

WORKLOAD FORMATION WITH DEA AND FTE METHOD IN PT. PLN LOCATED AT BANGKA BELITUNG

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ABSTRACT

Employee composition problem at PT. PLN (Persero) Bangka Belitung Region is still on demand. When a unit needs more employees, the unit makes a request for additional employees. Even though, it is not important to unit needs, moreover the background at additional employees cannot tell to add a number of these employees. The 35,000 MW project increases the number of projects in generation and distribution and transmission. Workload problems are influenced by the number of employees composition in a section, employees' competency, etc. Workload samples taken from each rayon found that Pangkal Pinang Rayon has the highest workload ratio in PLN Babel, the difference with other rayon is 6915.43 with the number of customers to 145,224 with the total number of employees 21 people. The total composition of employees is measured by Full Time Equivalent and Data Envelopment Analysis method is combined with business data to get the appropriate number of employees so that the reporting of workload data does not burden the employees in their daily activities. Due to a greater workload or lot compared to other offices. Therefore, an increase in workforce is needed.

Keywords: workload; Full Time Equivalent; Business Data; Data Envelopment Analysis

ABSTRAK

Masalah komposisi pegawai di PT PLN (Persero) Wilayah Bangka Belitung masih on demand. Ketika unit membutuhkan lebih banyak karyawan, unit membuat permintaan untuk karyawan tambahan. Padahal, tidak penting untuk kebutuhan unit, apalagi latar belakang di karyawan tambahan tidak bisa menyuruh untuk menambah sejumlah karyawan tersebut. Proyek 35.000 MW meningkatkan jumlah proyek dalam pembangkitan dan distribusi dan transmisi. Masalah beban kerja dipengaruhi oleh jumlah komposisi karyawan dalam suatu bagian, kompetensi karyawan, dll. Sampel beban kerja yang diambil dari setiap rayon menemukan bahwa Pangkal Pinang Rayon memiliki rasio beban kerja tertinggi di PLN Babel, selisihnya dengan rayon lainnya adalah 6915,43 dengan jumlah pelanggan menjadi 145.224 dengan jumlah karyawan 21 orang. Komposisi total karyawan diukur dengan metode Full Time Equivalent dan Data Envelopment Analysis dikombinasikan dengan data bisnis untuk mendapatkan jumlah karyawan yang sesuai sehingga pelaporan data beban kerja tidak membebani karyawan dalam kegiatan sehari-hari mereka. Karena beban kerja atau lot yang lebih besar dibandingkan dengan kantor lain. Oleh karena itu, diperlukan peningkatan tenaga kerja.

Kata Kunci: beban kerja; Setara Penuh Waktu; Data Bisnis; Analisis Penyelubungan Data

1. INTRODUCTION

PT. PLN (Persero) is a State-Owned Enterprises (SOEs) engaged in providing electricity for the community. Individual and group productivity have a great influence towards company's performance which is caused by the process of using inputs called human resources (employees) to earn the output, such as the number of customers. The company must achieve the target to be able to meet the needs of customer demand. The Pareto Data Ratio of number of customers to the number of employees in PT. PLN (Persero) Bangka Belitung can be seen in Figure 1.

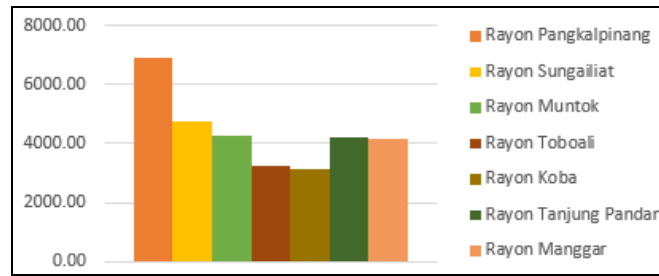


Figure 1. Ratio of Number of Customers to Number of Employees.

In previous study by Anisa and Prastawa (2019) in Yogyakarta and Hasnani and Hartini (2022) in Belitung, the same conclusion meet and end that should increase the number of employment due to the heavy world load in PLN case study. The increased number of customers makes the long term demand fulfilment plan and KPI target become more challenging because it will make employees' workload higher. This will make employees work overtime since the job description from each position are not in accordance with the realization, and coupled by the KPI sent by the superiors to the subordinates.

Based on this problem, this research is expected to solve the problem faced by PT. PLN Bangka Belitung Region by giving the right solution to improve productivity performance. This will be done by collecting data on each employee's workload and then using the FTE method to find out whether the employee is underloaded, fit, or overloaded. After knowing the categories of each employee in each rayon and sector, the next step is analysing employee productivity using DEA method.

