Salesperson Evaluation Using Relative Performance Efficiency: The Application of Data Envelopment Analysis

By: James S. Boles, Naveen Donthu, and Ritu Lohtia

James S. Boles, Naveen Donthu, and Ritu Lohtia, "Salesperson Evaluation Using Relative Performance Efficiency: The Application of Data Envelopment Analysis," *Journal of Personal Selling and Sales Management* 15 (Summer, 1995), 31-50.
https://doi.org/10.1080/08853134.1995.10754027

This is an Accepted Manuscript of an article published by Taylor & Francis in *Journal of Personal Selling and Sales Management* on 24 October 2013, available online: http://www.tandfonline.com/10.1080/08853134.1995.10754027. It is deposited under the terms of the Creative Commons Attribution-NonCommercial License (http://creativecommons.org/licenses/by-nc/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract:

A recurring, but unresolved, issue in salesforce research is the choice of salesperson performance evaluation methodology. Salesforce compensation is typically based on some form of evaluation, and hence the assessment method used is critical. The authors outline several evaluation methods currently in use and their pros and cons. Some methods are purely output or purely input based, and often employ only one indicator of performance. Still other methods use absolute ratios of outputs to inputs, or compare performance with the "average" performance rather than the "best." The authors propose a data envelopment analysis (DEA) based approach that provides a measure of relative (to best) performance efficiency. An empirical example illustrates the proposed method of salesperson evaluation. The advantages of the proposed approach are discussed along with a description of situations in which its use may be more appropriate.

Keywords: salespeople | data envelopment analysis | salesperson performance evaluation

Article:

The current emphasis on customer satisfaction and developing long-term relationships between buyers and sellers indicates that firms are relying increasingly on their salespeople to provide more and better service to their accounts (Crosby, Evans, and Cowles 1990). For many firms, however, the sales function represents a large expenditure of resources. The typical cost for the average sales call in 1992 was approximately $220 *(Sales and Marketing Management,* June 28, 1993). The expenses associated with fielding a salesforce emphasize the importance of accurately assessing salesperson performance to ensure that the salesforce makes a positive contribution to the firm's long-term survival and profitability. Consequently, salesperson performance evaluation is a recurring issue in salesforce research (e.g., Anderson and Oliver 1987; Cocanaugher and Ivancevich 1978; Mowen et al. 1985).

How organizations conceptualize salesperson performance affects how they attempt to assess it. Churchill, Ford, and Walker(l990), as well as Landy and Farr (1983), conceptualize performance evaluations as either objective or subjective. Objective performance assessments are based on quantitative measurements. They may further be divided into output measures (e.g., level of sales or quota attainment), input measures (e.g., number of calls, time utilization), or ratio measures (e.g., expense ratios, account development and servicing ratios) (Churchill et al. 1990). Subjective performance appraisals focus more on the quality and less on the quantity of salesperson activity. Some examples of these qualitative measures include territory management, knowledge, and customer relations. Instruments such as BARS (behaviorally anchored rating scales) can be used to help assess these qualitative inputs (Cocanougher and Ivancevich 1978). In addition, ratings of a salesperson's outputs such as sales volume can be incorporated into these subjective performance measures.

Porter, Lawler, and Hackman (1975) also view performance appraisals as measures of inputs or outputs. Outputs examine employee results, while inputs focus on the actions of the salesperson and how those actions are undertaken. Although prior conceptualizations have defined input measures as those associated with the effort sales representatives expend, other researchers have broadened this to include inputs such as territory workload (Cravens, LaForge, Pickett, and Young 1993) and market potential (Cravens, Woodruff, and Stamper 1972) which are outside the salesperson's control.

Eichel and Bender (1984) group performance evaluation approaches into comparative, outcome oriented, and absolute. Comparative approaches compare employees with each other (i.e. ranking, distribution, paired comparisons, etc.). Outcome based evaluations focus on measuring the results of a salesperson's efforts. Absolute appraisal methods focus on behaviors (inputs)- not outcomes or comparisons with other individuals.

These existing evaluation methods typically focus on some form of performance measured either objectively or subjectively. In addition, each of these methods also relate either to effectiveness or efficiency. Effectiveness examines the contribution of the individual salesperson to valued organizational outcomes such as total sales or market share (Churchill et al. 1990) and may be thought of as "doing the right things" (Drucker 1974). Efficiency, on the other hand, can be thought of as "doing things right." Though it is important to do the right things, in today's economic environment it may be equally valuable to do things right (Duhan 1985). While effectiveness appears to be the dominant theme throughout much of the sales evaluation literature, the current business environment's preoccupation with cost-cutting and maximizing productivity may require, in addition to effectiveness, a high level of efficiency from salespeople.

In the current study we conceptualize performance as a relative comparative measure incorporating both inputs and outputs. These measures can be subjective or objective. Under the proposed Data Envelopment Analysis (DEA) based approach, a salesperson's performance is compared to the best performer which provides a measure of relative performance. The "best" performer is one who maximizes outputs with respect to inputs.

For this research we integrate previous performance conceptualizations into four groups (class I, II, III, and IV) (see Figure 1) based on their use of input and output measures (Churchill et al. 1990; Porter, Lawler and Hackman 1975; and Eichel and Bender 1984). We also recognize conceptualizations based on comparative dimensions where salespeople are evaluated relative to their peers using either an implicit or explicit pe1formanee standard (Eichel and Bender 1984). Since few studies actually focus on the concepts of effectiveness and efficiency, we have not tried to determine where each of the studies would be categorized with respect to these dimensions. Table 1 provides a summary of these previous methods grouped by class.

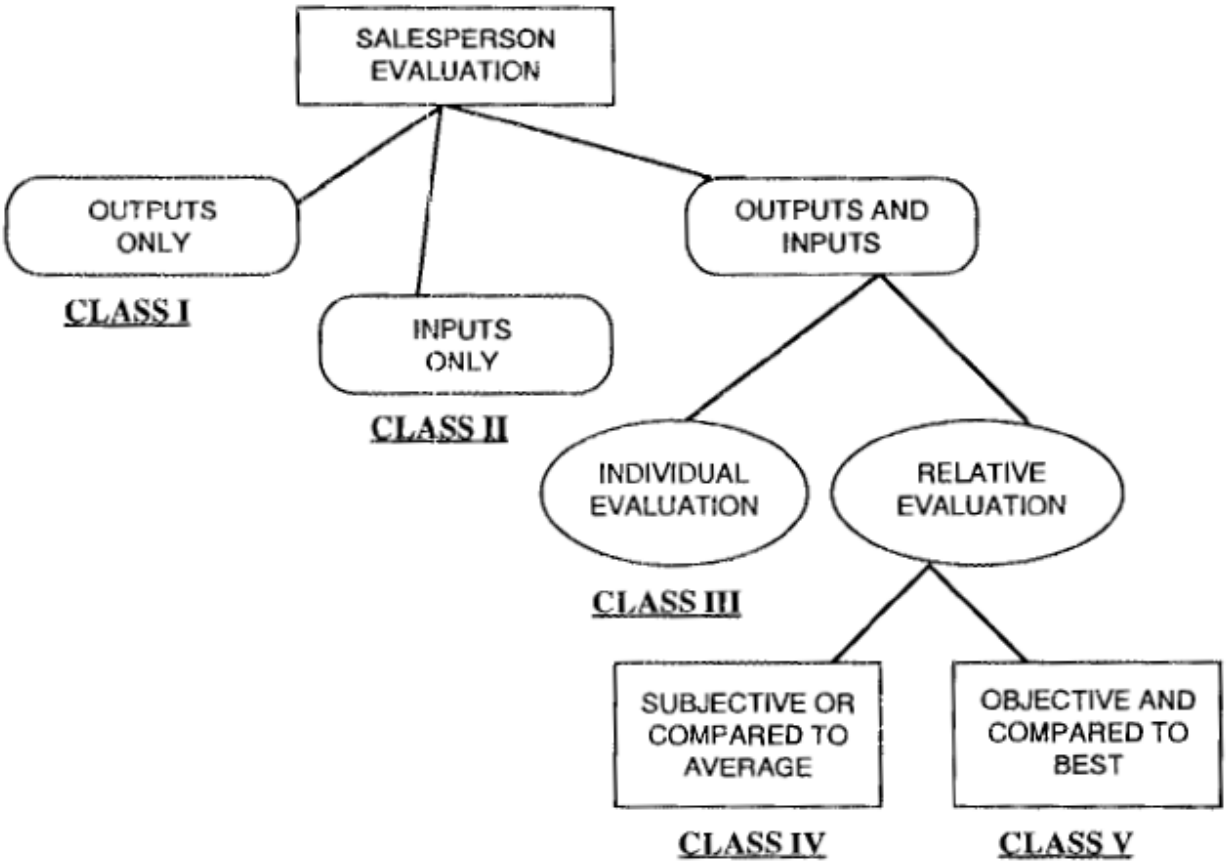

Figure 1. Approaches to Salesperson Performance Evaluation

We first review the four existing evaluation approaches and then describe the Data Envelopment Analysis (DEA) based approach (class V) which computes relative (to best) efficiency. Following the presentation of this proposed assessment method, results obtained by the five methods, when used to evaluate salespeople in a single firm, are compared. Finally, we explore the managerial implications of the proposed approach.

