Is Cost Accounting the Answer? Comparison of Two Behaviorally Based Methods for Estimating the Standard Deviation of Job Performance in Dollars With a Cost-Accounting-Based Approach

Olen L. Greer
Department of Accounting
Southwest Missouri State University

Wayne F. Cascio
Graduate School of Business and Administration
University of Colorado, Denver

Accurate estimation of the standard deviation of job performance in dollars ($SD_p$) can improve the precision of utility estimates of expected payoffs from personnel programs. The purpose of this study was to compare directly the estimates of $SD_p$ obtained using a cost-accounting-based estimate of $SD_p$, the Global Estimation Model, and the CREPID procedure. The study was conducted in a large, soft-drink bottling company. Each method for estimating $SD_p$ was applied to the job classification, route salesmen, producing three independent estimates of $SD_p$. These estimates were tested for significant differences. Results indicated that the Global Estimation Model estimate and the cost-accounting-based estimate were not significantly different, whereas the estimate produced by the CREPID procedure was significantly smaller. Limitations of the cost-accounting-based estimate are identified and results are discussed in terms of their implications for the theory and practice of utility analysis in organizations.

Utility analysis (or decision theory) is the determination of institutional gain or loss anticipated to result from various courses of action (Cascio, 1987a). The utility of a selection device is the degree to which its use improves the quality of the individuals selected, beyond what would have occurred had that device not been used (Blum & Naylor, 1968). A number of utility models have been proposed; the best known are those of Taylor and Russell (1939), Naylor and Shine (1965), Brogden (1949), and Cronbach and Gleser (1965). The Brogden-Cronbach-Gleser model is of particular interest, as it is the only model that incorporates the concept of cost of selection, or dollars gained or lost, into the utility index (Cascio, 1987b). This utility approach is intuitively appealing because outcomes are expressed in a form comprehended and appreciated at all levels of management: dollars. The Brogden-Cronbach-Gleser model expresses the utility index in the form of an increase (decrease) in the dollar payoff of the selected group.

Of the data requirements of this utility model, the standard deviation of job performance, $SD_p$, is the most difficult parameter to estimate. The difficulties associated with producing accurate estimates of $SD_p$ have long been the major impediment to the widespread implementation of the Brogden-Cronbach-Gleser model by personnel psychologists (Bobko, Karren, & Parkington, 1983; Burke & Frederick, 1984; Cascio, 1980; Schmidt, Hunter, McKenzie, & Muldrow, 1979; Schmidt, Mack, & Hunter, 1984; Weekley, Frank, O'Connor, & Peters, 1985). Three major approaches to the estimation of $SD_p$ have been advanced: the Global Estimation Model (Schmidt et al., 1979), the Cascio-Ramos estimate of performance in dollars (CREPID; Cascio, 1987b; Cascio & Ramos, 1986), and the cost-accounting approach (Roche, 1961). The first two approaches are behaviorally based, whereas Roche’s approach was based on the use of cost-accounting data. Note that Roche was a personnel psychologist working in an accounting arena, which resulted in his heavy reliance on the input of the firm’s accountants (Cronbach & Gleser, 1965). This introduces the possibility of contaminants, in the sense that a nonaccountant was working with data of which he had relatively little understanding. In addition, it may be (as Cronbach & Gleser pointed out) that the organization’s accountants did not clearly understand the problem, further complicating matters.

In spite of these and other criticisms of the study (e.g., Boudevau, 1983), a cost-accounting approach to the estimation of $SD_p$ remains as the conceptual standard of comparison (Cascio, 1987b), due to the fact that accounting data generally are objective, verifiable by a third-party observer, and subject to both internal and external audit (Bedford et al., 1966; Boatsman et al., 1977). However, the use of cost-accounting data to estimate $SD_p$ is both costly and time consuming (Cronbach & Gleser, 1965), inasmuch as the typical cost object is a unit of product, not human performance levels (Cherrington, Hubbard, & Luthy, 1985; Hornsgen, 1982). The cost object in Roche’s (1961) study was an individual worker’s performance level. For a cost-accounting system to provide a valid estimate of the cost of any cost object, it should be designed with that cost objective in mind. The cost objective and cost object were significantly different from the cost objectives and cost objects that the cost-accounting system was designed to accommodate. This led to many assumptions, estimates, and arbitrary allocations (Cronbach & Gleser, 1965).