2. LITERATURE REVIEW

Calculating workload with full time equivalent (FTE) method is a method in which compare the time used to complete various jobs to the available effective work time. FTE aims to simplify work measurement by changing hours of workload to the number of people needed to complete certain jobs (Adawiyah, 2013). The FTE is formulated as follows:

$$\sum_{i=1}^n \frac{a \times b}{c \times d} \tag{1}$$

where:

a is the number of days used to complete the work;

b is the number of hours / minutes / seconds in one working hour day used to complete the work;

c is the number of effective working days in 1 month;

d is the number of effective working hours in 1 day.

So the formula becomes

$$\sum_{i=1}^n \frac{Volume \ Day \ x \ Times}{7.5 \ x \ 20} \tag{2}$$

Based on the guidelines for workload analysis issued by the Nation Personnel Agency in 2010 are as follows:

Workload Category	Score
Underload	< 1
Fit	1-1.28
Overload	> 1.28

One of the most popular evaluation methods for calculating efficiency criteria is DEA. DEA method calculates technical efficiency for all units. Efficiency scores for each unit are relative, depending on the level of efficiency of the other units in the sample. Each unit in the sample is considered to have a non-negative level of efficiency, which is valued between 0 and 1 with provisions 1 determine perfect efficiency.

This model is used if we assume related to the input or output of a company will affect the productivity that might be achieved, namely VRS (Variable Returns to Scale) (Banker et. Al 1984).The DEA-CRS model can easily be developed in the DEA-VRS model by adding the Convexity Constrains (Banker et. Al 1984), by using:

$$\sum_{j=1}^n \lambda_j = 1$$

So, the model becomes:

a. DEA VRS *input oriented*

Objective Function:

$$\min \theta$$

Towards:

$$\begin{aligned} \sum_{j=1}^n \lambda_j Y_{rj} - Y_{rk} &\geq 0 ; r = 1, 2, \dots, s \\ \theta X_{ik} - \sum_{j=1}^n \lambda_j X_{ij} &\geq 0 ; i = 1, 2, \dots, m \\ \sum_{j=1}^n \lambda_j &= 1 \\ \lambda_j &\geq 0 ; j \in 1, 2, \dots, n \end{aligned}$$

b. DEA VRS *output oriented*

Objective Function:

$$\max \phi$$

Towards:

$$\begin{aligned} \sum_{j=1}^n \lambda_j Y_{rj} - \phi Y_{rk} &\geq 0 ; r = 1, 2, \dots, s \\ X_{ik} - \sum_{j=1}^n \lambda_j X_{ij} &\geq 0 ; i = 1, 2, \dots, m \\ \sum_{j=1}^n \lambda_j &= 1 \\ \lambda_j &\geq 0 ; j \in 1, 2, \dots, n \end{aligned}$$

3. RESEARCH METHODOLOGY

This research uses a descriptive method to systematically describe the facts or characteristics of a certain sector in an actual and accurate setting by using primary and secondary data. Schematically, the steps of this research method are shown in Figure 2 below.

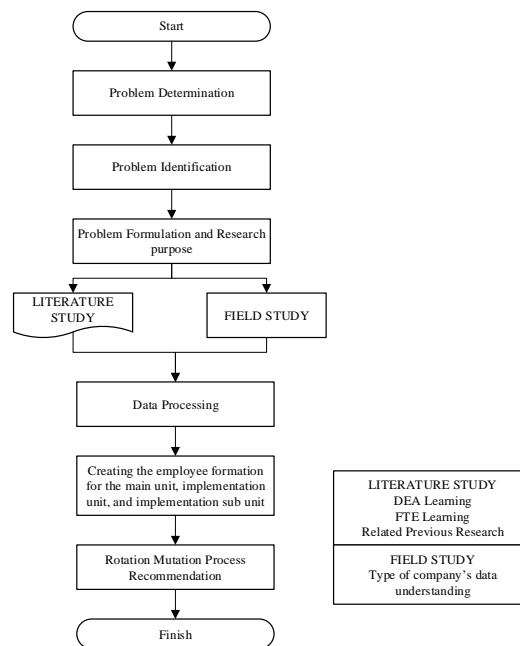


Figure 2. Research Methodology

Data is being proceed by using 2 methods, namely FTE and DEA. The following is data processing methodology using FTE.