Table 1. Selected Review of Salesperson Performance Measures

CLASS I	Input Measures	Output Measures	Churchill et al.	Eichel & Bender
Bagozzi, 1978		Sales	OB,OU	OU
Weitz, 1978		Sales	OB,OU	OU
		Sales/quota	OB,OU	OU
		Manager's rating on a 10 point scale on performance in selling 100 units of a product	SU,OU	OU
Ryans and Weinberg, 1979		Sales	OB,OU	OU
Bagozzi, 1980		Sales	OB,OU	OU
Tyagi, 1985		Self report by salesperson as to whether they fell short by x%, met, or exceeded by x% sales volume goals	OB,OU	OU
Dubinsky and Hartley, 1986		Prior years total earnings	OB,OU	OU
Kerber and Campbell, 1987		Average of orders shipped, not shipped, and new orders		
Hastings, Kiely, and Watkins, 1988		Unit sales	OB,OU	OU
CLASS II	**Input Measures**	**Output Measures**		
Futrell and Parasuraman, 1984	Sales managers ratings on 10 items:			
	•willingness to work hard		SU	AB
	•attitude		SU	AB
	•sales ability		SU	AB
	•planning ability		SU	AB
	•activity reporting		SU	AB
	•improvement in performance over last year		OB,OU	OU
	•human relations ability		SU	AB
	•product knowledge		SU	AB
	•current overall job performance		OB,OU	OU
	•territory coverage		SU	AB
Sager and Varadarajan, 1990	Average Ratings by sales manager on 87 items related to:			
	•in-store activities		SU	AB
	•relationship with supervisor		SU	AB
	•sales presentation		SU	AB
	•communication skills		SU	AB
	•personality		SU	AB
	•records and reporting		SU	AB
	•quantifiable activities		OB,OU	OU
	•competitive activities		SU	AB
Weeks and Kahle, 1990		Annual Sales	OB,OU	OU
	Sales manager's evaluation using reduced version of Futrell and Parasuraman's scale (1984):			
	•willingness to work hard		SU	AB
	•current general attitude		SU	AB
	•activity reporting		SU	AB
	•improvement in performance over last year		OB,OU	OU
	•human relations ability		SU	AB
	•product knowledge		SU	AB
Dalrymple and Strahle, 1990		Sales	OB,OU	OU
		Contribution dollars	OB,OU	OU
		Sales/Quota	OB,RA	OU
		Penetration	OB,OU	OU
		Sales/Call	OB,OU	OU
		Contribution/Call	OB,RA	OU
		Commission/Month	OB,OU	OU
	Total calls		OB,IN	AB

Brown, Cron, and Leigh 1993		Sales manager's evaluations on:		
		•total sales volume	OB,OU	OU
		•new account development	OB,OU	OU
		•full-line selling results	OB,OU	OU
	•leadership ability		SU	ABS
	•planning		SU	ABS
	•initiative		SU	ABS
	•resourcefulness		SU	ABS
CLASS III	**Input Measures**	**Output Measures**		
Lamont and Lundstrom, 1977		Commisions/total compensation	RA	OU
		Incentive earnings/total comp.	RA	OU
		Actual sales/quota	RA	OU
		New accounts sold/potential accounts	RA	OU
	Total sales calls		OB,IN	IN
	Technical competence		SU	AB
	Territory management		SU	AB
	Salesmenship skills		SU	AB
	Supportive and development skills		SU	AB
Adkins, 1979	Performance standards based on subjective judgment keeping in mind factors that impact performance		SU	AB
		Measures such as:		
		•sales revenue	OB,OU	OU
		•product units sold	OB,OU	OU
		•profit contribution	OB,OU	OU
		•new customers	OB,OU	OU
		•prospect demonstrations	SU	AB
		•sales calls	OB,OU	OU
Avila, Fern, and Mann, 1988		Sales managers overall performance assessment	SU	AB
	•sales behavior		SU	AB
	•goal achievement		SU	AB
Tanner and Castleberry, 1990		Manager's ratings on:		
		•total cases sold	OB,OU	OU
		•ads sold	OB,OU	OU
		•displays sold	OB,OU	OU
		•number of new distributors	OB,OU	OU
	•skills		SU	AB
	•strengths and weaknesses		SU	AB
	•developmental action		SU	AB
CLASS IV	**Input Measures**	**Output Measures**		
Pruden and Reece, 1972		Self-rating scale adapted from Pym and Auld 1965 (compared with people doing the same kind of work)	SU	CO
Cravens, Woodruff, and Stamper, 1972	Sales quota computed from: •market potential •territory workload •salesman experience •salesman motivation and effort •company experience •company effort	Sales	OB,RA	OU
Cravens and Woodruff, 1973	Sales quota computed from: •market potential •territory workload •salesman experience •salesman motivation and effort •company experience •company effort	Sales	OB,RA	OU
Beswick and Cravens, 1977	Sales quota computed from: •selling effort •workload •potential •company effort •company experience •salesman quality	Sales	RA	OU
Busch and Bush, 1978		Self rating scale: comparing self to other salesmen doing similar work; rate better than 75%, better than 50%, better than 25%, and below 25%.	SU	CO

Behrman, Bigoness, and Perreault, 1981		Sales manager's composite ratings on how the salesman compared to all other salesmen in a similar situation.	SU	CO
	•effectiveness in making sales presentations		SU	CO
	•providing customers with information		SU	CO
	•technical knowledge		SU	CO
	•controlling expenses		SU	CO
		•success in meeting sales objectives		
Bush and Busch, 1981-82		Self ratings (Pym and Auld 1965) compared with other people doing the same kind of work.	SU	CO
Behrman and Perreault, 1982		Ratings by salesmen and by sales managers on performance compared to average salesperson on:		
		•sales objectives	SU	CO
	•sales presentation		SU	CO
	•providing information		SU	CO
	•technical knowledge		SU	CO
	•controlling expenses		SU	CO
Behrman and Perreault, 1984		Average of 31 items tapping:		
		•success in achieving sales objectives	SU	CO
	•technical knowledge		SU	CO
	•providing information		SU	CO
	•controlling expenses		SU	CO
	•making presentations		SU	CO
Hampton, Dubinsky, and Skinner 1986		Self report 4 point scale used by Pruden and Reese, 1972	SU	CO
Spiro and Weitz, 1990		Self evaluation compared to average salesperson.	SU	CO
		Sales manager' evaluation	SU	CO
Lagase, 1991	Income as reported by salesmanager		OB,IN	OU
		Sales manager's evaluation using reduced version of Behrman and Perreault (1982) scale	SU	AB
Goolsby, Lagace, and Boorom 1992		Behrman and Perreault (1982) scale. Respondents provide subjective comparison of their performance with an average salesperson on:		
		•ability to meet sales objectives	SU	CO
	•technical knowledge		SU	
	•provide information		SU	
	•control expenses		SU	
	•sales interactions		SU	
Levy and Sharma, 1993		Sales volume compared to average sales of all salespeople.	OB,OU	CO
		Managerial comparative evaluation.	SU	CO
		Salesperson comparative self evaluation.	SU	CO
Cravens, LaForge, Pickett, and Young, 1993	Sales quota computed from:	Industry sales in territory	RA	OU
	•salesperson experience			
	•large accounts			
	•company share of industry sales in territory			

SU=subjective; OB,IN=objective-input; OB,OU=objective-output; RA=ratio;
CO=comparative; OU=outcome; AB=absolute

Salesperson Evaluation Methods

Class I evaluation techniques rely on results as the criteria of evaluation (Sokol and Oresick 1986). They can use objective measures (e.g., sales volume) or subjective measures (e.g.,

achieving sales objectives) (Futrell and Parasuraman 1984; Ryans and Weinberg 1987). The measures of output also can be non-sales related such aa a salesperson's standing with his or her customers. Though class I methods do not explicitly compare a salesperson with his or her peers, the measures could be used to rank salespeople for purposes of comparison and may be useful in promotion or compensation decisions which are often results based. This class includes measures that compare outputs against goals for performance such as sales/quotas or management by objectives.

