

# **SERVICE QUALITY IN POWER SECTOR**

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF

**BACHELOR OF TECHNOLOGY**

in

**MECHANICAL ENGINEERING**

by

**Mr. SENTHIL NATHAN**

**(ROLL NO. 107ME054)**



**Department of Mechanical Engineering**

**National Institute of Technology**

**Rourkela-769008**

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Under the Guidance of

**Dr. SAROJ KUMAR PATEL**



**Department of Mechanical Engineering**

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**2011**



# National Institute of Technology

## Rourkela

### C E R T I F I C A T E

This is to certify that the work in this thesis entitled “**Service Quality in Power Sector**” by **Senthil Nathan** has been carried out under my supervision in partial fulfillment of the requirements for the degree of **Bachelor of Technology** in *Mechanical Engineering* during session 2010 - 2011 in the Department of Mechanical Engineering, National Institute of Technology, Rourkela. To the best of my knowledge, this work has not been submitted to any other University/Institute for the award of any degree or diploma.

DATE:

PLACE: ROURKELA

**Dr. SAROJ KUMAR PATEL**

(Supervisor)

Associate Professor

Dept. of Mechanical Engineering

National Institute of Technology

Rourkela-769008

# A C K N O W L E D G E M E N T

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DATE:

PLACE: ROURKELA

**SENTHIL NATHAN**

Roll No. – 107ME054

8th Semester, B. Tech

Mechanical Engineering Department

National Institute of Technology

Rourkela-769008

# Abstract

Service quality is an important issue in the electricity distribution and retail sectors. Customers are highly sensitive to all aspects of service quality and value the speed and accuracy with which their requests are handled, the reliability of the electricity supply, and the characteristics of the supply voltage.

Quality regulation entails complications and subtleties. First of all, there is the multi-dimensional nature of service quality. Furthermore, the ideal level of quality depends on consumer preferences, and these preferences can vary widely among customers. In addition, measuring quality can be difficult, consumer behavior can affect the quality of the network, and so forth. As a result, there is no simple policy indication for service quality regulation: different means are normally used to induce regulated companies to deliver the desired levels of service quality on different quality dimensions.

In this project firstly some popular methods for measuring service quality have been analyzed briefly. A consumer survey was then done to demonstrate the importance of service quality in power sector and its use. A questionnaire containing six questions which was most relevant to the consumers dealt with in the survey was distributed to the respondents. The weight for each index in the questionnaire was determined using entropy method. Then the overall Customer Satisfaction Index (CSI) was determined using the weights previously calculated and the data obtained from the consumer survey and the results were plotted in bar charts. The results obtained demonstrated the importance of the service quality in power sector and also gave useful insight into consumer preferences and the changes required to deliver the quality of service expected by the consumers.

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# Chapter 1

## Introduction

The definition of Quality in its originality is “The extent to which a product conforms to technical standards”. ‘Service’ is value co-creation, i.e., useful changes that result from communication, planning, or other purposeful interactions between distinct entities. Hence the definition of Service quality is the ability of an organization to meet or exceed the customers’ expectations. During the past few decades service quality has become a major area of attention to practitioners, managers and researchers owing to its strong impact on business performance, lower costs, customer satisfaction, customer loyalty and profitability.

Delivering the customers with a quality service comes with a lot of benefits. First and most important is the fact that you can gain an enviable reputation and market advantage by delivering quality service. Secondly delivering quality service is the easiest and most cost effective way to enhancing the value of your product in the market. Thirdly it helps to develop loyal customers who are the actual foundation of a business model. Last but not the least is that customers will be willing to pay a premium for high quality service which satisfies all their expectations.

To provide the customers a satisfactory service it is important to develop efficient service quality models which can be used to find out the extent to which the customer requirement is fulfilled. A conceptual model attempts to show the relationships that exist between salient variables. It is a simplified description of the actual situations. It is envisaged that conceptual models in service quality enable management to identify quality problems and thus help in planning for the launch

of a quality improvement program thereby improving the efficiency, profitability and overall performance.

Quality in the electricity distribution and retail sectors spans a large number of technical and non-technical aspects. Commercial quality covers the quality of a number of services, such as the provision of a new connection (before the supply contract comes into force), as well as meter reading, billing, handling of customer requests and complaints (during the validity of the contract). A distinction between services provided by the distributor (network operator) and those provided by the retailer becomes strictly necessary as a country moves forward to full retail competition. For each of those services a quality dimension is identified (normally one per service): for instance, the ‘timing’ of the new connection or the ‘accuracy’ in meter reading and billing.



### Literature Review

A lot of research work reported in literature was based on product quality. Of late the Service industry has become one of the fastest growing industries and also is creating a huge number of opportunities. This rapid growth has put a lot of focus on service quality. One of the prominent areas of the service sector is the power sector. Specifically in India the power sector is one of the fundamental components of the economy growth.

The more drastic competition in power market needs power supply companies to improve service level in order to enhance their competitiveness, and service external evaluation to companies is the basis of the service improving. *Zhang et al (2009)* studied on the external evaluation of power supply service quality. Firstly, the paper confirms main layer indexes of the external evaluation according to power supply business. Secondly, it designs the service blueprints of the various service operations to build point layer indexes. Finally, it builds the evaluation model of power supply enterprise's service quality.

*Nitin et al (2004)* critically examined 19 different service quality models. The critical review of the different service quality models is intended to derive linkage between them, and highlight the area for further research. The review of various service quality model revealed that the service quality outcome and measurement is dependent on type of service setting, situation, time, need etc factors. In addition to this even the customer's expectations towards particular services are also changing with respect to factors like time, increase in the number of encounters with a

particular service, competitive environment, etc. This paper provides a rich agenda for future research in the subject.

Effective customer satisfaction investigation is a very important precondition for power supply enterprise to win in the market competition. It is the problems need to be solved for power supply enterprise how to use advanced and practiced method to evaluate electricity customer satisfaction and how to use the evaluation result to improve the service. *Liu et al (2007)* designed an electric customer satisfaction evaluation index system based on the service blueprint theory, which covered every process of the electric customer service. In order to avoid the problem of weight identity and consider the affection of information quality to weight, authors constructed a model of customer satisfaction comprehensive evaluation based on the entropy-weighting method.

*Parasuraman et al. (1985)* proposed that service quality is a function of the differences between expectation and performance along the quality dimensions. They developed a service quality model based on gap analysis. This exploratory research was refined with their subsequent scale named SERVQUAL for measuring customers' perceptions of service quality (*Parasuraman et al., 1988*). At this point the original ten dimensions of service quality collapsed in to five dimensions: reliability, responsiveness, tangibles, assurance (communication, competence, credibility, courtesy, and security) and empathy which capture access and understanding/knowing the customers.

## **Objective**

There was a need to gauge the Customer Satisfaction Index (CSI) among the consumers dealt with in the process of our customer survey. Hence the objectives of this project are to:

1. Devise a service blueprint suited to the consumers dealt with in the survey.
2. Use the entropy method to determine the weights of the different indices selected.
3. Find the CSI of the consumers.
4. Find the factors for dissatisfaction among the consumers, if there is any, and suggest areas of improvement.

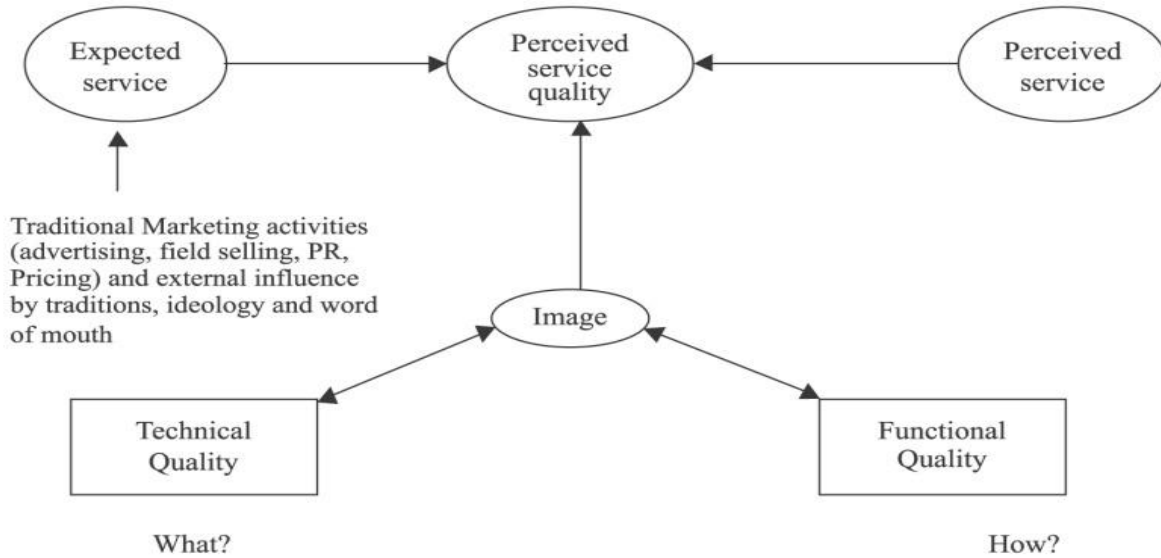
### Service Quality Models

There are many models which can be used to measure service quality and hence suggest observations and improvements. While selecting a service quality model for study it is quintessential to select the most appropriate and viable one. Some of the popular models are described in brief below.

