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# EVALUATION OF EMPLOYEES' PERFORMANCE USING DATA ENVELOPMENT ANALYSIS AS A TOOL: A PILOT STUDY OF HR EXECUTIVES OF THDCIL

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## ABSTRACT

*Global Competition has created a challenge for companies to either perform or perish. Therefore, Performance has become the litmus test for survival for any organization. It is generally said what cannot be measured cannot be managed. In order to manage and measure the performance of the employees companies use several types of methods, one being Performance Appraisal Method. Performance appraisal has been recognized as a strategic tool for improving organizational effectiveness. The success of any organization is dependent on how well the performance of every employee is effectively appraised, managed and measured. Performance Management System is therefore important process from the perspective of business alignment. Employee performance appraisal systems, which are well designed and properly used, are essential for the effective functioning of the organization. Due to some disadvantages of traditional methods, a need has been felt to develop new evaluation procedures. The main contribution of this paper is to apply a multidimensional approach, represented by the method of Data Envelopment Analysis (DEA) to measure the performance and efficiency of employees in association with the data accumulated from PARs.*


## KEYWORDS

performance appraisal, data envelopment analysis, performance analysis and THDCIL.

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## INTRODUCTION

 Performance Management is both a strategic and an integrated approach to delivering successful results in organizations by improving the performance and developing the capabilities of teams and individuals.

Today, so many organizations face the problem of satisfying their workers, despite the fact that they are given incentives. This happens because most of these organisations are unable to manage & measure the performance of their employees appropriately.

Performance Appraisal System is widely used as one of the key methods for measuring and managing the performance efficiency of its employees and at the same time identify the star and weak performers for rewarding and working on those who are lagging behind. Therefore, great efforts have been spent in developing most objective and effective system by the performance can be evaluated.

The success or failure of performance appraisal in an organization depends upon the philosophy on which it is established. There have been efforts to devise transparent and efficient Performance Measurement System and lot has been achieved in this area but still there are issues. Appraisal systems have also become more results-oriented, which means that appraisals are more focused on a process of establishing benchmarks, setting individual objectives, measuring performance, and then judging success based on the goals, standards and accomplishments. PMS has become a very important process from the perspective of business alignment.

Appraisal systems have helped in measuring the efficiency and performance levels of employees and the data has been used in incentivizing performance as well as devising training needs and other developmental planning of employees. High-performing employees contribute superior performance, giving the companies they work for a competitive advantage and their extra effort differentiates great organizations from merely good ones. An effective system should encourage collaboration, teamwork, and communication. It's crucial for businesses to have systems in place to identify, recognize, reward, and retain their top performers to achieve sustainable growth.

Business Organizations establish robust and attractive appraisal systems are to help motivate their employees to strive hard to be recognized and rewarded. Once the employees are motivated, their performance reflects on productivity. Employees strive hard by pooling together skills, knowledge and efforts to achieve maximum output.

Performance Appraisal (PA) is an important management tool to assess employees' efficiency in the workplace, and may be defined (Pearce & Porter 1986), as a structured formal interaction between a subordinate and supervisor that usually takes the form of a periodic interview (annual or semi-annual) to evaluate the work performance. Performance Appraisal is intended to engage, and align individual and group effort to continually improve overall organizational mission accomplishment (Grubb 2007). It provides a basis for identifying accomplishments (Grubb 2007) and at the same time it provides a basis for identifying and correcting disparities in performance.

However, no system is perfect and there is a room for improvement in all system, Performance Appraisal is one among them. Although, in past years Performance Appraisal System has acted as an instrument to measure, manage and improve the efficiency of employees. But there are inherent limitations of the system. There are several errors that managers make while making performance appraisals. Several authors have pointed out several shortcomings of existing performance appraisal systems. Owing to personal biases of the assessor and are often influenced more heavily by personality than by performance.

In the highly competitive business world, remaining productive and innovative is tantamount to success. Corporations are increasingly utilizing performance appraisals to ensure that all employees are working at optimal capacity while staying focused on overall business objectives. Several tools are available to help streamline the appraisal process, making it less burdensome for both supervisors and their direct reports. Today's, owing to technological advancements several tools and software's are being used to measure and manage the performance and efficiency of employees. Data Envelopment Analysis (DEA) a computer based tool is also one such tool being used now-a-days to eliminate the shortcomings of PAR system.

