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FACTORS CONTRIBUTING FOR SUPPLY AND DISTRIBUTION OF ELECTRICITY POWER IN KARNATAKA: A STUDY OF MYSURU DISTRICT

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ABSTRACT

The paper attempts to present the important factors contributing for supply and distribution of electrical power to the consumers in Mysuru district of Karnataka. The data were quantified based on an opinion survey at different levels. Though the study was taken up on six segments/stages, however, this paper traces out the contribution of important factors of production, supply and distribution stages. Factor analysis was employed to document contributing factors in those stages and contribution of important factors were identified for policy decision.

Key words: Production, Supply, Distribution, Consumers and Factor analysis.

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1. INTRODUCTION

India is the fifth largest electricity power producer and the sixth largest energy consumer in the world with 3.4 percent of global energy consumption. The demand for consumption of power supply has been on the increase over the decades. It is estimated that the consumption growth was to the extent of 3.6 percent. It is known fact that the consumption of energy has been directly related with progressively increasing fully utilization of modern technologies due to increasing living standards of the urban and semi-urban population in India in particular and developing countries in general.

Although the demand for consumption of electricity has been on the increase, there are several limitations to meet the increasing demand for power. The critical issue is lack of availability of resources such as water, manpower, and technology. The country like India has very vast manpower resources, however, she lacks technical manpower for the management of production and supply. In spite of such problems, the production, and supply of power has been gaining momentum since the post-independence period.

At the micro level, the distribution of power to the consumers are vested with State Electricity Boards/Corporations. To reduce technical and commercial losses, Govt. of Karnataka has established an independent body, namely, Karnataka Power Transmission Corporation Limited (KPTCL) through Karnataka Reforms Act in 1999. The KPTCL is responsible for Transmission and Distribution functions. Subsequently, Transmission and Distribution functions of KPTCL were separated and KPTCL remained as Transmission Company.

2. IMPORTANCE OF THE STUDY

One of the major problems in the power sector is the inefficient use of resources. There are several leakages in the sector. It starts with production to end user. In the case of a non-technical segment, the predominant issue is commercial losses at various stages that lead to short supply to the consumers. However, it is found that transmission losses in KPTCL are one of the lowest in the country and are on par with the international norms. It has recorded 4.2 percent transmission loss for 2009-10 which matches the best anywhere across the globe. In Karnataka, the current distribution loss levels are about 40% still that pose a significant challenge for the Chamundeshwari Electricity Supply Corporation (CESC) in 2010-11 when compare to Bangalore Electricity Supply Company (BESCOM), which is only 14.65%. The proper electricity distribution management may reduce to normal level, 14% from the existing. Shortage of electric power will balance during the off seasons. In view of the above, the present study has been taken up to investigate to important factors that are being contributed in the production, supply, and servicing stages of CESC in Mysore district of Karnataka.

3. DATA AND METHODOLOGY

The database for the study is from the primary source of randomly selected sample respondents at different levels. The study forms 200 sample respondents. To get data on different aspects of factors that could influence for production, supply and servicing of CESC, a five point scale methodology was devised to get information on statements, which are indicated below:

Table 1

Sl.No	Status	Scale
1	Very positive impact	1
2	Somewhat positive impact	2
3	Somewhat negative impact	3
4	Very negative impact	4
5	Not much impact	5

A pre-tested questionnaire has been submitted to the selected respondents to elicit opinion on CESC for its production, supply and marketing in Mysore district of Karnataka. The collected data were tabulated. The data were used for Factor analysis to draw inference.