#### 3.1. Technical and functional quality model

A company can compete successfully only if it has an accurate understanding of consumer perception of the quality and the influence on service quality. The company has to match the expected service and perceived service to each other so that each customer is satisfied. The author identified three components of service quality: technical quality, functional quality and image as shown in Figure 1.

1. Technical quality is the quality of what consumer actually receives as a result of his/her interaction with the service firm and is important to his/her evaluation of the quality of service.
2. Functional quality is how he/she gets the technical outcome. This is important to him and to his/her views of service he/she has received.
3. Image is very important to service firms and this can be expected to built up mainly by technical and functional quality of service including the other factors (tradition, ideology, word of mouth, pricing and public relations).



Source: Grönroos (1984)

Figure 1: Service quality model

### 3.2. SERVQUAL model

Parasuraman et al. (1985) proposed that service quality is a function of the differences between expectation and performance along the quality dimensions. They developed a service quality model based on gap analysis as shown in Figure 2. The various gaps visualized in the model are:

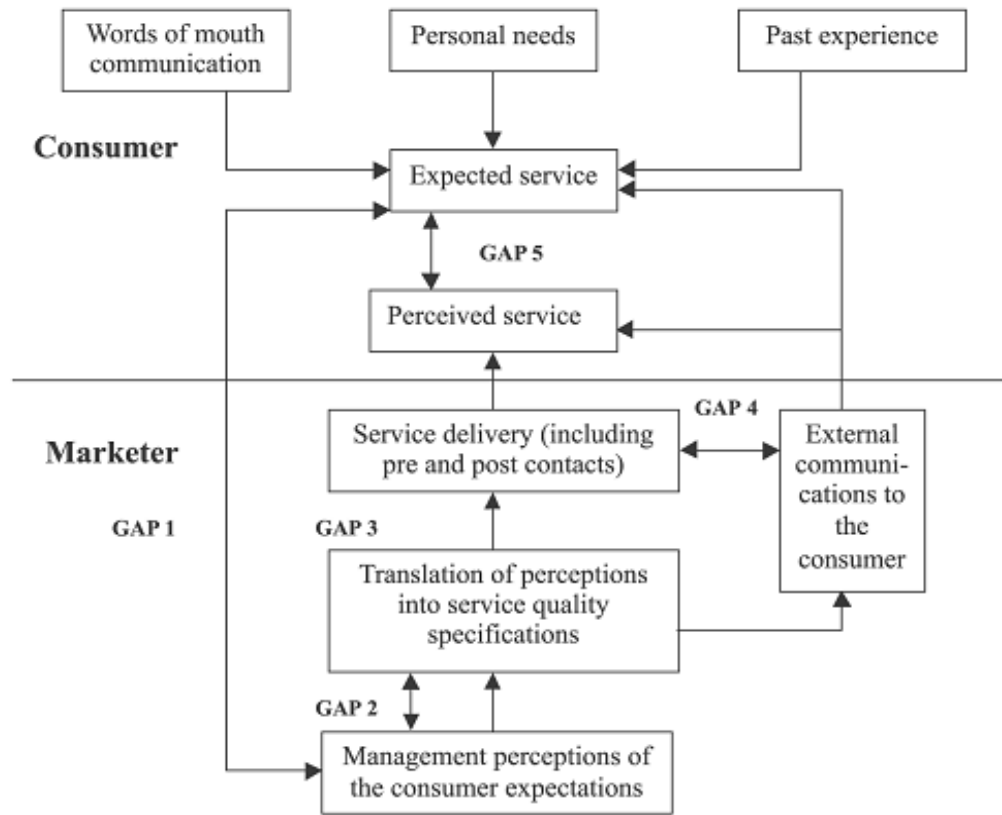
Gap 1: Difference between consumers' expectation and management's perceptions of those expectations, i.e. not knowing what consumers expect.

Gap 2: Difference between management's perceptions of consumer's expectations and service quality specifications, i.e. improper service-quality standards.

Gap 3: Difference between service quality specifications and service actually delivered i.e. the service performance gap.

Gap 4: Difference between service delivery and the communications to consumers about service delivery, i.e. whether promises match delivery?

Gap 5: Difference between consumer's expectation and perceived service. This gap depends on size and direction of the four gaps associated with the delivery of service quality of the marketer's side.



Source: Parasuraman *et al.* (1985)

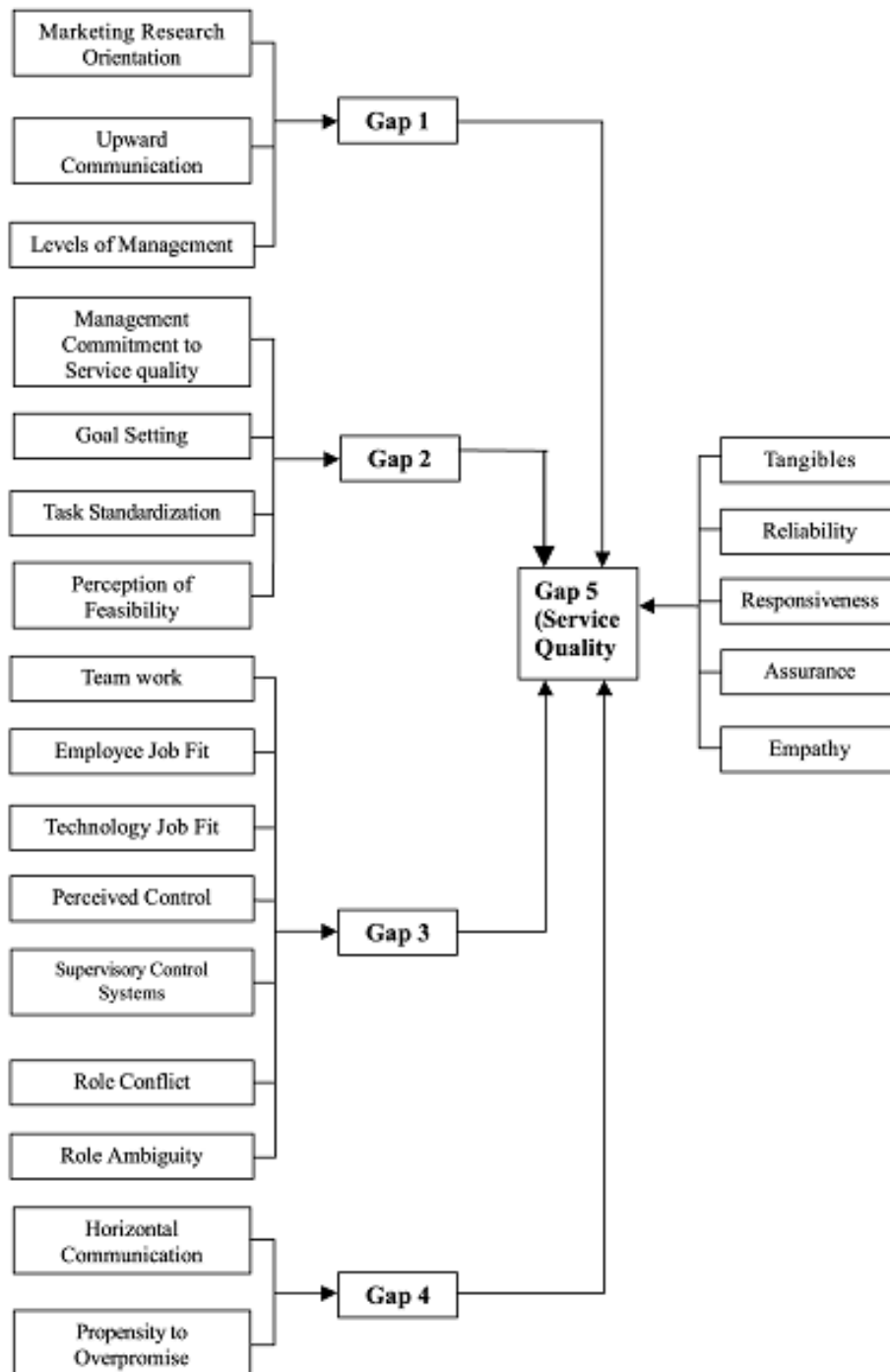
Figure 2: Gap analysis model

According to this model, the service quality is a function of perception and expectations and can be modeled as:

$$SQ = \sum_{j=1}^k (P_{ij} - E_{ij})$$

where: SQ = overall service quality; k = number of attributes.  
P<sub>ij</sub> = Performance perception of stimulus i with respect to attribute j.  
E<sub>ij</sub> = Service quality expectation for attribute j that is the relevant norm for stimulus i.

