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Performance Evaluation of Kerala State Road Transport Corporation

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***Abstract*—Kerala State Road Transport Corporation (KSRTC) is the oldest state run public bus transport services in India. It plays a crucial role in strengthening the public transport system in Kerala. But today the corporation is facing a big crisis. The main objectives of this study are to evaluate the operational and financial performance of KSRTC and to compare the performance of various depots in KSRTC. This study uses both primary and secondary data. It includes interviews with the employees and visiting major depots and KSRTC offices to collect the required data. Different parameters for data analysis are operational parameters and financial parameters which includes, fleet, collection and passengers etc. The analysis of 28 main bus depots of Kerala State Road Transport Corporations are done by using Data Envelopment Analysis (DEA) in the software DEAP 2.1. The analysis shows that Trivandrum City and Trivandrum Central depots have maximum degree of efficiency in every year with an average efficiency score of 1. Ernakulam is the most inefficient depot with average efficiency score of 0.741. It is found out from the Technical Efficiency analysis that on an average 11.5 percent of the technical potential of the depot is not in use. This study has discussed how DEA can be applied to evaluate the degree of efficiency of the depots. Thus, these results give an indication on the degree of efficiency of depots in the process of transforming inputs into output. Target values are also discussed in this project. Target values are the values of input and output which would result in an inefficient organization to become efficient.**

Keywords—KSRTC; Technical efficiency; Data Envelopment Analysis; Decision Making Units;

I. INTRODUCTION

Transportation is the most important part of human life. It allows people to travel from one place to another. To make people feel convenient and comfortable with their position, different modes of the transportation system are found and it is evolved from the earliest stage to the present stage of the transportation system. At present, with the upgraded technology different modes of transportation systems are developed. The primary mode of transport for most of the Indian citizens are public transport. The availability of a safe and comfortable passenger transport facility is an important index of the economic development of any Country. Public transport provides vital connectivity to different areas of society.

Kerala State Road Transport Corporation (KSRTC) was developed in 1961. KSRTC is a state-owned public transport corporation in the Indian State of Kerala. This organization divided into three different zones for its proper working namely North Zone, Central Zone, and South Zone, with headquarters at Thiruvananthapuram. The corporation has 6241 buses which include Scania, Volvo, Ashok Leyland, Tata Motors, Eicher Motors, and minibuses.

Kerala State Road Transport Corporation(KSRTC) It is one of the oldest state-run public bus transport services in India. It has an important role in the public transport system strengthening in Kerala. But today the corporation is facing a huge crisis in its operation. Management problems, increase in fuel price, etc. can be called as reasons for this crisis. This project aims to study the performance of Kerala Road Transport Corporation by collecting operational and financial parameters from all the depots in Kerala. So the main objectives of this project are

1. To evaluate the operational and financial performance of KSRTC
2. To compare the performance of various depots in KSRTC

In India, it is not a good experience to travel through public transport, and for good reason. Most of the vehicles run by its state road transport undertakings (SRTUs) is old, and there is a shortage of funds to replace them. The government report shows that most of the SRTUs are not profitable. So it is important to understand various problems associated with working of KSRTC which makes the corporation inefficient, to improve the efficiency of depots.

II. LITERATURE REVIEW

This section provides an overview of previous research on Road Transport Corporation with a specific focus on efficiency improvement, management strategies and related issues of the corporation. It shows the details and methods used for the case study that contains the main focus of the research explained in this thesis.

Bangalore is the largest city in the state of Karnataka and is considered to be the Information Technology capital of India. In order to fulfill the different needs of the growing city population BMTC had introduced different services to serve the different segments of public transportation users. The performance evaluation of Bangalore Metropolitan Transport Corporation specifically aiming at premium bus services of BMTC operating in Bangalore city is conducted by Devaraj Hanumappa et al. (2016). The performance measurement of premium bus services is done using two different approaches. Ratios were computed considering different operational and financial indicators and these ratios are benchmarked by considering the best performing units as the target to compare the bus depots performance. Further, they studied the performance of bus depots using data envelopment analysis (DEA). The main conclusion in our study is that even though the cost of operation in terms of fuel, type maintenance, etc., has increased in these days the efficiency of these depots and

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Premium services are showing very good efficiency scores. This can be attributed to the commuters and it can be seen that the number of people is using public transport over their private mode which is a prime reason for their efficiency.[4]

