[24] John C. Flanagan and Robert K. Burns, "The Employee Performance Record: A New Appraisal and Development Tool," Harvard Business Review, XXXV (September-October, 1957), 95-102.

[25] Wayne K. Kirchner and Marvin D. Dunnette, "Identifying the Critical Factors in Successful Salesmanship," Personnel, XXXIV (1957), 59.

out, workers typically dislike negative feedback and supervisors prefer to avoid any such confrontations, even to the extent of not giving a negative rating in the first place.[26] However, instead of debating personality traits, the critical incident method deals with real events that actually did take place. Therefore, the appraisal interview becomes less traumatic because actual performance is being criticized; not the worker's personality. Ling reenforces this concept[27] in that the critical incident method is "a factual record . . . rather than an arbitrary rating or assignment of members." In addition, by pinpointing specific incidents, the supervisor can be in a good position to suggest specific improvement.

There are, however, some drawbacks to this system. Development costs are quite high[28] and Miner observes that the basic procedures "have been criticized as fostering excessively close supervision and blame finding."[29] It does require that supervisors train themselves to record any critical incidents frequently and this "black book" approach may be particularly offensive to a professional worker. Also, it is possible for the supervisor to determine the direction (but not the magnitude) of the overall rating.

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[26] Winston Oberg, "Make Performance Appraisal Relevant," Harvard Business Review, L (January-February, 1972), 64.

[27] Cyril Curtis Ling, The Management of Personnel Relations (Homewood, Ill., 1965), p. 466.

[28] Glueck, op. cit., p. 300.

[29] John D. Miner, Personnel Psychology (New York, 1969), p. 115.

Rating Period Frequency

Regardless of the approach used, the question of how often to rate and what specifically to rate must be decided. Bittner suggests a rating period of from six months to one year so that raters will not feel overburdened with the administrative effort required.[30] The same study also recommends that merit reviews not be tied directly into salary changes. Supporting this viewpoint, Sisk[31] and others feel that the salary discussion portion of the merit rating should be held separately from the performance portion of the rating.

On the other hand, sometimes merit or performance reviews are combined with salary review and done together, at the same time. Texas Instruments Incorporated, Vought Corporation, Bell Helicopter Company, McDonnell Douglas Corporation (St. Louis), and others use this approach. Sometimes the double approach is used wherein the merit or performance review is given at one time and the firm follows up several months later with a salary review. Continental Can Company, Incorporated, Rockwell International Corporation (North American Aircraft Division), McDonnell Douglas

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[30]Reign Bittner, "Developing an Employee Merit Rating Procedure," Personnel Psychology, I (1948), 403-432.

[31]Henry L. Sisk, Management and Organization (Cincinnati, Ohio, 1973), pp. 429-430.

Corporation (Huntington Beach), General Electric Company, and others use this approach.[32]

Those that use the double approach believe that the combination approach soon becomes dominated by thought and concepts of impending salary changes and the other benefits expected from the review are mostly lost. Those that use the combination approach probably do so from force of habit or so as to hold such costs down or because they do not really subscribe to tenets of multiple benefits of any review system.

As brought out earlier, there are many benefits to be achieved from a properly performed merit review. But at the same time it should be noted that many factors other than performance may affect the salary review. Such items as (1) The firm's profit picture and available budget, (2) The opportunity cost of labor, (3) The cost of living, (4) Internal equity, and, (5) The supervisor's personal opinion, all must influence a prospective salary change. It would therefore seem most effective to have the merit review be done in two parts, (1) a salary review, and (2) a performance review.[33] Each should be separated from the other by a minimum of perhaps three months.

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[32]These data developed through personal or telephone interviews with the cognizant Administrative Engineer at the firm cited or with Henry L. Sisk at North Texas State University, Denton, Texas.

[33]Sisk, op. cit.

One basic overall problem that exists particularly in dealing with professional workers is that many of them view any performance or merit review as a threat--either real or perceived. And since a fairly predictable reaction to any threat is indifference or noncompliance, this tends to negate many of the expected benefits to the firm.

It has been repeatedly observed in engineering departments that these professional supervisors of professional workers have shown a remarkable zeal to "rig" performance/merit reviews.[34] First, any such review system is stubbornly resisted until the weighting code is deciphered or coaxed out of a friend in the Personnel Department. Then they consistently go to great lengths to decode the system's structure; decide which of their professional workers are to get raises (note that word "earned" is not used), and then force the system to confirm this. And of course they are properly "surprised" when the results are reviewed by the Wage and Salary Department.

Many engineering supervisors retain merit profiles on their people so that each subsequent review reflects the necessary performance and/or progress to justify the individual's current position in the overall ranking. When objectively done, this can be of value to the person, the supervisor, and to the firm. After all, the idea is not

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[34]The author draws on over twenty years experience in engineering management positions in the aerospace industry.

only to measure job proficiency, but to include some estimate of the future worth of the person being so evaluated and what is needed to fully develop this future worth.

Above all, whatever system is used, it should be periodically updated to insure current applicability. And this applies to both the job description itself and the evaluation or performance review factors considered. Surely a system developed twenty or more years ago should have been modified many times to maintain its effectiveness as a management control tool.

As a matter of fact, for any control system to be effective, the normal concepts of control as a four-step process must be considered. These are (1) Set a standard, (2) Measure the person's performance, (3) Compare to the original standard and analyze, (4) Take appropriate action.[35]

To set a standard here means to define the job. This means not only to prepare job descriptions and duties, but to relate these to specific factors such as: education and experience required, supervision to be received, effect of errors, working conditions, and any unusual mental, visual, or physical demands. Also, each job should be interrelated within the firm against the yardstick of salary equity and at the same time provide a reasonable salary range for each

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[35]Henry L. Sisk, Management and Organization (Cincinnati, Ohio, 1973), p. 616.

position. In addition, whatever approach the firm intends to use to evaluate performance to satisfy the job descriptions, duties, and required factors should be fully understood ahead of time by those being rated.

CHAPTER III

THE CRITICAL INCIDENT--FORCED CHOICE SYSTEM

In a recent study the comment was made that

> A merit pay plan rests on the assumption that a supervisor can make objective and valid distinctions between the performances of those who report to him. That the validity of this assumption is so often questioned probably explains why merit pay is not used more widely than it is.[1]

Meyer goes on to suggest that, because most people tend to overvalue their own effectiveness, they actually "feel cheated whenever they get a raise."

Now there should be little doubt that the competent supervisor _can_ objectively rate his people. But, whether he _is_ _willing_ to do so is another question. It takes a sturdy supervisor to explain, particularly to professional workers, just exactly why no raises are forthcoming. Supervisors have learned to avoid giving negative ratings when they know that the very form will later be shown to the worker. Thus the rating too often has been a game wherein the supervisor has (or believes he has) decoded the rating system and provides check marks in the appropriate boxes to substantiate his preformed conclusions as to the salary position of the individual.

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[1]Herbert H. Meyer, "The Pay-for-Performance Dilemma," _Organizational_ _Dynamics_, III (Winter, 1975), 39-50.

In an earlier study in which Meyer also participated, the overall value of the traditional performance review program was shown to be of decidedly questionable value. Stressing that "goal setting, not criticism, should be used to improve performance,"[2] the idea of a results oriented system is introduced as preferable to a trait oriented approach.

Since the critical incident technique is fundamentally based on things that have transpired in the firm which were either effective or ineffective, it was believed that this could provide the beginning of a good results oriented approach. The forced choice technique offered a way to prevent the rater from predetermining either the direction or magnitude of the rating. Yet, Zavala[3] and others felt that the forced choice should be reenforced to be most effective. It was therefore decided to combine the critical incident method with the forced choice technique and to test the combination by applying the resulting system to two departments of professional engineers at a large industrial concern in Dallas, the Vought Corporation.

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[2]H. H. Meyer, E. Kay, and John R. P. French, Jr., "Split Roles in Performance Appraisal," Harvard Business Review, XLIII (1964), 124-129.

[3]Albert Zavala, "Development of the Forced-Choice Rating Scale Technique," Psychological Bulletin, LXIII, No. 2 (1965), 117-124.

To accomplish this, a series of critical incidents was obtained and thirty sets of forced choice tetrads were generated directly, rather than attempting to extract them from descriptive essays as would ordinarily be the procedure. It was believed that these critical incidents, by being quite specific, would insure a higher degree of validity than those which might be obtained from essays. Also, it was hoped that, by only asking for critical incidents, busy supervisors would be more responsive than if they were requested to prepare a series of descriptive essays.

However, instead of asking each supervisor to list four incidents as might be anticipated for the forced choice system, each supervisor was somewhat restricted by asking him to first visualize three specific experienced engineers. One each of these engineers was to be

1. An outstanding, highly effective engineer,
2. An average, medium engineer,
3. An engineer who is considered to be one of the least effective people he has.

Then, for <u>each</u> of the three engineers so visualized, the supervisor was asked to record two critical incidents. One incident is to illustrate something very good; the other is to illustrate an ineffective event. The idea here is that even the best professional engineers err, and even the poorest, on occasion do well. The instruction letter and necessary forms soliciting six critical incidents[4] from each of seventy engineering supervisors were prepared for a Vought official's signature and distributed. The letter and set of forms is shown in Appendix A.

As the responses were received, they were serial numbered and the critical incidents were edited, abridged, and duplicates deleted. A series of 3 x 5 cards was used for this purpose and one is shown typically in Figure 1.

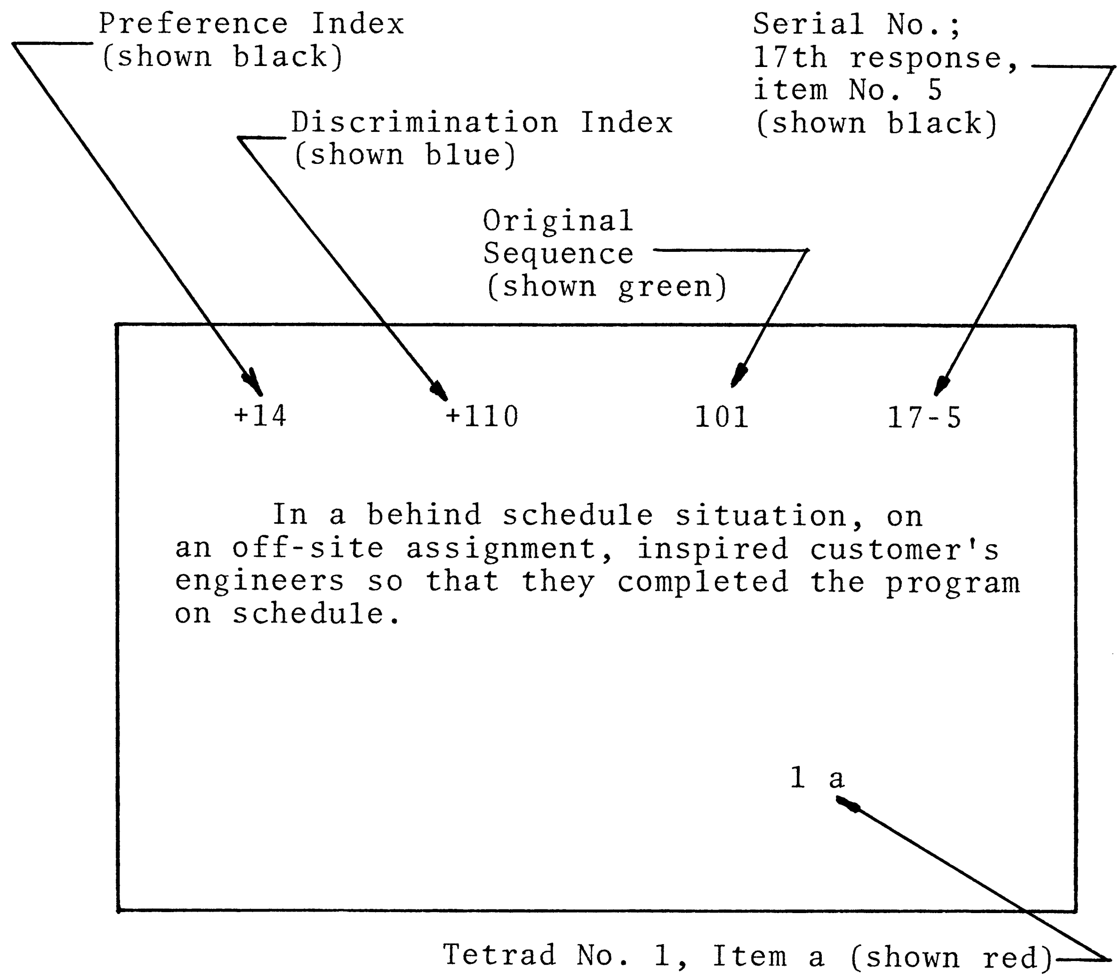

Fig. 1--Typical 3 x 5 coded card

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[4]Adapted from: Wayne K. Kirchner and Marvin D. Dunnette, "Identifying the Critical Factors in Successful Salesmanship," Personnel, XXXIV (1957), 54-59.

However, because an incident is contributed by one individual supervisor as illustrative of effective or ineffective professional activity, it does not necessarily follow that it is held in the same regard by other supervisors. Therefore, a discrimination index was generated on a consensus basis to measure the extent to which a critical incident distinguishes between effective and ineffective engineering performance. A statement (incident) will have a high positive discrimination index if it is quite frequently applied to effective performance but rarely to describe ineffective performance. The reverse is also true in that a high (but negative) discrimination index will result if a statement based on an incident is repeatedly used to describe ineffective performance but rarely to describe effective performance. If statements based on the critical incidents appear to be used about equally to describe either effective or ineffective performance, a low positive or negative discrimination index will result.

Discrimination indexes were calculated for each critical incident as follows. After the critical incidents were recorded, they were combined into a single listing from the 3 x 5 cards. This was reviewed by a special group of nine experienced engineering supervisors. Each supervisor estimated the approximate probability of each incident being typical of an engineer who is

1. Outstanding, highly effective,
2. Average,
3. Least effective.

Obviously, the combined probabilities for each incident must total 1.00.[5] The discrimination index (DI) for each incident was based on the mean of all nine estimates and computed on a weighted basis by using coefficients from Figure 2.

Type of engineer	Weighting Coefficient
1. outstanding	+2
2. average	0
3. least	-2

Fig. 2--Weighting coefficients

$$DI\Sigma = \left(\frac{2\Sigma p_1}{n} - \frac{2\Sigma p_2}{n} \right) \left(100 \right) \quad \text{. . . . . . .Eq. (1)}$$

where p_1 = probability of the incident being attributable to an outstanding, highly effective engineer.

p_2 = probability of the incident being attributable to a least effective engineer.

n = number of supervisors assigning the probabilities for each event.

The means of the probabilities assigned by the supervisors and the computed critical incident indexes are shown in Appendix B.

[5]With very slight differences accepted due to rounding to two significant figures.

Obviously these discrimination indexes were not made available to any subsequent evaluator, being retained only in a central coordinating agency. They were, however, listed on the cards, Figure 1, and shown in blue.

In a like manner a preference index was computed for each incident. This was done by setting up a review team of eight experienced professional engineers, each of whom evaluated each critical incident by asking himself the question: As a practicing professional engineer, to what degree would I like having this incident attributed to me, personally? Then, his response was indicated on the following scale.

DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
-2	-1	0	+1	+2

A preference index (PI) was then established for each critical incident by algebraically summing the individual responses to each incident as follows:

$$PI = (-2)\ (\Sigma DVM) - \Sigma DS + \Sigma LS + (2)\ (\Sigma LVM \quad . . . . Eq.\ (2)$$

where ΣDVM = sum of responses indicated as Dislike Very Much.

ΣDS = sum of responses indicated as Dislike Some.

ΣLS = sum of responses indicated as Like Some.

ΣLVM = sum of responses indicated as Like Very Much.

A summary of the responses of the eight professional engineers and the computed preference indexes for the critical incidents are shown in Appendix C. These preference indexes are also shown on the cards, Figure 1.