Traditionally, cost-accounting systems have not established the individual’s worth as a cost object, although in the accounting field, human resource accounting (HRA) represents an at-
temp to do so. A review of the various HRA models is beyond the scope of this article; however, it is sufficient to point out that, at present, the HRA movement has run aground due to the difficulties associated with operationally defining a relatively soft concept: the value of the human worker (DeAngelo, 1982; Dittman, Juris, & Reiv�e, 1976, 1980). Thus, HRA research has failed to provide either an acceptable method for valuing the human asset as a balance-sheet item or for calculating or estimating the value of $SD_y$. As a result, the accounting systems of organizations remain ill equipped to provide cost data when worth of the human asset is involved. In fact, behavioral methods are more feasible to implement in business settings (Weekley et al., 1985) because (a) the methodology required to estimate $SD_y$, using either the Global Estimation or the CREPID models, is specified clearly, (b) these procedures can be applied without regard to the nature of the business (profit or nonprofit, service, merchandising, or manufacturing; etc.), and (c) these procedures can be applied without regard to the type of accounting or management information system used by the firm (e.g., standard cost system or normal cost system; computerized or manual; Reilly & Smith, 1985).

However, a fundamental concern related to both of these methodologies is the accuracy or validity of the estimates of $SD_y$ obtained (Reilly & Smith, 1985; Weekley et al., 1985). Numerous studies have examined and compared the results of alternative procedures for estimating $SD_y$ (Bobko et al., 1983; Burke & Frederick, 1984; Landy, Farr, & Jacobs, 1982; Reilly & Smith, 1985; Weekley et al., 1985). Bobko et al. (1983) compared estimates of $SD_y$ derived from using the Global Estimation Model (Schmidt et al., 1979) with actual standard deviations of performance measures. They found that the estimates were not statistically different from (and, in fact, were quite close to) the actual standard deviation. In addition, they found strong support for the assumption of underlying normality for the objective measure of job performance. Finally, they found that although supervisors tend to underestimate actual performance values, the effect of the underestimation was reduced substantially when the difference in percentiles (the 85th percentile minus the 50th percentile and the 50th percentile minus the 15th percentile) was computed to estimate $SD_y$. In summary, the Bobko et al. study provided evidence that estimation of $SD_y$ is not necessarily the Achilles' heel of utility analysis.

Two other studies (Reilly & Smith, 1985; Weekley et al., 1985) compared the Global Estimation Model and CREPID and concluded that they produce different results. Both sets of authors called for comparative research in a field setting that also includes meaningful external criteria such as cost-accounting outcomes.

The purpose of this study was to compare directly the estimates of $SD_y$ using a cost-accounting-based estimate of $SD_y$ ($SD_y^*$), the Global Estimation Model ($SD_y^g$), and the CREPID procedure ($SD_y^r$). The cost-accounting-based estimate was used as the standard of comparison for the other methodologies.

The specific null hypotheses tested were

$$H_{01}: SD_{y1} = SD_{y2},$$

$$H_{02}: SD_{y1} = SD_{y3},$$

and

$$H_{03}: SD_{y2} = SD_{y3}.$$

Subjects

The major consideration in the design of a study of this nature is the identification and selection of a suitable data base, that is, the identification of an organization that meets the following criteria:

1. Cooperation—is willing to make the cost-accounting records and supervisory personnel available to the researcher.

2. Size—has a job classification in which there are significant numbers of employees to ensure adequate statistical power.

3. Performance—variability in performance levels must make a difference in the selected job classification; that is, high performance levels should be distinguishable from average performance levels in dollars. The use of utility analysis presupposes that differences in performance levels are important to the organization (Cronbach & Gleser, 1965).

The study was conducted in a midwestern soft-drink bottling company that manufactures, merchandises, and distributes nationally known products. The organization employs 221 people and serves a 25,000-sq mi region. Data were provided by 29 supervisors ($N = 29$) and from the accounting records of the firm. The average management experience of the supervisors was 9 years, 3 months (range = 9 months—30 years, 6 months). All of the supervisors were White men, and their average age was 40 years, 6 months (range = 29 years—60 years).