Similarly, an attempt has been made to analyze the Karnataka State Road Transport Corporation in Karnataka by Kavitha B.D et al. (2017). The study is based on secondary data collected from secondary sources and the Study gives a brief Picture about the Karnataka State Road Transport Corporation in Karnataka. From this study they found that Karnataka State Road Transport Corporation doing Inter State Services, Long Distance and Night Services, Express & Non-Stop Services City /Suburban Services, Advance Booking & Reservation facilities, Luggage & parcel Transport, Special Services of Jathras/Fairs, Quality Services and It stands 5th amongst State Transport Unions in the Nation by size. Karnataka has greater potential to increase Public Transport to make the Karnataka economy and Service sector more prosperous and sustainable.[7]

A similar study for the evaluation of the performance of Road transport corporations is done by Vishnu C R et al. (2014). The performances of Road Transport Corporations are compared and a generalized methodology is formulated using the technique of Data Envelopment Analysis. Benchmarking is used as an improvement technique essential in the case where similar organizations are functioning for satisfying the customers in a profitable way but delivering it with different efficiency. For the purpose of analysis three Road Transport Corporation in South India were selected. In which Kerala State Road Transport Corporation is regularly hitting the headlines with reports of huge financial loss every year. The nearby Tamil Nadu State Transport Corporation and Karnataka State Road Transport Corporation are performing extremely opposite by making huge profits. From this study they found that The burden of Interest over various loans is huge, the staff per schedule ratio of the less efficient depot is more when compared to efficient depots, inefficient in fuel consumption, break downs of buses are more and average revenue per kilometer is less for inefficient depots. This case study pinpoints the areas where Kerala SRTC needs to concentrate to improve its standard. Various suggestions to improve the standards of the less efficient depot is also framed and listed on the basis of the result obtained.[11]

An evaluation of urban public transport of twenty-one Brazilian largest cities through Data Envelopment Analysis Method (DEA) is conducted by Marcius Carvalho et al(2015) from 2005 to 2010 for three scenarios: infrastructure efficiency, service effectiveness, and efficiency versus effectiveness. In this study, they used the DEA models. The purpose is to benchmark Brazilian cities using secondary data on three performance measures: infrastructure efficiency, service effectiveness vs. efficiency score. Efficiency is an indicator of operational excellence, thus of service provider interest. Service effectiveness is a measure of the user satisfaction with the service delivered, thus of passenger interest. The last one allows identifying the city strategy balance regarding both criteria. The cities (DMUs) were selected from the ICC document taking into account the availability of data. As the topic under analysis is public road transport operating in the urban environment, the DMUs are in similar environments and have similar objectives. The selected variables for the study were: Municipality inhabitants, Number of buses, Average daily passengers, Average gratuity. The results have shown that the contribution of the DEA is quite significant to the urban transport area that has three main stakeholders: the service provider, the public sector and the passenger. They suggested that a policy aimed at urban public transport planning should establish regulations to protect the rights of users and ensure that the quality of public transport is maintained.[3]

Kerala SRTC is one of the premiers of public transport systems in India. The survival of this concern is more relevant in these present conditions. The public is facing a steep hike in transportation costs. The performance of public transport is becoming worse. An overview of the performance of Kerala State Road Transport Corporation is given by Vini MS et al. (2017). The study is purely theoretical work which depends on secondary data and it is confined to five financial years from 2012 to 2016. The key variables taken for the study are schedules operated, number of buses, average daily collection, average earnings per kilometer, and average earnings per bus. This study found that The schedules of the KSRTC show a positive slope when compared to the number of buses for the study period. Even the number of buses is increasing; the rate of increase is less when compared to a number of schedules operated. This proves that the public prefers this service more than that of other private services. But the average daily collection, average earnings per kilometer and average earnings per bus show a declining trend. The slight variation in the earnings can be the result of increased operating costs. The findings of the study are also pointing towards that the functioning of this concern is not so satisfactory. The number of schedules and buses is not correlated with its earnings capacity. And they concluded that the operational efficiency should be enhanced so as to robust the overall performance of the Kerala SRTC.[10]

The State of Kerala in 2012 through a notification stopped issuing new permits to inter-district buses in Kerala while exempting state-run Kerala State Transport Corporation. This was the beginning of the government's action against private operators as it eventually started taking up routes were private buses used to operate. Madhu Sivaraman(2016) studied the effect of private buses in the operation of public transport and he found that the public-private modal share has tilted in favor of private transport, due to the inefficiency and absence of public transport systems for supporting people's transportation needs and now the cities in India do not have an efficient public transportation system, as more people use their cars or depend on private taxis. Also, they concluded that Kerala has a favorable market for the growth of public transport, which is being distorted due to Government action. Public transportation can only be built with the support of private players, who should take the lead to offer efficient and effective transport services. Therefore, the rule related to banning private operators from inter-district operations needs to be lifted. This will give a strong positive signal to further private participation in Kerala and other states.