An advantage of class I measures is that sales figures can often be tied directly to a firm's bottom-line performance. A disadvantage is their exclusive reliance on some measure of output. Though one might argue that, in a sales setting, results (outputs) are the only thing that count, other factors also may accurately represent a salesperson's performance or, at least, provide some legitimate reasons for differences in evaluations (Cravens et al. 1993; Walker, Churchill and Ford 1979). Unfortunately these methods do not provide adequate information for coaching, feedback, training, and career improvement. Futhermore, accomplishments not explicitly measured in terms of outputs may be overlooked (Sokol and Oresick 1986).

Class II performance n1easures focus on salesperson actions such as number of sales calls made (objective measure), or salesmanship skills (subjective measure), rather than results or outcomes (Churchill et al. 1985) and include measures that compare inputs against performance goals (i.e. number of calls made/number of calls anticipated). These input based approaches may be useful to firms that use performance evaluations to determine an individual's training and development needs (Churchill et al. 1990). For example, a salesperson who has high expenses may be given training on how to better utilize his or her resources. Though there is no explicit standard of performance by which to directly compare a salesperson with his or her peers, the evaluations can be rank-ordered for purposes of comparison. Unfortunately, these approaches may motivate activities rather than accomplishn1ent (Porter, Lawler, and Hackman 1975). Furthermore, they may not adequately reward salespeople who accomplish things by engaging in nonstandard activities.

A third approach (class III) is based on both inputs and outputs, including input factors such as territory potential or number of calls made (objective measures) and development skills (subjective measure) as important components of salesperson evaluation (Adkins 1979; Cox and Havens 1977; Jackson, Keith, and Schlacter 1983). Supervisor evaluations are one often used method of simultaneously incorporating both inputs and outputs into an overall assessment of performance with no explicit standard for evaluating performance (Behrman and Perreault 1984; Futrell and Parasuraman 1984). These approaches, like class I and II methods, do not explicitly compare a salesperson with his or her peers, but can be rank-ordered for purposes of comparison. They may be particularly useful when the evaluation is used to provide feedback to assist in planning for further training.

A fourth approach, class IV, relies on the use of inputs and outputs (implicitly or explicitly) and an explicit standard to evaluate salespeople relative to their peers. Multiple inputs can be used, but typically only one output measure is examined (Beswick and Cravens 1977). One way of arriving at a relative evaluation of a salesperson's performance is to compare that individual with other salespeople through supervisory or self-reported ratings (Busch and Bush 1978; Kohli

1989). Regression-based methods are another approach in determining relative performance where a regression equation (linear or nonlinear) is created, based on salesperson inputs and outputs, and the individual is compared with the mean rating (Lucas, Weinberg, and Clowes 1975). Unfortunately, both supervisor evaluations and regression analysis have important limitations. Supervisor evaluations of relative performance are often based on subjective standards and regression analysis, by definition: only uses overage performances as the base for relative evaluations.

As mentioned before, Table 1 provides a summary of these previous methods grouped by class. Some studies use measures falling into multiple classes (i.e., some measures are class I, while others are class II). For example, Weeks and Kahle (1990) use both output measures (annual sales – class I) and input measures (e.g., human relations ability – class II) to evaluate salespeople. Since this study uses class I and class II methods, it is placed under class II. Studies like this that use both class I and class II measures independent of each other are not classified as class III because measures fitting class III classification involve using these measures in combination (e.g., ratio of output to input) not separately.

Though each of the four classes of performance evaluation are appropriate in some settings, they do not provide the level of information concerning individual efficiency that is available through the proposed DEA-based approach which views performance as a relative efficiency measure incorporating both inputs and outputs. These inputs and outputs can be objective and/or subjective—us long as they can be quantified in some way. From this perspective, salespeople who produce the highest output (i.e. sales volume, percent of quota attained, or sales manager evaluation) relative to their inputs are considered the most efficient. The current study uses four inputs (representing explicit or implicit costs to the firm) and three outputs as the basis for computing relative efficiency.

The most distinguishing feature of the proposed approach is that in computing the relative performance efficiency, the best performers are used as the bases for comparison. Comparing a salesperson's performance with that of the best performers (often referred to as benchmarking) is an important step towards achieving a salesforce oriented towards excellence (Pryor and Katz 1993). In today's competitive environment., it is important that everything a company does, including personal selling, is comparable with the leading firms in that industry. The proposed DEA-based approach provides a method to incorporate these standards in salesperson evaluation. Firms can use internal (own salesforce) or external (outside salesforce) standards as their benchmark (Camp 1992). If a firm feels that the top performer represents an unrealistic (either too high or too low) benchmark, they can incorporate their own best standard.

Conceptualizing salesforce performance in this way allows the appraisal process to simultaneously consider multiple output measures as well as the costs associated with maintaining a salesforce. Furthermore, by including input factors that are both within and outside the control of the salesperson, this method also can provide an indication of areas that a salesperson needs to improve or areas where the firm needs to make changes relative to their inputs for salespersons. This approach may be useful when the objective of the firm is to provide detailed feedback to its salespeople and also to help in making compensation decisions. It can be

used as a primary or supplemental approach to evaluating salesperson activities and is appropriate for a firm that wants to focus on minimizing inputs (costs) relative to outputs.

Data Envelopment Analysis

Data envelopment analysis (DEA) is a mathematical-programming-based method for measuring the efficiency of any process or unit that is characterized by multiple inputs and outputs. This idea is based on the engineering ratio efficiency concept. However, whereas the engineering ratio uses a single input and a single output and is absolute, DEA uses multiple inputs and multiple outputs, and is relative (compares inputs and outputs with those of the peer group). DEA basically converts multiple inputs and outputs into a single measure of performance, generally referred to as "relative efficiency."

Proposed first by Charnes, Cooper, and Rhodes (1978), DEA has been applied successfully to production functions (Banker and Maindiratta 1986), performance of school systems (Bessent et al. 1982; Chames, Cooper, and Rhodes 1981), performance of pharmacies (Banker and Morey 1986), performance of Small Business Development Centers (Lang and Golden 1989), performance of nursing homes chains (Fizel and Nunnikhoven 1993), maintenance units of US Air Force (Charnes, Cooper and Golany 1985), and performance of hospitals (Sherman 1984), to name a few. Seiford (1990) provides an excellent bibliography of DEA applications.

In the marketing literature, Charnes et al. (1985) first discussed potential applications of DEA. However, it has not been extensively applied in marketing. Kamakura, Ratchford, and Agrawal (1988) measured market efficiency and welfare loss using DEA. In other DEA applications, Mahajan (1991) examined brand operations of 33 insurance companies in a state, and Parsons (1990) studied performance of 56 salespersons of a building products manufacturer. While Mahajan examined performance of competing units (external benchmarking), Parsons looked at performance of units within a firm (internal benchmarking).

In using DEA to measure salesperson performance, we estimate the performance efficiency of a salesperson by comparing his or her inputs and outputs with the inputs and outputs of all peer salespersons. The DEA application produces an "efficient frontier" that represents the optimal levels of outputs for given levels of inputs. This efficient frontier is created by evaluating the performance of all comparable units. Observations at the efficient frontier are considered to be the most efficient. Units whose efficiency is less than one are placed inside the frontier. An observation is deemed efficient (efficiency = 1) if its output is optimal (maximum possible) for its inputs in comparison with the inputs and outputs of all comparable observations.