This exploratory research was refined with their subsequent scale named SERVQUAL for measuring customers' perceptions of service quality. (Parasuraman et al., 1988). At this point the original ten dimensions of service quality collapsed in to five dimensions: reliability, responsiveness, tangibles, assurance (communication, competence, credibility, courtesy, and security) and empathy which capture access and understanding/knowing the customers. This is shown in Figure 3. Later SERVQUAL was revised in 1991 by replacing "should" word by "would" and in 1994 by reducing the total number of items to 21, but five dimensional structure remaining the same. In addition to this empirical research, the authors characterized and further delineated the four gaps identified in their research of 1985. This led to extended service quality model (Figure 3). According to this extended model most factors involve communication and control process implemented in organizations to manage employees.



Source: Zeithaml *et al.* (1988)

Figure 3: Extended model of service quality



### 3.3. Customer satisfaction model

The customer satisfaction model from N. Kano is a quality management and marketing technique that can be used for measuring client happiness.

Kano's model of customer satisfaction distinguishes six categories of quality attributes, from which the first three actually influence customer satisfaction:

1. **Basic Factors** (Dissatisfiers, Must have.): The minimum requirements which will cause dissatisfaction if they are not fulfilled, but do not cause customer satisfaction if they are fulfilled (or are exceeded). The customer regards these as prerequisites and takes these for granted. Basic factors establish a market entry 'threshold'.
2. **Excitement Factors** (Satisfiers, Attractive.): The factors that increase customer satisfaction if delivered but do not cause dissatisfaction if they are not delivered. These factors surprise the customer and generate 'delight'. Using these factors, a company can really distinguish itself from its competitors in a positive way.
3. **Performance Factors**: The factors that cause satisfaction if the performance is high, and they cause dissatisfaction if the performance is low. Here, the attribute performance-overall satisfaction is linear and symmetric. Typically these factors are directly connected to customers' explicit needs and desires and a company should try to be competitive here.

The additional three attributes which Kano mentions are:

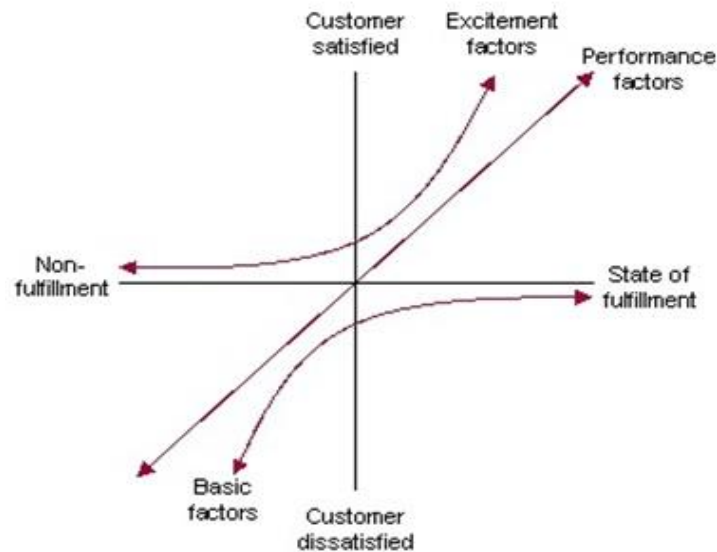
1. **Indifferent attributes:** The customer does not care about this feature.
2. **Questionable attributes:** It is unclear whether this attribute is expected by the customer.
3. **Reverse attributes:** The reverse of this product feature was expected by the customer.

How each of these criteria influence the customer's satisfaction and state of fulfillment is shown in Figure 4.

Kano also developed a questionnaire to identify the basic, performance and excitement factors as well as the other three additional factors.

1. For each product feature a pair of questions is formulated to which the customer can answer in one of five different ways.
2. The first question concerns the reaction of the customer if the product shows that feature (functional question).
3. The second question concerns the reaction of the customer if the product does NOT show this feature (dysfunctional question).
4. By combining the answers all attributes can be classified into the six factors.

## Customer Satisfaction Model Prof. N. Kano



(Adapted from Kano, 1984)

Figure 4: Customer satisfaction model

### 3.4. Service blueprint method

Service blueprint is a tool that depicts the service system precisely. With a flowchart, it demonstrates service intuitively by continuous description of service process, service encounter, the role of staff and customers, and the corporeal evidence of service. In the service blueprint description, service is disintegrated into steps and tasks of service process, and the approach to complete the tasks, so that everybody involved in the service process understands and handles his job objectively whatever his situation and goal is. Moreover, service connections between customers and staff are clearly shown in the service blueprint, which helps control and improve the quality of service.

In Figure 5, the service blueprint is divided by 3 lines into 4 parts, which are customer behavior, foreground staff behavior, background staff behavior, and support process 1-4.

1. Customer behavior can be expressed according to the customer's steps, options and behaviors in the process of purchase, consumption and evaluation. For instance, customer behavior in newly installation business includes filling in the application form, submitting the documents, paying the bill, signing the contract, etc.
2. Foreground staff behavior can be seen by customers. Take the service station for example, the staff behavior in newly installation business includes processing applications, checking submitted documents, releasing approved electricity supply schemes, sending bills, rechecking electricity price, and other behaviors that can be perceived by customers.
3. Background staff behavior cannot be seen by customers. According to the example mentioned above, the approval of electricity supply schemes is one of the background staff behaviors.
4. The support process of service includes the various internal services which are supposed to support the foreground and background staff, and the service interaction between the departments. In the example above, all the service support activities, e.g. communication between departments, staff training, and specifications for position and operation, are included in the support process.

Customer satisfaction evaluation should focus on the parts which are visible for customers, and especially pay attention to the foreground interaction. Meanwhile, the evaluation index system for customer satisfaction should be built, according to the services and promises provided by the electricity supplier.

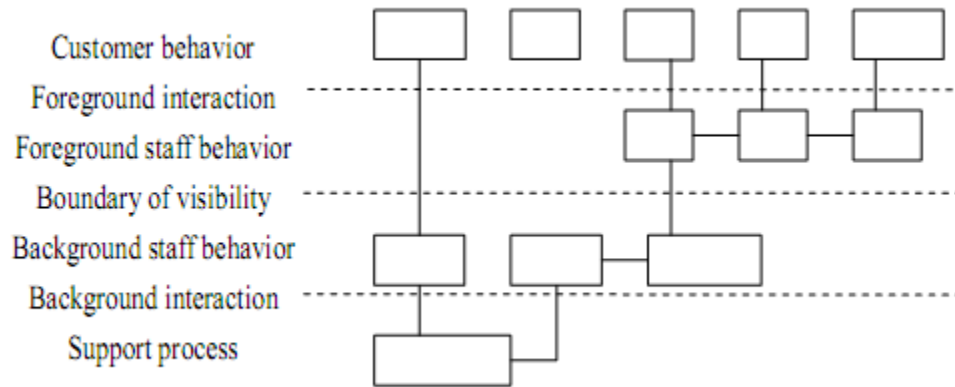


Figure 5: The structure of blueprint

#### Principles followed in the construction of the evaluation index system

- (1) **Completeness:** The service quality satisfaction evaluation made by customers should reveal their satisfaction with service quality, so the factors should be completely covered and the indexes should be typical.
- (2) **Independence:** The selection of indexes should be high enough in resolution to help distinguish the factors. Each index should independently reflect the service quality satisfaction from some aspect or level.
- (3) **Importance:** Since the customer demand varies greatly from one another, the indexes should differ in importance, and attention should be paid to the weighting of index.
- (4) **Comparability:** The index system should be comparable for different companies or stages. Moreover, all the objects that are to be compared are equal, and every index should be impartial to the objects.
- (5) **Feasibility:** It is the goal of customer evaluation that the shortages which reduce customer satisfaction be identified and modified. Hence the title and contents of each index should be well understood by the staff and customers.

The weight of each index can be calculated using the entropy method. The entropy method is objective, for the weight of an index is larger when the value of the same index on different objects varies greatly. It is because such index is high in resolution, and thus reflects more information, which means it is more helpful in distinguishing the objects. The steps of entropy method are:

(1) The determination of Weights for the different indices. There are many methods like the entropy method which can be used to calculate the weights of the indices. The entropy method is described below,

(a) Convert the actual index value to evaluation value,

$$b_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}}$$

$x_{ij}$  denotes the value of index  $j$  on object  $i$ . 'n' is the total number of objects, and  $i=1,2,\dots,n$ . 'p' is the total number of indexes, and  $j=1,2,\dots,p$

(b) The entropy of index  $j$  is

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n b_{ij} \ln b_{ij}$$

$$e_j \geq 0$$

(c) the index weight vector is  $\omega = (\omega_1, \omega_2, \omega_3, \dots, \omega_p)$

$$\omega_j = \frac{1 - e_j}{\sum_{j=1}^p (1 - e_j)}$$

(2)The Gap between customer satisfaction and expectation is calculated as shown below.

