Journal of Social Research

P-ISSN: 2827-9832
E-ISSN: 2828-335x
http://ijsr.internationaljournallabs.com/index.php/ijsr

AN EFFICIENCY STUDY IN INDONESIAN TELECOMMUNICATION COMPANY USING DATA ENVELOPMENT ANALYSIS DEA

Kokoh Kabul Amin[1*], Riko Hendrawan[2]
[1,2]*Universitas Telkom*
[*] *kokoh.kzn@gmail.com*

ABSTRACT

PT. Telekomunikasi Indonesia, Tbk (Telkom), as a state-owned company, has a dual mission, namely as a business company that must be managed professionally, as well as being mandated by the Indonesian government to accelerate the development of information technology, telecommunications, and digital infrastructure to improve the Indonesian economy. Until early 2018, Telkom with Indihome fixed broadband products had reached 3 million customers and a market share of 57.69%. However, that is only 4.50% of the 2019 IBP household penetration target. Telkom is required to increase productivity, especially the number of customers and revenue, while the allocation of available resources is limited and varies in each region. Another condition is the significant reduction in staff due to massive retirements and differences in employee productivity levels in each division. This research aims to determine and compare the efficiency level of 7 Telkom Regional Divisions for the 2016-2018 period using the DEA Data Envelopment Analysis method, with data collection based on the census. The analysis process goes through two stages, namely using the DEA Data Envelopment Analysis method, Constant Return to Scale (CRS/CCR), output-oriented. The next step is to measure the strength of the relationship between each input/output variable on efficiency using Pearson's correlation. The results of the study concluded that Divisions E and B have the highest efficiency values. On the other hand, Division G is the lowest. The variables that have the strongest correlation with the level of efficiency are the number of employees (input), the number of customers (output), and business income (output).

Keywords: *data envelopment analysis, DEA, efficiency, telecommunication*

INTRODUCTION

Indonesia, with the 4th largest population in the world and broad geography, currently faces challenges to transform from a country that relies on natural resources into an economically based country that provides added value through the utilization of technology and innovation. The mastery of information and communication technology (ICT) becomes a construction drive motor in all areas. The provision of broadband network infrastructure is very important to support the development of ICT, while the government goal that is stated in the Indonesia Broadband Plan (IBP) 2014-2019 (Zhu, 2016). Various international studies and experiences showed a strong correlation between broadband development and increased quality of development results, which determines national economic growth as well as increased workforce productivity (Moriwaki et al., 2009).

Telkom as a state-owned enterprise has a double mission as a business company that must be professionally governance and as an Indonesian government's mandate to accelerate the development of ICT and digital infrastructure to improve Indonesia's economy (Rabbaniyah & Afandi, 2019). Telkom, through its seven territory-based Regional Divisions (Divre), has an important role in building infrastructure and providing fixed broadband access service to the community throughout Indonesia nationwide (Ananda & Kurniawan, 2023). Telkom with Indihome a fixed broadband product, provides fixed access service broadband for residential

segments, and its subscribers up to the beginning of the year 2018 reached 3 million connected lines or 57.69% of the market share. That subscribers figure compared with the penetration rate of access to households is still very low, only 4.50% of IBP's planning target in 2019. Meanwhile, based on economic and market potential, the development opportunities of broadband in Indonesia, according to IBP, are still very large (Sharma et al., 2010). Thus, Telkom is required to further increase productivity, in particular, the number of subscribers and revenue. Telkom's challenges are the difference in resource availability and allocation in each region, as well as the number of employees that drastically decrease due to the massive retirement of normal retirement in the period 2018 – 2022 as much as 62% of total employees at the beginning of 2018 (Saxena et al., 2009). Besides, if observed based on its productivity, there is a different correlation in each Divre between cost allocation support, the number of employees allocated, employee productivity level, and revenue contribution (Rusdiana, 2013). Thus the research is important to measure and analyze the efficiency of each Regional division so that it can be known and compared to the already efficient and outdated Regional division, and what influenced them. Furthermore, it can give specific recommendations for each Divre as per the results of the study, what are the things that need to be increased or controlled for the productivity output to be improved.

METHOD

In the Telkom organization, there are 7 Regional divisions (Divre), which a division-shaped business units based on geographic territory, which is distinguished by the coverage of the operational area spread throughout Indonesia. In general, the databases used in this research are financial and subscriber realization data from quarter I/2016 to quarter IV/2018 (unaudited) sourced from some of the company's internal secondary data from the authorized work units. Previous research studies have become a reference to determine the input and output variables in this study. The input variables consist of the number of employees, operating expenses, personnel expenses, operation maintenance and service expenses (OM and service expense), network capital expenditure (network capex), and fixed assets. The output variable consists of the service line (number of subscribers), and operating revenue (Indrawati, 2015).