Efficiency is defined as the ratio of the weighted sum of outputs to the weighted sum of inputs. DEA allows for the weights to be estimated separately for each unit such that its efficiency is the maximum attainable. Mathematically, the measure of efficiency of any observation is computed as the maximum of a ratio of weighted outputs to weighted inputs, subject to the condition that similar ratios, using same weights, for all comparable units are less than or equal to one, Hence the maximum efficiency, h_o, for unit o is

$$\text{Max. ho} = \frac{\sum_{r=1}^{s} \text{Ur Yro}}{\sum_{i=1}^{m} \text{ViXio}}$$

$$\text{subject to } \frac{\sum_{r=1}^{s} \text{Ur Yrj}}{\sum_{i=1}^{m} \text{ViXij}} \leq 1 \quad j = 1, \ldots, n$$

$$\text{Ur, Vi} > 0 \quad r = 1, \ldots, s; i = 1, \ldots, m$$

Here, Yrj and Xij are the output and input observations for the j^{th} unit and Ur and Vi are the variable weights to be determined by the data of all comparable (peer group) units that are being used to arrive at the relative efficiency for the o^{th} unit. Here we haves output variables and m input variables.

In other words, for any unit (salesperson in our case), given the input observations, the proposed DEA method first computes the "maximum attainable output," which is determined by looking at the inputs and outputs of the peer group of salespeople. Then this "maximum attainable output" is compared with the "actual outputs" of the salesperson under consideration, and that individual's performance efficiency is computed. Therefore, for every salesperson, the weights Ur and Vi are computed separately to satisfy the preceding mathematical programming problem. DEA optimizes on each individual's performance in relation to the performance of all other salespeople. In comparison, regression methods perform just one optimization and obtain the "average" relationship across all salespeople.

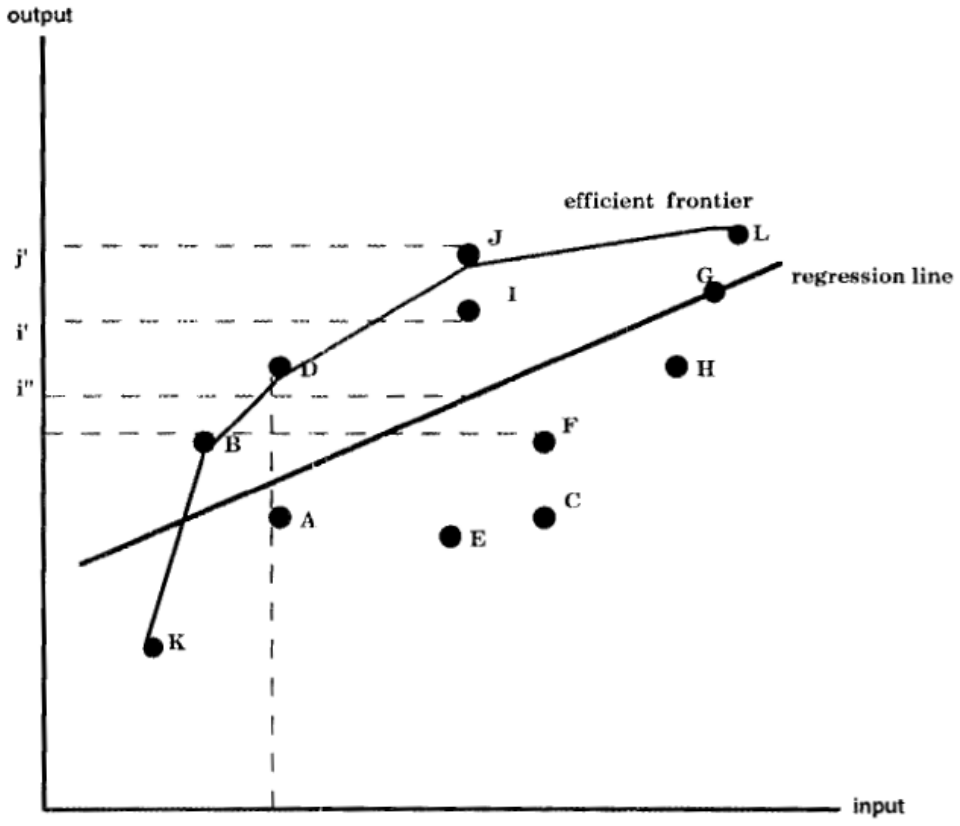

Figure 2. Illustration of Data Envelopment Analysis vs. Regression

The efficiency computed by DEA assumes that 100% efficiency is attained for a unit only when 1) none of the outputs can be increased without either increasing one or more inputs or decreasing some of its other outputs and 2) none of the inputs can be decreased without decreasing some of its outputs or increasing some of its other inputs. This definition accords with the concept of Pareto Optimality. If there is no absolute standard of efficiency, as is the case in performance evaluation, then we have to adopt a standard which refers to the levels of efficiency relative to known levels of attained efficiency by other units in similar conditions. Hence 100% efficiency is defined to have been attained by a unit only when comparisons with other relevant units do not provide evidence of inefficiency in the use of any inputs and outputs.

Figure 2 represents a hypothetical efficient frontier developed by using just one input (salary) and one output (percentage of sales quota met) of 12 salespeople (A through L). B, D, J, K, and L are on the efficient frontier because their efficiency is one. For their given input (salary) level, their output (percentage of sales quota met) is the maximum possible as determined by looking at the salary and percentage of sales quota met by all 12 individuals in the set. All other salespeople are inside the efficient frontier because their performance efficiency is less than one.

For example, D and A have the same salary; however, D has met a higher percentage of the sales quota and hence is more efficient than A. Similarly, B and F have both achieved the same quota level, but B gets much less salary than F and is deemed more efficient.

The regression line on Figure 2 is obtained by using salary as the independent variable and percentage of sales quota met as the dependent variable (a class IV approach). If we were to consider only the regression analysis, salesperson I would appear to be performing very well and to be very efficient as his or her output i' is higher than the level predicted by regression (i"). However, when we use DEA we see a different picture. I is not at peak performance in comparison with the performance of the peer group. Compared to J, who uses the same input (has same salary) as I, salesperson I has a lower output (j' vs. i'). Therefore J has an efficiency of one, whereas I has an efficiency of less than one. In regression we compare an individual's performance with mean or average performance, whereas in DEA, we compare an individual's performance with the best performance.

This example is a trivial one in the sense that we use only one input, one output and 12 observations. However, it illustrates the strength of the proposed DEA method in computing the relative performance efficiency of a salesperson and enables us to provide a pictorial representation of the efficient frontier concept. As mentioned before, DEA can handle multiple inputs and outputs with no specification of the variable importance and no specification of the functional relationship between the input and output variables.

At the individual unit level, DEA provides rich information by sensitivity analysis. Beyond the estimation of relative efficiency for each unit, DEA identifies a set of efficient reference units to form a peer group. Peer group units (whose efficiency is 100%) help in identifying the inadequacies (slacks) in the inputs/outputs of the inefficient unit. By comparing the inputs and outputs of the inefficient unit with the inputs and outputs of peer group units we can estimate the amount of slack in each of the variables. This helps the unit allocate resources more efficiently

and improve its performance. An inefficient unit may become efficient by increasing all outputs by an amount equal to its corresponding slack (i.e., move towards the efficient frontier vertically) or by decreasing all inputs by amounts equal to its corresponding slacks (i.e., move towards the efficient frontier horizontally). This issue is further illustrated in the empirical example and discussed in the Discussion section. Regression approaches may be useful when the general characteristics of performance are of interest for policy analysis or predicting future behavior of the whole salesforce. The DEA approach is more appropriate for individual level analysis and benchmarking of performances. DEA helps identify individual inefficiencies.

In summary, the main advantages of DEA-based evaluations are that:

1. DEA concurrently utilizes both output and input observations (not just output, or just input observations).
2. DEA accommodates multiple performance measures (inputs and outputs).
3. DEA explicitly takes into account the relative performance of the peer group.
4. DEA develops a relative measure of performance (efficiency) that is computed by comparing a salesperson's performance with that of the best performers (not just that of average performers as in regression).

An empirical study in the next section illustrates the proposed approach and demonstrate how it differs from other approaches.

An Empirical Application of DEA

Method

We conducted a study with the salesforce of a regional firm selling advertising to businesses. Survey instruments were distributed by the company and were returned directly to the researchers in return-mail envelopes. A second mailing was sent to persons not responding to the original request.

Survey instruments were distributed to approximately 135 salespeople. Of the salespeople who responded, 58 (43 percent) provided complete information on all measures. The average age of salespeople participating in the study was 31 years and they had an average of almost three years of sales experience with the firm. Approximately 70 percent had a college degree and 66 percent were male.