(a) Collect customer evaluation and expectation of each index of electricity supply service quality. Suppose the set of customers  $P = \{p_1, p_2, \dots, p_l\}$ , and the evaluation and expectation of index  $u_j$ , is  $z_{kj}$  and  $h_{kj}$  respectively, according to customer  $k$ . Therefore evaluation and expectation of index  $u_j$ , is

$$z_j = \sqrt[l]{\prod_{k=1}^l z_{kj}} \quad \text{and} \quad h_j = \sqrt[l]{\prod_{k=1}^l h_{kj}}$$

respectively according to all customers.

(b)Derive the customer satisfaction of service quality.

$$Z_{wx} = \sum_{j=1}^p z_j \omega_j$$

(c)Calculate the gap between customer satisfaction and expectation of electricity supply service quality,

$$SQ_x = \sum_{j=1}^p (z_j - e_j) \omega_j$$

### Methodology

In order to explain this method better a consumer survey was done, the details of which are given and explained in Chapter 5. In the power distribution sector in India there are four companies which operate in the four geographic regions of the country. In all these regions there are five types of consumers, which are Domestic, Public Organization, Commercial, Agricultural and Industrial. These cater to the needs of different types of consumers with different requirements.

In the consumer survey carried out in this project two types of users from the above mentioned five categories from the East Company (Power Distribution Company for the eastern region in India) were considered. The two categories which were taken into consideration are Domestic and Public Organization since a major chunk of the consumers in the area under consideration belonged to this category.

A Feedback Form containing six questions which were most relevant for the two categories of users in consideration was distributed. The questionnaire which was distributed to the consumers for responses was:

1. Advance information about power shut downs and notices.
2. Availability of utility staffs for registering complaint, enquiry.
3. Response time in case of problem with transformer.
4. Is load enhancement done during necessary condition?
5. Availability of electricians for maintenance and rectification work.
6. How would you rate the utility service work force in terms of knowledge, self confidence, skill and reliability.



The Likert scale was used for this survey. A Likert scale is one in which the subject has five levels of agreement for each question. These levels are:

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

The responses to these questionnaires from both the categories have been plotted in the form of pie charts and discussed in Chapter 5.

## Calculation, Results and Discussion

### 5.1 Advance information about power shut downs and notices

This index is useful to rank the power company based on the way they inform their consumers in advance and send notices before important decisions. The consumer responses for the domestic and public organization consumers are shown in Figure 6(a) and Figure 6(b) respectively. The results for the entropy calculation of domestic and public organization consumers are tabulated in Table 1(a) and Table 1(b) respectively.

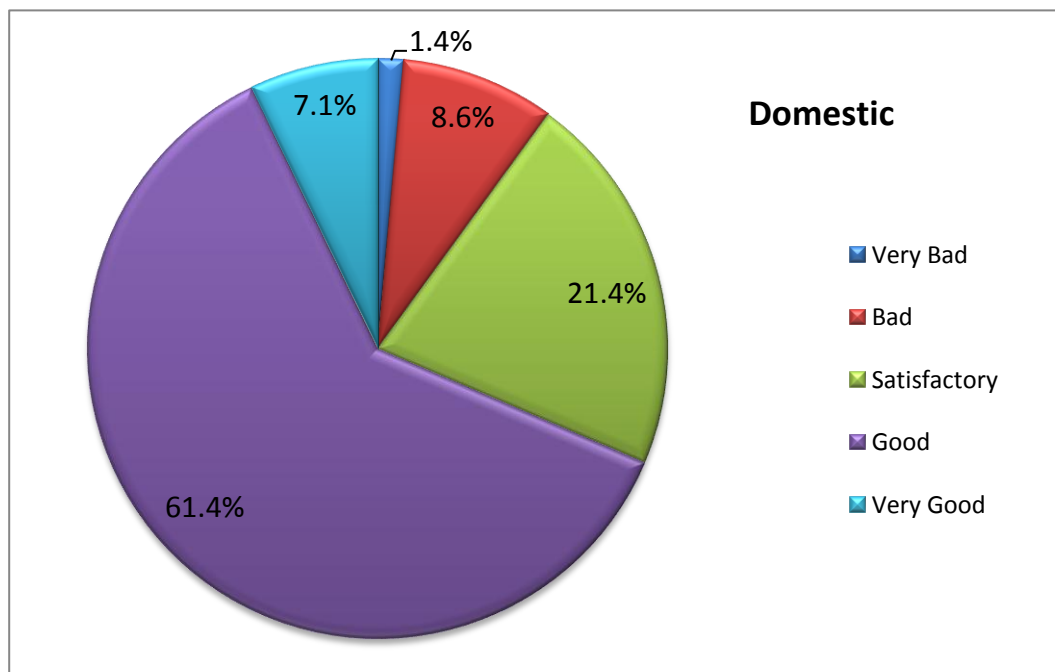


Figure 6(a): Response from domestic consumers regarding advance information

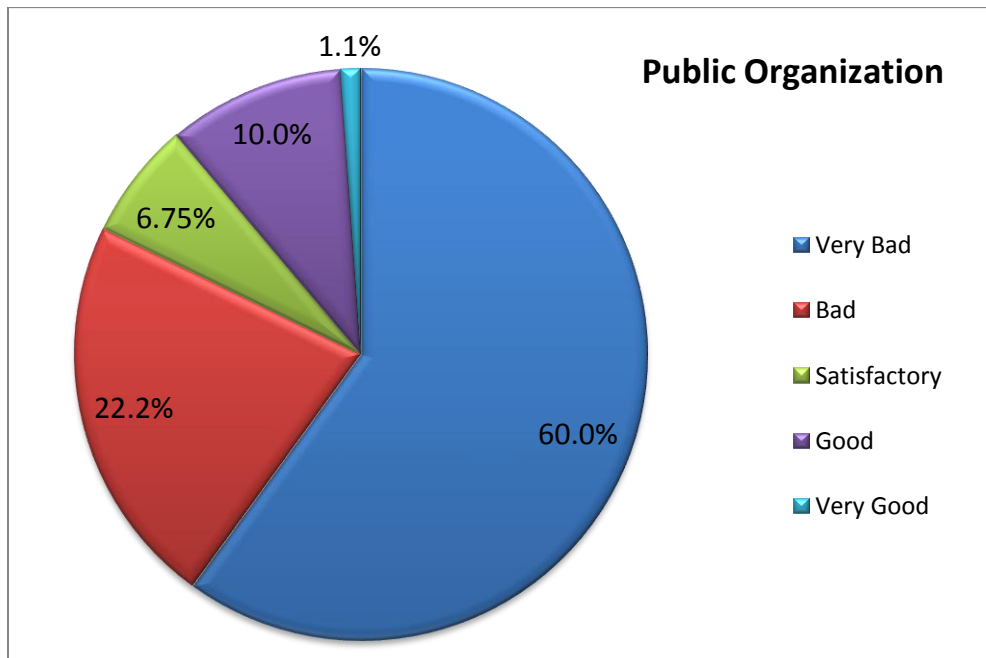


Figure 6(b): Response from public organization consumers regarding advance information

### Sample Calculation

An example of how to calculate the entropy and evaluation of an index is shown below.

$$\sum x_{i1} = [(1*1) + (2*6) + (3*15) + (4*43) + (5*25)]$$

$$B_{i1} = \text{Equivalent score} / \sum x_{i1}$$

$$B_{i1} = 1/255$$

$$B_{i1} = 0.00392$$

$$\sum B_{i1} * \ln (B_{i1}) = -4.2219$$

$$\text{Entropy, } e_1 = - (1/\ln N) * (\sum B_{i1} * \ln (B_{i1}))$$

$$e_1 = - (1/\ln 70) * (-4.2219)$$

$$e_1 = \mathbf{0.9937}$$

$$\text{Evaluation of index, } Z_1 = \sqrt[1]{(\prod Z_{k1})}$$

$$Z_1 = 3.530$$

Similarly the entropy and evaluation can be calculated for each index in each category and tabulated.

Table 1(a): Calculation of entropy for the first index for domestic consumers

<b>Domestic</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
No. of Replies	<b>1</b>	<b>6</b>	<b>15</b>	<b>43</b>	<b>5</b>
Percentage of replies	<b>1.40%</b>	<b>8.60%</b>	<b>21.40%</b>	<b>61.40%</b>	<b>7.10%</b>
$b_{ij}$	0.0039	0.0078	0.0118	0.0157	0.0196
$b_{ij} * \ln(b_{ij})$	-0.0217	-0.0380	-0.0523	-0.0652	-0.0771
$\sum b_{ij} * \ln(b_{ij})$	-0.0217	-0.2282	-0.7840	-2.8026	-0.3855
				Entropy	0.9937

Table 1(b): Calculation of entropy for the first index for public organization consumers

<b>Public Organization</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
No. of Replies	<b>54</b>	<b>20</b>	<b>6</b>	<b>9</b>	<b>1</b>
Percentage of replies	<b>60%</b>	<b>22.20%</b>	<b>6.70%</b>	<b>10%</b>	<b>1.10%</b>
$b_{ij}$	0.0065	0.0131	0.0196	0.0261	0.0327
$b_{ij} * \ln(b_{ij})$	-0.0329	-0.0567	-0.0771	-0.0953	-0.1118
$\sum b_{ij} * \ln(b_{ij})$	-1.7755	-1.1339	-0.4626	-0.8575	-0.1118
				Entropy	0.9648

## 5.2 Availability of utility staffs for registering complaint, enquiry

This index ranks the power company in terms of the availability of utility staff. The customer responses for the domestic and public organization consumers are shown in Figure 7(a) and Figure 7(b) respectively. The results for the entropy calculation of domestic and public organization consumers are tabulated in Table 2(a) and Table 2(b) respectively.

