Measurement Technology Applications in Performance Appraisal

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Abstract. Every employee needs a credible performance appraisal system. By using psychometric methods and computer technology, the process of developing such a system can be more efficient and demonstrably successful. This article raises issues that relate to changing the performance appraisal system and gives a clear, step-by-step description of how computerized, statistical procedures were applied in improving employee performance appraisal. This paper demonstrates how data envelopment analysis (DEA) can be applied as a fair evaluating and sorting tool to support the performance appraisal (PA) as well in the decision making process. DEA focuses on the best practices of efficient employees for the purpose of improving overall performance. Unlike traditional performance appraisals DEA searches for the efficient employees who will serve as peers. The DEA process identifies inefficient employees, magnitude of inefficiency and aids to eliminate inefficiencies with a relatively easy to employ framework. This study supports the ideas that rating formats need re-examination with a focus on computer based models as an alternative to traditional rating methods.

1. Introduction

The information collected from performance measurement is typically used for compensation, performance improvement or management (e.g., personnel decision making), and documentation. Performance data are often used for staffing decisions (e.g., promotion, transfer, discharge, layoffs), and this is where the entire PM system may fall under the scrutiny of the courts. PA is also used for training needs analysis, employee development, and research and program evaluation (e.g., validation research for selection methods).

Performance Appraisal and Compensation. Performance appraisal information is often used by supervisors to manage the performance of their employees. Appraisal data can

reveal employees' performance weaknesses, which managers can refer to when setting goals or target levels for improvements. A performance management system should include a diagnostic component where an evaluator attempts to explain a performance level based on a performer's traits, competencies, abilities, or motivations. But an effective PM system should first measure the performance level as accurately as possible and then attempt to explain the obtained level based on a performer's characteristics (competencies, KASOCs). One of the strongest trends in this country is toward some form of pay-for-performance (PFP) system. The important area of pay-for-performance is a critical component for effective compensation and, as evidenced by the economic meltdown of 2008, an HR functions with the potential to destroy an otherwise effective corporation.

The development of performance appraisal has four distinct phases. It is called TEAM (Technical, Extended, Appraisal and Maintenance) approach [10].Performance Appraisal is reviewing past performance, rewarding past performance, goal setting for future performance and employee development [14].Employee's appraisal system may be considered one of the indicators of the quality of Human Resource Management in an organization. Properly designed and realized process of employees appraisal is not only the necessary basis of successful employee performance management, but also provides valuable information for other human resource management functions [2].

2. Different Techniques of Performance Appraisal

There are two types of measures are used in performance appraisal: Objective measures which are directly quantifiable and Subjective measures which are not directly quantifiable. Performance Appraisal can be broadly classified into two categories: Traditional Methods and Modern Methods.

2.1. Traditional Methods

Traditional Methods are relatively older methods of performance appraisals. This method is based on studying the personal qualities of the employees. It may include knowledge, initiative, loyalty, leadership and judgment.

2.1.1. Ranking Method

According to Dessler et al. (2011), ranking method is ranking employees from best to worst on a particular trait, choosing highest, then lowest, until all ranked [5].

2.2.2. Graphic Rating Scales

In 1922, Paterson working with the employees of the Scott Company developed a graphic scale to provide the reliability, consistency over time, usefulness and practicality. Bradshaw in 1931 discussed improvements to the graphic rating scale that included "behaviourism" to anchor the scales and help better illustrate the trait [3]. In 1972, Flynn told that the five to nine scale points result in the highest quality of ratings.

2.2.3. Critical Incident Method

The technique was formally codified by the works of Fitts and Jones in 1947 for classifying pilot error experiences in reading and interpreting aircraft instruments. Fitts

and Jones used the term "errors" rather than "critical incidents". Flanagan (1954) defined the critical incident technique as a set of procedures designed to describe human behavior by collecting description of events having special significance and meeting systematically defined criteria.

2.2.4. Narrative Essays
Evaluator writes an explanation about employee's strength and weakness points, previous performance, positional and suggestion for his (her) improvement at the end of evaluation time. This technique mainly attempt to focus on behavior [7].

2.3. Modern Methods
Modern Methods were devised to improve the traditional methods. It attempted to improve the shortcomings of the old methods such as biasness, subjectivity, etc.

2.3.1. Management by Objectives
In1954, Peter F. Drucker introduced "Management by Objective" in his book "The Practice of Management". It comprises of three building blocks: object formulation, execution process and performance feedback. In 2000, Weihrich suggested a new model: the system approach to MBO (SAMBO). SAMBO comprises seven elements: strategic planning and hierarchy of objects, setting objectives, planning for action, implementation of MBO, control and appraisal, subsystems, and organizational and management development.