The job classification used was route salesman ($N = 62$). All route salesmen were White men. The average age of the route salesmen was 32 years, 2 months (range = 21 years, 1 month—33 years, 1 month). The average number of years of sales experience of the route salesmen was 7 years, 5 months (range = 3 years—34 years, 6 months). This job classification was selected for two reasons: (a) There were a large number of individuals in this job classification, and (b) variability in performance levels had a direct impact on output. Therefore, differences in job performance created significant differences both in payoff for the company and for the individual route salesman. Route salesmen were paid on the basis of a small weekly base wage and a commission per case of soft drink sold.

Procedures

Global Estimation Model. Following the questionnaire-based procedures developed by Schmidt et al. (1979), supervisors were asked to estimate the dollar value of route salesmen's job performance at the 15th, 50th, and 85th percentiles of the performance distribution. Differences between estimates of performance at the 15th and 50th percentiles, as well as between the 50th and 85th percentiles, were computed for each participant. The mean dollar value difference between low and average performance and the mean dollar value difference between average and high performance were then computed. These difference scores each represent estimates of $SD_y$, under the assumption that job performance outcomes are distributed normally. However, the final Global Estimation Model estimate of $SD_y$ was obtained by averaging these separate $SD_y$ estimates. All of the supervisors provided estimates of dollar value that were consistent with percentile magnitudes; that is, performance at the 50th percentile level was valued higher than performance at the 15th percentile level, and so forth.

CREPID. This procedure involved eight steps, as described by Cascio and Ramos (1986). Each route salesman was rated by two raters, a primary rater and a secondary rater, in order to assess interrater reliability.

Cost-accounting method. The cost-accounting method involved the following steps:

1. The authors are acutely aware of the importance of using nonexistent language. However, as all of the subjects in the study were men, the most accurate term was route salesman.
1. Output data on each of the route salesmen were collected from the records of the organization for a 1-year period. This was done to eliminate seasonality from the data. These output data were expressed in terms of number of cases sold and by package size and type.

2. The weighted average sales price per case of product \( SP_a \) by package size and package type was calculated using data provided by the accounting department. In calculating the \( SP_a \), discounts were taken into consideration.

3. The variable cost per unit \( VC_a \) by package size and package type was calculated using data provided by the accounting department. Variable costs are costs that vary in total as the volume of production or sales changes (Cherrington and others, 1985). Note that on a per-unit basis, variable costs are fixed (Cherrington and others, 1985). The \( VC_a \) was composed of direct labor, direct materials (syrup cost, \( CO_2 \) gas, crowns, closures, and bottles), variable factory overhead (state inspection fees, variable indirect materials, and variable indirect labor), and variable selling expenses (route salesman’s commission).

4. Using the information produced in the preceding steps, 2 and 3, the contribution margins per case of product \( CM_a \) by package size and type were calculated. Contribution margin per unit is defined as sales price per unit minus the variable cost per unit (Hornby, 1982). Fixed costs were not included in the calculation of the contribution margins. Fixed costs are costs that remain constant in dollar amount as volume of production or sales changes (Cherrington and others, 1985). Examples of fixed costs include fixed factory overhead (depreciation on plant equipment, factory supervision, etc.), general and administrative expenses (corporate officers salaries, clerical wages, office supplies, etc.), and fixed selling expenses (salaries of sales supervisors, advertising, etc.).

5. The contribution margins calculated in Step 4 were multiplied by the output figures (Step 1), thus producing a total contribution margin for the route salesman for the year. This figure represents the total amount (in dollars and cents) contributed toward the coverage of fixed costs, and then profit, by each route salesman.

6. The percentage of the total contribution margin attributable to the route salesman was calculated on a route-by-route basis. To accomplish this, the sales of each route were partitioned into two categories, home market and cold bottle. Data were available with respect to the following: the percentage of sales of the respective routes that were home market and cold bottle. Home market represents sales in large supermarkets and chain stores, in which the product is purchased and taken home to consume. Cold bottle represents sales in small convenience stores, filling stations, restaurants, and vending operations, in which the product is generally purchased and consumed on location. According to a consensus of top management, home market sales are influenced less by the efforts of the route salesman than by such variables as national advertising, the goodwill associated with the product itself, and the efforts of the route salesman’s supervisor. The other hand, the route salesman exercises greater influence over the relative sales level in the cold-bottle market, due to the fact that the supervisor makes few calls on the customer, and the route salesman has a greater degree of flexibility in offering price incentives, seeking additional display space, and so forth. The critical question was, “How much influence does the route salesman have in each of the respective sectors?” An attempt was made to isolate statistically the effect on output of performance or effort by the route salesman, using stepwise regression. However, measures of the variables that affect output on a given route were not available, such as effort or activity of the route salesman’s supervisor, the impact of national and local advertising, and activity of major competitors within a route. Therefore, the percentage of sales or contributions attributable to the efforts of the route salesman was determined by a consensus of six top managers, facilitated by a Delphi technique. The “problem” confronting the management of the organization in the current study was to determine the percentage of contribution attributable to the efforts of route salesmen within the home market and cold bottle sectors. The following instructions were communicated to the six top managers within the organization: 