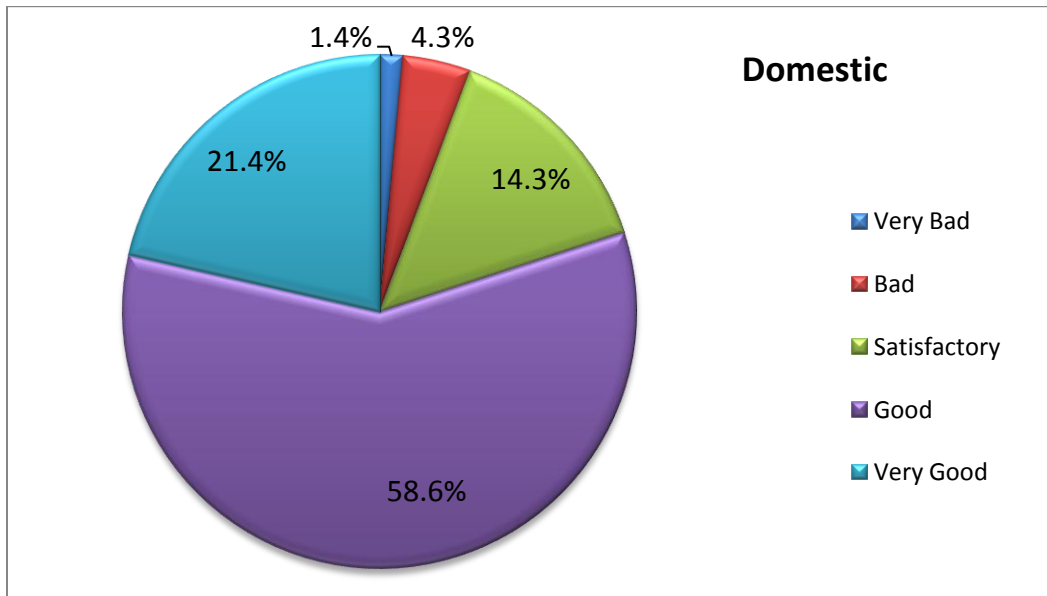


Figure 7(a): Response from domestic consumers regarding availability of utility staff

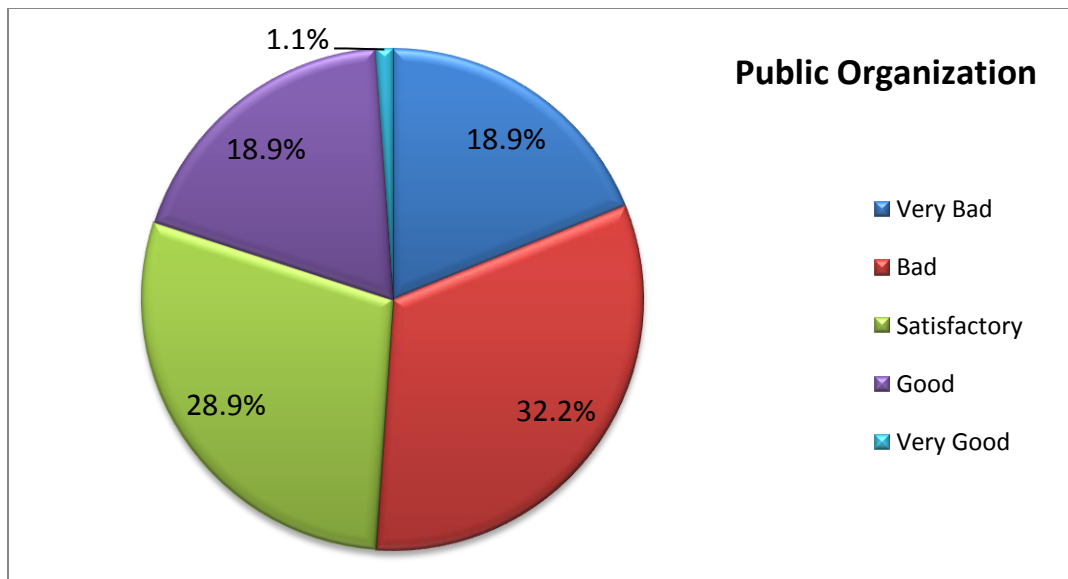


Figure 7(b): Response from public organization consumers regarding availability of utility staff

Table 2(a): Calculation of entropy for the second index for domestic consumers

<b>Domestic</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>1</b>	<b>3</b>	<b>10</b>	<b>41</b>	<b>15</b>
Percentage of replies	<b>1.40%</b>	<b>4.30%</b>	<b>14.30%</b>	<b>58.60%</b>	<b>21.40%</b>
$b_{ij}$	0.0036	0.0072	0.0109	0.0145	0.0181
$b_{ij} * \ln(b_{ij})$	-0.0204	-0.0357	-0.0492	-0.0614	-0.0727
$\sum b_{ij} * \ln(b_{ij})$	-0.0204	-0.1071	-0.4915	-2.5159	-1.0899
				Entropy	0.9944

Table 2(b): Calculation of entropy for the second index for public organization consumers

<b>Public Organization</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>17</b>	<b>29</b>	<b>26</b>	<b>17</b>	<b>1</b>
Percentage of replies	<b>18.90%</b>	<b>32.20%</b>	<b>28.90%</b>	<b>18.90%</b>	<b>1.10%</b>
$b_{ij}$	0.0044	0.0089	0.0133	0.0177	0.0221
$b_{ij} * \ln(b_{ij})$	-0.0240	-0.0418	-0.0574	-0.0714	-0.0843
$\sum b_{ij} * \ln(b_{ij})$	-0.4077	-1.2132	-1.4916	-1.2138	-0.0843
				Entropy	0.9801

### 5.3 Response time in case of problem with transformer

This index is used to rate the power company based on how quickly they respond in case of a problem with the transformer. The consumer responses for the domestic and public organization consumers are shown in Figure 8(a) and Figure 8(b) respectively. The results for the entropy calculation of domestic and public organization consumers are tabulated in Table 3(a) and Table 3(b) respectively.

