

# Benchmarking of Quality of Supply in Electricity Distribution Utilities – A Case Study of Private Franchisee in Karond Area of Bhopal City

S.K. Khatik and R.V. Saxena

## ABSTRACT

The process of benchmarking helps in revealing areas where a particular utility's performance is lacking and gives directions for further improvement of processes. It gives detailed examination to identify any causes that are bringing down performance. It gives a clear assessment of strengths and weaknesses, and hence a utility can formulate a better corporate strategy to improve its performance. The purpose of benchmarking is to help in improving the effectiveness of process and delivery of services.

The benchmarks aim to bring improvements in electricity distribution by providing performance measures that will (1) help utility managers to better understand their company's strengths and weaknesses and direct improvement efforts and (2) help public officials, investors, lending institutions, etc. India's private and public utilities, which are undergoing structural reform, offer many success stories in performance enhancement. Mumbai has been served by private utilities and enjoys international standards of reliability and low technical losses. There is progress in other utilities and states also such as Ahmedabad Electricity Company, Calcutta Electric Supply, the states of Orissa, Kerala, Karnataka and Maharashtra. In the Karond area of Bhopal in MP, Agrawal Power Pvt. Ltd. (APPL), who took over distribution franchise of the area in Oct, 2007, has also made substantial progress in reducing losses and increasing the collection efficiency.

**Keywords:** Benchmarking, Utility, Performance, Efficiency, Consumer service, Metering, Billing, Collection.

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## INTRODUCTION

Benchmarking is the continuous process of measuring products, services and practices against the toughest competitors or those companies recognized as industry leaders (best in class). Benchmarking can also be

defined as a process for improving performance by constantly identifying, understanding and adapting best practices and processes followed inside and outside the organisation and implementing the results. As per Bhushan (1995), the main emphasis of benchmarking

is on improving a given business operation or a process by exploiting 'best practices,' and not on 'best performance.' Simply put, benchmarking means comparing one's organisation or a part of it with that of the other companies.

In broader sense, benchmarking means that one company has to improve through learning process and this learning comes from other companies of the same trade. It involves sharing of information for learning from others and adoption of best practices for improvement and to bring changes in performance. It involves comparison of performance. Benchmarking is a process that develops performance indices for specific organisations and compares them to the industry norms for the purpose of measuring that particular organisation's performance, and identifying areas needing improvement.

The process of benchmarking helps in revealing areas where a particular utility's performance is lacking and gives directions for further improvement of processes. It gives detailed examination to identify any causes, which are bringing down performance. It gives a clear assessment of strengths and weaknesses, and hence an electricity utility can formulate a better corporate strategy to improve its performance. The purpose of benchmarking is to help in improving the effectiveness of process and delivery of services. Companies can adopt one or more of the following types of benchmarking:

- *Strategic Benchmarking*: Aimed at improving a company's overall performance by studying the long-term strategies and approaches that helped the 'best practice' companies to succeed. It involves examining the core competencies, product/service development and innovation strategies of such companies.
- *Functional Benchmarking or Generic Benchmarking*: Used by companies to improve their processes or activities by benchmarking with

other companies from different business sectors or areas of activity but involved in similar functions or work processes.

## IMPORTANCE OF BENCHMARKING

Evaluation of performance is important in establishing and maintaining the quality of electricity service provided to consumers. There are various forms of performance benchmarking and are commonly used in the United States, Europe, Japan and other developed countries.

- Utility managers use measures to compare operational performance among their distribution units to confirm that they provide a uniform quality of service and monitor their competitiveness.
- Distribution utilities prefer benchmarking to enable comparison with competitors.
- Regulators rely on cross-utility studies of service quality and cost of service every time they consider a utility's application to increase consumer tariffs.
- Investors and others in the financial community also compare each utility's performance against benchmark indices to evaluate management performance, company risk, etc., to determine cost of capital.