Planning

a. Conducting Interviews, Observation, and Shadowing of Workload Data

Interviews, observations, and shadowing workload data such as activity, volume, routine and non-routine time, and business data categories are conducted to all PLN employees in their respective units according to their organizational structure. Interviews, observations, and shadowing of workload data are carried out for 3 months. The target is capturing the routine and non-routine activities of all employees at PLN Babel. The workload data aims to:

1. Determine employee workload index and workload categories.
2. Determine the reduction or addition of employee in the section and determine recommendations for competencies granting.
3. As a template, especially routine activities on desktop and mobile web applications to facilitate employees (not typing the name of the activity but choosing the activity) in reporting workload.

b. Creating Algorithms to Simplify Calculations

Algorithms related to employee workloads, employee additions or reductions, and mathematical equations. The following is an explanation of the algorithms above.

Employee workload algorithm

This algorithm functions to calculate the workload of each employee and determine the categories of workloads underload, fit or overload. The algorithm can be seen in Figure 3:

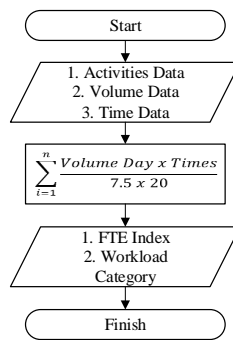


Figure 3. Employee Workload Algorithm

Adding or Reducing Employee Algorithm

The function of this algorithm is to get recommendations on the number of employees added and the number of employees reduced. The algorithm can be seen in Figure 4.

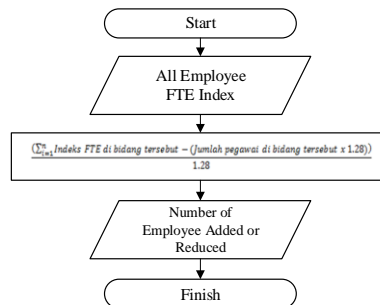


Figure 4. Adding or Reducing Employee Algorithm

Mathematical Equations Algorithm

The function of this algorithm is to find mathematical equations in determining the number of employees in the section because employees do not report their workload every day, but only a few periods. The rayon mathematical equation is based on static data by using the data of direct workload per month. The advantage of this mathematical equation is that it can get the amount of workforce planning and which points will be given competence and employee engagement in short time. The weaknesses of static data are:

1. Data tends to be less rigid
2. The mathematical equation cannot handle the work for the next month because the reference workload data is only the workload data during the interview month. The mathematical equation algorithm can be seen in Figure 5.

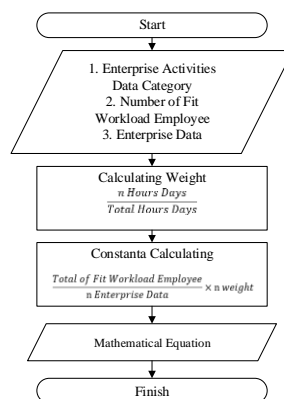


Figure 5. Mathematical Equation Algorithm

4. DATA COLLECTING AND PROCESSING

FTE Method

Workload data collected on July-September 2018 are being used for determining the mathematical equation. Total hours day can be seen in Table 2.

Table 2. Total Hours Days

Section	Total Volume x Time (Hours Days)	Total of Fit Workload Employee
Engineering	1375.24	7
Energy Transaction	1197.5	6
Customer Services	1176	6

The volume column (days) multiplied by the time (hours) is obtained from interviews, observations, and shadowing of employees in the field, for example the technical activity section is conducting ROW supervision, the work is carried out every day and every day takes 4 hours so the volume is 20 Days and Times are 4 Hours so the number of hours days is 80.

The column on the number of employees in the fit workload is obtained from the addition or subtraction algorithm for employees. For example the number of technical employees there are 6 employees turned out to be the result of the addition or subtraction algorithm of employees is the addition of 1 employee means the number of employees in the field of work load fit is 7 employees and vice versa. Thus, the formula for the Number of Employees of the Workload of the Fit Field is:

$$\text{Number of Existing Employee} + (\text{addition or reduction of employee})$$

Proportion rows in appendix 2 are obtained from defining routine and non-routine activities into the category of business data (appendix 1). For example the technical staff of his activity is conducting ROW supervision so that the activity can be categorized as a JTR Length.4 The weight line is the ratio of each hours days of business data to the number of hours days. The constants are found in Appendix 3 of the formula as follows:

$$\frac{\text{Number of Fit Workload Employee}}{n \text{ Enterprise Data}} \times (n \text{ weight})$$