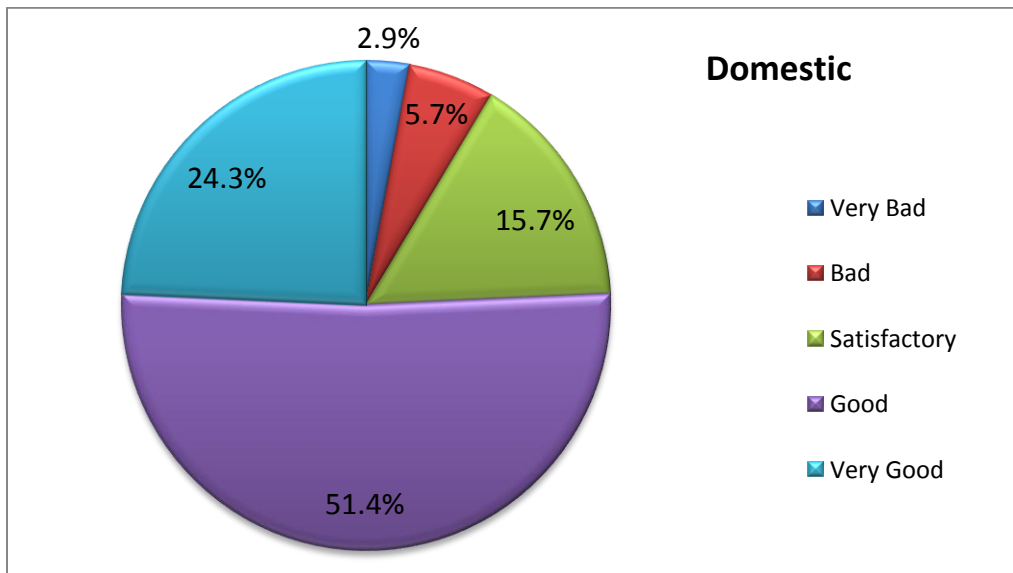


Figure 8(a): Response from domestic consumers regarding response time

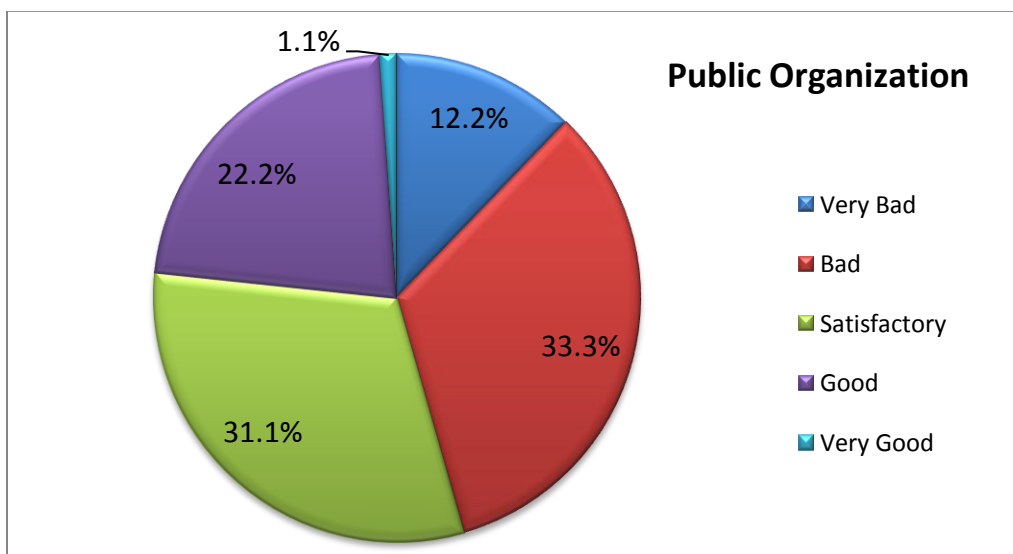


Figure 8(b): Response from public organization consumers regarding response time

Table 3(a): Calculation of entropy for the third index for domestic consumers

<b>Domestic</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>2</b>	<b>4</b>	<b>11</b>	<b>36</b>	<b>17</b>
Percentage of replies	<b>2.90%</b>	<b>5.70%</b>	<b>15.70%</b>	<b>51.40%</b>	<b>24.30%</b>
$b_{ij}$	0.0037	0.0074	0.0110	0.0147	0.0184
$b_{ij} * \ln(b_{ij})$	-0.0206	-0.0361	-0.0497	-0.0621	-0.0735
$\sum b_{ij} * \ln(b_{ij})$	-0.0412	-0.1445	-0.5468	-2.2339	-1.2489
				Entropy	0.9921

Table 3(b): Calculation of entropy for the third index for public organization consumers

<b>Public Organization</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>11</b>	<b>30</b>	<b>28</b>	<b>20</b>	<b>1</b>
Percentage of replies	<b>12.20%</b>	<b>33.30%</b>	<b>31.10%</b>	<b>22.20%</b>	<b>1.10%</b>
$b_{ij}$	0.0042	0.0083	0.0125	0.0167	0.0208
$b_{ij} * \ln(b_{ij})$	-0.0228	-0.0399	-0.0548	-0.0682	-0.0807
$\sum b_{ij} * \ln(b_{ij})$	-0.2512	-1.1969	-1.5337	-1.3648	-0.0807
				Entropy	0.9839



## 5.4 Is load enhancement done during necessary condition?

This index shows the opinion of the consumers towards the load enhancement done by the power company during necessary condition. The consumer responses for the domestic and public organization consumers are shown in Figure 9(a) and Figure 9(b) respectively. The results for the entropy calculation of domestic and public organization consumers are tabulated in Table 4(a) and Table 4(b) respectively.

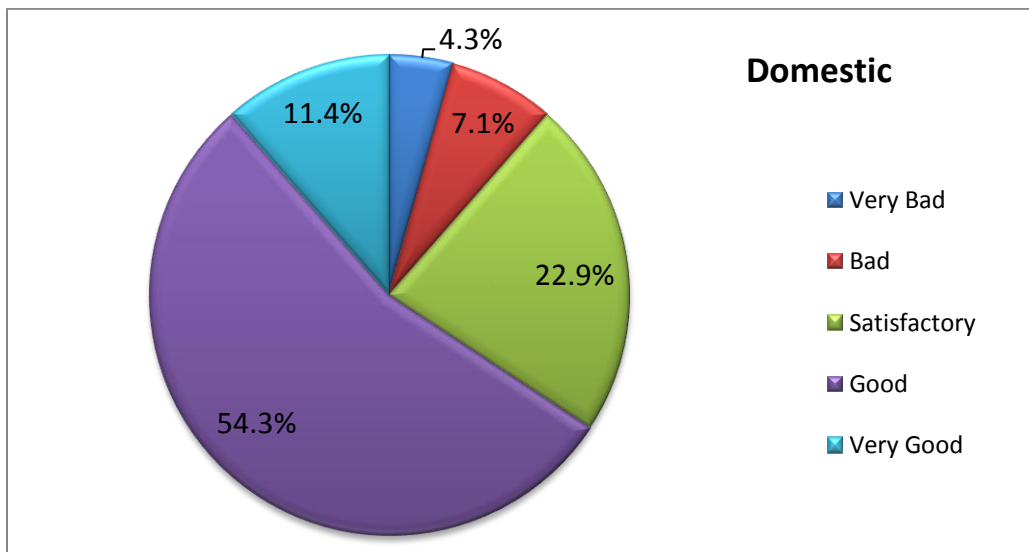


Figure 9(a): Response from domestic consumers regarding availability of load enhancement

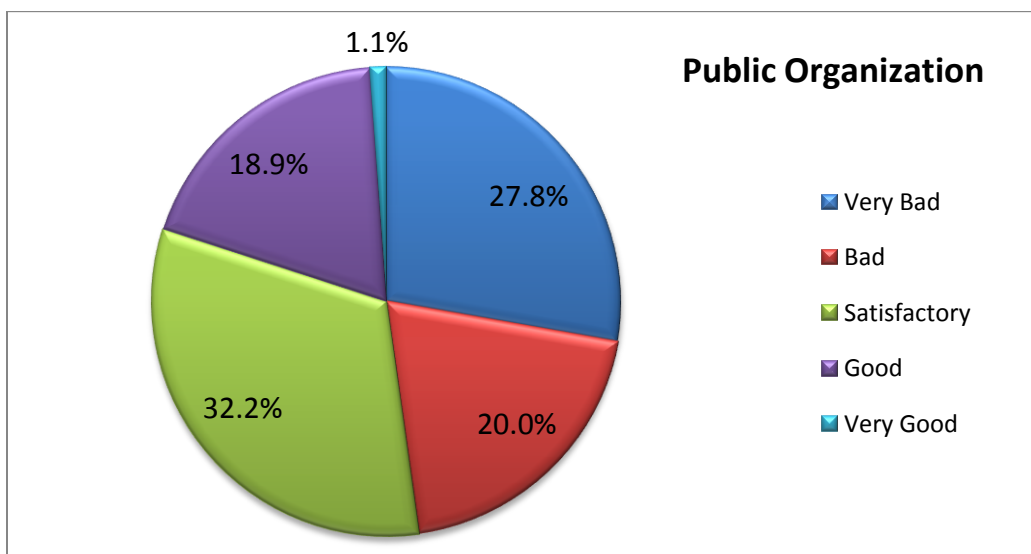


Figure 9(b): Response from public organization consumers regarding load enhancement

Table 9(a): Calculation of entropy for the fourth index for domestic consumers

<b>Domestic</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>3</b>	<b>5</b>	<b>16</b>	<b>38</b>	<b>8</b>
Percentage of replies	<b>4.30%</b>	<b>7.10%</b>	<b>22.90%</b>	<b>54.30%</b>	<b>11.40%</b>
$b_{ij}$	0.0040	0.0079	0.0119	0.0158	0.0198
$b_{ij} * \ln(b_{ij})$	-0.0219	-0.0383	-0.0526	-0.0656	-0.0776
$\sum b_{ij} * \ln(b_{ij})$	-0.0656	-0.1913	-0.8414	-2.4915	-0.6204
				Entropy	0.9909

Table 4(b): Calculation of entropy for the fourth index for public organization consumers

<b>Public Organization</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>25</b>	<b>18</b>	<b>29</b>	<b>17</b>	<b>1</b>
Percentage of replies	<b>27.80%</b>	<b>20.00%</b>	<b>32.20%</b>	<b>18.90%</b>	<b>1.10%</b>
$b_{ij}$	0.0045	0.0091	0.0136	0.0181	0.0226
$b_{ij} * \ln(b_{ij})$	-0.0244	-0.0426	-0.0584	-0.0726	-0.0857
$\sum b_{ij} * \ln(b_{ij})$	-0.6107	-0.7664	-1.6926	-1.2344	-0.0857
				Entropy	0.9755

## 5.5 Availability of electricians for maintenance and rectification work

This index shows the satisfaction of the people regarding the availability of electricians when there is a need for maintenance and rectification work. The consumer responses for the domestic and public organization consumers are shown in Figure 10(a) and Figure 10(b) respectively. The results for the entropy calculation of domestic and public organization consumers are tabulated in Table 5(a) and Table 5(b) respectively.