A single DMU represents each Divre with a data set of input and output per quarter. The population of all 7 Divres and 12 quarters (from quarter I/2016 to quarter IV/2018) build into a total of as much as 84 DMU, which is then processed by the DEA method of output-oriented CCR model to determine the efficiency value of each DMU, with the following equation:

$$Max(h_0) = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \quad \text{.....(1)}$$

where :

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \quad ; j = 1, \dots, N \; ; \; u_r, v_i \geq 0 \; ; \; r = 1, \dots, s \qquad ; i = 1, \dots, M \quad \text{.....(2)}$$

y_{rj} = value of output variables (number of subscribers, operating revenue)

x_{ij} = value of input variables (number of employees, operating expense, personnel expense, om & service expense, network capex , fixed asset)

u_r = weighted output variables;

v_i = weighted input variables.

The result of calculations and simulation with the DEA method above generates the efficiency value of each DMU. Further analysis compares the efficiency values of each Regional division. The subsequent process uses the Pearson correlation coefficient method to obtain a correlation coefficient or strength and direction of the relationship between each of the input variables and outputs to the efficiency value of each Regional division. If a coefficient correlation is positive, then the input/output variable has a direct relation to the efficiency value, meaning that if the value of the variable input/output is high, the efficiency value will be high anyway. This applies otherwise if the correlation is negatively valued (reverse relationship). Therefore it can be known which input variables or outputs have a substantial effect on the level of efficiency of each Regional division (Sugiyono, 2018).

RESULTS AND DISCUSSION

Table 1. Efficiency Value and Average Efficiency Value of Regional Divisions 2016-2018

Regional Division	2016 Q1	2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1	2018 Q2	2018 Q3	2018 Q4	Average Efficiency
DIV-A	0,736	0,767	0,731	0,760	0,806	0,649	0,721	0,805	0,778	0,850	0,846	0,884	**0,778**
DIV-B	1,000	0,980	0,981	0,839	1,000	0,950	0,911	1,000	1,000	1,000	1,000	1,000	**0,972**
DIV-C	0,899	0,888	0,881	0,768	0,919	0,880	0,919	0,929	0,920	1,000	1,000	1,000	**0,917**
DIV-D	0,854	0,849	0,837	0,763	0,939	0,872	0,861	1,000	1,000	0,975	1,000	0,988	**0,911**
DIV-E	1,000	1,000	0,999	0,895	1,000	0,976	1,000	0,994	1,000	1,000	1,000	1,000	**0,989**
DIV-F	0,773	0,778	0,762	0,757	0,755	0,771	0,813	0,865	0,909	1,000	1,000	1,000	**0,849**
DIV-G	0,573	0,535	0,534	0,576	0,556	0,550	0,573	0,600	0,662	0,720	0,754	0,822	**0,621**
Total Average	**0,834**	**0,828**	**0,818**	**0,766**	**0,854**	**0,807**	**0,828**	**0,885**	**0,895**	**0,935**	**0,943**	**0,956**	**0,862**

From this research was obtained that the measurement of the efficiency of all Regional divisions in PT. Telekomunikasi Indonesia, Tbk during 2016-2018, showed that the average value of all Divre's efficiency is 0.862 average, with a minimum amount of 0.766 (quarter IV/2016) and a maximum reach of 0.956 (quarter IV/2018).

Divre E is the Regional division that has the highest average efficiency value during the quarter I period from 2016 to quarter IV of 2018 with an average efficiency value of 0.989 and the lowest value of 0.895 (quarter IV/2016), and it eight times can reach a full efficient level which efficiency value = 1 (Ramadhan et al., 2017). Divre E consistently achieved a perfect efficient value in a row at four quarters in the year 2018.

Divre B has the second-highest average efficiency value for 2016-2018, with an average efficiency value of 0.972 and the lowest value of 0.839 (quarter IV 2016), as well as seven times can reach a full efficient level (efficiency value = 1). Divre B consistently achieves its

total efficient value in succession at five quarters in the first quarter of 2017 to the fourth quarter of 2018.

The condition of Divre E and Divre B with the highest and relatively stable efficiency trend showed that the management of its input resources has been excellent in producing maximum output.

Divre A is the Regional division that has an average efficiency value of 6th order of 7 Divres, with an average efficiency value of 0.778 and the lowest efficiency value of 0.649 (quarter II 2017), and never reaches a full efficient level (efficiency value = 1). Divre A, even under the national average value but its efficiency value based on the trendline looks increased from 0.737 in the initial period of 2016 to reaching 0.884 quarter IV 2018. Achievement at the end of the period if compared to the value already exceeds the average efficiency of all Divre 0.862

Divre G as the Regional division the lowest efficiency rank, if observed based on the trend, its efficiency value is seen steadily increasing from 0.573 in the initial period of 2016 to reaching 0.822 in quarter IV/2018. It indicates there is a continuous improvement that Divre G has done to manage input variables to produce maximum output.