Therefore, the rayon mathematical equations are:

$$Y_{\text{Engineering}} = 0.005579664695X1 + 0.002125459645X + 0.001863951224X4 + 1.0000012854584X5 + 0.0000000000001X8$$

$$2. Y_{\text{ET}} = 0.0011209X1 + 00.00004474X5 + 0.00000006X6$$

$$3. Y_{\text{CS}} = 00.001141396155X1 + 0.000042199925X5 + 0.0000000000009X8$$

DEA Method

Decision Making Unit Determination

According to Charnes (1978), the DMU selection process in the DEA method has several criteria including the selected DMU all having the same input and output variables (homogeneous). The number of regional offices of the island of Bangka Belitung, with the total 8 offices including:

1. Regional Office
2. Pangkal Pinang Sector
3. Sungailiat Sector
4. Toboali Rayon
5. Mentok Rayon
6. Belitung Sector
7. Tanjung Pandan Rayon
8. Manggar Rayon

Variable Identification

The process of selecting variables that have influence in the work activities of PT. PLN (Persero) Bangka Belitung Region, conducted through a brainstorming process with the PLN and previous research that has been done. The variables used can be seen in Table 3.

Table 3. Variables used in this research

Number	Variable
1	Interview Data
2	Allowance Scoring
3	Rating Factor Scoring
4	FTE Data Processing
5	Employee FTE
6	Employee Formation

DMU Classification

In classifying DMU the process of giving names to 8 offices of PT. PLN (Persero) Bangka Belitung Region which can be seen in Table 4.

Table 4. DMU Classification

Office	Decision Making Unit
Regional Office	DMU 1
Pangkalpinang Sector	DMU 2
Sungailiat Rayon	DMU 3
Toboali Rayon	DMU 4
Mentok Rayon	DMU 5
Belitung Sector	DMU 6
TanjungPandan Rayon	DMU 7
Manggar Rayon	DMU 8

Grouping of Input and Output

Grouping observations and direct interviews with several variables used in the study can be seen in Table 5.

Table 5. Grouping of Input and Output

Input	Output
Interview Data	FTE Employee
Allowance Scoring	Employee Formation
Rating Factor Scoring	
FTE Data Processing	

DMU Relative Efficiency Calculation

Calculation of relative efficiency using the DEA CRS Mathematical Model with the aim of calculating the value of relative efficiency constantly each addition of an input will produce a proportional and constant increase in output. Based on the Minister of Health Decree No. 81 of 2004 concerning guidelines for planning (human resources), this research is focused on output orientation. In the input orientation in the process will reduce the number of inputs later. The following is an example of the preparation of a DEA-CRS mathematical linear model by using the application of Lingo 11.0.

! Objective Function
 MAX 4329.6X1
 subject to
 (input) 1375.24Y1+ 1197.5Y2+ 1176Y3+ 0Y4=1
 ! Constraint DMU 1

```

12271.4X1- 4357.55Y1 -2600.21Y2 -4214.03Y3 -1101.64Y4<=0
! Constraint DMU 2
1653575X1- 3526.3Y1- 3567.33Y2- 3057Y3- 873Y4<=0
! Constraint DMU 3
4329.6X1- 1375.24Y1- 1197.5Y2- 1176Y3- 0Y4<=0
! Constraint DMU 4
396439X1- 1147.18Y1- 436.06Y2- 733.69Y3- 0Y4<=0
! Constraint DMU 5
429693.1X1- 381.67Y1- 1271Y2- 1121.95Y3- 0Y4<=0
! Constraint DMU 6
7808.52X1- 2348.84Y1- 1584.5Y2- 2477.71Y3- 1397.47Y4<=0
! Constraint DMU 7
3793.96X1- 1504.95Y1- 804Y2- 148401Y3- 0Y4<=0
! Constraint DMU 8
2280.5X1- 1169.5Y1- 491.5Y2- 619.5Y3- 0Y4<=0
X>=0 ; Y>=0
END

```

The following are the results of the DMU relative efficiency values in each office can be seen in Table 6.

Table 6. DMU Relative Efficiency Value in Each Office

DEA	Result
DMU 1	0.6990231E
DMU 2	0.9999970E
DMU 3	0.7519042E
DMU 4	1
DMU 5	1
DMU 6	0.7850550E
DMU 7	0.6525290E
DMU 8	0.6812790E

From Table 6 can be seen that DMU 4, DMU 5, the relative efficiency value is 1.00000 while the other DMU the relative efficiency value is less than 1.

DEA Factor Analysis

DEA factor analysis is needed to determine the weight given by the model to each factor. The factor that gets a small weight value means it has a small effect on its relative efficiency value.