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Bus operation service depends on varied factors like population, culture, atmosphere and social science. Types and options of bus operation services area unit designed in keeping with native wants. With special purpose designed technology applicable to the native climate or traveler wants, like air con in Asia, or cycle carrier mounts in UK buses, varied sorts of bus operation service target and become appealing to specific user teams. The important role played by public transport to meet the demand of business and social life is studied by Munirah Md. Rohani et al. (2013). The paper reviewed the kind of bus services, quality of service in the bus operation that influences the passenger decision and also the role of bus provider and bus driver. And they say that an improved understanding of the bus operation is important for well-managed bus services. Maintaining a high normal of quality in commission and performance is of predominant importance to encourage folks to create transport their most well-liked selection. They concluded that the performance of public bus service will be affected largely by the quality of service. In areas in which public transport especially buses are highly accessible, operation performance improvements may be required by improving factors that influence public bus ridership such as bus service reliability, safety, comfort, and cleanliness. Improving such a factor will help to encourage people to shift from private to public transport.[9]

A different study is conducted by Riyaz et al (2015). The purpose of their paper is to obtain a better understanding of the extent to which service quality is delivered by KSRTC to its passengers. The core importance of this study is to provide a base for understanding the problems in the transportation system and to know issues, or problems facing by the transportation community by collecting both primary and secondary data. Primary data was obtained from the distribution of questionnaires and secondary data through published sources. From the study, it is found that the majority of people don't feel secure or safe to travel in KSRTC local bus. In this context, the KSRTC department should try to make its service as best. There is a strong culture in KSRTC organization that "passenger's satisfaction is most important" but a lot of things are there to do when it comes to the matter of the passenger's satisfaction. First of all, the bus crews are supposed to behave in a co-operative, pleasant and in a helpful manner with passengers but in the practical only financial goal of the corporation assessed, but behavioral aspects of the crew are not assessed. In order to achieve success in maintaining standard service, the KSRTC should try to add more potential as well as qualified workers.[3]

Data Envelopment Analysis (DEA) is a decision making tool based on linear programming for measuring the relative efficiency of a set of comparable units. A survey of the basic DEA models and a comparison of DEA models is given by Milan M. Martic et al. (2009). DEA is a technique of mathematical programming that enables the determination of a unit's efficiency based on its inputs and outputs and compares it to other units involved in the analysis. This paper shows possibilities for using the DEA for the evaluation of the performance of bank branches, schools, university departments, farming estates, hospitals, and social institutions, military services, entire economic systems, and other things. It supplies important information for managing the operations of efficient and inefficient units. Since DEA is used to evaluate performances by directly considering input and output data, the results will depend on the input/output choice for the analysis and the number and homogeneity of the DMUs to be evaluated. The effect of model orientation (input or output) on the efficiency frontier and the effect of the convexity requirements on returns to scale are examined. The paper also explains how DEA models can be used to assess efficiency.

III. METHODOLOGY

Systematic and theoretical analysis of the methods adopted to a field of study is known as the methodology of the study. It mainly consists of the theoretical analysis of the methods and principles associated with a branch of knowledge. The methods describe actions applied to execute a research problem and for the application of specific procedures used to identify, select, process, and analyze the information applied to understand the problem, thereby, allowing the reader to evaluate a study's overall reliability. To achieve the goal of this study, all the data are collected from Kerala State Road Transport Corporation office.

A. Selection of variables for data collection

Anything used in a study that has a quantity or quality that varies can be defined as a variable. Most of the research projects are based on some variables. Here in this project, the variables are the characteristics or attributes of the road transport corporation selected for this project. For the data collection, the variables selected in this project are mainly classified into two. Operational variables and financial variables. Examples for operational variables are Number of schedules in operating from the depot, Number of vehicles, vehicle utilization, etc., And examples for financial variables are Total earnings per passenger kilometer(EPKM), Total cost per passenger kilometer, etc.,

B. Selection of depots

Kerala State Road Transport Corporation is a public transport corporation owned by the government of Kerala. South zone, Central zone, and North zone are the three zones in the KSRTC with the main office working at Thiruvananthapuram. As July 2018 KSRTC has three independent zones with each zone headed by zonal officers provided with self-administrative powers. This project deals with the collection and analysis of data for all the main depots under different zones of KSRTC.