<table>
<thead>
<tr>
<th>Manager</th>
<th>Home market</th>
<th>Cold bottle</th>
<th>Home market</th>
<th>Cold bottle</th>
<th>Home market</th>
<th>Cold bottle</th>
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<tr>
<td>1</td>
<td>50</td>
<td>90</td>
<td>40</td>
<td>75</td>
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<td>30</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
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<td>20</td>
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<td>5</td>
<td>25</td>
<td>70</td>
<td>25</td>
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<tr>
<td>6</td>
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<td>20</td>
<td>30</td>
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</tr>
<tr>
<td>M</td>
<td>26.7</td>
<td>53.3</td>
<td>24.2</td>
<td>45.0</td>
<td>20.0</td>
<td>30.0</td>
</tr>
<tr>
<td>SD</td>
<td>11.7</td>
<td>32.2</td>
<td>6.3</td>
<td>19.9</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 1
Percentage Estimates of the Influence of Route Salesmen in Home and Cold-Bottle Markets Using the Delphi Technique

While it is recognized that the Route Salesman himself can affect significantly the level of sales output of his route, there are other variables that affect output as well. Such variables include (but are not limited to) the sales-related efforts of the Route Salesman’s supervisor, advertising (both national and local), the performance of competitors within the Route Salesman’s territory, the route composition (i.e., the number of large, supermarket stores versus small, “Mom and Pop” operations), the temperature and general weather conditions, and the goodwill associated with the product itself. In this study, we are trying to isolate the effect of performance of the Route Salesman. That is, “What percentage of total output would you attribute to the efforts of a Route Salesman within the ‘Home Market’ and ‘Cold Bottle’ sectors, respectively?” We realize that this is a difficult judgment to make, but take into account two factors:

1. You will be provided with the estimates of other supervisors along with the rationale behind their decisions.
2. You will be allowed to adjust your estimate, after taking into account the additional information.

Please complete the following sentence: In my opinion, the efforts of a Route Salesman account for ____ percent of the total output within 'Home Markets' and ____ percent of the total output within 'Cold Bottle' markets. The rationale behind these estimates is ____

Convergence was obtained after three sets of independent estimates by the six judges. Table 1 summarizes their responses. As Table 1 demonstrates, the top management of the organization placed the portions of home market sales and cold-bottle sales attributable to the efforts of the route salesman at 20% and 30% respectively.

7. The percentages calculated in Step 6 were multiplied by the respective total contribution margins calculated in Step 5, yielding the total contribution margin attributable to each route salesman. An example calculation is shown in Table 2. This amount served as the cost-accounting-based estimate of each route salesman’s worth to the organization.

8. The mean and standard deviation of the preceding values were calculated. This standard deviation served as the cost-accounting-based estimate of \( SD \).

This approach can be characterized as a contribution approach to costing the performance of the route salesmen. It differs from Roche’s (1961) approach in that Roche used “the profit attributable to each Radial Drill Operator” as the surrogate measure of worth. The advantages of this approach include:

1. The Delphi technique was developed by researchers at the Rand Corporation to interchange employee’s ideas and feedback while avoiding the inefficiencies and inhibitions of face-to-face groups (Dalkey & Helmer, 1963).
Table 2
Sample of the Total Contribution Attributable to Route Salesman A (RSA) Using Cost-Accounting Procedures

<table>
<thead>
<tr>
<th>Product</th>
<th>SP_u - VC_u = CM_u × Sales output*</th>
<th>GCM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.00 - 2.75 = 2.25 × 40,000</td>
<td>90,000</td>
</tr>
<tr>
<td>2</td>
<td>7.60 - 4.85 = 2.75 × 20,000</td>
<td>55,000</td>
</tr>
<tr>
<td>3</td>
<td>8.30 - 5.65 = 2.65 × 15,000</td>
<td>39,750</td>
</tr>
</tbody>
</table>