According to Moncriefs (1986) typology of industrial salespeople, this salesforce fits the role of institutional sellers. These individuals are outside salespeople who are required to do creative selling to businesses. They need to build close relationships with their customers to ensure long-term success and are responsible for developing the potential of their sales territories. The nature of the sales setting requires that the firm hire and retain top quality salespeople. Their investment in these individuals and the costs associated with fielding such a salesforce represent a considerable expense to the firm. For these reasons, our analysis focuses on several types of implicit and explicit selling costs. These variables were deemed important by the management in this sales setting, but they are used here only for illustrative purposes. A different type of sales

situation, such as missionary selling, may require that different input, and output variables be selected to maximize the usefulness of the DEA approach.

We used three output measures of performance obtained from company records. One was percentage of quota attained. A second consisted of a three-item supervisor evaluation of overall. Salesperson performance. Questions included 1) this salesperson is one of the firm's most productive, 2) this salesperson's work is excellent, and 3) this salesperson is one of the best we employ. Cronbach's alpha for this three-item measure was 0.95. The third output measure was sales volume (dollar sales value).

In addition to these output measures, we used four measures of inputs: sales training, salary, management ratio, and territory potential. All of these inputs affect the sales transaction and can represent a direct or indirect cost to the firm. Further, the fact that some of them can be "controlled" by either the individual salesperson or the firm makes their investigation meaningful. Sales training level was directly related to experience because the company provides ongoing training for all salespeople. Therefore, at the suggestion of the management, we measured it as the number of months the salesperson had been in a sales position with the firm. While salesperson salary was used as an input, any commission-based compensation that the individual received was not included since ' was not directly controlled by the firm but was based on actual sales volume.

A ratio of managers to salespeople was computed by dividing the number of managers in an office by the number of salespeople in that office. The management felt that territory potential was related directly to the level of business activity, which is a function of the population. Hence, we computed territory potential by dividing the population of each territory by the number of salespeople assigned to that area. Other firms and situations may use alternative operationalization of territory potential. The above operationalization of territory potential was unique to just this one firm being investigated.

Data Analysis

We evaluated the performance of the 58 salespersons in the database by each of the five classes of approaches discussed previously. The salesperson rankings (in descending order of performance) obtained by the five classes of approaches are reported in Table 2. The class I rankings were obtained by using one output measure-percentage of sales quota met. This absolute approach may not provide the best evaluation of a salesperson's performance because it ignores the inputs used to attain the level of output. For example, salesperson 38, who ranks 1 on the basis of percentage of sales quota met, may have received a great amount of training, may be highly paid, and may work in a rich territory. Hence, he or she may not the be the best salesperson when we take all of these factors (inputs) into account. The class II rankings were obtained by using one input measure-sales training. Similar to class I approaches, this absolute rating may not provide the best evaluation of a salesperson's perforn1ance because it ignores the outputs obtained as a result of the input. Using sales training, salesperson 19 was ranked 1.

Table 2. Ranking of Salespersons by Five Classes of Approaches

Rank	Class I	Class II	Class III	Class IV	Class V	Rank	Class I	Class II	Class III	Class IV	Class V
	Salesperson identification number						Salesperson identification number				
1	38	19	48	45	7	**30**	58	35	53	58	48
2	11	20	31	19	20	**31**	30	55	57	55	37
3	31	25	41	11	19	**32**	34	47	18	4	22
4	26	31	42	7	38	**33**	50	27	56	5	25
5	19	38	30	18	55	**34**	36	33	14	1	1
6	25	42	40	38	45	**35**	55	34	15	53	54
7	22	11	36	25	10	**36**	56	43	58	34	4
8	2	45	26	20	36	**37**	14	18	34	21	50
9	18	7	32	33	8	**38**	40	5	39	35	18
10	45	48	23	10	46	**38**	21	46	35	54	15
11	41	2	20	8	29	**40**	28	1	55	30	56
12	48	9	43	26	5	**41**	47	4	27	28	53
13	53	22	12	49	11	**42**	54	12	54	56	12
14	49	32	22	46	33	**43**	35	14	38	47	34
15	8	10	6	22	31	**44**	1	6	16	14	16
16	9	3	17	32	9	**45**	5	44	4	29	24
17	20	13	29	3	2	**46**	16	51	37	40	14
18	32	23	9	43	26	**47**	29	57	7	27	41
19	7	26	25	2	30	**48**	27	52	24	16	58
20	23	28	33	36	42	**49**	24	29	50	24	28
21	43	21	28	42	51	**50**	15	37	46	44	13
22	46	17	52	9	3	**51**	57	36	2	12	44
23	42	41	47	31	49	**52**	39	16	10	39	27
24	10	30	21	17	32	**53**	12	24	5	15	6
25	3	50	3	50	52	**54**	44	44	45	52	23
26	4	49	49	13	17	**55**	52	15	1	57	40
27	13	58	11	41	43	**56**	51	39	8	51	21
28	33	8	51	48	57	**57**	37	54	19	37	35
29	17	53	13	23	47	**58**	6	6	44	6	39

The class III rankings in Table 2 are based on percentage of sales quota met in relation to training level (though any input measure could be used). This measure is superior to the class I and II approaches because now we are adjusting the percentage of sales quota met by an input variable that may directly affect performance and has a cost for the firm. Here the rankings have changed completely. For example, salesperson 48, who previously was ranked 12, is now ranked 1 (highest performer). Salesperson 38, who appeared to be the best performer when we considered only one output measure, is now ranked 43. Hence, it is clear that salesperson 38 met a high level of the sales quota by utilizing a great amount of input (sales training in this case).

Class III approaches could he further strengthened by using multiple measures of inputs and outputs, hut for simplicity of illustration, we used just one measure of each.

The class IV rankings in Table 2 were estimated by using the efficiencies computed as the ratio of "output attained" to "attainable output" (as predicted by regression), then re-scaling to a 0 to 1 scale. The dependent measure was percentage of sales quota met and the independent variables were the four input variables. Interestingly, salesperson 45 is ranked 1, whereas salesperson 48 (who was ranked 1 in class III approach) is ranked 28 and salesperson 38 (who was ranked 1 in class I approach) is ranked 6.

Finally, the class V rankings in Table 2 were obtained by using the proposed DEA approach. The main difference between this approach and the regression approach is that now we compute efficiencies by comparing a salesperson's performance with that of the best performers, not that of average performers as in regression. We use multiple (three) output variables (percentage of sales quota met, dollar sales value, and supervisor evaluation) and multiple (four) input variables (sales training, salary, manager ratio, and territory potential). By this class V approach (DEA), salesperson 7 is ranked best (number 1).

The rank order correlations of the salespeople rankings using the five approaches are shown in Table 3. From these correlations it is clear that the evaluation approaches are providing very different rankings. Interestingly. the rank order produced by DEA (class V) is closest to the regression (class IV) and very different from those obtained using single measures of performance (class I and II).

Table 3. Correlations of Salesperson Rankings by Five Classes of Approaches

	CLASS I	CLASS II	CLASS III	CLASS IV
CLASS II	.32			
CLASS III	.64	.10		
CLASS IV	.14	.24	.20	
CLASS V	.06	.20	.28	.44

The proposed DEA (class V) based method may be a conceptually powerful approach in many cases. There is obviously no way of knowing the actual (true) performance (or rankings) of the salespersons (Naylor 1983) in any study, so we cannot show empirically the superiority of the proposed approach. In fact, if we know the true performance (or rankings) of the salespeople then there is no need of developing alternative approaches to salesforce evaluation (such as Class

I, II, III, IV, and V). Moreover, as discussed before, DEA is a Pareto optimal method, and as there is no absolute standard of efficiency for salespeople, we have to adopt a standard which refers to the levels of efficiency relative to known levels of attained efficiency by other salespersons (within or outside the firm) in similar conditions. Hence 100% efficiency is defined to have been attained by a salesperson only when comparisons with other relevant salespersons (internal or external) do not provide evidence of inefficiency in the use of any inputs and outputs.

Using simulated data, some researchers in Operations Research and Management Science (e.g., Bowlin et al. 1985; Banker, Gadh, and Gorr 1993) have shown the DEA approach to be superior. To obtain face validity for the proposed approach, we showed the rankings to a salesforce supervisor of the company. This individual did not find the rankings unusual. Most of the salespeople who were considered "stars" were ranked highly by our proposed approach.