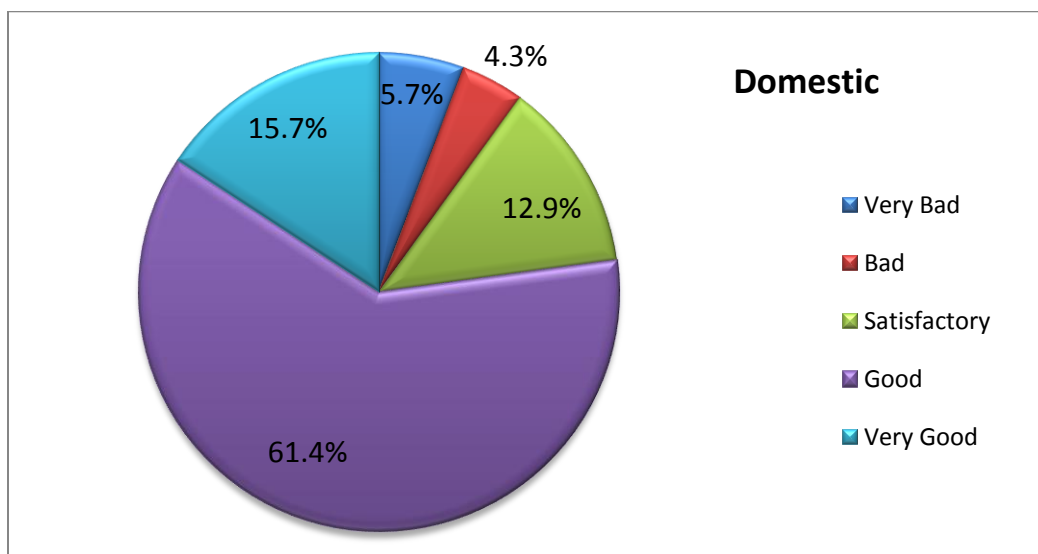


Figure 10(a): Response from Domestic consumers regarding maintenance

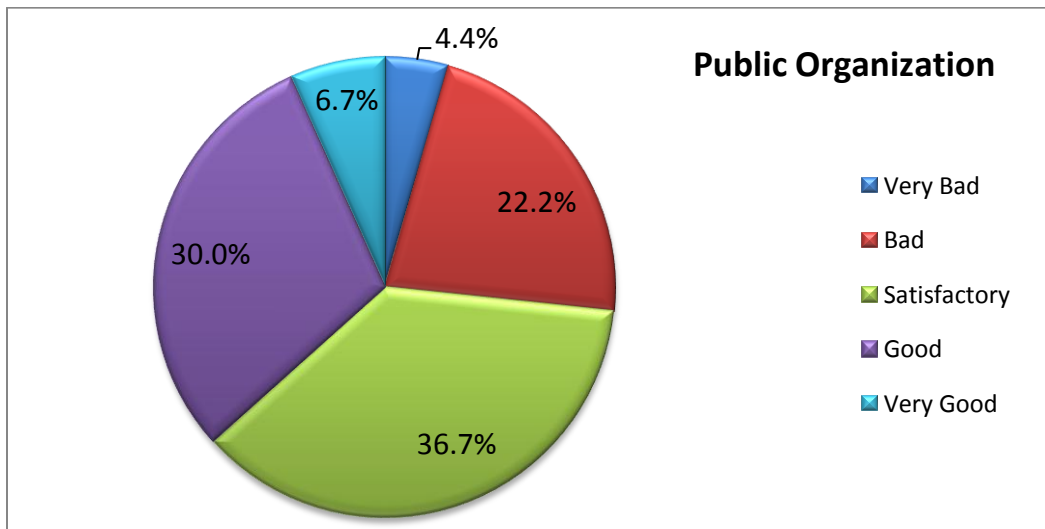


Figure 10(b): Response from public organization consumers regarding maintenance

Table 5(a): Calculation of entropy for the fifth index for Domestic consumers

<b>Domestic</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>4</b>	<b>3</b>	<b>9</b>	<b>43</b>	<b>11</b>
Percentage of replies	<b>5.7%%</b>	<b>4.30%</b>	<b>12.90%</b>	<b>61.40%</b>	<b>15.70%</b>
$b_{ij}$	0.0038	0.0076	0.0114	0.0152	0.0189
$b_{ij} * \ln(b_{ij})$	-0.0211	-0.0370	-0.0509	-0.0635	-0.0751
$\sum b_{ij} * \ln(b_{ij})$	-0.0845	-0.1110	-0.4579	-2.7296	-0.8264
				Entropy	0.9907

Table 5(b): Calculation of entropy for the fifth index for public organization consumers

<b>Public Organization</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>4</b>	<b>20</b>	<b>33</b>	<b>27</b>	<b>6</b>
Percentage of replies	<b>4.40%</b>	<b>22.20%</b>	<b>36.70%</b>	<b>30.00%</b>	<b>6.60%</b>
$b_{ij}$	0.0036	0.0071	0.0107	0.0142	0.0178
$b_{ij} * \ln(b_{ij})$	-0.0201	-0.0352	-0.0485	-0.0605	-0.0717
$\sum b_{ij} * \ln(b_{ij})$	-0.0803	-0.7039	-1.5994	-1.6342	-0.4301
				Entropy	0.9884

### 5.6. How would you rate the utility service work force in terms of knowledge, self confidence, skill and reliability?

This index shows what the consumers feel about the capacity of the utility service workforce. The consumer responses for the domestic and public organization consumers are shown in Figure 11(a) and Figure 11(b) respectively. The results for the entropy calculation of domestic and public organization consumers are tabulated in Table 6(a) and Table 6(b) respectively.

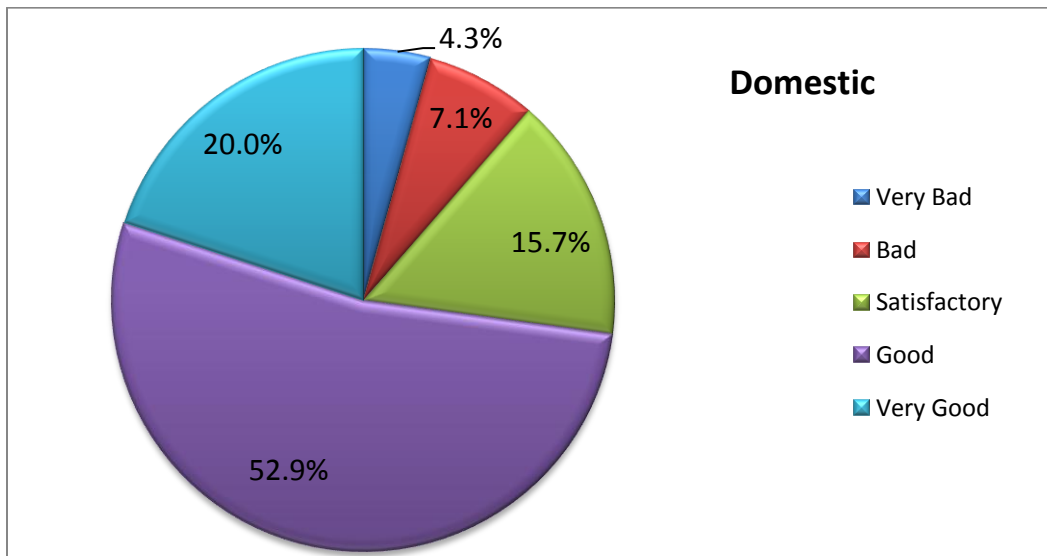


Figure 11(a): Response from domestic consumers regarding utility service workforce

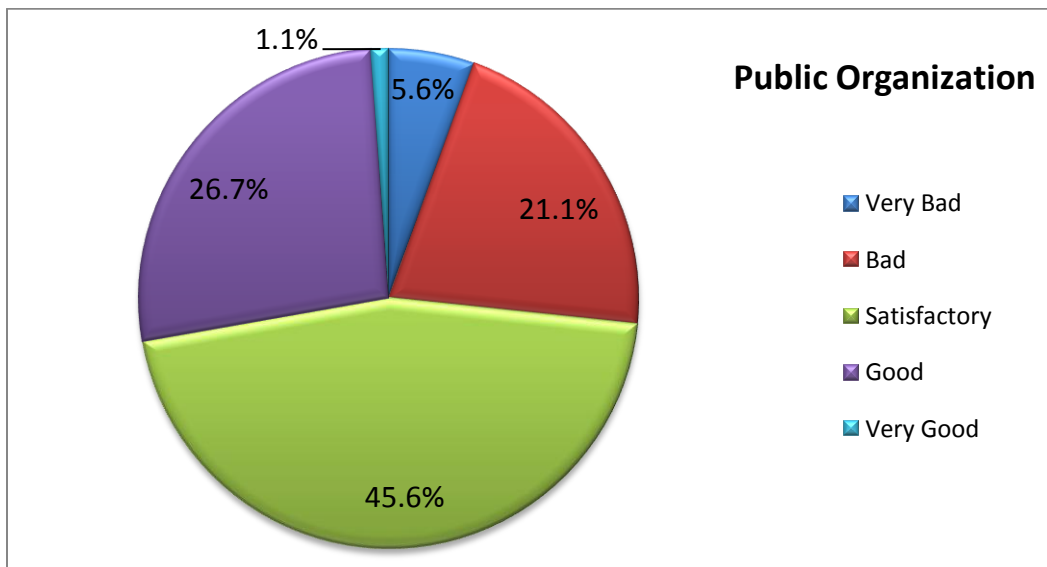


Figure 11(b): Response from public organization consumers regarding utility service workforce