Figure 3 shows the frequency of critical incidents received as compared to the preference index. The bipolar distribution is believed to be consistent with the definition of what constitutes critical incidents.

Having determined both a preference index and a discrimination index for each critical incident, fifteen tetrads were formed from sets of four positive critical incidents having approximately the same preference index but differing widely in discrimination indexes. Likewise, fifteen tetrads were formed using sets of negative critical incidents using the same index guidelines as above.

To accomplish this, an analysis was first made of Figure 3, the Frequency of Critical Incidents vs Preference Index. Considering the well-established dislike of supervisors to report negatively on their people, it was decided not to use incidents with a preference index of -16. By doing so, it was felt that any nonresponsiveness on the part of the supervisors would be avoided. It was also decided to ignore the few incidents between preference indexes (PI) from -8 to +8. Therefore five tetrads each were formed using:

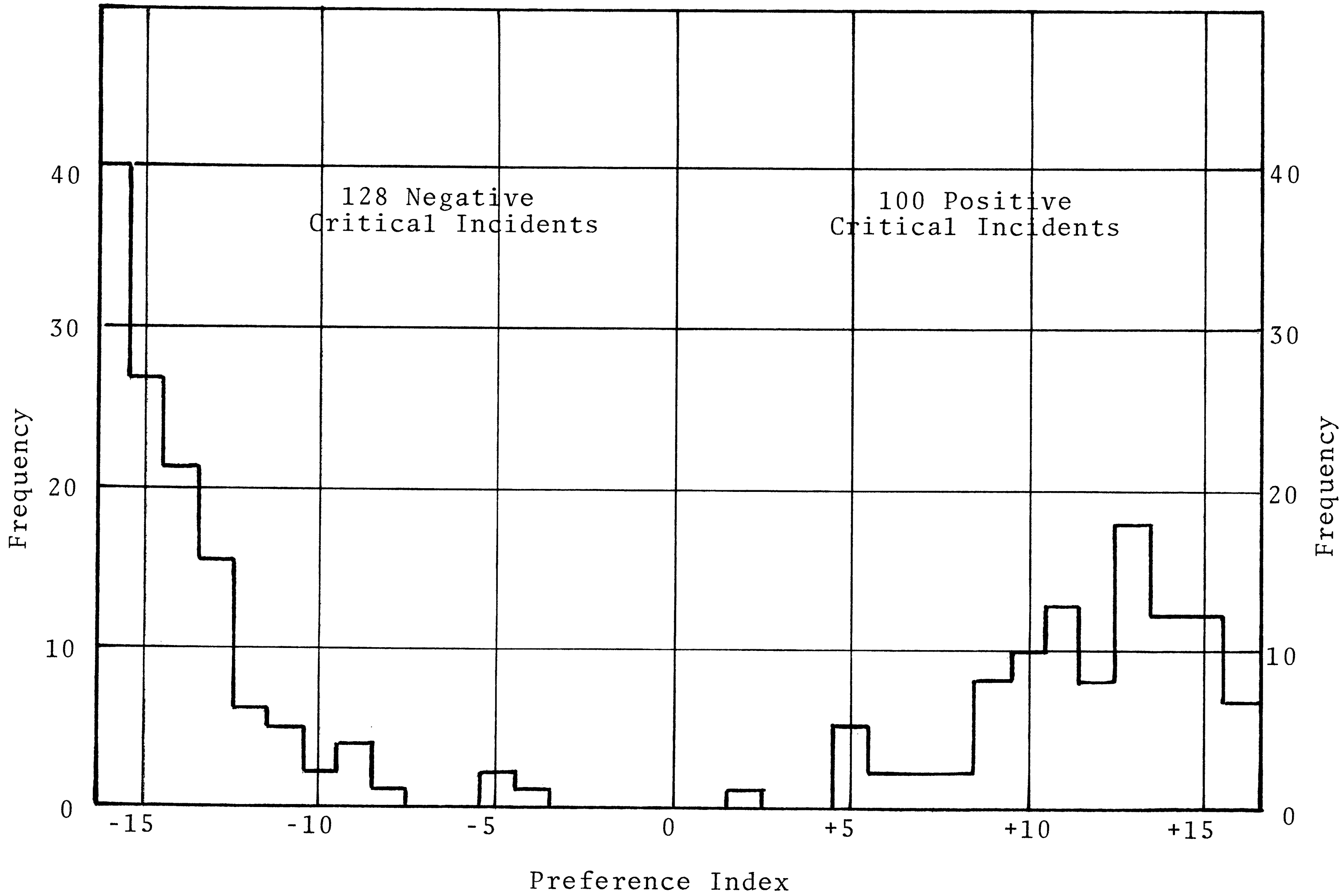

Fig. 3--Frequency of Critical Incidents VS Preference Index

PI = -15

PI = -13 & -14

PI = -9 to -12

PI = +8 to +10

PI = +11 to +13

PI = +14 to +16

To accomplish this the 3 x 5 cards were first sorted by PI as above. Each PI group was then sorted by discrimination index (DI). Four critical incidents were then chosen to form each tetrad subject to the following:

1. PI grouping as above.

2. The discrimination index had to vary at least ten points from one incident to the next and a minimum spread of 30 points from highest DI to lowest DI was maintained for each tetrad.

The unused critical incidents were discarded and each set of cards of the thirty tetrads was shuffled so as to avoid any pattern evolving. The final thirty set tetrad grouping was sequenced repetitively with respect to preference indexes as follows and as shown in Figure 4.

1. High positive incidents,
2. Low negative incidents,
3. Medium positive incidents,
4. Medium negative incidents,
5. Low positive incidents,
6. High negative incidents.

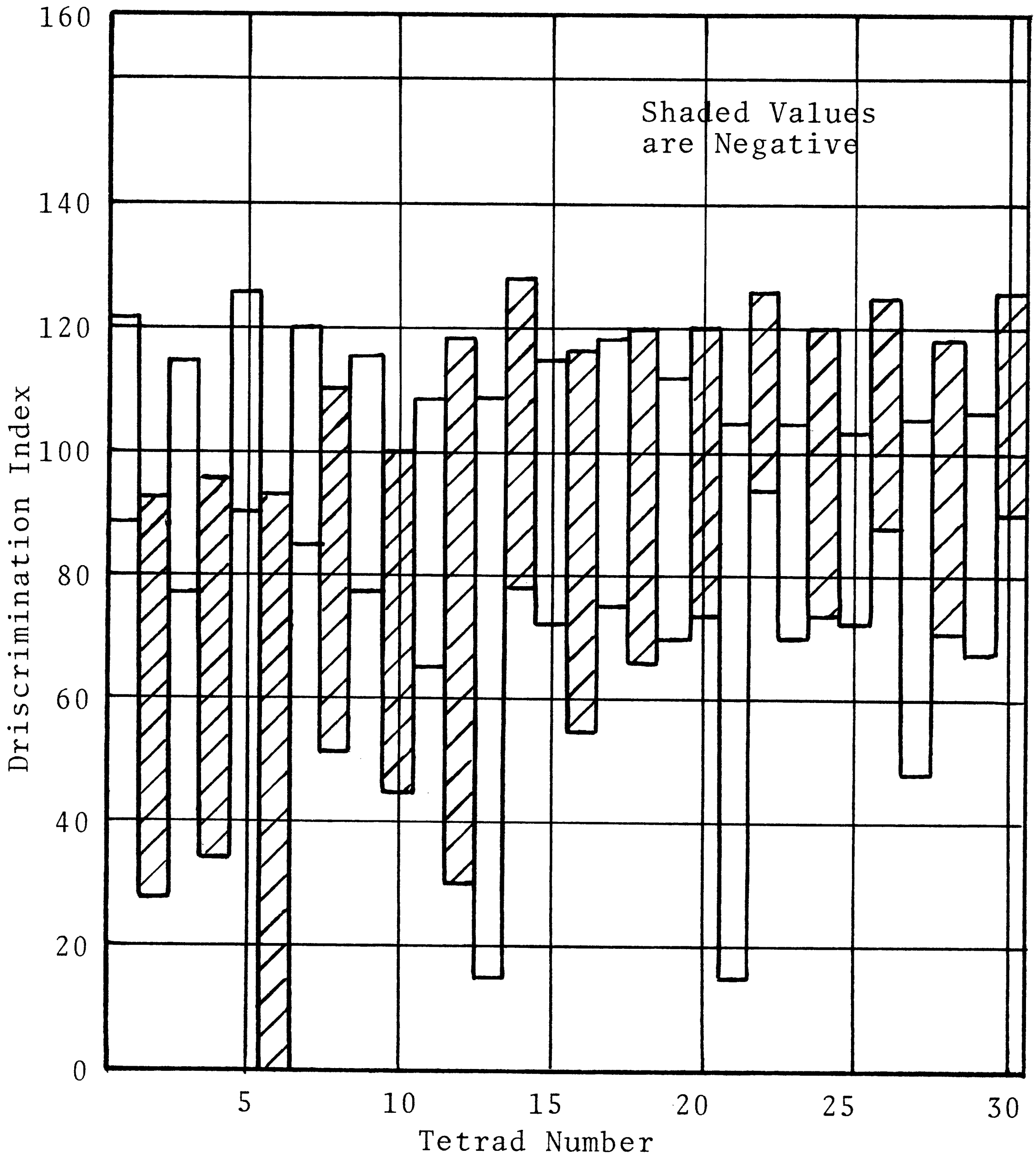

Fig. 4--Discrimination Index Range vs Tetrad Number

The managers of two separate departments within the Engineering Department were then furnished with sets of general instructions and enough sets of thirty tetrads each to rate their professional cadre.

Each manager was asked to have each of his engineers rated by indicating which element in each tetrad was most like the engineer and which element was most unlike him. The managers were further cautioned not to leave any tetrad incompleted; two choices had to be made out of each set of four.

The instructions given to each manager together with a full set of thirty tetrads are given in Appendix D.

CHAPTER IV

RESULTS, ANALYSIS, AND DUAL RUN COMPARISON

Of the 70 experienced engineering supervisors who were asked to submit critical incidents, 55 responded with well over 300 incidents. These were first screened to be sure that they were definitely job related. Then eliminating those that were not, duplicates, and nonresponsive replies resulted in accepting 226 usable critical incidents. By using the procedure previously discussed, these critical incidents were used to form the 30 tetrad series of 4 incidents each. All of the professional engineers in each of 2 departments were then evaluated using this 30 tetrad form.[1]

It was, of course, recognized that carefully filling out a series of thirty tetrads for each engineer would be very time consuming and that thirty tetrads were more than would be needed in a fully developed system. Yet, it was felt necessary to validate both the approach as well as the applicability of the critical incidents cited. It was planned to reduce to a twenty tetrad series for the final comparative runs.

To accomplish this reduction, it was decided to discard tetrads where either

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[1]See Appendix D.

1. The basic premise of a uniform preference index appeared violated, or

2. The response pattern in any tetrad showed a general misunderstanding of the critical incident or an unwillingness to use it.

As it turned out, a careful analysis made of the first department's returns, Department A, disclosed some problem tetrads. It was apparent that the supervisor's concepts of some of the preference indexes differed widely from those previously established by the firm's own professional engineers. This again illustrates the concept that supervisors, at times, feel that they know better than their people, what the people actually prefer. The net effect of this was that one specific element in a tetrad was almost universally selected as most representative of the performance of the individual named and another element almost universally selected as most unlike the probable performance of the individual named.

Using the aforementioned criteria, and bearing in mind the plan to reduce to twenty sets, tetrads Number 3, 6, 7, 9, 10, 14, 16, 20, 22, and 28 were deleted. Each engineer's rating was then scored on the basis of the discrimination index previously calculated using Equation (1). If the critical incident selected was designated as <u>most</u> representative of the performance of the individual named, the discrimination index was used with the sign as calculated.

If the critical incident selected was designated as most unlike the probable performance of the individual named, the calculated sign was reversed. The individual's score was then merely the algebraic sum of the individual scores of the twenty remaining tetrads.

Each engineer in the department was then ranked on the basis of his net discrimination index score, from highest to lowest, as shown in Figures 5 and 6.

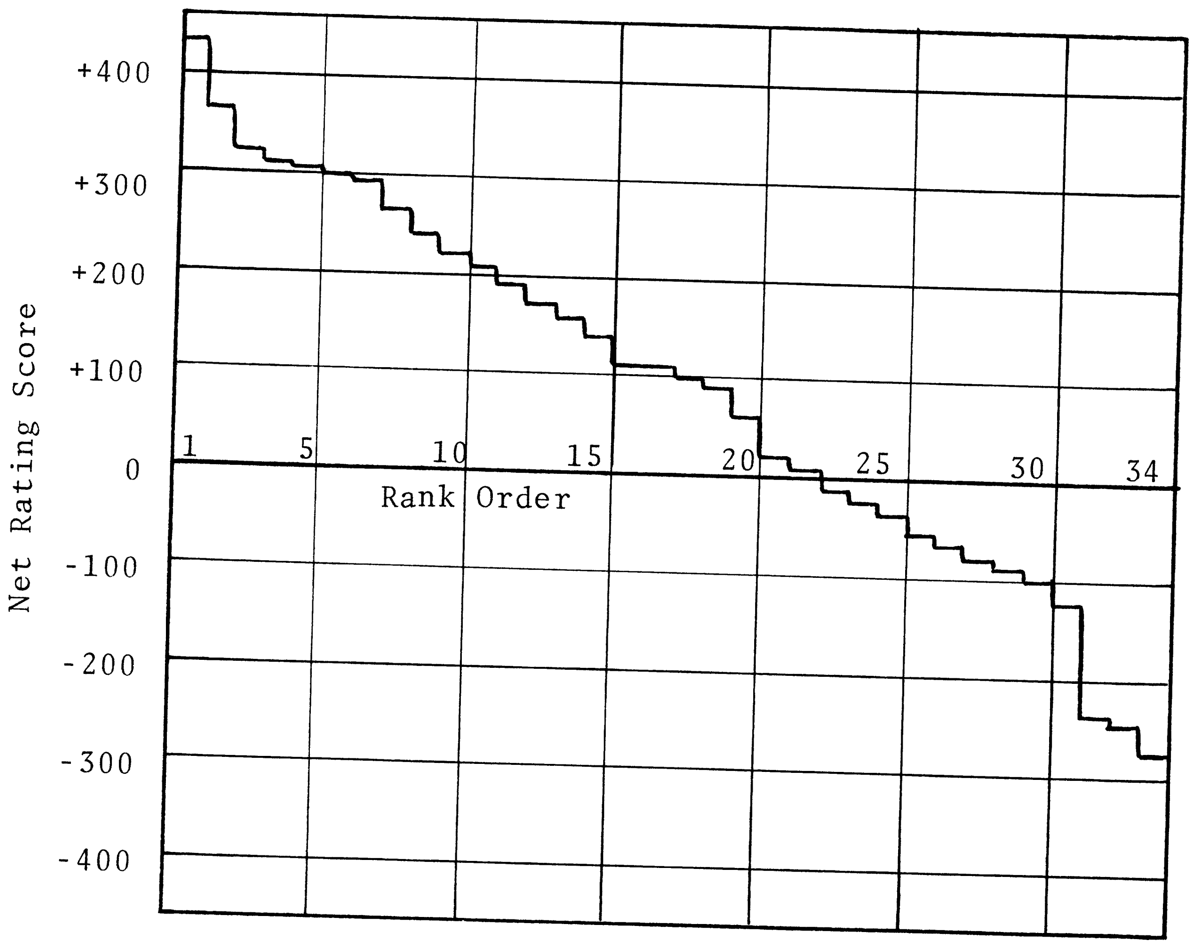

Fig. 5--Department A. Net rating score VS rank by the critical incident-forced choice system.