3.1. Factor Analysis

In this research, impact on supply chain management in distribution of Electricity of CESC Ltd are taken into consideration and steps of factor analysis are examined. Among several methods of factor analysis, the principal component method of factor analysis is more appropriate. Factor Analysis is a method for modeling observed variables, and their covariance structure, in terms of a smaller number of underlying unobservable (latent) "factors." The factors typically are viewed as broad concepts or ideas that may describe an observed phenomenon. These unobserved factors are more interesting to the social scientist than the observed quantitative measurements. Factor analysis is generally an exploratory/descriptive method that requires many subjective judgments by the user. While components are linear combinations of the observed variables, factors are linear combinations of unobserved variables. The usual factor analysis model expresses each variable as a function of factors common to several variables and a factor unique to the variable:

$$z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots.. + a_{jm}F_m + U_j$$

where:

z_j = the jth standardized variable

F_i = the common factors

m = the number of factors common to all the variables

U_j = the factor unique to variable z_j

a_{ji} = the factor loadings

Ideally, the number of factors, m, will be small, and the contribution of the unique factors will also be small. The individual factor loadings, a_{ji}, for each variable should be either very larger or very small so each variable is associated with a minimal number of factors. Thus, we want to explain the observed correlations using as few factors as possible. The unique factors, U's, are assumed to be uncorrelated with each other and with common factors.

4. RESULTS AND DISCUSSION

In Mysore district, CESC Ltd has been given the primary function of managing its operation and maintenance; empowerment of its staff for increasing their technical competence; and make them adopt new technologies for their continuous practices to maintain sustainability. In this context, the empirical findings will be discussed in the following paragraphs on power generation, supply and servicing from the opinions of perspective stakeholders.

4.1. Power Generation Stage

The power generation is the first stage, wherein six statements were prepared and the stakeholder's opinion has been sought against each statement. In the factor analysis, it is a mandatory that KMO and Bartlett's Test should be performed to assess the adequacy of sample size and evidence of strong correlation among variables.

Table 2 KMO and Bartlett's Test for Power Generation Stage

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.537
Bartlett's Test of Sphericity Approx. Chi-Square	540.280
df	15
Sig.	.000

From the Table 2, it could be observed that KMO Measure of Sampling Adequacy reveals about 0.54, which is acceptable as more than 0.50 is considered to be adequate. Further, Bartlett's Test is also found to be highly significant at 1 percent level, indicating all the six variables included in the analysis have strong correlations among them.

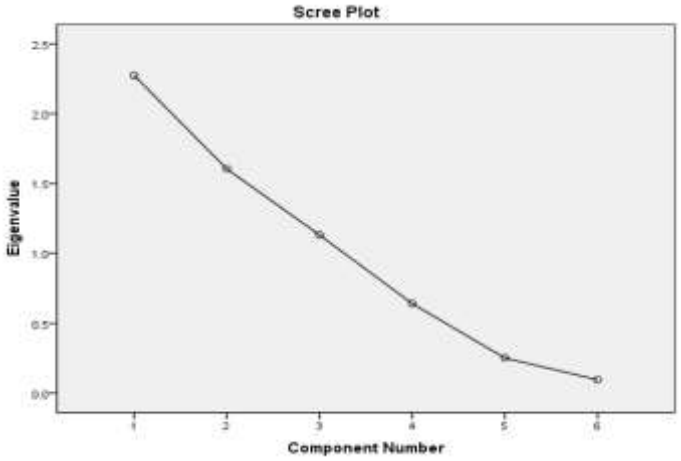

Figure 1 Power Generation Stage

The graphical picture gives an idea about the probable number of factors/components to be considered in the analysis. Scree plot (Figure 1) showed that there will be three components/factors in the data set as evident from Eigenvalues which is more than one.

The results of VARIMAX Rotated Component Analysis on Power Generation has been presented in Table 3.