2.3.2. Behaviourally Anchored Rating Scale (BARS)
BARS were introduced by Smith and Kendall in 1963 with the attention of researchers concerned with the issue of reliability and validity of performance ratings. Behavioural anchor scales are more informative than simple numbers. Behaviourally anchored performance dimensions can be operationally and conceptually can be distinguished from one another [12]. Ratter will act as observer not the judge. BARS help ratter focus on specific desirable and undesirable incidents of work behaviour which can serve as examples in discussing a rating. BARS use behavioural statements or concrete examples to illustrate multiple levels of performance for each element of performance [6].

2.3.3. Humans Resource Accounting
The concept of human resource accounting was first developed by Sir William Petty in 1691.But research into true human resource accounting began in the 1960 by Rensis Likert. Prof. Flamholtz defines human resource accounting for people as an organizational resource. The main theory underlying the HRA is: The people are valuable resources of an organization or enterprise, information on investment and value of human resource is useful for decision making in the organization [15].

2.3.4. Assessment Centers
The assessment center method, in its modern form, came into existence as a result of AT & T Management Progress Study by Bray, Campbell & Grant in 1974.Common job simulations used in assessment centers are in basket exercises, group discussions, and simulations of interviews with "subordinates" or "clients", fact finding exercises, analysis/decision making problems, oral presentation exercises, written communication exercises [4].

2.3.5. 360 Degree
It is a popular performance appraisal technique that involves evaluation input from multiple levels within the firm as well as external sources.360 Degree feedback relies on the input of an employee's superior, colleagues, subordinates, sometimes customers, suppliers and/or spouses[7].It provides people with information about the effect of their action on others in the workplace. It provides a notion of behavioural change might be elicited through a process of enhanced self awareness [6].

2.3.6. 720 Degree
Rick Gal breath became dissatisfied with 360 degree reviews. Gal breath started using the 720 degree and defined it as a more intense, personalized and above all greater review of the upper level managers that brings in the perspective of their customers or investors, as well as subordinates. 720 degree review focuses on what matter most, which is the customer or investor perception of their work . When the 360-Degree appraisal is done, then the performance of the employee is evaluated and having a good feedback mechanism, the boss sits down with the employee again a second time and gives him feedback and tips on achieving the set targets.

From this we conclude that there are many techniques that used for performance appraisal. It is very difficult to say that which technique is better than other technique because it depends upon the type and size of organization. To have better method, we can proceed with data envelopment analysis.

3. Data Envelopment Analysis
Traditionally, PA or efficiency measurement has been a major managerial concern in both the manufacturing sector and the service industry. Consequently, a wide variety of methods are used to measure efficiency. One of the methods is Frontier approach, which evaluates efficiency against production functions. A production function defines the maximum levels of outputs attainable with a certain combination of inputs or the minimum possible level of inputs for certain level of outputs. The engineering based approach defines productivity by comparing the current performance to a suitable set of engineering standards (Sueyoshi 1992). In both these methods controversy arises when the analyst attempts to assign relative weights to factors. Thus, prior assumptions on weights have reservations, and this problem is eliminated in the use of DEA, as the weights are assigned voluntarily by the method.

DEA measures efficiency by estimating an empirical production function, which represents the highest values of outputs that could be generated by relevant inputs, as obtained from observed and input output vectors for the analysed Decision Making Units (DMU). The efficiency of a DMU is then measured by the distance from the point representing its input and output values to the corresponding reference point on the production function (Mohamed & Luc 2008). DEA defines the relative efficiency for each DMU (bank branches, employees in engineering teams, hospitals, schools) by comparing its input and output data to all other DMUs in the same cultural environment Variation of outputs are not in same scale of inputs (Variable Return to Scale (VRS) Increasing Return to Scale (IRS) or Decreasing Return to Scale (DRS) can be found out

with this model on each DMU (i.e., employee). (Either an increase or decrease in input, which may result in output increase or decrease respectively to identify IRS or DRS.)