**Gross contribution generated by RSA = 184,750**

*Note.* If RSA sells 45% of his output in home markets (HM% = 0.45) and 55% in cold-bottle markets (CB% = 0.55), and given the influence ratios (IR_{hm}, IR_{cb}) of 20% and 30%, respectively (determined by the Delphi technique), then the total contribution attributable to RSA (TOTCM_{RSA}) is calculated as follows:

\[
\text{TOTCM}_{RSA} = \text{GCM} \times (\text{IR}_{hm} \times \text{HM}) + (\text{IR}_{cb} \times \text{CB})
\]

\[
\text{TOTCM}_{RSA} = 184,750 \times (0.20 \times 0.45) + (0.30 \times 0.55)
\]

\[
\text{TOTCM}_{RSA} = 47,111.25
\]

SP_u = sales price per unit of product; VC_u = variable cost per unit of product; CM_u = contribution margin per unit of product; GCM = gross contribution margin. Figures, except *, are in dollars.

*Numbers of cases.

The correlation between amount of experience as a route salesman and the cost-accounting-based estimates of worth was calculated. The resulting correlation coefficient (r = 0.118, p > .10, ns) indicated that little, if any, correlation exists between the two variables. This result corresponded to the predictions and comments made by company management.

The Global Estimation Model estimate of SDy (SD_{y2}) was $14,636, calculated by averaging the differences between the 15th and 50th percentiles ($14,834) and the 50th and 85th percentiles ($14,439). Estimates of worth at the 15th percentile ranged from 0 to $80,000 (M = $17,145; SD = $14,633). Comparable figures for the 50th and 85th percentiles were, respectively, $10,000 to $120,000 (M = $31,979; SD = $24,829) and $15,000 to $175,000 (M = $46,417; SD = $38,443). The estimate of SDy obtained by differencing the 15th and 50th percentile values was compared with the estimate of SDy obtained by differencing the 85th and 50th percentiles, and no significant difference was detected, t(56) = 0.085, p > .10, ns. Because there was no statistically significant difference between these means, the assumption of normality was supported. This result corresponds to the findings of Bobko et al. (1983), discussed earlier.

To evaluate differences in results produced by the cost-accounting procedure and the Global Estimation Model, 90% confidence intervals were constructed. If the intervals overlap, then we can conclude (with 90% confidence) that results from these two procedures do not differ significantly. The upper and lower limits of the 90% confidence interval for the cost-accounting model were $18,208 and $13,520, respectively. The upper and lower limits of the Global Estimation Model were $19,780 and $9,492, respectively. Because there was overlap between the confidence intervals derived from the two methods, we concluded that these estimates were not significantly different from each other.

The CREPID estimate of SDy (SD_{y2}) was $8,988, with a mean value of job performance of $38,435. Estimates of worth ranged from $19,890 to $53,171. As would be expected when dealing with experienced job incumbents, the data were skewed positively, but not to a degree that would jeopardize the underlying assumptions of the t test. A chi-square goodness-of-fit test resulted in failure to reject the null hypothesis that the data are normally distributed, $\chi^2(5, N = 62) = 11.51, p > .025, ns$. Moderate departures from the assumption of equal variances have been shown to have negligible effect on the operating characteristics of the t ratio (Boneau, 1960; Baker, Hardyy, & Petrinovich, 1966; Hardyck & Petrinovich, 1969).

In a previous article (Cascio & Ramos, 1986), the authors noted that although a modified magnitude estimation procedure was used in the CREPID performance scale, the underlying distribution is based on a percentile distribution that is rectangular in shape. A rectangular distribution has a fixed mean and standard deviation. The CREPID ratings would be expected to demonstrate a fixed mean and standard deviation only in the long run for each individual rater, inasmuch as each rater's definition of performance at the 25th, 50th, 75th, and so on, percentiles is likely to vary. When performance ratings are pooled across raters, as they were in this study, the distribution will not be uniform in shape, but rather will be skewed or normal. The use of such a distribution actually facilitates subse-
Table 3