Individual level analysis also was performed using DEA. Table 4 provides the summary results for salesperson 22. Similar tables can be obtained for every one of the 58 salespersons in the database. The main aim of this empirical application is illustration of the DEA method and hence we discuss the individual level results of one person only. Also, space limitations make discussion of 58 individual level results impossible.

Table 4. Summarized Results for Salesperson 22

Efficiency = 0.85	Iterations = 10

Variable Type	Variable Name	Value Measured	Value if Efficient	Slack
Output	Percent Quota Attained	100	120	20
Output	Superior Evaluation	5	5	0
Output	Sales Volume ($)	45,000	50,500	5,500
Input	Sales Training	5	5	0
Input	Salary	20,000	18,000	2000
Input	Management Ratio	3	2	1
Input	Territory Potential	60,500	50,000	10,500

Reference Set	
	Influence
Salesperson 7	0.49
Salesperson 20	0.43
Salesperson 45	0.08

From Table 4 we note the relative efficiency of salesperson 22 is 0.85. This was achieved after 10 iterations of the algorithm. Columns 1 and 2 indicate the variable-type and variables used in the analysis. Column 3 has the actual inputs and outputs recorded for salesperson 22, while column 4 has the levels of these variables if the salesperson 22 had 100% efficiency. This is computed by looking at this person's peer groups (salespersons 7, 20, and 45) which are indicated at the bottom of the results table. The influence of each of the peer group salesperson is also indicated at the bottom (influence of salespersons 7, 20, 45 in computing the efficiency of salesperson 22 was 0.49, 0.43 and 0.08, respectively). Column 5 presents the difference between the recorded inputs/outputs (column 3) and achievable inputs/outputs (column 4) for salesperson 22, This is often referred to as the slack and gives an indication of where the inputs and outputs may be improved.

For example, salesperson 22 should have achieved 20% more of quota and sold additional $5,500 worth of goods or should have made $2000 less salary, have one less managerial support person and worked in a territory with 10,500 less population to achieve 100% efficiency. All of this is based on comparing performances (inputs and outputs) of salesperson 22 with those of salespersons 7, 12 and 40. These salespeople can be considered role models for salesperson 22 because they worked in similar conditions yet achieved 100% efficiency. Given the above recommendations to become efficient, it is clear that some salespeople will never achieve efficiency of 100% as all recommendations are not achievable. Salesperson 22 may be able to improve some outputs or inputs by the slack amount, but, some suggested improvements may not be feasible. For example, it may be impossible to reassign the salesperson 22 to a lower potential territory or reduce management support by one to improve his/her efficiency. However, we still get a good idea of the dynamics involved and this sensitivity analysis can be further used for resource allocation and training decisions as discussed in the next section.

In the above sensitivity analysis, it is also possible to try alternative formulations of the objective function. For example, output maximization or input minimization (Charnes et al. l985). Depending on the situation, some formulations may be more meaningful than others. Here, the general sensitivity analysis was shown in Table 3 for illustrative purposes only. Banker and Morey (1986) provide algorithms where some inputs may be held constant, or some inputs may be categorical.

Discussion

Salesperson evaluation is a complex task because a wide range of factors influence the performance of an individual's sales activities. Various firms may require different tasks and/or behaviors from their salesforce which require different approaches to performance assessment. For some organizations, effectiveness (doing the right thing), which might include selling as much volume as possible, is the primary task, while another firm may focus on efficient operation (doing things right)- such as keeping costs per sale as low as possible while still meeting or exceeding quota (Parsons 1994). Still other companies may value effectiveness and efficiency equally. In the current economic environment, competitive pressures require many firms to be efficient in all aspects of operating a business.

We propose the data envelopment analysis (DEA) technique as one way to achieve a measure of relative (to best) performance efficiency. Our empirical example demonstrates how performance evaluations for the same person can vary depending on which assessment method is used. The proposed relative efficiency-based assessment method offers another alternative that, in some instances, may be able to solve problems firms encounter when evaluating salesperson performance.

Calculating salesperson performance efficiency as a form of evaluation addresses several issues of concern in today's business environment. First, many firms are "downsizing" or "right-sizing" as they attempt to cut costs and better allocate resources in their drive to become more competitive. By calculating salesperson performance on the basis of valuable inputs such as salary or supervision requirements: a company can determine which salespeople are using scarce

resources most efficiently. Second, evaluating salespeople on an efficiency basis enables a firm to incorporate multiple inputs (the levels of which may differ greatly among salespeople) into the evaluation process. DEA also allows the use of multiple output measures. We used sales volume, percentage of sales quota attained, and supervisor evaluations as the outputs, but some firms will find others to be equally valuable (e.g., number of new accounts opened or customer ratings of the salesperson).

Sales Management Implications

An evaluation based on DEA should be appealing to sales managers because it is relative and the performance of a salesperson is computed by comparing his or her work with that of the best performer. The emphasis is on moving away from average performers and trying to emulate the best. The idea of comparing an individual with the best, as opposed to the average, is analogous to the benchmarking concept. Benchmarking compares individuals or organizations to the best performers either within or even outside their organization to determine their performance level. For example, even if your firm's best salesperson appears to exhibit outstanding performance, DEA would allow the firm to establish a hypothetical "best" salesperson based on an external standard. This would ensure that the best performer in the firm is not mediocre. To improve salesforce performance it may be necessary to compare salespeople to the most efficient performers, not just those with high levels of output (Cravens, Holland, Lamb, and Moncrief 1988; Parsons 1994).

The DEA technique has been employed successfully in several fields. Sales managers, whose goals stress cost containment as well as output measures of performance, should consider adopting this efficiency-based method of evaluation — either as their primary evaluation approach or in conjunction with other assessment methods. For example, a company may want high levels of sales volume but also be concerned with efficiency. Salespeople could be rewarded based on sales volume as well as their efficiency in producing that volume. Thus, those individuals that produce a high sales volume also would be concerned with how they produced that level of sales.

The advantage of DEA over other evaluation approaches is that it enables a manger to understand which salespeople respond most efficiently to a given level of resources. It does not use the input measures solely to predict which salesperson will produce the most absolute outputs. Instead, it provides a relative performance measure developed by comparing each individual with the top performer.

DEA is an assessment approach that can aid managers in making fair evaluations of their salespeople. The method does not use one standard of performance to evaluate all salespeople. The performance standard (i.e., efficiency) is different for various levels of inputs. Hence, salespeople may be inclined to feel that no salesperson is getting away with a low standard in comparison with his or her capabilities.

The method can be used to accurately identify areas in need of specific improvement. For instance, suppose a firm provides ongoing sales training for all salespeople; however, DEA indicates that salespeople receiving training beyond a year tend to be less efficient than those that

have one year of training This firm may be able to reduce their training budget without having a detrimental effect on any important output measures, and thereby increase the firm's bottom line.

The flexibility of DEA makes it an excellent tool for prescriptive evaluation since it specifically indicates to a sales manager where each salesperson is not performing at maximum efficiency. Sales managers may find that some salespeople need more of certain inputs than others. For example, a relatively inexperienced salesperson may need considerable supervision during her or his initial work in sales, while an experienced salesperson may need very little supervision.

Use of a DEA approach to performance evaluation would encourage salespeople to work smarter rather than harder by encouraging them to use their time and effort (inputs that arc in their control) more efficiently so as to generate maximum outputs. A salesperson would realize that what matters in his or her evaluation are the outputs generated in comparison with not only his or her inputs, but also those of his or her peers. The absolute amount of inputs or outputs would no longer be a basis of evaluation. Salespeople could not assume that if they put in a certain amount of input toward a certain output their performance will be rated as superior. They need to match or exceed the efficiency of the best performer in their peer group. In addition to a firm giving salespeople incentives to exceed quota, the DEA method can give them incentives to constantly perform efficiently.

DEA could be an appropriate evaluation tool for many sales organizations. It may be particularly useful for firms whose salespeople have different backgrounds (i.e., personal inputs) or who are exposed to different selling environments (i.e., external inputs) that can influence performance. Diversified companies that market a range of products to different segments of customers also can benefit from this approach. Even if segments of the salesforce have differentiated needs, DEA can still provide efficiency reports. This approach would enable managers to objectively incorporate individual and situational differences into the evaluation process.