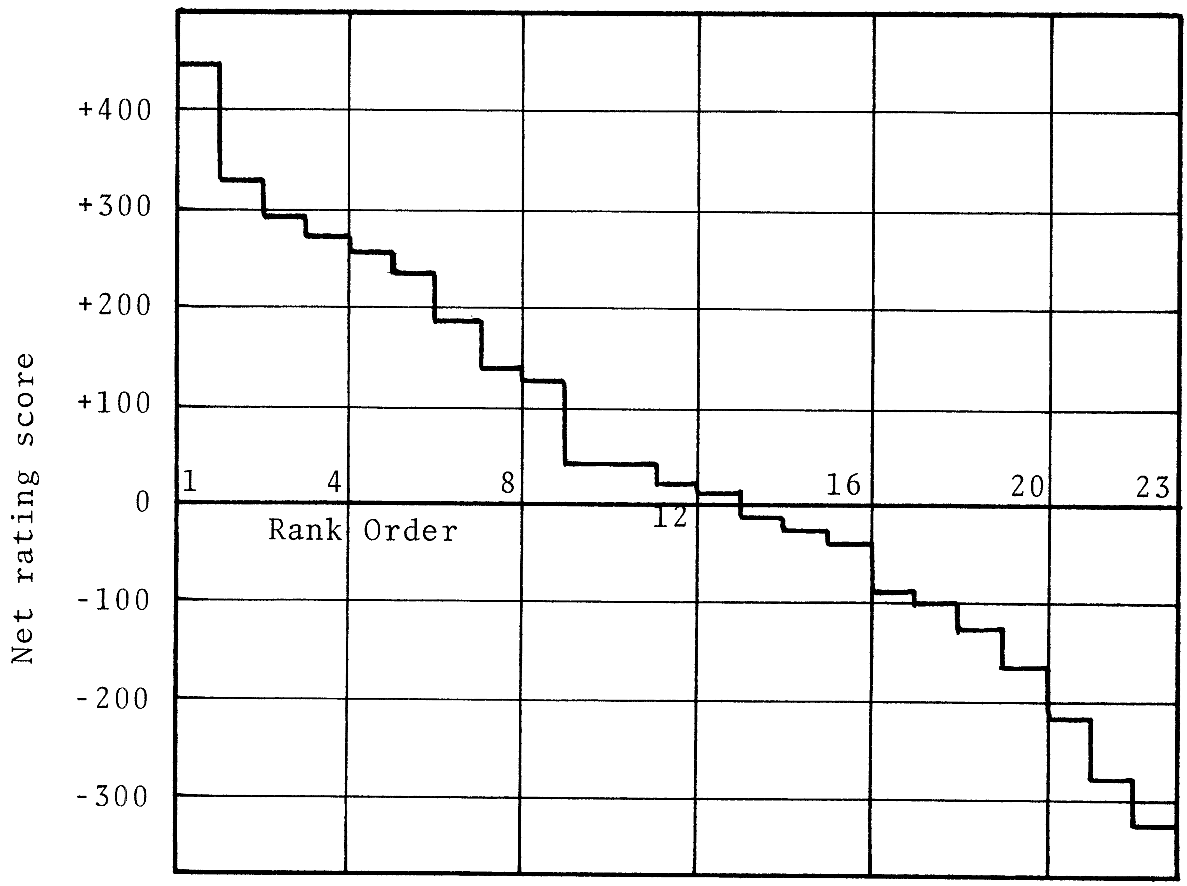

Fig. 6--Department B. Net rating score VS rank by the critical incident-forced choice system.

As is shown in Figures 5 and 6, there is a wide and almost uniform distribution of rating scores for each department ranging from a high of slightly over 400 for the Number 1 ranked engineer to approximately -300 for the lowest ranked engineer. If future testing confirms these widespread distributions of scores, one well-known shortcoming of conventional merit rating practices may be eliminated.

It is apparent in both Figures 5 and 6 that there are more positive than negative ratings in each department.

The reason for this is that, as noted earlier, ten tetrads were deleted. Of these, three were "positive" and seven were "negative." The net effect of this change would be to increase the relative number of positive scores.

Coincident with this evaluation, the Vought Corporation was proceeding with its regular engineering merit rating. In this process, Vought relies heavily on a consensus ranking method. Herein, their usual procedure is to "stackchart" all of the professional engineers in each department in terms of their overall value to the firm. Ideally this is done without regard to the individual's salary or labor grade; just considering the engineer as a whole. Ordinarily, there is quite a bit of give-and-take among the supervisors during this ranking and many of the problems associated with committee action arise. When the supervisors are unable to agree, and this happens occasionally, the manager is called upon to decide the final ranking. Of course, he may not be fully knowledgeable about all of his people (particularly the newer engineers or the junior engineers) but he surely will have enough empathy with his own supervisors so that the logical decision gets made. In any case, the manager personally reviews and approves the final ranking chart and proposed salary changes.

Thus, in fact, a dual run was completed in each of two departments. The critical incident-forced choice ranking had been established and the Vought ranking had been independently arrived at also. The results of these rankings are given in Tables I and II.

Validation

In order to correlate each department's ranking with that arrived at by the critical incident-forced choice technique, a nonparametric statistical procedure was applied to determine the degree of association between the two ranked series of data.[2]

Based on the Spearman rank correlation coefficient,[3] the measure of correlation between the two series is

$$r_{rank} = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \text{Eq. (3)}$$

where n is the number of ranked items and d is the difference in rank between paired items.

As developed by Clark and Schkade,[4] the standard error of r_{rank} is

$$\sigma_{r_{rank}} = \frac{1}{\sqrt{n - 1}} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \text{Eq. (4)}$$

and the value of r_{rank} obtained from Eq. (3) is tested for significance, assuming the null hypothesis, as follows:

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[2]Charles T. Clark and Lawrence L. Schkade, Statistical Methods for Business Decisions (Cincinnati, Ohio, 1969), pp. 570-571.

[3]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York, 1956), pp. 202-213.

[4]Clark and Schkade, op. cit., p. 571.

$$z_n = \frac{r_{rank}}{\sigma_{r_{rank}}} \quad \ldots\ldots\ldots \text{Eq. (5)}$$

Applying the data from Table I,

$$r_{rank} = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)} = 1 - \frac{6(4320)}{34(1155)} = .342$$

$$\sigma_{r_{rank}} = \frac{1}{\sqrt{n - 1}} = \frac{1}{\sqrt{33}} = .174$$

$$\therefore \quad z_1 = \frac{r_{rank}}{r_{rank}} = \frac{.342}{.174} = 1.96$$

Therefore, the value of r_{rank} is significant at the 0.05 level of significance.

As a verification, the significance of an r_{rank} under the null hypothesis was tested by the Kendall Method[5] where

$$t = r_{rank}\sqrt{\frac{n - 2}{1 - (r_{rank})^2}} \quad \ldots\ldots \text{Eq. (6)}$$

and, again with Table I data,

$$t = .342\sqrt{\frac{34 - 2}{1 - (.342)^2}} = 2.06$$

From the Table of Critical Values of t,[6] with df = n - 2 = 34 - 2 = 32, a t as large as 2.06 is significant at slightly less than the .05 level but not at the .02 level for a two-tailed test. This then confirms the previous data.

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[5]Siegel, op. cit., p. 212.

[6]Ibid., p. 248.

TABLE I

ENGINEERS IN DEPARTMENT A

Engineer (1)	Dept. A Ranking (2)	CI-FC Ranking (3)	Ranking Difference d (4)	d^2 (5)
A	1	6	- 5	25
B	2	11	- 9	81
C	3	4	- 1	1
D	4	10	- 6	36
E	5	27	-22	484
F	6	34	-28	784
G	7	9	- 2	4
H	8	8	0	0
I	9	2	+ 7	49
J	10	7	+ 3	9
K	11	13	- 2	4
L	12	25	-13	169
M	13	17	- 4	16
N	14	30	-16	256
O	15	1	+14	196
P	16	21	- 5	25
Q	17	14	+ 3	9
R	18	22	- 4	16
S	19	28	- 9	81
T	20	18	+ 2	4
U	21	20	+ 1	1
V	22	3	+19	361
W	23	26	- 3	9
X	24	31	- 7	49
Y	25	23	+ 2	4
Z	26	29	- 3	9
A'	27	12	+15	225
B'	28	32	- 4	16
C'	29	5	+24	576
D'	30	16	+14	196
E'	31	33	- 2	4
F'	32	24	+ 8	64
G'	33	19	+14	196
H'	34	15	+19	361
Total	34	. . .	0	4320

TABLE II

ENGINEERS IN DEPARTMENT B

Engineer (1)	Dept. B Ranking (2)	CI-FC Ranking (3)	Ranking Difference d (4)	d^2 (5)
A	1	4	- 3	9
B	2	2	0	0
C	3	5	- 2	4
D	4	12	- 8	64
E	5	1	+ 4	16
F	6	6	0	0
G	7	18	-11	121
H	8	3	+ 5	25
I	9	15	- 6	36
J	10	19	- 9	81
K	11	11	0	0
L	12	16	- 4	16
M	13	9	+ 4	16
N	14	13	+ 1	1
O	15	8	+ 7	49
P	16	10	+ 6	36
Q	17	20	- 3	9
R	18	7	+11	121
S	19	21	- 2	4
T	20	14	+ 6	36
U	21	23	- 2	4
V	22	17	+ 5	25
W	23	22	+ 1	1
Total	23	. . .	0	674

Applying the data from Table II,

$$r_{rank} = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)} = 1 - \frac{6(674)}{23(528)} = .667$$

$$\sigma r_{rank} = \frac{1}{\sqrt{n - 1}} = \frac{1}{\sqrt{22}} = .213$$

$$\text{and } z_2 = \frac{r_{rank}}{\sigma r_{rank}} = \frac{.667}{.213} = 3.13$$

Therefore, the value of r_{rank} is significant at the .0017 level of significance.

While the correlation in both ranked series of Table I is surely acceptable, it certainly does not have the correlation of Table II. Therefore the manager of Department A was shown the data and asked if there was anything unusual that he could see concerning engineers E, F, and C' since they appeared to be so differently ranked by the two systems.

After careful consideration the manager of Department A decided that these specific engineers had been departmentally ranked by administrative decision rather than by overall value or by demonstrated performance. He also suggested that the critical incident-forced choice system ranking was probably much more realistic, and that in fairness to the research, engineers E, F, and C' should be deleted from consideration. If this is done, Table I becomes modified into Table III and applying the new ranking data as before:

TABLE III

ENGINEERS IN DEPARTMENT A DELETING ENGINEERS ORIGINALLY RANKED E, F, AND C' IN TABLE I

Engineer (1)	Dept. A Ranking (2)	CI-FC Ranking (3)	Ranking Difference d (4)	d^2 (5)
A	1	5	- 4	16
B	2	10	- 8	64
C	3	4	- 1	1
D	4	9	- 5	25
E	5	8	- 3	9
F	6	7	- 1	1
G	7	2	+ 5	25
H	8	6	+ 2	4
I	9	12	- 3	9
J	10	24	-14	196
K	11	16	- 5	25
L	12	28	-16	256
M	13	1	+12	144
N	14	20	- 6	36
O	15	13	+ 2	4
P	16	21	- 5	25
Q	17	26	- 9	81
R	18	17	+ 1	1
S	19	19	0	0
T	20	3	+17	289
U	21	25	- 4	16
V	22	29	- 7	49
W	23	22	+ 1	1
X	24	27	- 3	9
Y	25	11	+14	196
Z	26	30	- 4	16
A'	27	15	+12	144
B'	28	31	- 3	9
C'	29	23	+ 6	36
D'	30	18	+12	144
E'	31	14	+17	289
Total	31	. . .	0	2120

$$r_{rank} = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)} = 1 - \frac{6(2120)}{31(960)} = .573$$

$$\sigma r_{rank} = \frac{1}{\sqrt{n - 1}} = \frac{1}{\sqrt{30}} = .183$$

$$\text{and } z_3 = \frac{r_{rank}}{\sigma r_{rank}} = \frac{.573}{.183} = 3.13$$

and, the value of z is coincidentally the same as that from Table II and r_{rank} is significant at the .0017 level of significance.

Table II was then shown to the manager of Department B and he was given the opportunity to comment thereon. This manager felt that engineer R had been administratively ranked too low and that the critical incident-forced choice system probably had more fairly ranked him. However, since both rankings of Department B had already shown to be correlated so well, it was not believed necessary to restate the data because of a one-man improvement change. It may, however, be shown that by deleting engineer R, $z_4 = 3.24$ and the r_{rank} would be .71 and is significant at the .0012 level of significance.

Supporting these correlation values, Lepkowski reports[7] on a forced choice scale for engineers as an alternative to more conventional ratings. Using a 20-triad set 33 engineers were rated by their supervisors and the reliability of these ratings was determined to be .90.

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[7] J. Richard Lepkowski, "Development of a Forced-Choice Rating Scale for Engineer Evaluation," Journal of Applied Psychology, XLVII, No. 2 (1963), 87-88.

Of perhaps greater interest might be the question of what is validating what. Recognizing the fact that workers are occasionally ranked using criteria other than performance or overall value to the firm, the departmental consensus ranking must itself be imperfect. Zavala investigated the problem of validity in depth[8] and suggests that while a criterion based on the judgment of those in a position to judge may not be fully valid, it is better than no criteria at all and is "not a weakness peculiar to FC (forced choice) scales." Without minimizing the idea of validity, Zavala concludes, "it seems that criticisms of a scale based on validities fail to take into consideration the context within which the scale is to be used."

It would seem that this is a very good point. The forced choice-critical incident system does not make any management decision as to a salary change of any worker. The system ranks the workers in an order consistent with a predetermined objective rationale, tailor-made for a specific department within a particular firm. The individual department manager must still make his own subjective decision as to any proposed salary change.

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[8]Albert Zavala, "Development of the Forced-Choice Rating Scale Technique," Psychological Bulletin, LXIII, No. 2 (1965), 118-119.

CHAPTER V

OPERATING MANAGERS' EVALUATION

After each of the operating managers had been given the opportunity to carefully review the end products of this research (Tables I and III and the related analysis), they were separately interviewed in depth concerning their feelings about this project.[1] Anonymity was promised so each would feel as free as possible to reveal his true feelings.

As previously reported, each of the managers was impressed with the correlation and a bit surprised that the critical incident-forced choice system could identify specific engineers ranked by administrative decision rather than by demonstrated performance and overall value to the firm.

Both managers admitted to having spent much personal time on the project but each felt it to have been a worthwhile and much needed exercise. Each indicated that he would prefer a structured approach to merit rating rather than just "stacking" their people. These feelings reenforce an earlier Vought audit study[2] which concluded that a structured and less subjective merit rating procedure should be developed for professional workers.

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[1] Vought Corporation, Dallas, Texas, interviews with participating menagers, June 2, 1976.

[2] Vought Corporation internal memo report 2-94300/4M-35 dated 31 July 1974.

As a matter of fact, one of the managers felt so strongly about needing a structured approach that he developed his own system in 1970 and has been using it ever since. He even has it programmed and stored in the computer. With this as a guiding tool, he has been maintaining systematic and periodically revised profiles on all of his people. He sincerely feels that engineers need continual reassurance that management does care about them and that the critical incident-forced choice system might just be the proper vehicle to achieve this purpose. He reported that he disliked the idea of engineers seemingly "taking turns" for their salary increases and he did not like the idea of salary increases being at all dependent on supervisory whims. On the other hand, he admitted to being "a bit suspicious of any system that he couldn't interfere with."

He said that he wished that enough advance notice of this project had been given him so that he could have kept notes on critical incidents as they occurred earlier. Along this vein, he would like for Vought Engineering to really develop a system such as this, upgrading and updating the critical incidents regularly.

The other manager said that he developed a bit of an uneasy feeling that the critical incident-forced choice system was really evaluating him.[3] He liked the system and

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[3]Not true, but an interesting observation.

said that it helped him sort out his own thoughts about his people and what was needed for their development.

The question was asked if they, the managers, would perhaps have felt more comfortable about the system if the unfavorable tetrads were eliminated and they had to choose from among only favorable elements. Each manager thought that the unfavorable tetrads represented real problems that had occurred and needed to be faced and they would not particularly care for all favorable tetrads. One manager commented, "Everyone makes mistakes and we'd better know how to handle them."