**Data envelopment analysis (DEA)** is a nonparametric method in operations research and economics for the estimation of production frontiers. It is used to empirically measure productive efficiency of decision making units (or DMUs). Although DEA has a strong link to production theory in economics, the tool is also used for benchmarking in operations management, where a set of measures is selected to benchmark the performance of manufacturing and service operations.

DEA identifies a "frontier" which are characterized as an extreme point method that assumes that if a firm can produce a certain level of output utilizing specific input levels, another firm of equal scale should be capable of doing the same.

In this study Data Envelopment Analysis (DEA) has been used to evaluate the performance of executives in Corporate HR department of THDCIL and the use of DEA to improve methods of measuring employees' efficiency of executives of different sub departments of Corporate HR department of THDCIL.

## OBJECTIVES

1. Evaluate and rank the employees based on their performance using the DEA in HR department of THDCIL.
2. Determine the peer for each underperforming employee.
3. Scope for using DEA as a tool for measuring performance.
4. Formulate recommendations and suggestions to the management, which should lead to enhancing employee efficiency using DEA.

## REVIEW OF LITERATURE

Working towards common goals often employees get so caught up in our daily work routine that we forget about our purpose in an organization. Individual performance drives organizational performance. It is important to ensure everyone understands the organization's vision and goals, and how their work fits in to the organization, and how they contribute to our mission accomplishment. Doing this increases engagement and improves our program delivery.

Performance appraisal is an important step in the organization's HRM system and influences employee performance and then organizational performance. Therefore, devising Performance Appraisal System for efficiently managing the performance of employees is important. If there is no measure to performance, there will be no sign of feedback and continuous improvement.

Well designed and properly used appraisal systems are essential for effective functioning of organizations (Slusher 1975). A well devised Performance Appraisal System can tightly link strategy (mission, vision and values) with daily performance. Many companies pay close attention to the hard science of performance measurement, particularly the financial and operational sides, while successful companies play equal attention to the art, which is the softer aspect of selecting and applying performance measures (Singh & Finn 2003).

An effective PA programme should do more than set salary and promotion decisions on past performance. It should aid in the development of a performance improvement plan that utilizes coaching from the department supervisor or manager to increase skills development.

## PRODUCTIVITY AND EFFICIENCY

Although, we often use the term productivity and efficiency. It is efficiency that leads to productivity and at the same time an increased productivity means that there is increased efficiency.

According to a classic definition (see e.g. Vincent 1968) *productivity* is the *ratio* between an output and the factors that made it possible. In the same way, Lovell (1993) defines the *productivity* of a production unit as the ratio of its output to its input. This ratio is easy to compute if the unit uses a single input to produce a single output. On the contrary, if the production unit uses several inputs to produce several outputs, then the inputs and outputs have to be aggregated so that productivity remains the ratio of two scalars.

Similar, but not equal, is the concept of efficiency. Even though, in the efficiency literature many authors do not make any difference between productivity and efficiency. For instance, Sengupta (1995) and Cooper, Seiford and Tone (2000) define both productivity and efficiency as the ratio between output and input.

Instead of defining the efficiency as the ratio between outputs and inputs, we can describe it as a distance between the quantity of input and output, and the quantity of input and output in an industry. Efficiency and productivity, anyway, are two cooperating concepts.

## PROFILE OF THDC INDIA LIMITED

Tehri Hydro Development Corporation India Limited (THDCIL) is a Joint Venture of Government of India and Government of Uttar Pradesh. The Equity is shared in the ratio of 75:25 between GoI and GoUP. The Company was incorporated in July '88 to develop, operate & maintain the 2400 MW Tehri Hydro Power Complex and other hydro projects. The Company has an authorised share capital of INR 4000 cr. THDCIL is a Mini Ratna Category-I and Schedule 'A' CPSE.