Data collection is done by approaching KSRTC transport Bhavan. For the purpose of data collection, details about all the depots in KSRTC are studied. The data collected for this study are the month wise operational and financial details for a period of three financial years from 2015 April to 2018 March.

IV. DATA ANALYSIS

After the information has been collected, it has to be bestowed during an approach that communicates the knowledge and permits conclusions to be drawn. Clear, correct and applicable ways that of presenting information were chosen out of the many ways that of information presentation. The many ways that of presenting information

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embrace tables, pie charts, bar graphs, and line graphs, only tables, pie charts, and bar graphs were used in this research.
This section deals with the analysis of 28 main depots in KSRTC by considering the data for three financial years from 2015 to 2018.
The concept of productivity of any firm relates to the efficient and effective use of resources in terms of the quantified output obtained from the system and input resources used for the proper running of the system. It can be determined by dividing the output by the inputs. When we compare the productivity of two firms, the more productive firm will produce more output with the same inputs or which will produce the same output with fewer inputs. In this study, an attempt has been made to develop a model to assess the efficiency of KSRTC depots in Kerala using Data Envelopment Analysis (DEA).
Input variable considered in the Data Envelopment analysis is the fleet size. Which is one of the most important variable in producing the output. Fleet size comprises the number of buses in the depots. It is a representative of capital input. In this study two output variables are considered namely passengers and earnings. The extent of relationship between input and output variables has been analyzed using correlation analysis. It is found that the output variables have good correlation with the input variable.

A. Application of Model

The Data Envelopment Analysis is applied for the data from three financial years 2015-2016, 2016-2017 and 2017-2018.Input and output variables used in the analysis is given in the table I.

TABLE I. INPUT AND OUTPUT VARIABLES

Depots	Passengers	Collection	Fleet
Alappuzha	1507573	25855740	2406
Aluwa	1310901	17853058	1871
Attingal	1759507	26975655	2474
Changanassery	917556	16450766	1649
Chengannoor	1186966	21070799	2077
Cherthala	1634935	24498281	2329
Eranakulam	1384921	35411003	3213
Kannur	1756753	32595922	3049
Kasergode	1643524	32527862	2405
Kayamkulam	1297038	19964684	1805
Kollam	1940712	31159770	2803
Kottarakkara	2183842	34716459	2991
Kottayam	1318154	35632387	2808
Kozhikkode	438017	21494542	1393
Moovattupuzha	1076895	19414024	1831
Nedumangadu	1142460	16695121	1633
Neyyattinkara	1628857	22674167	2389
Pala	1126338	27014750	2319
Palakkad	1079337	35878723	2300
Pappanamcode	1648424	16456555	2105
Pathanamthitta	1045092	22786875	1982
Perumbavoor	973576	13542506	1260
Sulthan bathery	1343566	30324703	2519
Thiruvalla	1059826	19759303	1807
Thrissur	791999	26547502	1905
Tvm. City	2316812	24882880	2637
Tvm.central	1007923	63747737	3432
Vizhinjam	1296339	17531135	1633

The model has been applied to assess the performance of bus depots of Kerala State Road Transport Corporation, India for the data collected for the year 2015 – 2018. The efficiency score (TE, PTE and SE) of the 28 depots of Kerala State Road Transport Corporation for the year 2015-18 obtained from CRS and VRS input oriented models along with reference set, peer weights and peer counts are presented in Table II.

5.7.1.1 Technical Efficiency (TE)

TE scores are calculated through CRS Model. Table 5.1 shows that out of 28 depots, three depots [D9, D26, D27] are relatively technically efficient (efficiency score =1) and thus form the efficient frontier. The average of TE score works out to be 0.885, which implies that on an average a depot can reduce its resources by 11.5% to obtain the existing level of output. Out of 28 depots, 15 depots have an efficiency score lower than the average efficiency score and 13 depots have higher than the average efficiency.