In a way, this does not support the results obtained by Berkshire and Highland.[4] In their study, as reported in Chapter II, they came to the conclusion that the best liked format had four statements per set, all favorable, where the rater was to choose the two most descriptive elements. However, it must be noted that they did not test a format with four statements per set, all unfavorable.

Another point that should be brought is that Miner felt[5] the critical incident procedures "have been criticized as fostering excessively close supervision and blame finding." While this perhaps might have been true in a strictly critical

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[4]James R. Berkshire and Richard W. Highland, "Forced Choice Performance Rating--A Methodological Study," Personnel Psychology, VI (Autumn, 1953), 355-358.

[5]John D. Miner, Personnel Psychology (New York, 1969), p. 115.

incident system, adding the forced choice feature and the accompanying personal anonymity as to who occasioned each critical incident apparently successfully negated this criticism. In addition, the concern reflected by Patton and Littlefield[6] that a forced choice system would be unsuitable for use "as a counseling guide for employees, where that is one of the purposes to be served" did not materialize, probably because of the use of specific critical incidents in the forced choice setting. In fact, not only did one of the operating managers comment on using this system for development purposes, but another observing manager commented that this system "reminds people of what Vought considers good and bad engineering performance . . . without getting into money and salary concepts."

Along these lines, Flanagan and Burns suggest[7] the critical incident method as being a basis for talking to an employee about his job plans. And Glueck[8] comments that "critical incidents . . . become the data used for coaching, counseling, developing and evaluating employees. Emphasis can be placed on facts rather than vague impressions."

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[6]John A. Patton and C. L. Littlefield, Job Evaluation (Homewood, Ill., 1957), p. 306.

[7]John C. Flanagan and Robert K. Burns, "The Employee Performance Record: A New Appraisal and Development Tool," Harvard Business Review, XXXV (September-October, 1957), 95-102.

[8]William F. Glueck, Personnel: A Diagnostic Approach (Dallas, Texas, 1974), p. 298.

The experiences with the Vought Corporation Engineering Department have certainly reenforced these points.

Insofar as their general merit rating system is concerned, another comment made was that this system forces the top man to look "one more time" at what the subordinate managers do.

In summary, the Vought engineering management position at the conclusion of this study is

> The evaluation of professional employees is always a difficult and exacting task. When the professionals involved are engineers who work on project teams often geographically removed from their supervision, their evaluation gets involved in a higher order consensus process as well. The critical incident-forced choice system offers an interesting possibility for improvement over our currently used methods.[9]

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[9]Expressed by J. F. Courtney, who authorized the Vought participation in this study, Dallas, Texas, June 5, 1976.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The fundamental purposes of this study was to develop a new merit rating technique or system for professional workers using an independent results oriented approach. To accomplish this, the best features of the critical incident technique were to be combined with those of the forced choice method. The resulting system was then to be applied to two departments of the Vought Corporation's Engineering Department in Dallas, Texas, and the results compared to their currently used methods.

General Aspects of Merit Rating

Since people have always made value judgments about other people, the question of whether or not to merit rate should be superseded with the more relevant query of how shall the merit rating be accomplished.

Although the term itself was not yet in use, Siegel[1] attributes the first known case of merit rating to the Army in 1813 wherein a General Cass formally submitted comments on each of his officers to his superior. The first known

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[1] Laurence Siegel, Industrial Psychology (Homewood, Ill., 1969), pp. 216-242.

industrial use of a merit rating form was in 1916 and this form was promptly disapproved by a group of personnel directors because they felt strongly that the human being could not be scientifically rated.[2]

However, despite these inauspicious beginnings, merit rating has now become a well-accepted way of life in American industry. At least, in 1972, Oberg[3] comments that "over three-fourths of U.S. companies now have performance appraisal programs." During this intervening period, generalities were replaced with evaluations of specific traits,[4] forced choice ratings[5] appeared in 1948, and the critical incident technique[6] was introduced in 1954. Yet it was apparent that merit rating somehow was not fulfilling the high expectations that management had for it. Amid much critical material in the literature, in 1964 Meyer, Kay, and French reported[7] that the traditional merit rating programs were of questionable value because supervisory criticisms of workers disrupted

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[2] G. D. Halsey, Making and Using Industrial Service Ratings (New York, 1944), p. xix.

[3] Winston Oberg, "Make Performance Appraisal Relevant," Harvard Business Review, L (January-February, 1972), 61.

[4] R. B. Starr and R. J. Greenly, "Merit Rating Survey Findings," Personnel Journal, XVII (1939), 378-384.

[5] E. Donald Sisson, "Forced Choice-The New Army Rating," Personnel Psychology, I (Autumn, 1948), 365-381.

[6] John C. Flanagan, "The Critical Incident Technique," Psychological Bulletin, LI (July, 1954), 327-357.

[7] H. H. Meyer, E. Kay, and John R. P. French, Jr., "Split Roles in Performance Appraisal," Harvard Business Review, XLIII (1964), 124-129.

rather than improved the situation. Because of the controversial aspects[8] of merit reviews, yet acknowledging their usefulness, a number of firms have now chosen to become more results oriented and to consider the man-as-a-whole and his relative overall value to the firm. Davies and Francis[9] reenforce this trend toward rewarding achievement of corporate objectives.

In a general sense it is likely that the firm can receive several benefits[10] from a properly administered merit rating system. On the other hand, there are many factors[11] other than performance that should be considered if a salary revision is contemplated. Therefore, Sisk[12] and others feel that the salary discussion portion of the merit rating should be held separately from the performance portion of the rating. Apparently this is the current trend.

Current merit rating procedures of most firms probably involve the use of some form of a rating scale. Either the

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[8]George A. Rieder, "Performance Review--A Mixed Bag," Harvard Business Review, LI (July-August, 1973), 61-67.

[9]Celia Davies and Arthur Francis, "There Is More to Performance Than Profits or Growth," Organizational Dynamics, III (Winter, 1975), 51-65.

[10]See page 11 of this report.

[11]See page 25 of this report.

[12]Henry L. Sisk, Management and Organization (Cincinnati, Ohio, 1973), pp. 429-430.

worker is evaluated as-a-whole, and/or a specific set of traits or attributes is considered. Such procedures have numerous shortcomings, and, as Flanagan observes,[13] "numerous attempts have been made to patch up rating scales by making minor modifications in the procedures." Most of these "patches" are of dubious value, involving primarily only small changes in the firm's administrative practices. In the same study Flanagan offers some hope that the forced choice technique may provide a rating validity not existing in the usual rating methods. However, it should be repeated that, in a typical forced choice setting where each tetrad is comprised of two equally favorable elements and two equally unfavorable elements, the rater could control the direction (but not the magnitude) of the rating. Also, while the properly constructed forced choice technique may have much to offer, Zavala learned[14] that many users found it desirable to use a forced choice rating in combination with some other conventional scale.

The critical incident technique is then advocated by Flanagan as being the logical approach to eliminate the shortcomings of the more conventional merit rating methods.[15]

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[13]John C. Flanagan, "A New Approach to Evaluating Personnel," Personnel, XXVI (July, 1949), 38.

[14]Albert Zavala, "Development of the Forced-Choice Rating Scale Technique," Psychological Bulletin, LXIII, No. 2 (1965), 117.

[15]Flanagan, "The Critical Incident Technique," pp. 327-357.

"Tailor-made" for the using firm, this method has an authenticity that materially adds to its acceptability.[16] Ling[17] and others reenforce this concept in that the critical incident method is "a factual record . . . rather than an arbitrary rating or assignment of numbers." There are, however, some drawbacks to the system. In addition to development costs being quite high,[18] Miner feels that the system may foster "excessively close supervision and blame finding,"[19] and Lopez is concerned that it resembles the authoritarian supervisor's technique of the "little black book."[20]

Admitting that the development costs might be significant, it was believed that by carefully combining the forced choice technique with the critical incident method the best features of each could be retained and most of the undesirable features avoided. It was also felt that this new approach could properly be thought of as being results-oriented.

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[16]Wayne K. Kirchner and Marvin D. Dunnette, "Identifying the Critical Factors in Successful Salesmanship," Personnel, XXXIV (1957), 59.

[17]Cyril Curtis Ling, The Management of Personnel Relations (Homewood, Ill., 1965), p. 466.

[18]William F. Glueck, Personnel: A Diagnostic Approach (Dallas, Texas, 1974), p. 300.

[19]John D. Miner, Personnel Psychology (New York, 1969), p. 115.

[20]Felix M. Lopez, Evaluating Employee Performance (Chicago, 1968), p. 222.

It was also believed that this approach, requiring both analysis and participation, would appeal to professional engineers.

Selection of the Participating Firm

The Vought Corporation's Engineering Department seemed to be a natural choice for participation in this research. Having well over 1,000 engineers employed, it was known that they were using an unstructured ranking merit approach, having years earlier ceased using a rating scale based on a series of traits. Further, a study audit[21] had established the idea that supervisors and professional workers alike would prefer a structured and more objective merit rating procedure. Vought was therefore approached in July, 1975 to determine their interest and they volunteered to participate as a part of their 1976 Engineering Objectives.[22]

Research Methodology

A series of critical incidents was originally requested from seventy experienced engineering supervisors using the very specific guidelines of Appendix A. As these incidents were received, they were screened to insure that they were job related. They were then edited, abridged, and duplicates were deleted.

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[21] Vought Corporation internal memo report 2-94300/4M-35 dated 31 July 1974.

[22] See cover letter, Appendix A.

A discrimination index was then calculated for each critical incident using estimated probabilities assigned by a special group of Vought engineering supervisors.[23] In a like manner a preference index was calculated for each critical incident using a special group of professional engineers, each of whom reviewed each critical incident.[24]

Thirty tetrads of four critical incidents were then formed, fifteen all "favorable," and fifteen all "unfavorable." The fundamental concept was that each tetrad had to be composed of four critical incidents wherein the preference index was essentially constant but the discrimination index varied widely. This was done and the managers of two separate departments within the Vought Engineering Department were furnished general instructions and enough sets of thirty tetrads each to rate all of their professional engineers.

Recognizing that carefully filling out a series of thirty tetrads for each engineer would be very time-consuming, it was originally planned to reduce this quantity to twenty for the final run. Yet it was felt necessary to at first proceed with the thirty tetrad set in order to validate both the approach as well as the critical incidents cited. This was done, and as planned, the series was reduced to twenty

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[23]For a full discussion, see pages 33 and 34 of this report.

[24]For a full discussion, see pages 35 and 36 of this report.

tetrads and each department's group of professional engineers was scored, ranked, and compared against the ranking arrived at using their normal merit rating procedures.

Validity was then determined by applying a nonparametric statistical procedure based on the significance of the Spearman Rank correlation coefficient[25] as developed by Clark and Schkade.[26] Following analysis of this validation, comments and recommendations concerning the desirability of the critical incident-forced choice system were obtained from the operating managers. Conclusions were then to be made, recommendations suggested, and the study closed.

Dual Run Results

Final results were given in Tables I and III. Final computed Spearman rank correlation coefficients were .57 and .67, each of which is significant at the .002 level of significance.

Each of the operating managers spent considerable personal time on the project and each felt it to have been a worthwhile and much needed exercise. Each also stated that he would like to see this system developed further at Vought. Each manager also felt that both "favorable" and "unfavorable"

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[25] Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York, 1956), pp. 202-213.

[26] Charles T. Clark and Lawrence L. Schkade, Statistical Methods for Business Decisions (Cincinnati, Ohio, 1969), pp. 570-571.

tetrads should remain in the series because the real world is not all "favorable."

Conclusions

A number of significant conclusions may be drawn from this study.

1. As substantiated by Rieder,[27] the application of formal merit ratings is fraught with criticism and administrative problems. Yet modest improvements have been obtained and the basic intent of merit rating remains valid.

2. Supervisors and professional workers alike would prefer a structured and objective merit rating procedure.

3. By combining the best features of the forced choice technique with those of the critical incident method, a new system is developed that offers promise of:

   a. Eliminating many of the criticisms directed at conventional merit ratings,

   b. Eliminating many of the criticisms directed singly at either the forced choice technique or the critical incident method,

   c. Being acceptable to professional engineers,

   d. Being results oriented,

   e. Being objective,

   f. Reasonable reliability, although the question of validity is sure to arise.

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[27] Rieder, op. cit.

It is, however,

a. Moderately expensive to implement,

b. Probably costly to maintain,

c. Not yet proven or fully understood, and

d. Viewed with some degree of suspicion in that the rater cannot control the outcome.

Concerning the question of rating system validity, one should perhaps inquire as to what is validating what. Particularly when the subjective nature of the conventional merit rating is well-known and established, it must be concluded that departmental consensus ranking itself is imperfect. But as pointed out by Zavala,[28] while a criterion based on judgment may not be fully valid, it is better than nothing and "is not a weakness peculiar to FC (forced choice) scales." It should therefore be concluded that the important point lies in how the scale is to be used. Since, in the final analysis, each manager still must make his own subjective decision as to any proposed salary change, it would appear to follow that he has another decision making tool available to him.

It should also be pointed out that nothing in this research developed the concept that merit rating, particularly of engineers, is easy. To the contrary, despite the

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[28] Albert Zavala, "Development of the Forced-Choice Rating Scale Technique," Psychological Bulletin, LXIII, No. 2 (1965), 118-119.

utmost Vought Engineering cooperation, trying to establish an understandable, acceptable, and objective merit rating procedure is quite difficult. As commented by Patton, Littlefield, and Self, "Despite growing usage, merit increases are generally considered to be the most difficult of all types to administer."[29]

Recommendations

The critical incident-forced choice system has developed encouraging results on the basis of limited testing. So far, most of the usual criticisms have not materialized and the "tailor-made" and internal participative aspects have elicited some favorable user comments. Development costs have been relatively low and the system currently must be viewed as promising but unproven and, to a large extent, unknown.

It is therefore recommended that Vought (or another prospective user) develop the system further.

1. The twenty tetrad series should be applied to other groups of professional engineers and the rankings correlated against their current merit rating methods.

2. Additional critical incidents should be regularly developed so that the series can be continuously upgraded. To accomplish this, a standard procedure should be issued

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[29] John A. Patton, C. L. Littlefield, and Stanley Allen Self, Job Evaluation (Homewood, Ill., 1964), p. 321.

requiring supervision to record critical incidents as they occur. Being certain that anonymity is maintained, these incidents should be stored for use in a central agency. To determine the discrimination indexes and the preference index, standing review committees should be established each with a rotating membership.

3. The philosophy of the critical incident-forced choice system should be explained carefully to all professional engineers and their supervisors so that they do not view it with suspicion. It is necessary that all understand that the critical incidents used really happened and exactly how these incidents are viewed by their own engineering management.

4. It would also seem desirable to run two critical incident-forced choice ratings on a number of the same people. Of course, this could be done only where two or more supervisors were fully qualified to rate the same engineer. Then the raters should get together with a neutral coordinator and try to agree on a common rating.

5. Of course, ANY engineers placed in a ranking by administrative decision rather than by demonstrated performance or overall value should be deleted prior to attempting any rank correlation. Gamesmanship must be removed for a meaningful rating.

6. Despite the fact that the two operating managers felt it better to retain some "unfavorable" tetrads, the

Berkshire and Highland tetrads, Form C,[30] should be explored using critical incidents. This form had all "favorable" elements and the rater was to choose the two most descriptive. This study reported this form to be the most bias resistant. It also yielded consistently high validities.

7. If enough engineers and departments are tested and validated within a firm, there may be a possibility worth exploring in attempting to correlate forced choice-critical incident scores directly with given salary ranges and a given price level index.

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[30]James R. Berkshire and Richard W. Highland, "Forced-Choice Performance Rating--A Methodological Study," Personnel Psychology, VI (Autumn, 1953), 355.

APPENDIX A

DEPARTMENTAL CORRESPONDENCE

SUBJECT: Merit Review Study DATE: 29 March 1976

TO:

FROM: Mr. J. F. Courtney

As part of our 1976 objectives which in turn resulted from suggestions and action assignments at the series of Engineering Off-site Management sessions held by George Upton in 1975, Don McGinn and I are trying to develop improved performance evaluation and merit system.