Its greatest strength is highly skilled and committed workforce of 2000 employees. Every employee is given an equal opportunity to develop himself/herself and grow in his/her career. Continuous training and retraining, career planning, a positive work culture and participative style of management - all these have engendered development of a committed and motivated workforce setting new benchmarks in terms of productivity, quality and responsiveness.

## PERFORMANCE MANAGEMENT SYSTEM IN THDCIL

The world is a global village today where boundaries have diminished and due to liberalization of economy worldwide including India there has been tremendous change in the business scenario. Utmost utilization and effective management of human resource in era of competition is crucial and one of the tools to manage and motivate employees today is performance Appraisal System which has now been transformed to Performance management System.

The historic service culture was based on the principle of equality and experience and people in the same job with the same experience as well as same qualifications expected and got the same pay and had around the same prospects of promotion. By providing many years of service, one gained experience and showed loyalty and commitment as well as learned the corporate culture. Reward and their seniority were based on number of years of service and if people were in the same job they were paid equally, irrespective of performance.

To be competitive and to even retain market-share in the local economy, companies have to look beyond Indian shores and offer products and services of global quality and prices. This requires benchmarking of practices, standards of performance and efficiency in line with the worldwide competition. The performance management has importance wherein companies have to monitor their performance factors affecting them on a proactive and hands-on basis (Rao, A Srinivasa, 2007).

THDC India Limited is a Schedule "A" Mini Ratna Central Public Sector Undertaking under Ministry of Power. Erstwhile the name of the Company was Tehri Hydro Development Corporation. The company was earlier into Hydro power generation but in the past few years it has diversified into Thermal, Solar, Wind power as well.

The company has a stable financial performance earning profits and is known for its best HR policies and practices and also bagged several awards for it including SCOPE Meritorious Award for Best HR Practices. In the past few years company has revisited and modified several HR policies to synchronize them with the trends of time and industry standard. It has formulated and implemented several new policies and issued several guidelines one such improvement is in the field of managing performance of employees through Performance Management System.

Earlier the system of Annual Confidential report was closed system where the report was prepared by senior in confidential manner. The concerned employee who was rated by his senior was not informed of his rating and thus he was not given chance to know and improve upon.

Public Sector Undertakings function in a different atmosphere where skill, talent and potential of employees are to be nurtured properly and efficiently to gain competitive advantage over peer companies and sustain. These PSUs are further governed by guidelines issued by different agencies of Govt. who issue orders from time to time. There has been emphasis from the Govt. to bring in a culture of performance, its effective measurement and management to gain competitive advantage and transparency. Therefore, the govt. has issued various guidelines with regard to devising robust and transparent Performance Management System. While issuing directives with regard to pay revision of CPSEs in the year 2007, Department of Public Enterprises issued an Office Memorandum dated 26.11.2008 in this regard vide which not only guidelines with regard to Pay scales were issued but Govt. introduced the scheme of Variable pay/ Performance Related Pay and directed the CPSE to devise a robust and transparent Performance Management System. Therefore, for the first time performance of an employee was linked to payment of incentive. Department of Public Enterprises also introduced a method of "Bell Curve" one of the forced ranking method wherein direction with regard to rating employees was also given.

However, the new Performance Management System was introduced in THDCIL during the year 2006-2008. This new system of appraisal was a shift from the old system of annual appraisal method. The new Performance Appraisal System introduced in THDCIL started with setting of targets/key result areas(KRA) in consonance with the business objectives of the Organization. The system gradually modified and several improvements were made with introduction of Balance Score Card for executives of Sr. Manager and above.

### DEA (DATA ENVELOPMENT ANALYSIS) @THDCIL

Data envelopment analysis (DEA) is a linear programming based technique for measuring the relative performance of organisational units where the presence of multiple inputs and outputs makes comparisons difficult.