Uses and Limitations

A company that decides to use the proposed method will choose input and output measures that accurately reflect that firm's goals, objectives, and sales situation. The choice of the input and output variables is critical to the successful application of this technique. Moncriefs (1986) typology may provide a starting point to suggest inputs and outputs a firm should consider when using DEA in the salesperson evaluation process. Activities that are most often performed by salespeople and are critical to their success would be a good choice to include in the selection of input and output measures for analysis. Input and output variables should be selected such that no individual salesperson is penalized. For example, if some salespeople take a lot of risk, and invest considerable time to pursue big accounts, then that variable (e.g., level of risk taking) should be included in the model.

DEA is a fairly complex methodology and some firms may find communication of the results to be tedious. It may make sense to first use- DEA as a supplementary evaluation tool. Initially, DEA results may be used for counseling salespeople as to how they can improve their efficiency. Over time, as the salesforce gets used to the relative efficiency concept, the firm may start using DEA as the primary evaluation tool. Firms also need to take great care in measuring the input

and output variables. DEA can be very sensitive to measurement errors. While DEA does not have any minimum and maximum restrictions on how many entities may be evaluated, the analysis becomes cumbersome as the number of entities being evaluated becomes large. Past applications have used as few as 10 and as many as 500 entities in DEA analysis.

DEA does not allow the user to specify any weighting scheme for the input and output variables. The methodology assigns the optimal weight to the variables in order to maximize the estimated efficiency.

Conclusion

A performance evaluation method incorporating both input and output measures, such as DEA, may be useful to firms that are interested in the efficient use of all resources in the sales environment. In reporting the results of our study, we bring such a method to the attention of sales managers. However, our application has certain limitations. First, it is based on inputs and outputs that may not be of interest to all firms. Second, the sample is from one firm. However, because the purpose of our study was to illustrate a new approach to salesperson performance evaluation, these limitations should not be a major problem.

Organizations that are not concerned about inputs and their effect on performance will find other evaluation methods equally appropriate. These might include firms that use independent contractors as salespeople and reward them on a commission only basis (i,e., real estate). These firms would not be overly concerned about the salesperson's inputs since the firm would only pay based on results and is often not responsible for selling expenses. In these instances some form of output measures alone may be sufficient to assess salesperson performance.

Salesforce performance evaluation is not only very important, but also highly complex and challenging. Some firms may find the approach we propose useful in making this task more conceptually sound and easy to execute.

References

Adkins, Robert T. (1979), "Evaluating and Comparing Salesmen's Performance," *Industrial Marketing Management,* 8 (August), 207-12.

Anderson, Erin and Richard L. Oliver (1987), "Perspectives on Behavior-Based Versus Outcome-Based Salesforce Control Systems," *Journal of Marketing,* 51 (October), 76-88.

Avila, Ramon A., Edward F. Fern, and O. Karl Mann (1988), "Unraveling Criteria for Assessing the Performance of Salespeople," *Journal of Personal Selling and Sales Management,* 8 (May), 45-54.

Bagozzi., Richard P. (1978), "Salesforce Performance and Satisfaction as a Function of Individual Difference, Interpersonal, and Situational Factors," *Journal of Marketing Research,* 15 (November), 517-31.

——— (1980), "Performance and Satisfaction in an Industrial Sales Force: An Examination of Their Antecedents and Simultaneity," *Journal of Marketing,* 44 (Spring), 65-77.

Banker, R. D. and A. Maindiratta (1986), "Piecewise Loglinear Estimation of Efficient Production Surfaces," *Management Science,* 32 (January), 126-35.

——— and R. D. Morey (1986), "The Use of Categorical Variables in Data Envelopment Analysis," *Management Science,* 32 (December), 1613-27.

———, Vandana M. Gadh, and Wippen L. Gorr (1993), "A Monte Carlo Comparison of Two Production Frontier Estimation Methods," *European Journal of Operational Research,* 67, 332-343.

Behrman, Douglas N., William Biggoness, and William Perreault (1981), "Sources of Job Related Ambiguity and Their Consequences Upon Salespersons Job Satisfaction and Performance," *Management Science,* 27 (November), 1246-60.

——— and William D. Perreault (1982), "Measuring the Performance of Industrial Salespersons," *Journal of Business Research,* 10 (October), 355-70.

——— and ——— (1984), "A Role Stress Model of the Performance and Satisfaction of Industrial Salespersons," *Journal of Marketing,* 48 (Fall). 9-21.

Bessent, A., W. Bessent, J. Kennington, and B. Regan (1982), "An Application of Mathematical Programming to Assess Productivity in the Houston Independent School District," *Management Science,* 28 (December), 1355-67.

Beswick, Charles A. and David W. Cravens (1977), "A Multistage Decision Model for Salesforce Management," *Journal of Marketing Research,* 14 (May), 135-44.

Bowlin, W. F., A. C. Cham.es, W.W. Cooper, and H. D. Sherman (1985), "Data Envelopment Analysis and Regression Approaches to Efficiency Estimation and Evaluation," *The Annals of Operations Research,* 2, 113-38.

Brown, Stephen P., William L. Cron, and Thomas W. Leigh (1993), "Do Feelings of Success Mediate Sales Performance-Work Attitude Relationships?" *Journal of the Academy of Marketing Science,* 21 (Spring), 91-100.

Busch, Paul and Ronald F. Bush (1978), "Women Contrasted to Men in the Industrial Salesforce: Job Satisfaction, Values, Role Clarity, Performance, and Propensity to Leave," *Journal of Marketing Research,* 15 (August), 438-48.

Bush, Ronald F. and Paul Busch (1981-82), "The Relationship of Tenure and Age to Role Clarity and Its Consequences in the Industrial Salesforce," *Journal of Personal Selling and Sales Management,* 1 (Fall/Winter), 17-23.

Bush, Robert P., Alan J. Bush, David J. Ortinau and Joseph F. Hair, Jr. (1990), "Developing a Behavior-based Scale to Assess Retail Salesperson Performance," *Journal of Retailing,* 66 (Spring), 119-136.

Camp, Robert C. (1992), "Learning from the Best Leads to Superior Performance," Journal of Business Strategy, 13 (May-June), 3-6.

Charnes, A.C., W.W. Cooper and E. Rhodes (1981), "Evaluating Program and Managerial Efficiency; An Application of Data Envelopment Analysis to Program Follow Through," *Management Science,* 27 (June), 668-97.

———, ——— and ——— (1978), "Measuring Efficiency of Decision Making Units," *European Journal of Operations Research,* 2, 429-49.

——— and B. Golany (1985), "A Developmental Study of Data Envelopment Analysis in Measuring The Maintenance Units in the U.S. Air Forces,"' *The Annals of Operations Research,* R. Thompson and R. M. Trall (eds.), V 2, 95-112.

Churchill, Gilbert A. Jr., Neil M. Ford, Steve W. Hartley and Orville C. Walker, Jr. (1985), "The Determinants of Salespersons Performance: A Meta Analysis,"' *Journal of Marketing Research,* V22 (May), 103-118.

———, ———, and Orville C. Walker, Jr., (1990), Sales Force Management, 3rd, Homewood, IL: Irwin.

Cocanaugher, A. Benton and John M. Ivancevich (1978), "BARS Performance Rating for Sales Force Personnel,"' *Journal of Marketing,* 42 (July), 87-95.

Cox, William E. and George N. Havens (1977), "Determination of Sales Potentials and Performance for an Industrial Goods Manufacturer,"' *Journal of Marketing Research,* 14 (November), 574-8.

Cravens, David W., Raymond W. Laforge, Gregory M. Pickett, and Clifford E. Young (1993), "Incorporating a Quality Improvement Perspective into Measures of Salesperson Performance," *Journal of Personal Selling and Sales Management* 13 (Winter), 1-14,

——— and Robert B. Woodruff (1973), "An Approach for Determining Criteria of Sales Performance," *Journal of Applied Psychology,* 57 (3), 242-47.

———, ———, and Joe C. Stamper (1972), "An Analytical Approach for Evaluating Sales Territory Performance," *Journal of Marketing,* 36 (January), 31-37.

———, Charles W. Holland, Charles W. Lamb Jr., and William C. Moncrief. III (1988), "Marketing's Role in Product and Services Quality,"' *Industrial Marketing Management,* 17, 285-304.