We have agreed to participate with the Management School at North Texas State University in a study which will involve a variant of the critical incident technique method of evaluation. I would appreciate your personal experience and participation. The study is to be completely anonymous so please do not identify yourself or anyone else on the forms in any way. After you have thoughtfully completed the questionnaire sheets, seal them in the self addressed envelope furnished.

We are trying to isolate in detail just what highly successful engineering includes and what things happen that you personally would consider poor or ineffective engineering. As a leader, we would like you to relate specific incidents from your memory wherein one of the engineers under your direction did something:

1. That you thought should be further encouraged because it was an example of better-than-average engineering.

2. That you thought was an example of exceptional performance; a type of action that illustrates superior engineering.

3. That you thought was not quite up to par; not quite up to normal, sound engineering.

4. That you thought was really poor engineering--the sort of thing which <u>if repeated</u> would indicate the person not to be an effective engineer.

As a possibly helpful guide, you should view an incident as critical or significant only if it satisfies one or more of these criteria--either positively or negatively.

a) Makes a difference in either performance or morale.

b) Demonstrates something that you would consider along with other facts in a personnel evaluation.

c) Develops a situation which you would ordinarily discuss with the engineer himself.

For consistency, we would like you to do this in the following manner.

I. Think of one of your people whom you believe to be an outstanding, highly effective engineer. For this person, describe some "good" incident per item 1 or 2 above, using Form I.

Then, recognizing that all engineers occasionally do err, describe another (poor) incident <u>for this same person</u> per item 3 or 4 above, using Form II.

II. Think of one of your people whom you believe to be one of the least effective engineers you have. For this person, describe some "poor" incident per item 3 or 4 above, using Form III.

Then, recognizing that even an ineffective engineer will occasionally do something quite well, describe another incident (good) <u>for this same person</u>, per item 1 or 2 above using Form IV.

III. Think of one of your middle-of-the-road engineers and repeat, using Forms V and VI.

IV. Then give all six forms in the unidentified envelope provided directly to my secretary. Have her check your name on her list so we will know who has responded. <u>Do not put your name on the forms or the envelope</u>.

J. F. Courtney

J. F. Courtney

Supervisor's Critical Incident Form I
Positive Performance

Think back over the past year or so as you have observed the major activities of your engineers. Focus your attention on one of your top people and on any one thing which led you to think of him or her as having done a better-than-average or an outstanding job. In other words, think of a critical incident which added materially to your group's success at that time.

PLEASE DO NOT RECORD ANY NAME OR DATES.

1. What were the general circumstances leading up to this incident?

2. What exactly did the engineer do that you felt was good?

3. How did this incident contribute to your group's overall effectiveness?

4. Approximately how many years of engineering experience beyond BS (or equivalent) did this engineer have?

Supervisor's Critical Incident Form II
Negative Performance

Think back over the past year or so as you have observed the major activities of your engineers. Focus your attention on one of your top people and on any one thing done which led you to think of him or her as having done a poorer-than-average or a very poor job. In other words, think of a critical incident which detracted materially from your group's success at that time.

PLEASE DO NOT RECORD ANY NAMES OR DATES.

1. What were the general circumstances leading up to this incident?

2. What exactly did the engineer do that you felt was poor?

3. How did this incident contribute to your group's overall ineffectiveness?

4. Approximately how many years of engineering experience beyond BS (or equivalent) did this engineer have?

Supervisor's Critical Incident Form III
Negative Performance

Think back over the past year or so as you have observed the major activities of your engineers. Focus your attention on one of your least effective people and on any one thing done which led you to think of him or her as having done a poorer-than-average or a very poor job. In other words, think of a critical incident which detracted materially from your group's success at that time.

PLEASE DO NOT RECORD ANY NAMES OR DATES.

1. What were the general circumstances leading up to this incident?

2. What exactly did the engineer do that you felt was poor?

3. How did this incident contribute to your group's overall ineffectiveness?

4. Approximately how many years of engineering experience beyond BS (or equivalent) did this engineer have?

Supervisor's Critical Incident Form IV
Positive Performance

Think back over the past year or so as you have observed the major activities of your engineers. Focus your attention on one of your least effective people and on any one thing done which led you to think of him or her as having done a better-than-average or an outstanding job. In other words, think of a critical incident which added materially to your group's success at that time.

PLEASE DO NOT RECORD ANY NAMES OR DATES.

1. What were the general circumstances leading up to this incident?

2. What exactly did the engineer do that you felt was good?

3. How did this incident contribute to your group's overall effectiveness?

4. Approximately how many years of engineering experience beyond BS (or equivalent) did this engineer have?

Supervisor's Critical Incident Form V
Positive Performance

Think back over the past year or so as you have observed the major activities of your engineers. Focus your attention on one of your average, middle-of-the-road people and on any one thing done which led you to think of him or her as having done a better-than-average or an outstanding job. In other words, think of a critical incident which added materially to your group's success at that time.

PLEASE DO NOT RECORD ANY NAMES OR DATES.

1. What were the general circumstances leading up to this incident?

2. What exactly did the engineer do that you felt was good?

3. How did this incident contribute to your group's overall effectiveness?

4. Approximately how many years of engineering experience beyond BS (or equivalent) did this engineer have?

Supervisor's Critical Incident Form VI
Negative Performance

Think back over the past year or so as you have observed the major activities of your engineers. Focus your attention on one of your average, middle-of-the- road people and on any one thing done which led you to think of him or her as having done a poorer-than-average or a very poor job. In other words, think of a critical incident which detracted materially from your group's success at that time.

PLEASE DO NOT RECORD ANY NAMES OR DATES.

1. What were the general circumstances leading up to this incident?

2. What exactly did the engineer do that you felt was poor?

3. How did this incident contribute to your group's overall ineffectiveness?

4. Approximately how many years of engineering experience beyond BS (or equivalent) did this engineer have?

APPENDIX B

	AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00	OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
1	Uncovered major discrepancy in the way data was presented and used and corrected same. +106	.62	.29	.09
2	Questioned key assumptions made by others prior to his being assigned the task. +104	.61	.30	.09
3	Proceeded with calculations using various assumed conditions instead of using constant conditions. - 26	.27	.33	.40
4	Grumbled and complained, much reducing own effectiveness. - 96	.11	.30	.59
5	Determined that previous work was erroneous; then took responsibility for making necessary engineering changes. +106	.63	.27	.10
6	Developed innovative design and coordinated his approach with potential supplier. +104	.60	.32	.08
7	Presented ideas which were limited in scope and not very imaginative. - 84	.16	.26	.58
8	Tended to coast and not look around for work that needed to be done. -124	.06	.26	.68
9	Developed a new and innovative procedure in a field with few if any precedents. +106	.62	.29	.09
10	Did not adjust self to temperamental ways of colleague. - 46	.23	.31	.46
11	Did not exercise proper precautions to insure correct instrumentation during a test program. - 78	.16	.29	.55
12	Developed a test program which satisfactorily met requirements on time and within budgets. + 72	.51	.34	.15

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR <u>EACH</u> INCIDENT MUST TOTAL 1.00		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
13	Developed a new type of probability analysis for design evaluation. + 88	.56	.32	.12
14	Was quick to grasp a new and difficult computer concept to which he had never been previously exposed. + 88	.57	.30	.13
15	Failed to complete requested forms in a timely fashion claiming instead that he was too busy with more important things. - 46	.23	.31	.46
16	During a busy period, engaged in much casual conversation which lowered his and his colleagues' productivity. -100	.11	.28	.61
17	Volunteered to help and provide leadership in a neighborhood youth organization. + 16	.32	.43	.24
18	Cleverly reversed a design concept that resulted in proper functioning with very little extra cost. + 90	.57	.31	.12
19	Tried to commit too many details to memory and omitted an important point in the report. - 50	.21	.33	.46
20	Anticipated a problem before it happened and developed, on his own time, a suitable replacement for the questionable part. + 90	.56	.33	.11
21	Changed an existing design for primarily cosmetic reasons. - 54	.21	.31	.48
22	Made correct design decision but forgot to coordinate the change with interfacing departments. - 52	.22	.30	.48
23	Anticipated a material shortage and initiated early procurement action. + 76	.51	.36	.13

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
24	Justified a cost estimate that had previously been submitted in a situation where no backup data were available. + 76	.50	.38	.12
25	Got himself too involved in work he had previously delegated to colleagues. - 34	.22	.39	.39
26	Thoroughly researched a developmental effort and well documented the results. +104	.61	.30	.09
27	Ignored supervisor's suggestions in preparing an R & D proposal. - 66	.19	.29	.52
28	Demonstrated lack of basic knowledge in an area wherein he had many years of exposure. -132	.06	.22	.72
29	With very little supervision, quickly researched and developed a system to aid in troubleshooting a manufactured part. +102	.61	.29	.10
30	Modified existing computer model and performed analysis with documentation on a developmental program. + 80	.52	.36	.12
31	Poorly organized his planning effort which resulted in excessive hours being spent on the project. - 88	.13	.30	.57
32	Volunteered to go off-site to a subcontractor's plant to assist him in his design effort. + 52	.47	.32	.21
33	Failed to inform superior of an impending engineering problem when it was first discovered. - 76	.18	.27	.56
34	Allowed his creative urges to outweigh best judgment thereby creating an excessively costly product. - 68	.19	.28	.53

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00			OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
35	Applied initiative and creative analysis to an engineering problem and developed adequate design parameters.	+ 74	.51	.34	.14
36	Produced an efficient, workable design within budget and schedule constraints.	+ 70	.51	.33	.16
37	Selected a number of unproven and unreliable components in an effort to economize on material cost.	- 90	.14	.27	.59
38	Assumed responsibility for a floundering project and, with much personal effort, got it back on the track.	+116	.66	.26	.08
39	Obviously worked on non-company work during working hours.	- 92	.14	.26	.60
40	Essentially wasted three months of engineering effort.	-126	.09	.19	.72
41	Did a sloppy and careless job in a field that he was uniquely qualified.	-122	.09	.21	.70
42	Established reasonable justification for past poor progress and results and convinced customer that problems could be resolved in a timely fashion.	+ 92	.57	.32	.11
43	Recommended that analysis be performed using an inadequate computer routine.	- 54	.22	.29	.49
44	Left on vacation without adequate carry-over notes.	- 90	.14	.27	.59
45	Assumed authority that had not been delegated to him and approved controversial report while supervisor was on vacation.	+ 24	.41	.30	.29

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER.

REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00

		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
46	Strained interface working relationships unnecessarily by assuming authority that had not been delegated. - 56	.18	.37	.46
47	Tackled a problem "cold," did necessary research quickly and issued report promptly. +108	.62	.30	.08
48	Suggested the group have an outside social event to restore a faltering morale. + 8	.32	.40	.28
49	Arrived at customer's facility intoxicated and belligerent. -142	.07	.16	.78
50	With minimal change significantly reduced complexity of original design. + 90	.56	.33	.11
51	Was unable to adapt self to highly authoritarian supervisor in another area. + 6	.39	.26	.36
52	Functioned primarily as an individualist, rather than as a team member with a common goal. - 28	.28	.30	.42
53	Developed detailed procedures for checking the accuracy of a software system. + 74	.51	.34	.14
54	While unfamiliar with the simulation technique, formulated the problem and developed computer presentation resolving the problem. + 98	.59	.31	.10
55	Because of inadequate preparation, gave incorrect impression during view graph presentation that he did not know his subject. - 96	.13	.26	.61
56	Just prior to a major test, discovered vendor's omission of a significant part of their product. + 64	.48	.37	.16

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00			OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
57	Failed to determine that a design deficiency existed which led to a test failure.	- 54	.22	.29	.49
58	Wasted an excessive amount of time during a design analysis.	-106	.11	.24	.64
59	Contributed much free overtime and made excellent use of available time to get a report out promptly.	+108	.62	.30	.08
60	Surprised many with highly innovative approach to a design problem.	+ 14	.40	.27	.33
61	Unable to accept criticism on a project that was not going well; became overly defensive.	- 66	.19	.29	.52
62	Designed, organized, and was responsible for a large test program that turned out to be successful.	+104	.60	.32	.08
63	Became angered when requested to go through supervisory channels.	-110	.12	.21	.67
64	Chose to design to the "latest-state-of-the-art" when an equally satisfactory but simpler and less costly design was available.	- 72	.17	.30	.53
65	Took over tasks of an absent colleague satisfactorily and with minimum indoctrination.	+ 74	.51	.34	.14
66	Highly innovative in solving an engineering problem.	+106	.62	.29	.09
67	Failed to properly analyze a design which resulted in delay and increased cost.	-100	.12	.26	.62
68	Innovative to extent of having a patent disclosure or a patent issued because of his work.	+ 94	.57	.33	.10

	AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00	OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
69	Planned, scheduled, budgeted and led a large design development project. +112	.63	.30	.07
70	Displayed poor judgment in accepting an unrealistic project schedule.- 88	.16	.24	.60
71	Knowingly proposed a test program that exceeded the maximum funding available. - 92	.14	.26	.60
72	Fitted in well with another group of engineers on an off-site assignment. + 48	.44	.36	.20
73	Through careful analysis, showed that what at first had appeared to be a serious product defect, turned out to be an inadvertent misuse.+ 58	.49	.31	.20
74	Failed to scope the work effort to the time and resources available. - 96	.12	.28	.60
75	Seemed unable to come to grips with the task and bring it to a successful completion. -108	.09	.28	.63
76	Demonstrated indecisiveness in that he could not make a needed decision without an excessive amount of detailed substantiation. - 94	.13	.27	.60
77	Outside of own Specialty, offered highly constructive suggestion to improve quality and reduce cost at same time. +110	.63	.29	.08
78	Refused to assist colleague who was having technical difficulties. -114	.10	.23	.67
79	During a product evaluation, suspected a serious deficiency and required additional studies which eventually verified his earlier suspicion. Was properly persistent. + 98	.59	.31	.10

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80	Became interested in another program and did not complete own work on schedule. -100	.12	.26	.62
81	Wrote his report so poorly that it had to be redone. -112	.10	.24	.66
82	Worked too slow; did not complete assigned task on time. -118	.09	.23	.68
83	Reviewed system test procedures and identified areas that needed improvement. + 64	.48	.37	.16
84	Uniquely broke down a new design into critical components so that meaningful requirements could be specified for other disciplines. + 80	.53	.33	.13
85	Overgeneralized design parameters thus specifying inadequate design conditions. - 90	.13	.29	.58
86	Talked down to the customer, giving impression that customer would not understand what had been done. - 96	.13	.26	.61
87	Obtained necessary data for definition of new product. + 68	.48	.38	.14
88	Formulated detailed R & D plans including customer contacts and schedule. +100	.59	.32	.09
89	Was defensive and slow in answering customer's critique of his earlier report. -102	.11	.27	.62
90	Designed a very complex piece of equipment which included components foreign to his normal skill area. +108	.62	.30	.08
91	While normally very thorough, designed an actuation system without considering one of the key parameters. - 94	.12	.29	.59

#	AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
92	Did not take appropriate action to correct a problem wherein a new product did not fit properly.	-102	.10	.29	.61
93	Designed a minor but new system and followed up to insure that it functioned properly.	+ 70	.49	.37	.14
94	Designed a relatively complex and large aircraft system in a highly successful manner.	+126	.67	.29	.04
95	Failed to accept proper responsibility for failure of an outside purchased part. Took passive role in trying to resolve problem.	-106	.10	.27	.63
96	Highly innovative in that he developed a new method of making test measurements.	+112	.64	.28	.08
97	Prepared engineering report including appropriate data but with little or no analysis.	- 52	.22	.30	.48
98	On an off-site program, did only as he was told and made no effort to communicate back to his home supervisor.	-124	.08	.22	.70
99	In a brainstorming session, was overly cynical, generally rejecting all suggestions.	-128	.07	.22	.71
100	Prepared a test report and other documents which were well researched, complete, and timely.	+104	.60	.32	.08
101	In a behind schedule situation on an off-site assignment, inspired customer's engineers so that they completed the program on schedule.	+110	.64	.27	.09