The trend of national average efficiency, in general, is improving and increasing. The average efficiency value of 0.834 at the beginning of the period tended to decline up to a minimum level of 0.766 in the fourth quarter of 2016. Then, it improved back above 0.800 and continued to increase until the end of the observation period in quarter IV/2018.

Table 2. Pearson Correlation Coefficient between Input/Output Variables and Efficiency Value of Regional Divisions

Rank	Regional Division	Efficiency score	Pearson Correlation Coefficient							
			Operating Expense	OM & Service Expense	Employee Expense	Employee	Network Capex	Fixed Asset	Line in Service	Operating Revenue
1	DIV-E	0,989	-0,23	0,34	-0,63	-0,67	0,10	0,70	0,79	0,84
2	DIV-B	0,972	-0,43	-0,15	-0,27	-0,26	-0,43	-0,17	0,41	0,13
3	DIV-C	0,917	-0,41	-0,26	-0,22	-0,71	-0,15	0,20	0,62	0,69
4	DIV-D	0,911	-0,73	-0,32	-0,47	-0,76	0,10	0,32	0,69	0,77
5	DIV-F	0,849	-0,13	-0,30	0,06	-0,17	0,25	-0,15	0,22	0,27
6	DIV-A	0,778	-0,05	-0,04	-0,19	-0,82	0,15	0,63	0,96	0,96
7	DIV-G	0,621	-0,19	0,31	-0,39	-0,86	0,40	0,56	0,98	0,95

Based on Table 2, the input and output variables that affect the average efficiency value of Divre E, according to the calculation using the Pearson correlation coefficient. The input network variable capex, and the operating revenue output are positively correlated (unidirectional) and have quite a strong correlation ($0.25 < |\rho| < 0.50$). While it has a negative correlation with input OM & service expenses. Based on the statistical data from 2016-2018, Divre E has a high ability to maintain its high-efficiency level in both maintaining the subscribers and increasing the maximum operating revenue. The opportunities are through controlling the amount of OM & service expenses and increasing the network capex to improve the quality and technology of the existing network (Hendrawan & Sumantri, 2013).

Variables that affect the value of efficiency Divre B are input operating expense, personnel expense, number of employee, and network capex which negatively and quite strongly

correlate. It also has a unidirectional strong enough correlation with the line in service variables (Hendrawan & Nugroho, 2018). The potential of Divre B to maintain its efficiency level through its operating revenue and increase the number of subscribers, by controlling the operating budget, the number of employees, personnel costs, and also continue to expand new network investments (Masson et al., 2016).

The correlation between the average value of the efficiency of Divre A is robust ($0.75 < | \rho | < 0.99$) in the positive direction with the variable output line in service and operating revenue. A strong correlation ($0.50 < | \rho | < 0.75$) in the negative direction with employee input and employee expense, and a positive correlation with fixed assets. Also, the efficiency of Divre A is correlated negatively enough with the input OM & service expenses (Torres & Bachiller, 2013). The ability of Divre A to increase its efficiency level is by controlling the negative strong correlation variables, i.e., maintaining the negative growth of employees and controlling the employee costs. Simultaneously Divre A needs to keep increasing the allocation for variables that are strongly positively correlated. Besides, to continue to grow fixed assets in particular that support the addition of the number of new subscribers, also need to increase the budget allocation for operation maintenance & and service expenses (Charnes et al., 1978; Fried et al., 2014).

The variable that affects the efficiency of Divre G is the output line in service and operating revenue, which is very strong in positive correlation and negatively correlates very strongly with employee input variables, as well as a strong positive correlation with fixed asset input. Divre G must act harder to increase its efficiency value to remain equal with other Divre. The action should consist of improving process management of information into output variables, by priority control over the number of employees and employee expense. Also, through more budget allocation on maintenance and service operational expenses, an increase in fixed assets and networks capex to support new subscribers' sales programs and grow their operating revenue more optimally.

CONCLUSION

This research on measuring and analyzing the efficiency of all 7 Regional divisions obtains the conclusion that the efficiency level of five Divres is excellent, and two Divres is good. The average efficiency level is 0.862, while the minimum is 0.621, and the maximum level is 0.989.

There are 4 Divre whose efficiency value is above the national average rate of efficiency, Divre E is the Regional division with the highest average efficiency of 0.989 followed by the next stage Divre B (0.972), Divre C (0.917), and Divre D (0.911). Divres with below-average efficiency are Divre F (0.849) and Divre A (0.778), which the lowest average efficiency value is Divre G (0.621).