Determination of an efficient and inefficient DMU

Based on the value of relative efficiency (Technical Efficiency = TE) in Table 6, it can be determined that an efficient and inefficient DMU are:

1. DMU1, DMU 2, DMU 3, DMU 6, DMU 7, DMU 8 are inefficient because the efficiency value is relative less than 1 (TE <1).
2. DMU 4 and DMU 5 are efficient DMU because the efficiency value is relative the same with 1 (TE = 1)

The relative efficiency value is not too far from 1. This does not mean the office is in a condition that is really inefficient, it is that the DMU can increase its efficiency value so that it can approach the efficient category.

5. CONCLUSION

From the use of the FTE method, the world load consists of Engineering Section, Energy Section and Customer Section. It was found that one of the Sungai Liat office workforce formulations for the Engineering section is $0.005579664695X1 + 0.002125459645X3 + 0.001863951224X4 + 0.000012854584X5 + 0.0000000000001X8$, Energy Transaction is $0.0011209X1 + 0.00004474X5 + 0.00000006X6$, and Customer Service section is $0.001141396155X1 + 0.000042199925X5 + 0.0000000000009X8$. Data from the DEA method, in some offices there are inefficient values. Due to a greater workload or lot compared to other offices. Therefore, an increase in workforce is needed.

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APPENDIX

Appendix 1 Quantitative Ratio

No	Implementation Unit	Broad Area Service	JTM Length	JTR Length	Distribution Substation	Total Customer	Power Connected	Electric Power Sales	Income
		KM2	Kms	Kms	Unit	Customer	Kva	kWh	Rupiah
		X1	X2	X3	X4	X5	X6	X7	X8
1	PANGKALPINANG RAYON	89.40	970.695	1,420.108	923	131,541	243,639.395	371,221,473	388,858,403,575

Appendix 2 Proportion and Weight (Hours)

	X1	X2	X3	X4	X5	X6	X7	X8	Total
Engineering Proportion	98	0	593	338	332.2	8.04	0	6	1375.24
ET Proportion	20	0	0	0	1174.5	3	0	0	1197.5
CS Proportion	20	0	0	0	1088	0	0	68	1176
Engineering Weight	0.07126	0	0.431197	0.245775	0.241558	0.005846	0	0.004363	1
ET Weight	0.016701	0	0	0	0.980793	0.002505	0	0	1
CS Weight	0.017007	0	0	0	0.92517	0	0	0.057823	1

Appendix 3 Constants

	X1	X2	X3	X4	X5	X6	X7	X8
Engineering	5.58E-03		2.13E-03	1.86E-03	1.29E-05	1.68E-07		7.58E-14
Energy Transaction	1.12E-03				4.47E-05	6.17E-08		
Customer Services	1.14E-03				4.22E-05			8.92E-13

Appendix 4 Application Program

MAX 4329.6X1

SUBJECT TO

1375.24Y1+ 1197.5Y2+ 1176Y3+ 0Y4=1
 12271.4X1- 4357.55Y1 -2600.21Y2 -4214.03Y3 -1101.64Y4<=0
 1653575X1- 3526.3Y1- 3567.33Y2- 3057Y3- 873Y4<=0
 4329.6X1- 1375.24Y1- 1197.5Y2- 1176Y3- 0Y4<=0
 396439X1- 1147.18Y1- 436.06Y2- 733.69Y3- 0Y4<=0
 429693.1X1- 381.67Y1- 1271Y2- 1121.95Y3- 0Y4<=0
 7808.52X1- 2348.84Y1- 1584.5Y2- 2477.71Y3- 1397.47Y4<=0
 3793.96X1- 1504.95Y1- 804Y2- 148401Y3- 0Y4<=0
 2280.5X1- 1169.5Y1- 491.5Y2- 619.5Y3- 0Y4<=0

END

Global optimal solution found.

Objective value: 0.7519042E-02

Infeasibilities: 0.000000

Total solver iterations: 5

Model Class: LP

Total variables: 5

Nonlinear variables: 0

Integer variables: 0

Total constraints: 10

Nonlinear constraints: 0

Total nonzeros: 39

Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
X1	0.1736660E-05	0.000000
Y1	0.2233628E-03	0.000000
Y2	0.000000	2.214541
Y3	0.5891348E-03	0.000000
Y4	0.3242472E-03	0.000000

Row	Slack or Surplus	Dual Price
1	0.7519042E-02	1.000000
2	0.000000	0.7519042E-02
3	3.791839	0.000000
4	0.000000	0.000000
5	0.9924810	0.000000
6	0.000000	0.8169033E-02
7	0.000000	0.2539200E-02
8	2.423914	0.000000
9	87.75776	0.000000
10	0.6222313	0.000000