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102	Downgraded colleague's ideas because colleague had not been directly involved in the project. -112	.10	.24	.66
103	Redesigned a critically overweight component and developed a new satisfactory design much less costly to produce and lighter than anticipated. + 88	.56	.32	.12
104	Became intrigued with an overly complex design and released it for production without properly considering simpler alternates. - 72	.14	.36	.50
105	Became overly argumentative for extra time and budget which clearly were not available. - 86	.16	.26	.59
106	Vacillated badly in converging systems options and presenting available data for management decision. - 96	.11	.30	.59
107	Performed a timely systems analysis, established design requirements, and selected components to meet those requirements. + 86	.54	.34	.11
108	Successfully implemented a new technical management system in a field wherein we were quite inexperienced. + 94	.57	.33	.10
109	Accepted direction through improper channels and produced a design which had to be abandoned and redone. - 88	.16	.24	.60
110	Developed a new method to test aircraft equipment using a feedback from the equipment itself. + 94	.58	.31	.11
111	Specified a new and expensive piece of test equipment when equipment on hand would do the job. -102	.12	.24	.63

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112	In preparing a report, collected wrong data, interpreted it erroneously and submitted it in an incorrect format.	-154	.02	.19	.79
113	During routine investigation, recognized a serious production defect and took necessary action to correct the situation.	+ 98	.59	.31	.10
114	Clarified a confusing technical issue, much improving both the customer's and our own understanding of the problem.	+ 94	.57	.33	.10
115	Prepared and submitted data at quitting time. Feeling task complete, took next day off. However, data was not in usable format and since engineer was not available, unacceptable delay resulted.	-104	.12	.23	.64
116	Innovative in that he thought of a way to obtain data on a system test without having to spend capital equipment dollars.	+ 98	.61	.27	.12
117	Became angered at his lead engineer and told supervisor that he would no longer work on that task.	-104	.11	.26	.63
118	Went to sleep on the job.	-124	.09	.20	.71
119	So impressed customer with his efforts during a critical test program that customer wrote commendation letter.	+120	.68	.24	.08
120	Did an outstanding job of substituting for supervisor while supervisor was on vacation.	+106	.61	.31	.08
121	Did a mediocre job; much below his known capabilities.	-110	.11	.23	.66

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122	In a new field and in a minimal time designed a complex system, had it installed, and it worked properly the first time.	+116	.66	.27	.08
123	Developed, prepared, and presented an excellent engineering paper at an International Symposium.	+110	.62	.31	.07
124	Produced incorrect data because he did not follow written instructions furnished.	-112	.10	.24	.66
125	Allowed self to be used as a high level clerk instead of getting into the technical aspects of the investigation.	-122	.08	.23	.69
126	Allowed self to become overly influenced by supplier to the extent that his judgment was impaired and a wrong decision made.	-106	.11	.24	.64
127	Coordinated fabrication and test of model in a minimum of time and effort.	+ 78	.53	.32	.14
128	Developed a unique data processing hardware solution establishing self as expert in this field in eyes of customer.	+116	.64	.30	.06
129	Used trial and error technique rather than analytical engineering approach.	-100	.12	.26	.62
130	Developed a new technique to speed up data processing.	+ 90	.57	.31	.12
131	Failed to join analytical methods for smooth transition from one step to the next.	- 94	.13	.27	.60

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132	Directed efforts of several colleagues, coordinated inputs and trade studies, and skillfully prepared an outstanding compliance report. +110	.63	.29	.08
133	Poorly organized data and results for an R & D project report. -120	.08	.24	.68
134	Procrastinated in making comparative analysis because he felt the request was stupid and the results obvious. -104	.12	.23	.64
135	Displayed high degree of initiative in researching basic theory and experimental techniques which resulted in him developing a unique approach to analyzing experimental results. +114	.64	.29	.07
136	Through his customer contacts, obtained contract work to keep a design team busy for many months. +112	.62	.32	.06
137	When the priority level on his project was lowered, his leadership became poor and he lost his initiative. - 58	.21	.29	.50
138	Because of inadequate technical knowledge, permitted inaccurate and incomplete work to slip through. -126	.08	.21	.71
139	Neglected a project so much that it had to be reassigned to another engineer who, by then, could not complete it on time. -144	.04	.20	.76
140	On his own initiative, procured a computer routine from outside sources and adapted the program to our problem. +108	.63	.28	.09

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER.

REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00

		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
141	Allowed a colleague to improperly extrapolate data he was responsible for. This resulted in an incorrect specification. -104	.11	.26	.63
142	Evaluated and selected a vendor who, when called in to negotiate, admitted that his system would not work. -120	.08	.24	.68
143	Did excellent job of collecting test requirements and executing test on a new program while continuing his regularly assigned duties satisfactorily. +102	.61	.29	.10
144	Contributed many free overtime hours and days to insure that a test program on a new and complex system was properly coordinated so as to insure successful testing. + 88	.57	.30	.13
145	Strong proponent of NIH syndrome; if it wasn't invented here, it can't be any good. -102	.12	.24	.63
146	In a packaging design problem, made no attempt to minimize number of components. -120	.08	.24	.68
147	With necessary data unavailable, on his own, developed and collected information needed to complete his design in a timely fashion. +106	.61	.31	.08
148	Solved a complicated design problem on paper, proving his concept without necessity of producing hardware. +100	.59	.32	.09
149	Given the observed test data, was unable to satisfactorily present it to his colleagues. - 96	.13	.26	.61

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150	On a 3-month special off-site assignment, not only did assigned task well but was commended for extra efforts he cheerfully made. + 98	.59	.31	.10
151	Assumed his design would be strong enough without analysis. It wasn't and had to be redone. -112	.10	.24	.66
152	Required an abnormal amount of supervision in order to accomplish a normal task. -132	.06	.22	.72
153	Completed the design of a new product in less time and with much less supervision than was expected. + 84	.56	.30	.14
154	Readily adapted himself to an unusual quantity of design changes given to him. + 94	.58	.31	.11
155	Prepared and released a design with inadequate manufacturing information in it. -106	.11	.24	.64
156	Analyzed customer's requirements and conceived a completely unique product. +108	.63	.28	.09
157	Adopted a negative attitude with regard to product performance on a new proposal. -110	.11	.23	.66
158	Did a poor job in organizing a rather routine engineering report. -120	.09	.22	.69
159	In a rush proposal effort, unexpectedly took responsibility and did a task well. + 88	.56	.32	.12
160	Significantly improved harmony within the group by initiating and following through with much needed communications. + 94	.58	.31	.11

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
161	Reported a project as having met a checkpoint when, in fact, it had not. -128	.08	.20	.72
162	Showed great reluctance to work overtime even though colleagues did work overtime and overtime was necessary to complete work on time. -114	.10	.23	.67
163	Used assertive attitude and prevailed on friends for help in acquiring a much needed product in one-half the usual time. +112	.63	.30	.07
164	With only one day advance notice, pulled together necessary data and made a good presentation to the customer. +118	.66	.28	.07
165	In a large project requiring much coordination, became overly possessive and highly defensive of his contribution thus delaying project completion. -102	.12	.24	.63
166	On own initiative devised a new work task and sold it to the customer. + 98	.58	.33	.09
167	Repeated a rumor that a specific colleague was to be terminated thus causing a moral problem. - 92	.14	.26	.60
168	Disassembled a part without taking proper safety precautions; an accident occurred, ruining the part. -108	.12	.22	.66
169	Without even fully understanding the problem, discovered an obscure discrepancy and insisted that it be fixed. The man was correct. + 80	.53	.33	.13
170	On an off-site demonstration was able to successfully troubleshoot all problems, despite a limited exposure to some elements of the system. + 92	.56	.34	.10

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER.

REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00

		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
171	Appeared slovenly and unkempt at a design review with the customer.- 98	.13	.24	.62
172	Adopted a superior attitude toward customer during a design review thus eliminating his effectiveness. - 96	.14	.23	.62
173	Because of his expertise, was assigned key position on new project. This engineer, however, took it as a personal affront and developed a negative attitude on the new project. - 98	.14	.22	.63
174	Was unable to limit scope of task to available budget. - 92	.13	.28	.59
175	Worked on his own to develop understanding of computer aided engineering. + 86	.54	.34	.11
176	Because of his normal approach, slow but sure, became an excellent instructor for customer's relatively low skill level people. + 48	.43	.38	.19
177	Used an overly sophisticated and risky engineering technique because it appeared interesting. A simple, straightforward approach would have been better and less costly. - 92	.13	.28	.59
178	When the responsible colleague disclaimed any responsibility for an unfortunate test result, this engineer took initiative to satisfactorily resolve the problem. +104	.62	.28	.10
179	Presented inaccurate set of data for management consideration. -116	.09	.24	.67
180	Prepared and presented a comprehensive comparison of competitive products so that management was able to assess the risks involved. + 96	.59	.30	.11

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181	Overlooked effect on center of gravity of vehicle when deleting a large component. -114	.10	.23	.67
182	Prepared and submitted a statement of work which inadequately described the scope of work to be done. - 94	.13	.27	.60
183	Failed to properly coordinate his planned work with his supervisor. - 78	.17	.28	.56
184	Performed poorly on a proposal effort. Was inadequately prepared and his report was unacceptable technically. -134	.06	.21	.73
185	Did outstanding job in accepting full responsibility for submitting a new equipment proposal to the customer. +108	.63	.28	.09
186	Failed to properly coach a junior colleague who obviously did not understand the problem being worked on. -86	.16	.26	.59
187	Despite being unable to resolve them himself, did not make his supervisor aware of technical problems he encountered. -114	.10	.23	.67
188	Became interested in a particular project and, on his own time, wrote it up and had it accepted for publication in a professional journal. +104	.61	.30	.09
189	Insisted on developing a new program manually even when it became obvious that he should have made use of computer assistance. - 94	.13	.27	.60
190	Embarrassed a colleague publicly by adopting a know-it-all manner. -102	.13	.22	.64

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191	Did not thoroughly analyze available data which resulted in false proposal documentation. -114	.09	.26	.66
192	In a study project wherein he was NOT involved, reviewed methodology on his own and made several worthwhile and constructive suggestions which were adopted. +102	.59	.33	.08
193	Could not be bothered with filling out the necessary paperwork to provide others with the status of his work. - 96	.13	.26	.61
194	Pursued own incorrect arguments beyond the point of reasonableness. -132	.07	.20	.73
195	While unfamiliar with a new technology in which he suddenly found himself, educated himself so that he could respond properly and in a timely manner. +104	.61	.30	.09
196	Submitted a lengthy report in which the recommendations could not be justified by the data in the report. -116	.09	.24	.67
197	Despite many years' experience, made many major engineering errors in a project he was assigned. -128	.07	.22	.71
198	Became disinterested in assignment and took far too much time to complete it. - 98	.13	.24	.62
199	Was highly creative and successfully extended the state of the art in his specific expertise. +110	.63	.29	.08
200	Became overly friendly with one vendor and accepted an inferior product. -130	.08	.19	.73

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER.

REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00

		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
201	Carelessly approved completed engineering which later turned out to have contained many errors in it. -106	.11	.24	.64
202	Found a flaw in a published method of analysis. Developed own model and convinced management of the greater validity of his method. Later successfully proved his concept by test. +122	.67	.28	.06
203	Blindly followed a previous analysis without compensating for known differences in the component. -118	.09	.23	.68
204	Despite customer's expertise in this field, discovered significant error in customer furnished data which had been overlooked for several years. + 98	.59	.31	.10
205	Became inattentive while monitoring a test and allowed the test equipment itself to fail. -108	.12	.22	.66
206	Was able to find and repair a malfunction in a product not normally considered repairable. + 78	.52	.34	.13
207	Established a check-off procedure for a technical performance test that was so complete that it prevented probable human error. +106	.62	.29	.09
208	Presented a poor image to customer because of "blowing his cool" during a negotiating conference. -116	.11	.20	.69
209	Adapted readily to a new and unfamiliar technology. +106	.60	.33	.07
210	Was not capable of branching out and accepting new assigned responsibility. -120	.09	.22	.69

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
211	Was unable to properly delegate and as a result found himself unable to keep track of his own project. - 84	.14	.30	.56
212	Repeatedly obtained top performance from subordinates by emphasizing their contributions to the project. +106	.62	.29	.09
213	On a routine project spent too much time doing research rather than getting on with the problem. - 66	.20	.27	.53
214	Sarcastic manner significantly reduced his professional effectiveness. - 96	.12	.28	.60
215	Developed a unique "responsibility matrix" that identified each objective with the responsible engineer. + 86	.56	.31	.13
216	Obviously showed little interest in subordinate development. Viewed younger colleagues as threats to own security. -106	.10	.27	.63
217	Developed design that was ambiguous. Was misunderstood by manufacturer and parts would not fit. -106	.11	.24	.64
218	Developed a distinctly new and novel shop process for a material that had been previously thought not adaptable to this process. Much money was saved and additional flexibility provided. +104	.62	.28	.10
219	Materially falsified his expense account by claiming expenses that were never incurred. -114	.09	.26	.66
220	Placed Vought in a bad light with customer by agreeing with and magnifying original customer complaint. -118	.08	.26	.67

AS AN ENGINEERING SUPERVISOR, PLEASE ESTIMATE THE PROBABILITY OF EACH INCIDENT LISTED HEREIN AS BEING TYPICAL OF THE DESCRIBED ENGINEER. REMEMBER, THE COMBINED PROBABILITIES FOR EACH INCIDENT MUST TOTAL 1.00		OUTSTANDING, HIGHLY EFFECTIVE ENGINEER	AVERAGE ENGINEER	LEAST EFFECTIVE ENGINEER
221	After completing required analysis on product, further refined his approach so that it became a general solution rather than a specific one. + 84	.54	.33	.12
222	In a negotiating conference, conceded several major points, getting nothing in return. Was later repudiated by supervisor. -116	.10	.22	.68
223	Cheerfully accepted suggestions as to how he might become more productive. Then became more productive. + 94	.57	.33	.10
224	Took too many untried shortcuts which severely limited his effectiveness. -100	.12	.26	.62
225	Insisted on acquiring a new and expensive piece of capital equipment that was not necessary to accomplish the task on hand. -108	.10	.26	.64
226	Reduced morale and effectiveness of his colleagues by issuing ultimatums that could not be backed up. -126	.09	.19	.72

APPENDIX C

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
1	Uncovered major discrepancy in the way data was presented and used and corrected same.	+14				2	6
2	Questioned key assumptions made by others prior to his being assigned the task.	+ 5		1	2	4	1
3	Proceeded with calculations using various assumed conditions instead of using constant conditions.	- 4		4	4		
4	Grumbled and complained, much reducing own effectiveness.	-16	8				
5	Determined that previous work was erroneous; then took responsibility for making necessary engineering changes.	+16					8
6	Developed innovative design and coordinated his approach with potential supplier.	+15				1	7
7	Presented ideas which were limited in scope and not very imaginative.	-12	4	4			
8	Tended to coast and not look around for work that needed to be done.	-15	7	1			
9	Developed a new and innovative procedure in a field with few if any precedents.	+16					8
10	Did not adjust self to temperamental ways of colleague.	- 5	1	3	4		
11	Did not exercise proper precautions to insure correct instrumentation during a test program.	-14	6	2			
12	Developed a test program which satisfactorily met requirements on time and within budgets.	+13			1	1	6

No.	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
13	Developed a new type of probability analysis for design evaluation.	+13			1	1	6
14	Was quick to grasp a new and difficult computer concept to which he had never been previously exposed.	+13				3	5
15	Failed to complete requested forms in a timely fashion claiming instead that he was too busy with more important things.	- 9	2	5	1		
16	During a busy period, engaged in much casual conversation which lowered his and his colleagues' productivity.	-16	8				
17	Volunteered to help and provide leadership in a neighborhood youth organization.	+ 6			3	4	1
18	Cleverly reversed a design concept that resulted in proper functioning with very little extra cost.	+15				1	7
19	Tried to commit too many details to memory and omitted an important point in the report.	-13	5	3			
20	Anticipated a problem before it happened and developed, on his own time, a suitable replacement for the questionable part.	+14				2	6
21	Changed an existing design for primarily cosmetic reasons.	- 8	2	4	2		
22	Made correct design decision but forgot to coordinate the change with interfacing departments.	-10	2	6			
23	Anticipated a material shortage and initiated early procurement action.	+ 9			2	3	3