5.7.1.2 Pure Technical Efficiency (PTE)

Table II also provides details about DEA results from VRS model. It is evident from the table that out of 28 depots, seven are efficient (VRS Score = 1), i.e, none of these have scope to further reduce inputs for maintaining the same output level. The remaining 21 depots are relatively inefficient. The average PTE works out to be 0.907. This means that given the scale of operation, on average, a depot can reduce its inputs by 9.3%. Out of the 28 depots, 13 depots have an efficiency score lower than the average efficiency score and 15 depots have higher than the average efficiency.

It is observed that D12, D14, D22 and D28 are poor in CRS Technical efficiency but efficient in pure technical efficiency. This indicates that these depots are able to convert their inputs into outputs with 100% efficiency but their overall efficiency (TE) is low due to their scale size disadvantage (low scale efficiency). D9 has the highest peer count of 24 and D22 has the peer count of 14, D26 has peer count of 17, D27 has a peer count of 11, and D28 has a peer count of 7(Table II). Therefore, these depots can be considered as the best practice depots.

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TABLE II. CRS AND VRS EFFICIENCY OF DEPOTS

Depot No.	Depots name	CRS Technical Efficiency				VRS Pure Technical Efficiency			
		Efficiency Score	Peer	Peer Weight	Peer Count	Efficiency Score	Peer	Peer Weight	Peer Count
D1	Alappuzha	0.857	9,26	0.650,0.190	0	0.862	28,9,26	0.434,0.544,0.022	0
D2	Aluwa	0.87	9,26	0.254,0.386	0	0.884	28,9,26	0.974,0.017,0.008	0
D3	Attingal	0.927	9,26	0.543,0.374	0	0.929	28,9,26	0.224,0.489,0.288	0
D4	Changanassery	0.777	9,26	0.443,0.081	0	0.827	22,27,14	0.852,0.041,0.107	0
D5	Chengannoor	0.794	9,26	0.559,0.115	0	0.813	9,27,22	0.317,0.030,0.653	0
D6	Cherthala	0.906	9,26	0.466,0.375	0	0.911	27,9,26	0.429,0.362,0.209	0
D7	Eranakulam	0.742	9,27	0.731,0.183	0	0.747	9,27,22	0.603,0.207,0.189	0
D8	Kannur	0.818	9,26	0.923,0.104	0	0.823	12,26,9	0.163,0.038,0.800	0
D9	Kasergode	1	9	1	24	1	9	1	18
D10	Kayamkulam	0.938	9,26	0.406,0.272	0	0.952	9,28,22	0.226,0.532,0.241	0
D11	Kollam	0.92	9,26	0.693,0.346	0	0.929	12,26,9	0.241,0.248,0.511	0
D12	Kottarakkara	0.966	9,26	0.757,0.406	0	1	12	1	2
D13	Kottayam	0.839	27,9	0.218,0.668	0	0.847	9,27,22	0.502,0.250,0.248	0
D14	Kozhikkode	0.872	27,9	0.293,0.087	0	1	14	1	2
D15	Moovattupuzha	0.823	9,26	0.528,0.091	0	0.854	9,27,22	0.151,0.060,0.789	0
D16	Nedumangadu	0.894	9,26	0.297,0.282	0	0.914	28,9,22	0.317,0.100,0.584	0
D17	Neyyattinkara	0.854	9,26	0.348,0.456	0	0.86	9,26,28	0.220,0.251,0.529	0
D18	Pala	0.802	27,9	0.108,0.619	0	0.825	9,27,22	0.218,0.186,0.596	0
D19	Palakkad	0.969	9,27	0.453,0.331	0	0.987	9,27,22	0.138,0.393,0.469	0
D20	Pappanamcode	0.891	26	0.712	0	0.927	26,22	0.502,0.498	0
D21	Pathanamthitta	0.819	27,9	0.048,0.606	0	0.854	22,9,27	0.754,0.099,0.147	0
D22	Perumbavoor	0.967	9,26	0.207,0.273	0	1	22	1	14
D23	Sulthan bathery	0.847	27,9	0.085,0.765	0	0.859	9,27,22	0.546,0.128,0.326	0
D24	Thiruvalla	0.834	9,26	0.563,0.058	0	0.868	22,9,27	0.799,0.125,0.077	0
D25	Thrissur	0.863	9,27	0.330,0.248	0	0.918	27,14,22	0.203,0.352,0.445	0
D26	Tvm. City	1	26	1	17	1	26	1	8
D27	Tvm.central	1	27	1	8	1	27	1	11
D28	Vizhinjam	0.983	9,26	0.243,0.387	0	1	28	1	7

5.7.1.3 Scale Efficiency (SE)

Scale efficiency is the ratio of TE to PTE score. If the value of SE score is one, then the depot apparently operates at an optimal scale. If the value is less than one, then the depot operates at either small or big relative to its optimum scale size. The fourth column of Table III shows the SE score of the depots.