Crosby, Lawrence A., Kenneth R. Evans, and Deborah Cowles (1990), "Relationship Quality in Services Selling: An Interpersonal Influence Perspective," *Journal of Marketing,* 54 (July), 68-81.

Dalrymple, Douglas J. and William M. Strahle (1990), "Career Path Charting: Framework for Salesforce Evaluation," *Journal of Personal Selling and Sales Management,* 10 (Summer), 59-68.

Drucker, Peter F (1974), Management: *Tasks, Responsibilities, and Practices,* New York: Harper & Row.

Dubinsky, Alan J., and Steven W. Hartley (1986), "A Path-Analytic Study of a Model of Salesperson Performance," *Journal of the Academy of Marketing Science,* 14 (Spring), 36-46.

Duhan, Dale F (1975), "A Taxonomy of Marketing Productivity Measures," in Proceedings of American Marketing Association, Robert F. Lusch et al. (eds.), 229-232.

Eichel, E. and H. E. Bender (1984), *Performance Appraisal: A Study of Current Techniques,* New York: American Management Association.

Fizel, John L. and Thomas S. Nunnikhoven (1983), "The Efficiency of Nursing Home Chains," *Applied Economics,* V 25, 49-55.

Futrell, Charles and A. Parasuraman (1984), "The Relationship of Satisfaction and Performance to Sales force Turnover." *Journal of Marketing,* 48 (Fall), 33-40,

Goolsby, Jerry R., Rosemary R. Lagace, and Michael L. Boorom (1992), "Psychological Adaptiveness and Sales Performance," *Journal of Personal Selling and Sales Management,* 12 (Spring), 51-66.

Hampton. Ron, Alan J. Dubinsky, and Steven J. Skinner (1986), "A Model of Sales Supervisor Leadership Behavior and Retail Salespeople's Job-Related Outcomes.," *Journal of the Academy of Marketing Science,* 14 (Fall), 33-42.

Hastings, Bill, Julia Kiely, and Trevor Watkins (1988), "Sales Force Motivation Using Travel Incentives: Some Empirical Evidence; *Journal of Personal Selling and Sales Management,* 8 (August), 43-51.

Jackson, Donald W., Jr., Janet E. Keith, and John L. Schlueter (1983), "Evaluation of Selling Performance: A Study of Current Practices," *Journal of Personal Selling and Sales Management,* 3 (November), 42-51.

Kamakura, Wagner A., Brian T. Ratchford, and Jagdish Agrawal (1988), "Measuring Market Efficiency and Welfare Loss,"' *Journal of Consumer Research,* 15 (December), 280-302.

Kerber, Kenneth W. and James P. Campbell (1987), "Correlates of Objective Performance Among Computer Salespeople: Tenure, Work Activities and Turnover," *Journal of Personal Selling and Sales Management,* 7 {November), 39-50.

Kohli, Ajay K (1989), "Effects of Supervisory Behavior: The Role of Individual Differences Among Salespeople," *Journal of Marketing,* 53 (October), 40-50.

Lagace, Rosemary R. (1991), "An Exploratory Study of Reciprocal Trust Between Sales Managers and Salespersons," *Journal of Personal Selling and Sales Management,* 11 (Spring), 49-58.

Lamont, Lawrence A. and William J. Lundstrom (1977), "Identifying Successful Industrial Salesmen by Personality and Personal Characteristics," *Journal of Marketing Research,* 14 (November), 517-529.

Landy, Frank J. and James L. Farr (1983), The Measurement of Work Performance: *Methods, Theories and Applications,* New York: Academic Press.

Lang, James R. and Peggy A. Golden (1989), "Evaluating the Efficiency of SBDCS with Data Envelopment Analysis: A Longitudinal Approach," *Journal of Small Business Management,* 27 (April), 42-9.

Levy, Michael and Arun Sharma (1993), "Relationships Among Measures of Retail Salesperson Performance," *Journal of the Academy of Marketing Science,* forthcoming.

Lucas, Henry C., Jr., Charles B. Weinberg, and Kenneth W. Clowes (1975), "Sales Response as a Function of Territorial Potential and Sales Representative Workload," *Journal of Marketing Research,* 12 (August), 298-305.

Mahajan, Jayashree (1991), "A Data Envelopment Analytic Model for Assessing the Relative Efficiency of the Selling Function," *European Journal of Operational Research,* 53, 180-205.

Moncrief, William. C., II (1986), "Selling Activity and Sales Position Taxonomies for Industrial. Salesforce," *Journal of Marketing Research,* 23 (August), 261-270.

Mowen, John C., Janet E. Keith, Stephen W. Brown, and Donald W. Jackson, Jr. (1985), "Utilizing Effort and Task Difficulty Information in Evaluating Salespeople," *Journal of Marketing Research,* 22 (May), 185-91.

Naylor, James C. (1983), "Modeling Performance," in *Performance Measurement and Theory,* Landy, Frank, Sheldon Zedeck and Jeanette Clevland (eds.), Hillsdale, NJ: Lawrence Erlbaum Associate Publishers.

Parsons, Leonard J. (1994), "Marketing Productivity Versus Relative Efficiency: Past and Future," in *Research Traditions in Marketing,* G. Lilien, G. Laurent, and B. Pras (eds.), Amsterdam: Kluwer,

——— (1990), "Assessing Salesforce Performance with Data Envelopment Analysis," paper presented at TIMS Marketing Science Conference, University of Illinois, Urbana.

Porter, Lyman W., Edward E, Lawler, III, and J. Richard Hackman (1975), *Behavior in Organizations,* New York: McGraw Hill.

Pryor, Lawrence- S. and Steven J. Katz (1993), "How Benchmarking Goes Wrong (And How to do it Right)," *Planning Review,* (Jan-Feb), 6-11.

Pruden, Henry O. and Richard M. Reese (1972), "Interorganizntion Role-Set Relations and the Performance and Satisfaction of Industrial Salesmen.," *Administrative Science Quarterly,* 17 (4), 601-09.

Pym, D. S. A. and H. D. Auld (1965) "The Self-Rating as a Measure of Employee Satisfaction, *Occupational Psychology,* 39, 103-113.

Ryans, Adrian and Charles Weinberg (1979), "Territory Sales Response," *Journal of Marketing Research,* 16 (November), 453-65.

Sager, Jeffrey and Rajan Varadarajan (1990), "'The Fine Art of Performance Appraisal: The Art of Overkill," *Akron Busi*ness *and Economic Review,* 21 (Spring), 38-50.

Sciford, Larry (1990), "A Bibliography of Data Envelopment Analysis," University of Massachusetts, working paper.

Sherman, H. D. (1984), "Data. Envelopment Analysis as a New Managerial Audit Methodology—Test and Evaluation," *Auditing,* 4 (1), 35-53.

Sokol, Michael and Robert Oresick (1986), "Managerial Performance Appraisal" in *Performance Assessment: Methods and Applications,* Ronald A. Berk (ed.), Baltimore: Johns Hopkins University Press.

Spiro, Rosann L. and Barton A. Weitz (1990), "Adaptive Selling: Conceptualization, Measurement, and Nomological Validity," *Journal of Marketing Research,* 27 (February), 61-69.

Tanner, John F. Jr. and Stephen B. Castleberry (1990), "Vertical Exchange Quality and Performance: Studying the Role of the Sales Manager," *Journal of Personal Selling and Sales Management,* 10 (Spring), 17-27.

Tyagi, Pradeep K. (1985), "Relative Importance of Key Job Dimensions and Leadership Behaviors in Motivating Salesperson Work Performance," *Journal of Marketing,* 49 (Summer), 76-86.

Walker, Orville C, Jr., Gilbert A. Churchill, Jr., Neil M. Ford (1979), "Where Do We Go From Here: Selected Conceptual and Empirical Issues Concerning the Motivation and Performance of Industrial Salesforce," in *Critical Issues in Sales Management,* Gerald Albaum and Gilbert A. Churchill, Jr. (eds.), Eugene: University of Oregon Press.

Weeks, William A. and Lynn R. Kahle (1990), "Salespeople's Time Use and Performance," *Journal of Personal Selling and Sales Management,* 10 (February), 29-37.

Weitz, Barton A. (1978), "Relationship Between Salesperson Performance and Understanding of Customer Decision Making." *Journal of Marketing Research,* 15 (November), 501-16.