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
24	Justified a cost estimate that had previously been submitted in a situation where no backup data were available.	+ 8			3	2	3
25	Got himself too involved in work he had previously delegated to colleagues.	- 9	2	5	1		
26	Thoroughly researched a developmental effort and well documented the results.	+10			1	4	3
27	Ignored supervisor's suggestions in preparing an R & D proposal.	-11	3	5			
28	Demonstrated lack of basic knowledge in an area wherein he had many years of exposure.	-16	8				
29	With very little supervision, quickly researched and developed a system to aid in troubleshooting a manufactured part.	+13			1	1	6
30	Modified existing computer model and performed analysis with documentation on a developmental program.	+11			1	3	4
31	Poorly organized his planning effort which resulted in excessive hours being spent on the project.	-15	7	1			
32	Volunteered to go off-site to a subcontractor's plant to assist him in his design effort.	+ 5			5	1	2
33	Failed to inform superior of an impending engineering problem when it was first discovered.	-14	6	2			
34	Allowed his creative urges to outweigh best judgment thereby creating an excessively costly product.	-16	8				

No.	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
35	Applied initiative and creative analysis to an engineering problem and developed adequate design parameters.	+13			1	1	6
36	Produced an efficient, workable design within budget and schedule constraints.	+13			1	1	6
37	Selected a number of unproven and unreliable components in an effort to economize on material cost.	-12	6	1		1	
38	Assumed responsibility for another's floundering project and, with much personal effort, got it back on the track.	+16					8
39	Obviously worked on non company work during working hours.	-15	7	1			
40	Essentially wasted three months of engineering effort.	-14	7		1		
41	Did a sloppy and careless job in a field that he was uniquely qualified.	-16	8				
42	Established reasonable justification for past poor progress and results and convinced customer that problems could be resolved in a timely fashion.	+11				5	3
43	Recommended that analysis be performed using an inadequate computer routine.	-12	4	4			
44	Left on vacation without adequate carry-over notes.	-13	5	3			
45	Assumed authority that had not been delegated to him and approved controversial report while supervisor was on vacation.	-11	4	3	1		

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
46	Strained interface working relationships unnecessarily by assuming authority that had not been delegated.	-12	4	4			
47	Tackled a problem "cold," did necessary research quickly and issued report promptly.	+12				4	4
48	Suggested the group have an outside social event to restore a faltering morale.	+ 2		2	3	2	1
49	Arrived at customer's facility intoxicated and belligerent.	-16	8				
50	With minimal change significantly reduced complexity of original design.	+11			1	3	4
51	Was unable to adapt self to highly authoritarian supervisor in another area.	- 5	2	1	5		
52	Functioned primarily as an individualist, rather than as a team member with a common goal.	-12	4	4			
53	Developed detailed procedures for checking the accuracy of a software system.	+10				6	2
54	While unfamiliar with the simulation technique, formulated the problem and developed computer presentation resolving the problem.	+ 9			1	5	2
55	Because of inadequate preparation, gave incorrect impression during view graph presentation that he did not know his subject.	-16	8				
56	Just prior to a major test, discovered vendor's omission of a significant part of their product.	+13			1	1	6

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
57	Failed to determine that a design deficiency existed which led to a test failure.	-13	5	3			
58	Wasted an excessive amount of time during a design analysis.	-14	6	2			
59	Contributed much free overtime and made excellent use of available time to get a report out promptly.	+11			1	3	4
60	Surprised many with highly innovative approach to a design problem.	+13				3	5
61	Unable to accept criticism on a project that was not going well; became overly defensive.	-13	5	3			
62	Designed, organized, and was responsible for a large test program that turned out to be successful.	+16					8
63	Became angered when requested to go through supervisory channels.	-11	4	3	1		
64	Chose to design to the "latest-state-of-the-art" when an equally satisfactory but simpler and less costly design was available.	- 9	4	2	1	1	
65	Took over tasks of an absent colleague satisfactorily and with minimum indoctrination.	+ 9			1	5	2
66	Highly innovative in solving an engineering problem.	+11			2	1	5
67	Failed to properly analyze a design which resulted in delay and increased cost.	-15	7	1			
68	Innovative to extent of having a patent disclosure or a patent issued because of his work.	+15				1	7

No.	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?	DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
69	Planned, scheduled, budgeted and led a large design development project. +16					8
70	Displayed poor judgment in accepting an unrealistic project schedule. -13	5	3			
71	Knowingly proposed a test program that exceeded the maximum funding available. -11	4	3	1		
72	Fitted in well with another group of engineers on an off-site assignment. + 7			3	3	2
73	Through careful analysis, showed that what at first had appeared to be a serious product defect, turned out to be an inadvertent misuse. +10			1	4	3
74	Failed to scope the work effort to the time and resources available. -11	3	5			
75	Seemed unable to come to grips with the task and bring it to a successful completion. -15	7	1			
76	Demonstrated indecisiveness in that he could not make a needed decision without an excessive amount of detailed substantiation. -15	7	1			
77	Outside of own Specialty, offered highly constructive suggestion to improve quality and reduce cost at same time. +14				2	6
78	Refused to assist colleague who was having technical difficulties. -15	7	1			
79	During a product evaluation, suspected a serious deficiency and required additional studies which eventually verified his earlier suspicion. Was properly persistent. +11			1	3	4

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
80	Became interested in another program and did not complete own work on schedule.	-14	6	2			
81	Wrote his report so poorly that it had to be redone.	-15	7	1			
82	Worked too slow; did not complete assigned task on time.	-14	6	2			
83	Reviewed system test procedures and identified areas that needed improvement.	+ 6			3	4	1
84	Uniquely broke down a new design into critical components so that meaningful requirements could be specified for other disciplines.	+11			1	3	4
85	Overgeneralized design parameters thus specifying inadequate design conditions.	-16	8				
86	Talked down to the customer, giving impression that customer would not understand what had been done.	-16	8				
87	Obtained necessary data for definition of new product.	+ 7			2	5	1
88	Formulated detailed R & D plans including customer contacts and schedule.	+ 9			1	5	2
89	Was defensive and slow in answering customer's critique of his earlier report.	-13	5	3			
90	Designed a very complex piece of equipment which included components foreign to his normal skill area.	+12				4	4
91	While normally very thorough, designed an actuation system without considering one of the key parameters.	-14	6	2			

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
92	Did not take appropriate action to correct a problem wherein a new product did not fit properly.	-13	5	3			
93	Designed a minor but new system and followed up to insure that it functioned properly.	+ 8			3	2	3
94	Designed a relatively complex and large aircraft system in a highly successful manner.	+15				1	7
95	Failed to accept proper responsibility for failure of an outside purchased part. Took passive role in trying to resolve problem.	-15	7	1			
96	Highly innovative in that he developed a new method of making test measurements.	+12				4	4
97	Prepared engineering report including appropriate data but with little or no analysis.	-10	2	6			
98	On an off-site program, did only as he was told and made no effort to communicate back to his home supervisor.	-15	7	1			
99	In a brainstorming session, was overly cynical, generally rejecting all suggestions.	-13	5	3			
100	Prepared a test report and other documents which were well researched, complete, and timely.	+10			1	4	3
101	In a behind schedule situation on an off-site assignment, inspired customer's engineers so that they completed the program on schedule.	+14				2	6

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?	DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
102	Downgraded colleague's ideas <u>because</u> colleague had not been directly involved in the project. -15	7	1			
103	Redesigned a critically overweight component and developed a new satisfactory design much less costly to produce and lighter than anticipated. +14				2	6
104	Became intrigued with an overly complex design and released it for production without properly considering simpler alternates. -15	7	1			
105	Became overly argumentative for extra time and budget which clearly were not available. -10	3	4	1		
106	Vacillated badly in converging systems options and presenting available data for management decision. -15	7	1			
107	Performed a timely systems analysis, established design requirements, and selected components to meet those requirements. +11			1	3	4
108	Successfully implemented a new technical management system in a field wherein we were quite inexperienced. +13				3	5
109	Accepted direction through improper channels and produced a design which had to be abandoned and redone. -16	8				
110	Developed a new method to test aircraft equipment using a feedback from the equipment itself. +13				3	5
111	Specified a new and expensive piece of test equipment when equipment on hand would do the job. -16	8				

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
112	In preparing a report, collected wrong data, interpreted it erroneously and submitted it in an incorrect format.	-16	8				
113	During routine investigation, recognized a serious production defect and took necessary action to correct the situation.	+10			1	4	3
114	Clarified a confusing technical issue, much improving both the customer's and our own understanding of the problem.	+11			1	3	4
115	Prepared and submitted data at quitting time. Feeling task complete, took next day off. However, data was not in usable format and since engineer was not available, unacceptable delay resulted.	-14	6	2			
116	Innovative in that he thought of a way to obtain data on a system test without having to spend capital equipment dollars.	+13				3	5
117	Became angered at his lead engineer and told supervisor that he would no longer work on that task.	-15	7	1			
118	Went to sleep on the job.	-16	8				
119	So impressed customer with his efforts during a critical test program that customer wrote commendation letter.	+14				2	6
120	Did an outstanding job of substituting for supervisor while supervisor was on vacation.	+10			2	2	4
121	Did a mediocre job; much below his known capabilities.	-15	7	1			

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
122	In a new field and in a minimal time designed a complex system, had it installed, and it worked properly the first time.	+15				1	7
123	Developed, prepared, and presented an excellent engineering paper at an International Symposium.	+12				4	4
124	Produced incorrect data because he did not follow written instructions furnished.	-16	8				
125	Allowed self to be used as a high level clerk instead of getting into the technical aspects of the investigation.	-16	8				
126	Allowed self to become overly influenced by supplier to the extent that his judgment was impaired and a wrong decision made.	-16	8				
127	Coordinated fabrication and test of model in a minimum of time and effort.	+10			2	2	4
128	Developed a unique data processing hardware solution establishing self as expert in this field in eyes of customer.	+14				2	6
129	Used trial and error technique rather than analytical engineering approach.	- 9	2	5	1		
130	Developed a new technique to speed up data processing.	+14				2	6
131	Failed to join analytical methods for smooth transition from one step to the next.	-13	5	3			

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
132	Directed efforts of several colleagues, coordinated inputs and trade studies, and skillfully prepared an outstanding compliance report.	+15				1	7
133	Poorly organized data and results for an R & D project report.	-15	7	1			
134	Procrastinated in making comparative analysis because he felt the request was stupid and the results obvious.	-14	6	2			
135	Displayed high degree of initiative in researching basic theory and experimental techniques which resulted in him developing a unique approach to analyzing experimental results.	+13				3	5
136	Through his customer contacts, obtained contract work to keep a design team busy for many months.	+16					8
137	When the priority level on his project was lowered, his leadership became poor and he lost his initiative.	-16	8				
138	Because of inadequate technical knowledge, permitted inaccurate and incomplete work to slip through.	-15	7	1			
139	Neglected a project so much that it had to be reassigned to another engineer who, by then, could not complete it on time.	-16	8				
140	On his own initiative, procured a computer routine from outside sources and adapted the program to our problem.	+13				3	5

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
141	Allowed a colleague to improperly extrapolate data he was responsible for. This resulted in an incorrect specification.	-15	7	1			
142	Evaluated and selected a vendor who, when called in to negotiate, admitted that his system would <u>not</u> work.	-14	6	2			
143	Did excellent job of collecting test requirements and executing test on a new program while continuing his regularly assigned duties satisfactorily.	+12			1	2	5
144	Contributed many free overtime hours and days to insure that a test program on a new and complex system was properly coordinated so as to insure successful testing.	+ 9		1		4	3
145	Strong proponent of NIH syndrome; if it wasn't invented here, it can't be any good.	-15	7	1			
146	In a packaging design problem, made no attempt to minimize number of components.	-14	6	2			
147	With necessary data unavailable, on his own, developed and collected information needed to complete his design in a timely fashion.	+14				2	6
148	Solved a complicated design problem on paper, proving his concept without necessity of producing hardware.	+14				2	6
149	Given the observed test data, was unable to satisfactorily present it to his colleagues.	-12	4	4			

AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?

		DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
150	On a 3-month special off-site assignment, not only did assigned task well but was commended for extra efforts he cheerfully made. +14				2	6
151	Assumed his design would be strong enough without analysis. It wasn't and had to be redone. -16	8				
152	Required an abnormal amount of supervision in order to accomplish a normal task. -16	8				
153	Completed the design of a new product in less time and with much less supervision than was expected. +15				1	7
154	Readily adapted himself to an unusual quantity of design changes given to him. +10			1	4	3
155	Prepared and released a design with inadequate manufacturing information in it. -14	6	2			
156	Analyzed customer's requirements and conceived a completely unique product. +12				4	4
157	Adopted a negative attitude with regard to product performance on a new proposal. -14	6	2			
158	Did a poor job in organizing a rather routine engineering report. -16	8				
159	In a rush proposal effort, unexpectedly took responsibility and did a task well. +12				4	4
160	Significantly improved harmony within the group by initiating and following through with much needed communications. +13				3	5

AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?

			DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
			-2	-1	0	+1	+2
161	Reported a project as having met a checkpoint when, in fact, it had not.	-14	6	2			
162	Showed great reluctance to work overtime even though colleagues did work overtime and overtime was necessary to complete work on time.	-14	6	2			
163	Used assertive attitude and prevailed on friends for help in acquiring a much needed product in one-half the usual time.	+ 5		2	1	3	2
164	With only one day advance notice, pulled together necessary data and made a good presentation to the customer.	+13			1	1	6
165	In a large project requiring much coordination, became overly possessive and highly defensive of his contribution thus delaying project completion.	-15	7	1			
166	On own initiative devised a new work task and sold it to the customer.	+15				1	7
167	Repeated a rumor that a specific colleague was to be terminated thus causing a morale problem.	- 9	2	5	1		
168	Disassembled a part without taking proper safety precautions; an accident occurred, ruining the part.	-14	6	2			
169	Without even fully understanding the problem, discovered an obscure discrepancy and insisted that it be fixed. The man was correct.	+ 5		1	1	6	
170	On an off-site demonstration was able to successfully troubleshoot all problems, despite a limited exposure to some elements of the system.	+12				4	4

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?	DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
		-2	-1	0	+1	+2
171	Appeared slovenly and unkempt at a design review with the customer. -16	8				
172	Adopted a superior attitude toward customer during a design review thus eliminating his effectiveness. -16	8				
173	Because of his expertise, was assigned key position on new project. This engineer, however, took it as a personal affront and developed a negative attitude on the new project. -16	8				
174	Was unable to limit scope of task to available budget. -11	3	5			
175	Worked on his own to develop understanding of computer aided engineering. + 9			2	3	3
176	Because of his normal approach, slow but sure, became an excellent instructor for customer's relatively low skill level people. + 5	1		2	3	2
177	Used an overly sophisticated and risky engineering technique because it appeared interesting. A simple, straightforward approach would have been better and less costly. -14	6	2			
178	When the responsible colleague disclaimed any responsibility for an unfortunate test result, this engineer took initiative to satisfactorily resolve the problem. + 9			2	3	3
179	Presented inaccurate set of data for management consideration. -16	8				
180	Prepared and presented a comprehensive comparison of competitive products so that management was able to assess the risks involved. +13			1	1	6