<table>
<thead>
<tr>
<th>Method</th>
<th>SDy estimate</th>
<th>M worth</th>
<th>M value</th>
<th>Range</th>
<th>Test of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost accounting (SDy1)</td>
<td>$15,864</td>
<td>$44,985</td>
<td>$41,166</td>
<td>$11,237-$99,557</td>
<td>90% CI (ns)</td>
</tr>
<tr>
<td>Global estimation</td>
<td>$14,636</td>
<td>$31,979</td>
<td>$23,000</td>
<td>0-$175,000</td>
<td>90% CI (ns)</td>
</tr>
<tr>
<td>CREPID (SDy3)</td>
<td>$8,988</td>
<td>$40,489</td>
<td>$38,435</td>
<td>$16,855-$53,171</td>
<td>t(60) = 5.344, p &lt; .10</td>
</tr>
</tbody>
</table>

Note. The percentage figures after each of the dollar values represent the dollar values expressed as a percentage of the corresponding cost-accounting-based value. SDy = standard deviation of job performance; CI = confidence interval; CREPID = Cascio–Ramos estimate of performance in dollars.

Discussion

At first glance, the results of the data analysis seem to provide strong support for the accuracy of the Global Estimation Model, whereas the CREPID approach appears to underestimate SDy. The magnitude and direction of the relations among the three estimates of SDy is obvious, even without the benefit of statistical testing. However, several limitations of the cost-accounting-based measures must be considered. The discussion that follows will be organized along the following major themes: (a) an examination of the cost-accounting-based procedure as a measure of “truth,” (b) the results associated with the Global Estimation Model, in light of prior research, (c) the results associated with the CREPID model, in light of prior research, (d) implications for accounting research, and (e) implications for future psychometric tests of the SDy parameter.

Validity of the Cost-Accounting-Based Approach

Our study used a cost-accounting-based estimate of SDy as a standard for comparing the behaviorally based methods for estimating SDy. Therefore, conclusions about the validity (or lack of validity) of the behaviorally based approaches for estimating SDy necessarily depend on the validity of the cost-accounting-based approach. Careful scrutiny of the proposed cost-accounting methodology revealed that the procedure was not based entirely on objective data. Note that the first five steps of the cost-accounting-based approach involved the use of objective, verifiable data, and involved procedures that were supportable by conventional managerial accounting theory. However, determining the degree of influence that a route salesman has over the output level on his route (Step 6) was not a completely objective process.

The approach used in the current study to determine this degree of influence could be labeled a universal, nonspecific approach. The approach was universal in that the question was phrased in terms of the “general level of influence exerted by Route Salesmen over sales/output on their routes.” Two major issues merit consideration with respect to Step 6 of the cost-accounting-based procedure.

First, the method for determining the influence percentages was the Delphi method. Although there is an extensive body of research supporting the procedure as an effective method for structuring a group-consensus-seeking process and for improv-

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3 Interested readers may obtain a list of the 26 principal activities and the weights assigned by the judges by writing to the first author.

4 $t = (\bar{s}_1 - \bar{s}_2) \sqrt{N} - 2 \sqrt{ \frac{s_1^2 + s_2^2}{n_1 + n_2 - 2}}$.
ing the efficiency and quality of the group decision-making process (Linstone & Turoff, 1975), the Delphi method is a behavioral technique. The original objective was to estimate \( SD_y \) using a method based completely on objective, reliable, verifiable cost-accounting procedures. Integrating a behaviorally based procedure with the cost-accounting data may limit our ability to conclude that what is called the cost-accounting-based estimate of \( SD_y \) is, in fact, a measure of "truth," against which the other behaviorally based measures can be evaluated. The issue here is not the relative validity of the Delphi technique for achieving group consensus; rather, the issue centers around the propriety of incorporating a behaviorally based method into a cost-accounting-based estimate of \( SD_y \).

Second, the percentages identified were applied to route salesmen across the board. Therefore, distinctions among levels of performance and worth were solely a function of the total output on each route. The problem is obvious: Individual differences in performance result in differing levels of influence in the home and cold-bottle markets. A more accurate approach would have involved establishing the level (or percentage) of influence exercised by each individual route salesman over the sales on his specific route. With such an approach, distinctions among levels of performance and dollar worth would be a function both of the total output on each route and of the percentage of that total attributable to the efforts of the respective route salesman.

Cravens and Woodruff (1973) outlined a stepwise regression procedure for determining criteria of sales performance that may have value in addressing this problem. They identified territory performance as a function of (a) industry market potential in the territory, (b) territory work load, (c) sales experience, (d) sales motivation and effort, (e) company experience in the territory, (f) company effort in the territory, and (g) other factors. Stepwise multiple regression was used to analyze the relationship between the criterion variable (sales territory performance) and the predictor variables (industry market potential, territory work load, etc.).