DEA defines the relative efficiency for each decision making unit (DMU) (bank, department etc.) by comparing the DMU's inputs and outputs to other DMUs data in the same "cultural or working" environment. The outcomes of a DEA includes:

- (i) A piecewise linear empirical envelopment frontier surface of the best practice internal benchmark, consisting of DMUs exhibiting the highest attainable outputs for their given level of inputs;
- (ii) An efficiency metric (score) to represent the maximal performance measure for each DMU measured by its distance to the efficient frontier surface;
- (iii) Efficient projections onto the efficient frontier to project improvement with an identification of a reference set of efficient units which consists of the "close" efficient DMUs to suggest internal benchmarks to guide inefficient units; a ranking of units from best (highest score) to worst (lowest score). There are mainly two types of DEA models: constant returns-to-scale (CRS, or CCR) model and introduced the variable returns-to-scale (VRS or BCC) model. The VRS model is one of the extensions of the CRS model where the efficient frontiers set is represented by a convex curve passing through all efficient DMUs.

There is an increasing concern with measuring and comparing the efficiency of organizational units such as industries, schools, hospitals, shops, bank branches and similar instances where there is a relatively homogeneous set of units.

The usual measure of efficiency, i.e.:

$$\text{efficiency} = \frac{\text{output}}{\text{input}}$$

is often inadequate due to the existence of multiple inputs and outputs related to different resources, activities and environmental factors. This problem can be illustrated for different departments of HR which are indulged in customer and employee delivery in an organization. In this case the inputs for an efficiency measure are taken to be the time taken in processing the different requests of fellow employees by number of employees in each department and the recurrent costs mainly in the form of wages, as these HR employees are resources supporting the people in line function and operation. Time taken and number of tasks processed is an input to an efficiency measure as an efficient department will attempt to give a good service at minimum time, saving on capital and resulting in satisfaction of employees.

The outputs correspond to activities of the department are measured by the number of issues representing failure of processing of such requests of fellow employees, number of grievance raised due to non-processing of such requests in time.

With two inputs and three outputs the difficulty of comparing the efficiency of department becomes apparent. Some statements concerning the relative efficiency of department can be made, for example comparing two sub departments of HR viz. Establishment and Welfare. These both have the same number of employees handling the tasks and the same costs but Welfare department has activity levels which are all as great or greater than those of Establishment department. However the majority of comparisons are difficult to make.

A formula for relative efficiency incorporating multiple inputs and outputs is introduced now, and the DEA model which allows relative efficiency measures to be determined is developed.

The main objective of this paper is to verify the possibility of using efficiency evaluation methodology Data Envelopment Analysis to measure performance of executives in the E2 to E5 grade of sub departments of HR at Corporate Office. The secondary purpose of this work is to examine the impact of ranking method used for finalizing Performance Appraisal Report on the calculated PMR score depicting the efficiency score of employees, using various statistical techniques.

Let us have  $n$  mutually compared decision making units (DMU) producing outputs  $y_{rj}$  ( $r = 1, 2, \dots, s$ ), using inputs  $x_{ij}$  ( $i = 1, 2, \dots, m$ ). If we use output-oriented model DEA with constant returns to scale for evaluation of decision making unit DMU<sub>0</sub>, then we are solving the following linear programming task:

Objective function:

$$\phi^* = \max \phi_0$$

$n$

Subject to:  $\sum_{j=1}^n x_{ij} \lambda_j \leq x_{i0} \quad i=1, 2, \dots, m$

$J=1$

$n$

$$-\phi y_{r0} + \sum_{j=1}^n y_{rj} \lambda_j \geq 0 \quad r=1, 2, \dots, s$$

$J=1$

$$\lambda_j \geq 0 \quad j=1, 2, \dots, n$$

where:

$x_{ij}$  is  $i$  input of  $j$  employee;  $y_{rj}$  is  $r$  output of  $j$  employee;

$x_{i0}$  is  $i$  input of evaluated employee;  $y_{r0}$  is  $r$  output of evaluated employee;  $\lambda_j$  is intensity variable of  $j$  employee;

$\phi_0$  is the coefficient of expansion of output, the technical efficiency score of the evaluated employee.