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
181	Overlooked effect on center of gravity of vehicle when deleting a large component.	-14	6	2			
182	Prepared and submitted a statement of work which inadequately described the scope of work to be done.	-13	5	3			
183	Failed to properly coordinate his planned work with his supervisor.	-13	5	3			
184	Performed poorly on a proposal effort. Was inadequately prepared and his report was unacceptable technically.	-16	8				
185	Did outstanding job in accepting full responsibility for submitting a new equipment proposal to the customer.	+13			1	1	6
186	Failed to properly coach a junior colleague who obviously did not understand the problem being worked on.	-13	5	3			
187	Despite being unable to resolve them himself, did not make his supervisor aware of technical problems he encountered.	-15	7	1			
188	Became interested in a particular project and, on his own time, wrote it up and had it accepted for publication in a professional journal.	+11		1		2	5
189	Insisted on developing a new program manually even when it became obvious that he should have made use of computer assistance.	-13	5	3			
190	Embarrassed a colleague publicly by adopting a know-it-all manner.	-14	6	2			

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?		DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
191	Did not thoroughly analyze available data which resulted in false proposal documentation.	-16	8				
192	In a study project wherein he was NOT involved, reviewed methodology on his own and made several worthwhile and constructive suggestions which were adopted.	+11				5	3
193	Could not be bothered with filling out the necessary paperwork to provide others with the status of his work.	-13	5	3			
194	Pursued own incorrect arguments beyond the point of reasonableness.	-16	8				
195	While unfamiliar with a new technology in which he suddenly found himself, educated himself so that he could respond properly and in a timely manner.	+10			2	2	4
196	Submitted a lengthy report in which the recommendations could <u>not</u> be justified by the data in the report.	-16	8				
197	Despite many years' experience, made many major engineering errors in a project he was assigned.	-16	8				
198	Became disinterested in assignment and took far too much time to complete it.	-15	7	1			
199	Was highly creative and successfully extended the state of the art in his specific expertise.	+14				2	6
200	Became overly friendly with one vendor and accepted an inferior product.	-16	8				

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?	DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
201	Carelessly approved completed engineering which later turned out to have contained many errors in it. -15	7	1			
202	Found a flaw in a published method of analysis. Developed own model and convinced management of the greater validity of his method. Later successfully proved his concept by test. +15				1	7
203	Blindly followed a previous analysis without compensating for known differences in the component. -16	8				
204	Despite customer's expertise in this field, discovered significant error in customer furnished data which had been overlooked for several years. +15				1	7
205	Became inattentive while monitoring a test and allowed the test equipment itself to fail. -16	8				
206	Was able to find and repair a malfunction in a product not normally considered repairable. +14				2	5
207	Established a check-off procedure for a technical performance test that was so complete that it prevented probable human error. +13				3	5
208	Presented a poor image to customer because of "blowing his cool" during a negotiating conference. -14	6	2			
209	Adapted readily to a new and unfamiliar technology. +10			1	4	3
210	Was not capable of branching out and accepting new assigned responsibility. -16	8				

	AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?	DISLIKE VERY MUCH -2	DISLIKE SOME -1	IMMATERIAL 0	LIKE SOME +1	LIKE VERY MUCH +2
211	Was unable to properly delegate and as a result found himself unable to keep track of his own project. -15	7	1			
212	Repeatedly obtained top performance from subordinates by emphasizing their contributions to the project. +16					8
213	On a routine project spent too much time doing research rather than getting on with the problem. -13	5	3			
214	Sarcastic manner significantly reduced his professional effectiveness. -16	8				
215	Developed a unique "responsibility matrix" that identified each objective with the responsible engineer. +11			2	1	5
216	Obviously showed little interest in subordinate development. Viewed younger colleagues as threats to own security. -16	8				
217	Developed design that was ambiguous. Was misunderstood by manufacturer and parts would not fit. -16	8				
218	Developed a distinctly new and novel shop process for a material that had been previously thought not adaptable to this process. Much money was saved and additional flexibility provided. +15				1	7
219	Materially falsified his expense account by claiming expenses that were never incurred. -15	7	1			
220	Placed Vought in a bad light with customer by agreeing with and magnifying original customer complaint. -15	7	1			

AS A PRACTICING PROFESSIONAL ENGINEER, TO WHAT DEGREE WOULD YOU LIKE HAVING THIS INCIDENT ATTRIBUTED TO YOU PERSONALLY?

		DISLIKE VERY MUCH	DISLIKE SOME	IMMATERIAL	LIKE SOME	LIKE VERY MUCH
		-2	-1	0	+1	+2
221	After completing required analysis on product, further refined his approach so that it became a general solution rather than a specific one. + 9			3	1	4
222	In a negotiating conference, conceded several major points, getting nothing in return. Was later repudiated by supervisor. -16	8				
223	Cheerfully accepted suggestions as to how he might become more productive. Then became more productive. +11		1	1		6
224	Took too many untried shortcuts which severely limited his effectiveness. -15	7	1			
225	Insisted on acquiring a new and expensive piece of capital equipment that was not necessary to accomplish the task on hand. -14	6	2			
226	Reduced morale and effectiveness of his colleagues by issuing ultimatums that could not be backed up. -16	8				

APPENDIX D

GENERAL INSTRUCTIONS

Critical Incident-Forced Choice Ratings
as Applied to Professional Workers

We are trying to develop a new rating system for our engineering department. To the best of our knowledge, this approach represents a new concept which we expect will provide us with an objective merit rating tool. In this run, we need to validate both this approach and the applicability of the incidents cited. Therefore, this evaluation will be much more time-consuming than that which we expect to finally develop. Please bear with us and be assured that our final product will be <u>much</u> shorter.

The ground rules are quite simple. You will find a series of thirty tetrads, each consisting of four specific incidents which really happened in this department within the past year or so and which Vought Engineering Supervisors stated were critical to them.

In the first group of four incidents, circle the small letter (a, b, c, or d) which <u>you</u> believe <u>most</u> representative of the performance of the individual named. Label this circled letter "M." Then, in the <u>same group</u> of four incidents, circle another small letter which you believe most <u>unlike</u> the probable performance of the individual named. Label this circled letter "U." Repeat this process for each of the thirty sets of critical incidents.

Do not allow yourself to get hung up in the semantics involved or be concerned whether the individual named would really ever do or not do the incident described. This is a hypothetical situation and your best and careful judgments are needed.

Since this is a forced choice system, do not leave any tetrad incompleted. Two choices must be made out of each set of four critical incidents and labeled respectively "M" and "U." A full set of tetrads must be completed for each person rated.

We understand that this will not be an easy task. Yet, any well-prepared merit review does take a lot of thought and time. Hopefully, when completed, this system will be well worth the time and energy expended on it.

NAME________________________ SS#____________ UNIT__________

1.

a. In a behind schedule situation on an off-site assignment, inspired customer's engineers so that they completed the program on schedule.

b. Redesigned a critically overweight component and developed a new satisfactory design much less costly to produce and lighter than anticipated.

c. Found a flaw in a published method of analysis. Developed own model and convinced management of the greater validity of his method. Later successfully proved his concept by test.

d. Despite customer's expertise in this field, discovered significant error in customer furnished data which had been overlooked for several years.

2.

a. Presented ideas which were limited in scope and not very imaginative.

b. Changed an existing design for primarily cosmetic reasons.

c. Functioned primarily as an individualist, rather than as a team member with a common goal.

d. Knowingly proposed a test program that exceeded the maximum funding available.

3.

a. In a new field and in a minimal time designed a complex system, had it installed, and it worked properly the first time.

b. Anticipated a problem before it happened and developed, on his own time, a suitable replacement for the questionable part.

c. Was able to find and repair a malfunction in a product not normally considered repairable.

d. Developed a new and innovative procedure in a field with few if any precedents.

NAME________________________ SS#____________ UNIT__________

4.

a. Failed to scope the work effort to the time and resources available.

b. Recommended that analysis be performed using an inadequate computer routine.

c. Got himself too involved in work he had previously delegated to colleagues.

d. Became overly argumentative for extra time and budget which clearly were not available.

5.

a. Outside of own Specialty, offered highly constructive suggestion to improve quality and reduce cost at same time.

b. Solved a complicated design problem on paper, proving his concept without necessity of producing hardware.

c. Designed a relatively complex and large aircraft system in a highly successful manner.

d. Developed a new technique to speed up data processing.

6.

a. Prepared engineering report including appropriate data but with little or no analysis.

b. Chose to design to the "latest-state-of-the art" when an equally satisfactory but simpler and less costly design was available.

c. Assumed authority that had not been delegated to him and approved controversial report while supervisor was on vacation.

d. Repeated a rumor that a specific colleague was to be terminated thus causing a morale problem.

NAME____________________ SS#__________ UNIT__________

7.

a. Innovative to extent of having a patent disclosure or a patent issued because of his work.

b. Completed the design of a new product in less time and with much less supervision than was expected.

c. With necessary data unavailable, on his own, developed and collected information needed to complete his design in a timely fashion.

d. So impressed customer with his efforts during a critical test program that customer wrote commendation letter.

8.

a. Made correct design decision but forgot to coordinate the change with interfacing departments.

b. Ignored supervisor's suggestions in preparing an R & D proposal.

c. Was unable to limit scope of task to available budget.

d. Became angered when requested to go through supervisory channels.

9.

a. Developed a unique data processing hardware solution establishing self as expert in this field in eyes of customer.

b. Cleverly reversed a design concept that resulted in proper functioning with very little extra cost.

c. Was able to find and repair a malfunction in a product not normally considered repairable.

d. Determined that previous work was erroneous; then took responsibility for making necessary engineering changes.

NAME________________________ SS#____________ UNIT__________

10.

a. Strained interface working relationships unnecessarily by assuming authority that had not been delegated.

b. Failed to complete requested forms in a timely fashion claiming instead that he was too busy with more important things.

c. Selected a number of unproven and unreliable components in an effort to economize on material cost.

d. Used trial and error technique rather than analytical engineering approach.

11.

a. Just prior to a major test, discovered vendor's omission of a significant part of their product.

b. Designed a very complex piece of equipment which included components foreign to his normal skill area.

c. Modified existing computer model and performed analysis with documentation on a developmental program.

d. Significantly improved harmony within the group by initiating and following through with much needed communications.

12.

a. Worked too slow; did not complete assigned task on time.

b. Used an overly sophisticated and risky engineering technique because it appeared interesting. A simple, straightforward approach would have been better and less costly.

c. Tried to commit too many details to memory and omitted an important point in the report.

d. Was defensive and slow in answering customer's critique of his earlier report.

NAME________________________ SS#____________ UNIT__________

13.

a. Tackled a problem "cold," did necessary research quickly and issued report promptly.

b. Uniquely broke down a new design into critical components so that meaningful requirements could be specified for other disciplines.

c. Surprised many with highly innovative approach to a design problem.

d. Clarified a confusing technical issue, much improving both the customer's and our own understanding of the problem.

14.

a. Left on vacation without adequate carry-over notes.

b. Prepared and released a design with inadequate manufacturing information in it.

c. In a brainstorming session, was overly cynical, generally rejecting all suggestions.

d. Did not exercise proper precautions to insure correct instrumentation during a test program.

15.

a. During a product evaluation, suspected a serious deficiency and required additional studies which eventually verified his earlier suspicion. Was properly persistent.

b. Developed a new type of probability analysis for design evaluation.

c. Developed a test program which satisfactorily met requirements on time and within budgets.

d. Displayed high degree of initiative in researching basic theory and experimental techniques which resulted in him developing a unique approach to analyzing experimental results.

NAME________________________ SS#____________ UNIT__________

16.

a. Failed to determine that a design deficiency existed which led to a test failure.

b. Presented a poor image to customer because of "blowing his cool" during a negotiating conference.

c. Failed to properly coach a junior colleague who obviously did not understand the problem being worked on.

d. Became interested in another program and did not complete own work on schedule.

17.

a. With only one day's advance notice, pulled together necessary data and made a good presentation to the customer.

b. Innovative in that he thought of a way to obtain data on a system test without having to spend capital equipment dollars.

c. Applied initiative and creative analysis to an engineering problem and developed adequate design parameters.

d. Was quick to grasp a new and difficult computer concept to which he had never been previously exposed.

18.

a. On a routine project spent too much time doing research rather than getting on with the problem.

b. Insisted on developing a new program manually even when it became obvious that he should have made use of computer assistance.

c. Procrastinated in making comparative analysis because he felt the request was stupid and the results obvious.

d. In a packaging design problem, made no attempt to minimize number of components.

NAME________________________ SS#____________ UNIT__________

19.

a. Developed a unique "responsibility matrix" that identified each objective with the responsible engineer.

b. Produced an efficient, workable design within budget and schedule constraints.

c. Highly innovative in that he developed a new method of making test measurements.

d. Prepared and presented a comprehensive comparison of competitive products so that management was able to assess the risks involved.

20.

a. Displayed poor judgment in accepting an unrealistic project schedule.

b. Adopted a negative attitude with regard to product performance on a new proposal.

c. Evaluated and selected a vendor who, when called in to negotiate, admitted that his system would <u>not</u> work.

d. Failed to inform superior of an impending engineering problem when it was first discovered.

21.

a. Through careful analysis, showed that what at first had appeared to be a serious product defect, turned out to be an inadvertent misuse.

b. Coordinated fabrication and test of model in a minimum of time and effort.

c. While unfamiliar with a new technology in which he suddenly found himself, educated himself so that he could respond properly and in a timely manner.

d. Volunteered to help and provide leadership in neighborhood youth organization.

NAME________________________ SS#____________ UNIT__________

22.

a. Because of inadequate technical knowledge, permitted inaccurate and incomplete work to slip through.

b. Became angered at his lead engineer and told supervisor that he would no longer work on that task.

c. Demonstrated indecisiveness in that he could not make a needed decision without an excessive amount of detailed substantiation.

d. Refused to assist colleague who was having technical difficulties.

23.

a. Anticipated a material shortage and initiated early procurement action.

b. Did an outstanding job of substituting for supervisor while supervisor was on vacation.

c. Designed a minor but new system and followed up to insure that it functioned properly.

d. Readily adapted himself to an unusual quantity of design changes given to him.

24.

a. Did a mediocre job; much below his known capabilities.

b. Took too many untried shortcuts which severely limited his effectiveness.

c. Poorly organized data and results for an R & D project report.

d. Was unable to properly delegate and as a result found himself unable to keep track of his own project.

NAME________________________ SS#____________ UNIT__________

25.

a. Worked on his own to develop understanding of computer aided engineering.

b. Reviewed system test procedures and identified areas that needed improvement.

c. Prepared a test report and other documents which were well researched, complete, and timely.

d. Took over tasks of an absent colleague satisfactorily and with minimum indoctrination.

26.

a. In a large project requiring much coordination, became overly possessive and highly defensive of his contribution thus delaying project completion.

b. Tended to coast and not look around for work that needed to be done.

c. Downgraded colleague's ideas because colleague had not been directly involved in the project.

d. Poorly organized his planning effort which resulted in excessive hours being spent on the project.

27.

a. Fitted in well with another group of engineers on an off-site assignment.

b. Developed detailed procedures for checking the accuracy of a software system.

c. After completing required analysis on product, further refined his approach so that it became a general solution rather than a specific one.

d. When the responsible colleague disclaimed any responsibility for an unfortunate test result, this engineer took initiative to satisfactorily resolve the problem.

NAME________________________ SS#____________ UNIT__________

28.

a. Seemed unable to come to grips with the task and bring it to a successful completion.

b. Became intrigued with an overly complex design and released it for production without properly considering simpler alternates.

c. Became disinterested in assignment and took far too much time to complete it.

d. Placed Vought in a bad light with customer by agreeing with and magnifying original customer complaint.

29.

a. Adapted readily to a new and unfamiliar technology.

b. Justified a cost estimate that had previously been submitted in a situation where no backup data were available.

c. Contributed many free overtime hours and days to insure that a test program on a new and complex system was properly coordinated so as to insure successful testing.

d. Obtained necessary data for definition of new product.

30.

a. Strong proponent of NIH syndrome; if it wasn't invented here, it can't be any good.

b. Despite being unable to resolve them himself, did not make his supervisor aware of technical problems he encountered.

c. Obviously worked on non-company work during working hours.

d. On an off-site program, did only as he was told and made no effort to communicate back to his home supervisor.

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