In a trend, both the average Divre and each Divre show an efficient average value that incline over time. It indicates there is continuous improvement management on inputs and outputs throughout all Divres, so there is still a potential ability for the Divisi regional to sustain efficiency growth in subsequent periods.

There is a correlation between the level of efficiency and the input/output variables. Each Divre differs in range and number of influential input/output variables, as well as different levels of strength and direction of the correlation. Based on the calculation result and analysis of the Pearson correlation between average efficiency with each input/output variable obtained,

the employee input variable (number of employees) has the most strong negative correlation with the efficiency level of five Divres. Another variable that has a robust positive correlation is the output variable line in service and operating revenue, which correlated with the efficiency of five Divres, as well as the input variable fixed asset that correlated with three Divres.

REFERENCES

Ananda, D. R. D., & Kurniawan, R. (2023). Management Information System For Telecommunication Tower Fee Payment At The Department Of Communication And Informatics Of Mempawah Regency. *Journal of Social Research, 2*(8), 2564–2577.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision-making units. *European Journal of Operational Research, 2*(6). https://doi.org/10.1016/0377-2217(78)90138-8

Fried, H., Lovell, K., & Schmidt, S. (2014). The Measurement of Productive Efficiency and Productivity Growth. *Disputatio, 6*(38).

Hendrawan, R., & Nugroho, K. W. A. (2018). Telecommunication Sector Reform in Southeast Asia: A New Rationality. *GATR Global Journal of Business Social Sciences Review, 6*(4). https://doi.org/10.35609/gjbssr.2018.6.4(6)

Hendrawan, R., & Sumantri, M. B. A. (2013). Efficiency Of Indonesia's Mutual Funds During 2007-2011 By Using Data Envelopment Analysis (DEA). *Jurnal Keuangan Dan Perbankan, 17*(1), 99–110.

Indrawati, P. D. (2015). Metode Penelitian Manajemen dan Bisnis Konvergensi Teknologi Komunikasi dan Informasi. *Bandung: PT Refika Aditama*.

Masson, S., Jain, R., Ganesh, N. M., & George, S. A. (2016). Operational efficiency and service delivery performance: A comparative analysis of Indian telecom service providers. *Benchmarking, 23*(4). https://doi.org/10.1108/BIJ-02-2014-0014

Moriwaki, S., Era, A., Osajima, M., & Umino, A. (2009). Efficiency comparison of telecommunication industry among Asia-Pacific region countries. *Institute for Information and Communications Policy*, 1–17.

Rabbaniyah, L., & Afandi, A. (2019). Analisis Efisiensi Perbankan Syariah di Indonesia Metode Stochastic Frontier Analysis. *Conference on Islamic Management, Accounting, and Economics (CIMAE) Proceeding., 2*(1992).

Ramadhan, A., Purnomo, D., Muhtarom, M., & Chuzaimah, C. (2017). Mengukur Tingkat Efisiensi Bank Pembiayaan Rakyat Syari'ah dengan Menggunakan Data Envelopment Analysis (DEA). *Cakrawala: Jurnal Studi Islam, 12*(2). https://doi.org/10.31603/cakrawala.v12i2.1704

Rusdiana, A. S. (2013). *Mengukur Tingkat Efisiensi dengan Data Envelopment Analysis (DEA): Teori dan Aplikasi*. SMART Publishing.

Saxena, V., Thakur, T., & Singh, R. P. (2009). Evaluating the performance of mobile telecom operators in India. *International Journal of Simulation: Systems, Science and Technology, 10*(4).

Sharma, S., Momaya, K., & Manohar, K. (2010). Assessing the Performance of Telecommunication Industry in India: A Data Envelopment Analysis. *Journal of International Business and Economy, 11*(2). https://doi.org/10.51240/jibe.2010.2.2

Sugiyono. ; 2018. (2018). Metode Penelitian Kuantitatif Kualitatif dan R&D. Bandung: Alfabeta. In *Angewandte Chemie International Edition, 6(11), 951–952.* (Issue Septembfile:///C:/Users/asus/Downloads/29-64-1-SM.pdffile:///C:/Users/asus/Downloads/29-64-1-SM.pdfer 2016). Alfabeta.

Torres, L., & Bachiller, P. (2013). Efficiency of telecommunications companies in European countries. *Journal of Management and Governance*, *17*(4). https://doi.org/10.1007/s10997-011-9203-4

Zhu, J. (2016). Data Envelopment Analysis. A Handbook of Empirical Studies and Applications. In *International Series in Operations Research and Management Science* (Vol. 238).