The result of thus formulated linear programming task is technical efficiency score  $\phi_0$  of evaluated decision making unit, in this case, the executive, which is defined as the ability to achieve maximum outputs at a given level of inputs. This measurement indicates how many times level of outputs has to be proportionally increased, maintaining the unchanged level of inputs, for executive to be technically efficient. If  $\phi_0$  equals one and a variable  $\lambda_j$  is equal one for rated executive and zero for all other executives, the executive is technically efficient. Otherwise, if the technical efficiency measurement  $\phi_0$  is greater than 1, the executive is not technically efficient in comparison with others and must increase outputs while level of inputs remains the same. If executive is rated inefficient, non-zero variables  $\lambda_j$  points to the elements of referential set. Convex combination of outputs and inputs of efficient employees' reference set with coefficients  $\lambda_j$  indicates so called target values, i.e. values of inputs and outputs of a virtual efficient reference employee on the frontier. Model assumes constant returns to scale, which means the proportional change in outputs due to the change of inputs. Therefore, if the inputs increase by 1%, outputs also increase by 1%.

Five input and Five output variables have been used in the work. Inputs were overall work atmosphere, salary (average salary including incentives as stated in employees' questionnaire), career progression opportunities, working condition and working time (ordinary scale of 1 - really poor and 10 - definitely suitable) and benefits (list of benefits provided by employer).

Performance Appraisal Report is also considered as the system used to evaluate employees' performance apart from other factors like production / generation figures in case of THDCIL being a power generating Company. Performance Appraisal Report which consists of Key Result Areas (the task or assignment that the employee has to perform in mutual consultation and agreement with reporting officer within designated time). PAR also consists of list of Competencies and Potential traits which employee exhibits at workplace and is rated by his superior. Since, career progression / promotion is determined through Performance Appraisal Reports but several other output factors have impact of employees efficiency and therefore, four other factors have been selected that have positive effect on it - work motivation, job satisfaction and commitment to the organization, Likelihood to stay with the company & Job Security.

The level of these outputs has been determined by the attitudes of employees to 35 questions in the questionnaire on a 6-level Likert-type scale from strongly disagree to strongly agree. The first 10 propositions ascertained the level of working motivation of employees. On the basis of the responses Motivating Potential

Score (MPS) of individual respondents have been calculated. (Hackman and Oldham (1976). 15 statements has been taken from the job satisfaction research by Brayfield and Rothe (1951) and the last 15 ascertained commitments to the organization, according to research of Mowday, Steers and Porter (1979) and 03 statements has been taken from likelihood to stay with the company, 02 statements has been taken from Job Security.

TABLE 1: INPUTS AND OUTPUTS OF THE MODEL

Inputs	Outputs
Salary	Work motivation
Overall work atmosphere	Organization Commitment
Work condition and working time	Likelihood to stay with the company
Benefits	Job Satisfaction
Career Progression	Job Security & Retention

In order to test the validity of the hypotheses on the impact of demographic factors (age, gender, length of service, level of education, employment status and number of previous jobs) on the technical efficiency score of employees, the non-parametric tests of compliance of mean values to test validity of the hypotheses on the impact of demographic factors (age, gender, length of service, level of education, employment status and number of previous jobs) on the technical efficiency score of employees. Kruskal-Wallis test and Wilcoxon-Mann-Whitney two sample test was used.

The Kruskal-Wallis H test (sometimes also called the "one-way ANOVA on ranks") is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable.

The Mann Whitney U test, sometimes called the Mann Whitney Wilcoxon Test or the Wilcoxon Rank Sum Test, is used to test whether two samples are likely to derive from the same population (i.e., that the two populations have the same shape).

## RESULTS AND DISCUSSION

THDC India Limited is engaged in power generation formerly it was only into Hydro Power generation but now it has diversified into Thermal, Wind and Solar Power generation. Like other companies THDCIL banks on its employees, its policies to gain competitive advantage against its competitors. Therefore, maintaining and making efforts to derive utmost performance from employees is must. HR executives serve an important role in catering to the day to day requirements of line managers/function and carrying out several crucial activities.

The DEA method for employee performance was used in Corporate HR department of THDCIL, where the number of Executives in the grade of E2 to E5 posted in different departments of Corporate HR is 25. The different wings of HR department are generally headed by executives in the rank of E7 (DGM). There are 03 DGMs and at least 03 -05 executives in the rank of E2 to E5 report to them functionally. All these 25 employees underwent a PA within a framework of DEA that provided data for this study. The DGMs are not included for PA. The Performance Appraisal Report is same for executives in the rank of E2 to E5.