Table 6(a): Calculation of entropy for the sixth index for domestic consumers

<b>Domestic</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>3</b>	<b>5</b>	<b>11</b>	<b>37</b>	<b>14</b>
Percentage of replies	<b>4.30%</b>	<b>7.10%</b>	<b>15.70%</b>	<b>52.90%</b>	<b>20.00%</b>
$b_{ij}$	0.0037	0.0075	0.0113	0.0151	0.0189
$b_{ij} * \ln(b_{ij})$	-0.0211	-0.0369	-0.0508	-0.0634	-0.0751
$\sum b_{ij} * \ln(b_{ij})$	-0.0633	-0.1849	-0.5596	-2.3487	-1.0517
				Entropy	0.9905

Table 6(b): Calculation of entropy for the sixth index for public organization consumers

<b>Public Organization</b>	Very bad	Bad	Satisfactory	Good	Very Good
Equivalent score	1	2	3	4	5
Number of Replies	<b>5</b>	<b>19</b>	<b>41</b>	<b>24</b>	<b>1</b>
Percentage of replies	<b>5.60%</b>	<b>21.10%</b>	<b>45.60%</b>	<b>26.70%</b>	<b>1.10%</b>
$b_{ij}$	0.0037	0.0075	0.0112	0.0150	0.0187
$b_{ij} * \ln(b_{ij})$	-0.0209	-0.0367	-0.0504	-0.0629	-0.0745
$\sum b_{ij} * \ln(b_{ij})$	-0.1046	-0.6965	-2.0678	-1.5105	-0.0745
				Entropy	0.9898

Now we can calculate the weights of each of the indices using the formula,

$$\omega_j = \frac{1 - e_j}{\sum_{j=1}^p (1 - e_j)}$$

Customer Satisfaction of service quality

$$Z_{wx} = \sum_{j=1}^p z_j \omega_j$$

Gap between customer satisfaction and electricity supply service quality

$$SQ_x = \sum_{j=1}^p (z_j - e_j) \omega_j$$

Table 7: Calculation of Customer Satisfaction Index and the Gap between Satisfaction and Expectation for **Public Organization Consumers**.

Sl. No,	Index	Weight	Expected Quality	Actual Quality	Customer Satisfaction
1.	Advance information	0.300	5	1.46	0.440
2.	Availability of utility staffs for enquiry	0.169	5	2.27	0.383
3.	Response time	0.138	5	2.45	0.338
4.	Load enhancement	0.208	5	2.16	0.450
5.	Availability of electricians for maintenance	0.098	5	2.94	0.288
6.	How would you rate the utility service work force	0.087	5	2.81	0.244
	<b>Total</b>	1			2.15

Table 8: Calculation of Customer Satisfaction Index and the Gap between Satisfaction and Expectation for **Domestic Consumers**.

Sl. No,	Index	Weight	Expected Quality	Actual Quality	Customer Satisfaction
1.	Advance information	0.132	5	3.53	0.465
2.	Availability of utility staffs for enquiry	0.118	5	3.83	0.452
3.	Response time	0.165	5	3.72	0.615
4.	Load enhancement	0.190	5	3.44	0.654
5.	Availability of electricians for maintenance	0.195	5	3.58	0.698
6.	How would you rate the utility service work force	0.199	5	3.58	0.713
	<b>Total</b>	1			3.59



### Conclusions

This customer survey exercise and the subsequent discussion has thrown some useful light into the consumer preferences and also highlighted the areas of improvement for the future. Based on the results above we can conclude the following:

1. There is a clear gap between the quality of service in these two categories, Domestic Consumers and Public Organization consumers. The Domestic consumers are relatively satisfied with most of the services where as the consumers in the Public Organization are much more dissatisfied.
2. The major factor for the low level of satisfaction of the domestic consumers is due to the very poor rating for the advance information and notices which shows that the power distribution company is complacent and in future it needs to be more alert and inform the consumers in advance so that the consumers can plan according to the information.
3. Both the categories of consumers have given a relatively high rating for the utility service workforce and the availability of electricians for maintenance and rectification which shows that the company has enough resources and is competent to handle the existing complaints and capacity.
4. In case of public organization consumers the high rating for the last two indices show that the company is handling personal complaint and issues (Decisions and steps taken concerning a single person) relatively well but the poor rating in the first four categories show that they are not devoting enough resources and time to take care of the collective issues (Decisions concerning more than one person).

These results have been plotted on a graph for better understanding in Figure 12.

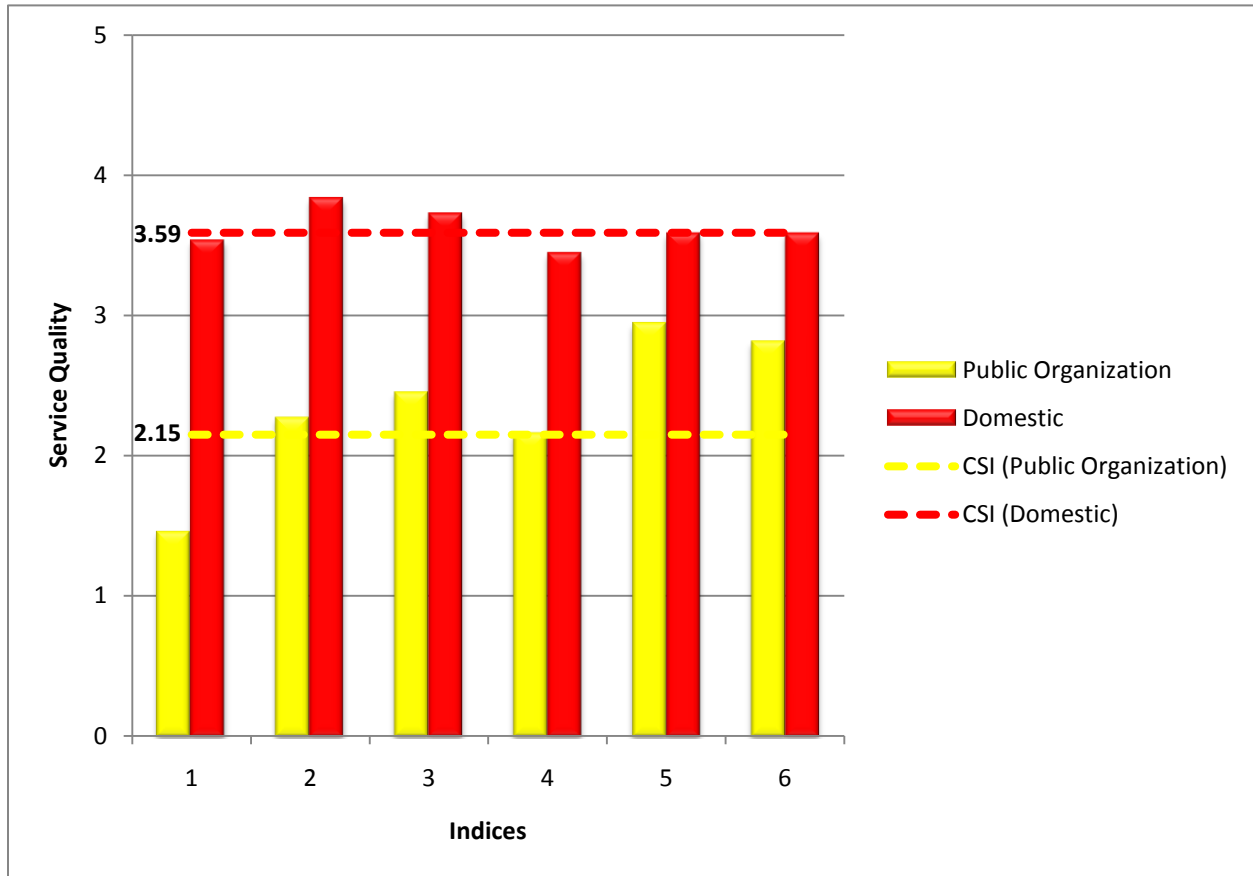


Figure 12: Graphical representation of the results obtained.

#### Indices

1. Advance information about power shut downs and notices.
2. Availability of utility staffs for registering complaint, enquiry.
3. Response time in case of problem with transformer.
4. Is load enhancement done during necessary condition?
5. Availability of electricians for maintenance and rectification work.
6. How would you rate the utility service work force in terms of knowledge, self confidence, skill and reliability.

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