The result presented in Table III show that out of 28 depots, only 3 depots are scale efficient (D9, D26 and D27) while the remaining 25 depots are scale inefficient. The average SE is 0.976. It means that on an average a depot may be able to decrease the input by 2.4% maintaining the same output.

TABLE III. SCALE EFFICIENCY OF DEPOTS

Depot	Depot name	Scale efficiency	Return to scale
D1	Alappuzha	0.994	Irs
D2	Aluwa	0.984	Irs
D3	Attingal	0.997	Irs
D4	Changanassery	0.94	Irs
D5	Chengannoor	0.977	Irs
D6	Cherthala	0.994	Irs
D7	Eranakulam	0.993	Irs
D8	Kannur	0.993	Drs
D9	Kasergode	1	Crs
D10	Kayamkulam	0.986	Irs
D11	Kollam	0.991	Drs
D12	Kottarakkara	0.966	Drs
D13	Kottayam	0.99	Irs

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D14	Kozhikkode	0.872	Irs
D15	Moovattupuzha	0.965	Irs
D16	Nedumangadu	0.978	Irs
D17	Neyyattinkara	0.993	Irs
D18	Pala	0.972	Irs
D19	Palakkad	0.981	Irs
D20	Pappanamcode	0.961	Irs
D21	Pathanamthitta	0.959	Irs
D22	Perumbavoor	0.967	Irs
D23	Sulthan bathery	0.986	Irs
D24	Thiruvalla	0.96	Irs
D25	Thrissur	0.941	Irs
D26	Tvm. City	1	Crs
D27	Tvm.central	1	Crs
D28	Vizhinjam	0.983	Irs
	Mean	0.976	

It is observed from Table III that only 3 depots have CRS (operates on optimum scale size) and 3 depots have DRS and remaining 22 depots operate under IRS. Figure 1 shows depot-wise DEA Efficiency Score of KSRTC.

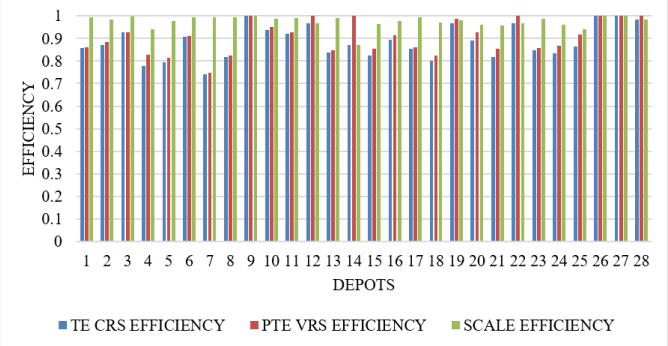

Fig.1. Combined three-year efficiency of depots

V. CONCLUSION

In this study, an attempt has been made to measure the technical and scale efficiency of the depots of Kerala State Road Transport Corporation using DEA. One input and two output DEA model has been developed with fleet size as inputs and passengers and collection as output. The model has been applied to evaluate 28 bus depots of Kerala State Road Transport Corporations. The model provides relative efficiencies and bench marks (Peer group). From the analysis Trivandrum City and Trivandrum Central are the depots which are working efficiently in every year and have maximum degree of efficiency in every year with an average efficiency score of 1 and Ernakulam is the most inefficient depot with average efficiency score of 0.741. The overall mean TE of the depots is found to be 88.5%. This indicates that on an average 11.5% of the technical potential of the depot is not in use. And this implies that these depots have the scope of producing the same output with inputs of 11.5% less than the existing level. In the recent year's peer count is higher for Kasaragod depot. i.e.It is the depot to which most of the inefficient organizations are compared.

This study has discussed how DEA can be applied to evaluate the degree of efficiency of the depots. Thus, these results give an indication on the degree of efficiency of depots in the process of transforming inputs into output. The results also depend upon the choice of inputs and output and the way the DEA model measures efficiency.

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