Table 3 VARIMAX- Rotated Component Analysis for Power Generation Stage

Factors	Component factors			Communalities
	1	2	3	
Plant Location selection	.215	.878	.246	.878
Grid Planning	-.691	-.366	-.088	.619
Load Management	.930	-.136	.077	.890
Grid Dispatching	-.145	.853	-.242	.808
Capacity planning	.893	-.011	-.293	.884
Grid Blocking	-.067	-.006	.964	.933
				Total
Eigen values	2.212	1.652	1.147	5.011
Percentage of Trace	38.874	27.533	19.116	83.523
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				

For power generation stage, out of six factors or variables, the first component loaded strongly with load management (0.930) and capacity planning (0.893). These two factors are considered to be crucial contributing factors in the production stage. For the second and third components, plant location selection (0.878), grid dispatching (0.853), and grid blocking (0.964) were observed to be important variables. The total percentage of Trace value was estimated to be 83.52 % which is a substantial to explain the contribution of variables included in the model. When we look at the individual trace value on factor wise, the first component showed 38.87 % , followed by second (27.53 %) and third components (19.12 %) respectively. The percentage of communalities showed the contribution of individual

variables to the total trace value. It varies from 61.9 % to 93.3 % indicating share of lowest to the highest variability among the variables. In sum, among six variables in the component analysis on power generation stage, load management and capacity planning were seem to be critical factors as opinioned by sample respondents.

4.2. Supply Stage

This is another strategy stage to ensure frequent power supply to the consumers. The KMO showed 0.603 which is more than 0.50, hence the sampling adequacy test is satisfied. Bartlett's Test is also showed highly significant at 1 percent level. The results of KMO and Bartlett's Test (Table 4) both were satisfied as per the requirement values.

Table 4 KMO and Bartlett's Test for Supply Stage KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.603
Bartlett's Test of Sphericity Approx. Chi-Square	553.303
df	15
Sig.	.000

Figure 2 of Scree plot showed the selection of two factors/components in the supply data.

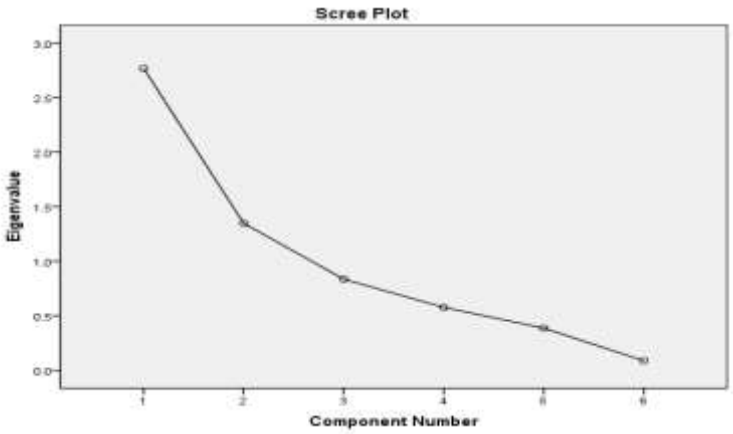

Figure 2 Power Supply Stage

Table 5 VARIMAX- Rotated Component Analysis for Supply Stage

Factors	Component factors		Communalities
	1	2	
Supplier Selection	-.223	.846	.766
Demand planning	-.616	.292	.465
Supplier Assessment	.910	.004	.827
Strategic Alliances	.912	.016	.831
Vertical Disintegration	.002	.837	.700
Marketing/ Distribution	-.700	.197	.528
			Total
Eigen values	2.577	1.541	4.118
Percentage of Trace	42.951	25.678	68.629
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			

The components wise factor analysis are discussed in Table 5 Out of six variables considered in the supply side, first factor loaded with supplier assessment (0.910) and

strategic alliance (0.912). Both are considered to be important variables to ensure power supply as opinioned by sample respondents. The second factor loaded with supplier selection (0.846) and vertical disintegration (0.837). The first factor showed 42.95 % of variation explained by the variables included in the model; while the second factor revealed 25.68 % of variation. The total variability (trace value) was to the tune of 68.63 % which is a substantial to explain variability of variables include in the first and second factors. The communalities of each variables showed that their individual contribution varied from minimum 0.465 to maximum 0.831. It can be inferred that supplier assessment and strategic alliances variables of first factor and supplier selection and vertical disintegration of second factor were found to be important contributing variables in the supply stage.