Such a procedure could be integrated with the cost-accounting procedures of the current study (Steps 1–5) as a method for identifying the portion of the total contribution (as opposed to sales) attributable to a given route salesman, if data are available with which to measure the variables. To the extent that objective measures of predictor variables with strong relations to the criterion variable can be identified, a procedure of this nature would pose no threat to the objectivity of the remaining cost-accounting-based information used in the model. The possibilities for future studies are encouraging.

We discovered an interesting fact while investigating the extreme values in the cost-accounting data set: Subsequent to the period covered by the study, the route salesman at the low end and the route salesman at the high end of the distribution were fired. The low performer was fired for nonperformance; however, the highest producing route salesman was fired for reckless driving that led to a serious accident and a lawsuit against the organization. The costs associated with this reckless behavior were not evident in the cost-accounting-based values; however, further investigation revealed that the supervisors rating this individual using CREPID took these behaviors into account. The result was low degree of agreement between the cost-accounting-based estimate of worth and the CREPID model estimate of worth for this individual.

### Global Estimation Model

Proponents of the Global Estimation Model are sure to be encouraged by the results of the current study. Three observations seem warranted.

First, Bobko et al. (1983), in an earlier study, found that although supervisors underestimated the actual values of the three point estimates (as indicated by objective sales data), the \( SD_y \) estimate produced by the Global Estimation Model was quite accurate. The findings of the current study appear consistent with this finding. Table 3 reveals a mean worth to the organization of \( \$3,979 \) (71% of the mean worth estimate provided by the cost-accounting approach), but an estimate of \( SD_y \) of \( \$14,636 \) (92% of the estimate of \( SD_y \) provided by the cost-accounting approach).

Second, the Global estimate of \( SD_y \) was approximately 1.6 times larger than the CREPID estimate of \( SD_y \). This finding is consistent with the outcome in a study by Weekley et al. (1985), in which the global estimate of \( SD_y \) was 1.8 times larger than it was in the CREPID approach. The consistency of the relation between the global and CREPID estimates of \( SD_y \) appears to be quite strong. Actually, there is a very plausible reason why the CREPID method should yield \( SD_y \) estimates that are considerably smaller than those produced by the global or cost-accounting methods. The CREPID approach is based on salary, not on the value of output as sold. It (CREPID) considers only the contribution of labor, not the combined contribution of labor, equipment, capital, overhead, and profit, as does a standard based upon the value of output as sold.

In the U.S. economy, wages average 57% of the value of output (Hunter & Schmidt, 1983). Hence, one would expect the CREPID \( SD_y \) estimate to average about 57% of the value of \( SD_y \) based on methods that consider the value of output as sold. As can be seen in Table 3, the CREPID \( SD_y \) estimate is exactly 57% of the cost-accounting-based \( SD_y \), and 61% of the \( SD_y \) value produced by the Global Estimation Model. Conversely, results from both the cost-accounting procedure and Global Estimation Model should be approximately \( 1/0.57 = 1.75 \) times as large as the CREPID \( SD_y \) value—and they are. This kind of multimethod convergence is impressive.

Three, the global estimate of \( SD_y \) was 55% of the average salary of route salesmen, somewhat larger than the 40% lower bound suggested by Hunter and Schmidt (1983), but significantly less than the 133% observed by Reilly and Smith (1985). However, examination of raters' raw estimates reveals at least two sets that were significantly greater than the other estimates, suggesting different interpretations of overall worth.

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5 In fact, the Delphi technique has been proposed by Bobko et al. (1983) as a method for improving the accuracy of Global Estimation Model point estimates of \( SD_y \). A subsequent study by Burke and Frederick (1984) indicated that such a procedure does, in fact, reduce within-column (percentile point) variation.

6 We made an attempt in the current study to develop a similar model; however, the organization was unable to provide the necessary data.

7 We would like to acknowledge an anonymous reviewer for pointing out these relationships among alternative methods for estimating \( SD_y \).
This phenomenon was observed in studies by Bobko et al. (1983), Weekley et al. (1985), and Reilly and Smither (1985). However, when these outlier values are eliminated from the calculations, the estimate of the average worth of route salesmen is reduced from $31,979 to $26,200. This value is 99% of the actual average wage paid ($26,585) to route salesmen. The closeness of the estimates supports the notion that most of the supervisors were using salary as the criterion for estimating closeness of the estimates.