The BCC Model

Indices:	j – DMUs, $j = 1, \ldots, n$ r – outputs, $r = 1, \ldots, t$ i – inputs, $1, \ldots, m$
Data:	y_{rj} – the value of the rth output of the jth DMU x_{ij} – the value of the ith input for the jth DMU ε – a small positive number (non-Archimedean constant, order 10^{-5} or 10^{-6})
Variables:	s_i, σ_r – slacks corresponding to input i, output r respectively ($>= 0$) λ_j – weight of DMU in the facet for the evaluated DMU ($>= 0$) μ_r, v_i – virtual multipliers for output r, input i respectively ($>= \varepsilon$) h_k – relative efficiency of DMU$_k$ u_k – returns to scale, is an indicator interpreted by BCC

The linear programming problem (LPP) formulation for each individual DMU to solve is

$$\text{Max } h_k = \sum_r u_r y_{rk} - u_k) \qquad \text{subject to} \qquad \sum_i v_i x_{ik} = 1$$

$$\sum_r u_r y_{rj} - \sum_i v_i x_{ij} - u_k \le 0 \qquad (1)$$

The objective here is to find the largest sum of weighted outputs of individual while keeping the sum of its ratio of the sum of weighted outputs to the sum of weighted inputs for any individual to be less than one. This ratio corresponds to the classical engineering ratio definition of efficiency. Consequently, the dual formulation for DMU is written as and solved.

$$\sum_j x_{ij} \lambda_j - \theta_k x_{ik} + s_i = 0$$

$$\text{Min } h_k = \theta_k - \varepsilon \left(\sum_r \sigma_r - \sum_i s_i \right) \qquad \text{subject to} \qquad \sum_j y_{rj} \lambda_j - \sigma_r = y_{rj}$$

$$\sum_j \lambda_j = 1$$

In addition to relative efficiency measures, a DEA study provides the following four properties (Paradi, Smith & Schaffnit-Chatterjee 2002).

A piecewise linear empirical envelopment surface to represent the best practice frontier, consisting of units which exhibit the highest attainable outputs in relation to all other DMU's in the population, for their given level of inputsAn efficiency metric to represent the maximal performance measure for each DMU measured by its distance to the frontierSpecific targets or efficient projections onto the frontier for each inefficient

DMUAn efficient reference set or peer group for each DMU defined by the efficient units closest to the DMU.

DEA is an appropriate method of evaluation of employees. Apart from giving individuals an efficiency score DEA is also able to identify the following five features.
The efficiency frontier which consists of the best practice units:

   i. The most and the least efficient units, which are ranked accordingly. The efficiency rating of any unit reflects its distance from the frontier, and it is equal to 1 for all efficient units and is less than 1 for all inefficient units.

   ii. An efficiency reference set, or peer group, for each inefficient unit. This is a subset of all the efficient units closest to the unit under evaluation, it contains the efficient units which have the most similar input output orientation to the inefficient unit, and should, therefore, provide examples of good operating practice for the inefficient unit to emulate.

   iii. Input output target levels for each inefficient unit that would, if reached, make that unit relatively efficient (i.e., increase its rating from less than 1 to exactly 1).

   iv. Critical inputs and outputs for any inefficient unit which need to be given priority during the application of an improvement procedure.

DEA is a powerful technique for performance measurement (Cook & Seiford 2009). There is considerable evidence of the strengths of DEA (Ramanathan 2003).

   i. The main strength of DEA is its objectivity (i.e., DEA provides efficiency ratings that make the maximum possible objective use of the available data).

   ii. Unlike statistical methods of performance analysis, DEA is non parametric in the sense that it does not require an assumption of a functional form relating inputs to outputs.

   iii. The sources of inefficiency can be analysed and quantified for every evaluated unit.

   iv. Large volumes of data can be handled.

   v. DEA can handle multiple inputs and multiple outputs, and they can be measured in very different units of measurement (Ramanathan 2003)[18] whereas in traditional methods of appraisals, performance indicators are limited to one measure of output input, and they cannot easily accommodate situations where multiple outputs are produced using multiple inputs (Wagner, et al. 2003). To compensate for the one dimensional nature of the indicators a large set of ratios and normative values needs to be calculated in the performance reports (Locher & Teel 1977).

4. Conclusion

Unlike traditional performance appraisals, DEA searches for the efficient employees who will serve as role models. The efficiency of a machine can be determined by comparing its actual output to its engineering specifications. However, when considering human service generally, the optimum efficiency is unknown, and, therefore, cannot be determine whether an employee is absolutely efficient (Sowlati & Paradi 2004). DEA can

be used to identify employees, who are relatively inefficient, measure the magnitude of the inefficiency, and aids to select the alternative paths to eliminate inefficiencies. More efficient employees, who can act as trainers to the less efficient employees, can have a stake in the employee performance improvement process. A DEA aided appraisal process has four potential benefits.

i. Determines the performance levels of employees relative to others
ii. Finds the shortfalls in the outputs and surpluses in inputs for employees
iii. Ranks the employees in terms of their performance
iv. Set targets for inefficient employees to become efficient

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