4.3. Service Stage

This is very important stage as it deals directly with the consumers. In this stage, pricing, consumer response on efficiency of power distribution, efficient replenishment, customer service management, after sales service and other service matters are used to determine the important variables contributing on service stage. The KMO showed 0.717 and Bartlett's Test of Sphericity was highly significant at 1 percent level. Hence, both measures showed data set used in the analysis adequate. Figure 3.1 showed the number of factors/components considered in the analysis. Two factors/components were selected for the final analysis.

Table 6 KMO and Bartlett's Test for Servicing

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.717
Bartlett's Test of Sphericity	Approx. Chi-Square	526.334
	df	15
	Sig.	.000

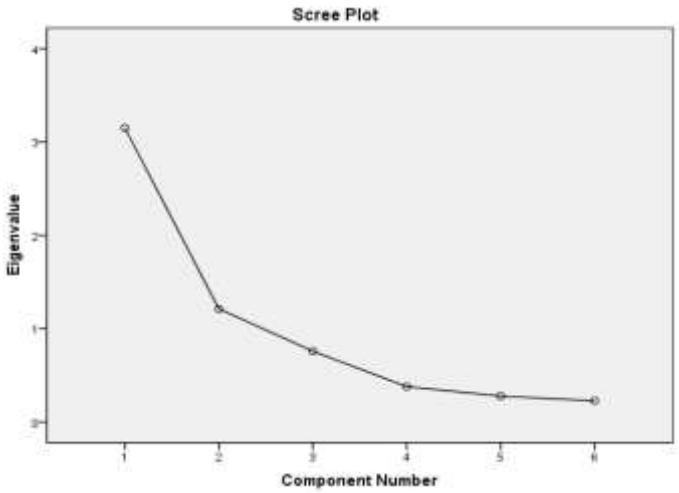

Figure 3 Scree plot for Servicing

The VARIMAX –Rotated component analysis (Table 7) presents detailed contribution of individual variables included in the analysis. Only two factors were loaded as per Principal Component Analysis. The first factor loaded with efficient replenishment (0.876) and other service matters (0.880) . In the second factor, efficient consumer response was loaded (0.848). The share of individual variables contribution was presented under communalities. The lowest was customer service management (0.582) and the highest was other service matters (0.810).

Table 7 VARIMAX- Rotated Component Analysis for Servicing

Factors	**Component factors**		**Communalities**
	1	**2**	
Pricing	.498	.643	.661
Efficient Consumer Response	.245	.848	.779
Efficient Replenishment	.876	-.009	.767
Customer Service Management	.130	-.752	.582
After Sale Service	.602	.633	.762
Others	.880	.188	.810
			Total
Eigen values	2.228	2.133	4.361
Percentage of Trace	37.139	35.554	72.693
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			

With regard to contribution of each factors to total variability, the first factor showed 37.14 % followed by the second factor (35.55 %). The sum of two factors contribution was to the extent of 72.69 %. This is sufficient to explain the variables that considered in the analysis are more adequate.

5. CONCLUSIONS

The empirical study using factor analysis has revealed several facts before CESC Ltd, Mysore. In Mysore district, CESC is the sole power supplier to the consumers. In the present paper, we attempted to show consumers opinion on CESC Ltd, for service perspective. The main objective of the study was to investigate important factors such as production, supply and service towers consumers and their contribution to reach the expected level of consumers. The findings showed that load management and capacity planning for power generation stage; supplier assessment and strategic alliance for supply stage; and efficient replenishment and other service matters for servicing stage considered to be crucial variables to provide good services to the consumers in the study district. It is suggested that CECS Ltd may take into account the findings of the study for its future course of actions on better delivery of power supply to the consumers.

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