Calculations, the estimate of the average worth of route salesmen (1983), Weekley et al. (1985), and Reilly and Smither (1985). This phenomenon was observed in studies by Bobko et al. at least one rater asked whether he could use salary as a basis for making the estimates.

CREPID Model

The conservative estimate of SDγ yielded by the CREPID model is consistent with the earlier finding by Reilly and Smither (1983) that, at worst, CREPID underestimates the value of labor. Studies by Weekley et al. (1985) and Reilly & Smither found the CREPID procedure to yield a smaller estimate of SDγ than the Global Estimation Model. This finding was reinforced by the current study. Several observations with respect to the CREPID procedure merit attention.

First, the CREPID procedure produced a much tighter range of values than did the other methods. The CREPID range of values was $36,316, as compared to cost-accounting and global ranges of $88,320 and $175,000, respectively (see Table 3). Excessive variability in the point estimates of worth, combined with confusion regarding interpretations of what to use as an index of individual worth, are practical problems that have been identified with use of the Global Estimation Model (Reilly & Smither, 1985). The results of the current study indicate that CREPID avoids these problems.

Second, the CREPID model provided a median value of worth ($40,489) that was 98% of that produced by the cost-accounting-based method ($41,166). Although median worth is not the parameter of interest in this study, the closeness of the values is worth noting.

Third, the CREPID model had the highest degree of face validity with those individuals within the organization who were familiar with all three methodologies. During the course of the study, four of the top managers and the firm’s accountant became familiar with each of the procedures and the data used to provide the estimates of SDγ. These individuals were asked, individually, which of the procedures they would prefer. The unanimous choice was the CREPID procedure. Earlier, it was noted that the behaviorally based methods for estimating SDγ lack credibility among practitioners, due to the fact that they have not been validated by examining them against some meaningful external criteria, such as cost-accounting outcomes. This finding seems to indicate that the credibility of the CREPID procedure may not be a significant issue.

Implications for Accounting Research

Earlier, it was noted that human resource accounting has a limited future with respect to financial reporting. Although most researchers have abandoned attempts to place a dollar valuation of human assets on the balance sheet, recent studies have focused on the decision usefulness of human resource information. Shimerda and Pufahl (1983) identified five studies in which the provision of human resource data resulted in decisions that were significantly different from those that would have been made on the basis of conventional financial data alone. A study by Hendricks (1976) found that stock investment decisions were affected by including human resource accounting information with conventional financial statements. The current study presents another challenge for accountants: that of developing an objective, verifiable, and reliable method for estimating the dollar value of job performance levels. As noted earlier, the cost-accounting systems of organizations have not established job performance level as a cost object, inasmuch as estimation of the dollar differences in levels of job performance traditionally has not been a cost objective. Given the decision usefulness of human resource information, and given the specific informational need described in this article (i.e., the ability to produce a valid, cost-accounting-based estimate of SDγ), the implication of the current study is clear: Researchers within the accounting profession must develop an objective, verifiable, and reliable method for estimating the standard deviation of job performance in dollars (SDγ). Although behaviorally based methods have been developed for the estimation of SDγ, Weekley et al. (1985) noted that without an appropriate outside criterion against which to validate the behaviorally based methods for estimating SDγ, one is unable to support strongly one method over the others. The accounting sector must provide that outside criterion. The current study merely provides a start in this direction.

Implications for Future Tests of the SDγ Parameter

Future studies evaluating the SDγ parameter should attempt to eliminate the sources of within-column variability of the Global Estimation Model. Future studies should focus on the identification and elimination of the sources of rater confusion in the completion of the Global Estimation Model questionnaire. There is a need for researchers to examine conditions under which the CREPID model underestimates (or overestimates) SDγ. There is a need for more studies that compare and contrast behaviorally based estimates of SDγ with external, objective measures of SDγ. Finally, future studies should continue a call to the accounting profession to develop objective, verifiable, and reliable methods for estimating the SDγ parameter.

Despite the fact that we have focused exclusively in this study on the SDγ parameter, other parameters in the general utility equation also deserve attention, for they too are estimates. Much work needs to be done in developing refined estimates of the size of the samples selected or trained, the mean time selectees stay on the job, or the mean duration of a training effect.
and the selection ratio. That kind of research can lead only to better decisions about personnel programs, and better decision making is what utility analysis is all about.

References


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