Corporate Office is the main office of the company; the Board level Directors have their offices at corporate Office. The policies, procedures of the company are framed here. The Office has manpower of approx. 800 employees and the HR department caters to these 800 employees. HR department at Corporate Office has five wings: Policy and Promotions Department, Establishment Department, Employee Relation and recruitment, Employee Welfare Department and Administration Department.

The major functions of these wings relates to framing of HR policies, carrying out annual appraisals, doing promotions based of Annual Appraisal Reports, dealing with several day to day functions of HR department viz. Pay roll, Attendance, Employee Advances, Loans, Leave Management, Recruitment, Employee Relations, carrying out various employee welfare measures and office administration, Vehicle, Guest house Management etc.

The efficiency of HR department with regard to effective customer (employees are internal customers) service delivery has wide ramifications and satisfaction of employees. Therefore, it is required that Executives posted in HR department work with utmost efficiency, sincerity and dedication.

Questionnaire was used to collect information from these executives. The first part of questionnaire examined demographic characteristics of respondents. Further, the age, gender, employment status, highest level of education, length of service and number of previous jobs were also examined. The resulting statistics are presented in table 2:

TABLE 2

Variable	%
<b>Gender</b>	
Male	80
Female	20
<b>Age</b>	
18-25	0
26-35	10
36-45	7
46-55	8
more than 55	
<b>Highest level of education</b>	
Primary School	0
Secondary School	0
University	25
<b>Employment status</b>	
<b>Operating Department</b>	25
<b>Length of Service</b>	
0-1	0
1-5	0
5-10	10
More than 10 years	15
<b>Nos. of previous jobs</b>	
None	23
1-2	1
3-5	1
More than 5	None

The technical efficiency scores of individual employees were calculated by applying Data Envelopment Analysis model.

Results indicated 15 efficient employees whose technical efficiency score was equal to 1 and 48 employees with score greater than 1. These executives need to improve their performance to achieve full efficiency. Average technical efficiency score was 1.18, meaning that the average employee of Corporate HR deptt. had

almost 85% of the best employee's performance. Worst employee had technical efficiency score of 2.08, which was only 36% of the employees with the maximum efficiency.

Time that employee spent in the company had a statistically significant impact on his efficiency measure. The longer employee worked in the company, the better his performance (efficiency score) was. Employees have built a relationship with organization over the years; they are more committed, willing to make greater effort than is expected of them. After 10 years of working, however, there has been deterioration in performance, which may be connected with reduced motivation to work after long years spent in the same company. The company should therefore try to motivate such employees, whether with new work tasks or greater independence. Results are presented in **table 3**.

TABLE 3

Length of service	Mean	St.Dev.	Min	Max	Mode	Median
0-1 year	0	0,000	0	0		0
1-5 years	0	0,000	1	0	0	0
5-10 years	1,131	0,208	1	1,43	1	1,035
more than 10 years	1,117	0,164	1	1,02	1	1,21

The impact of other demographic characteristics was not statistically significant. The efficiency score has deteriorated in average with increasing age, men were on average slightly more efficient than women. Educated workers were slightly more efficient than employees with lower level of educational attainment. An interesting finding was that while the executives in Policy, Welfare department were more motivated, happier and more committed than their colleagues in Establishment & Administration department, however technical efficiency did not differ significantly between these groups of employees. So, from the overall perspective, both groups were equally efficient. There was no significant difference among workers with different numbers of previous employment.

## CONCLUSION

The objective of this paper was to apply the method of Data Envelopment Analysis in assessing employee performance and using the PAR (Performance Appraisal Report) variables and scores.

Furthermore, it was discovered that the length of service has statistically positive impact on employee performance. This increases their commitment to the organization and they are willing to do more. The performance of the employees who have worked for the company for more than 15 years, were slightly low probably due to reduced work motivation. That is why the management of the organization should motivate them more and reinforce motivation through different HR interventions.

Because of distinct advantages of DEA method over traditional systems of employee performance evaluation it may be recommended that DEA method may be applied in future in THDCIL in conjunction with Performance Management System to better measure efficiency of employees and gain competitive advantage against its sectoral rivals.

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