## JUSTIFICATION OF THE STUDY

India's private and public electricity utilities that are undergoing structural reform offer many success stories in performance enhancement. The Andhra Pradesh Central Power Distribution Company Limited has made noteworthy progress towards improving performance in service delivery and consumer care. Mumbai has been served by private utilities and enjoys international standards of reliability and low technical losses. There is progress in other utilities and states

also such as Ahmedabad Electricity Company, Calcutta Electric Supply, the states of Orissa, Kerala, Karnataka and Maharashtra.

The Madhya Pradesh Electricity Regulatory Commission has prepared performance standard regulations that cover areas such as new connections, existing connections, billing, metering, disconnection and reconnection, energy pilferage, compensation for delays in providing services, complaint handling, meter testing and other areas.

In the Karond area of Bhopal in MP, Agrawal Power Pvt. Ltd. (APPL), who took over distribution franchise of the area in Oct, 2007, has also made substantial progress in reducing losses and increasing the collection efficiency. They have also brought consumer services to a level, which can be compared with the best in India.

Such a study will help in giving suggestions for improvement of fiscal health of ailing power distribution utilities. The strategy adopted by the Franchisee in Karond can then be followed for improvement of power distribution utilities.

## REVIEW OF LITERATURE

Jamas and Pollitt (2001) in their paper titled “Benchmarking and regulation: International electricity experience” say “Benchmarking with the use of physical quantities of inputs measures the potential for efficiency improvements in terms of reductions in physical units. However, the primary aim of regulators when using benchmarking is to promote cost savings in the utilities that result in lower prices for the end-users. Relative performance measured in terms of units of physical inputs bears an indirect relationship with cost savings potential as the basis for setting X-factors.”

Daid and Roland (1989), in their book “Financial

planning modelling methods and techniques” say “One cannot conclude however that international benchmarking would be completely without interest, quite the contrary. Both distribution companies and regulators can find it very useful. There are various factors that make cross-border comparisons interesting for both industry and regulators:

- comparing companies between countries and among each other,
- exchange of practices in countries,
- developing common understanding of benchmarking methods,
- developing common understanding of data definitions,
- learning about methods and the pros and cons of international practices,
- comparing different methods of using the results of benchmarking in regulation.

From a business point of view, there exists common ground for international benchmarks, also for distribution companies themselves. The fact that distribution companies are not direct competitors with each other in their core business of operating electricity distribution grids helps to provide incentives to undertake cross-border comparisons. The interest in benchmarking can thus arise from at least the following:

- o Similar companies across borders can help each other to streamline processes in order to produce real cost savings. This is a goal that is common to customers, companies and authorities.
- o A co-ordinated exchange of views between companies and regulators may serve to further the common understanding of good benchmarking methods. European regulators exchange information on benchmarking methods and it

may thus prove useful to establish regular discussion links between companies and authorities also in this field. Therefore companies develop their knowledge on benchmarking in general and on international practices in particular.

- o Benchmarking can also provide useful ways to understand what drives the efficiency of a company, which is elementary in today's business environment driven by, among other things, shareholder value and industry consolidation.

### OBJECTIVES OF THIS RESEARCH PAPER

Objectives determine the future course of events by establishing goals and aims. They provide spotlight over the area along which the activities are to be organized and efforts should be directed to achieve them. This study is conducted to achieve the following objectives:

- I. To analyze the concept of benchmarking in electricity distribution business.
- II. To enumerate various aspects employed by the private franchisee that lead to improvement in benchmarking parameters in Karond.

### HYPOTHESIS OF THE STUDY

The following hypothesis has been set for testing in the study:

$H_0$  = Null hypothesis

- i. The methods adopted by the franchisee at Karond have not made significant difference.

### LIMITATIONS

Benchmarking has proven itself as a tool of management. Well-known both in research and business practice, employing benchmarking as a means of increasing the competitiveness goes along with considerable problems and challenges.

- i. Here, attempt is being made to compare distribution utilities that may have different operating conditions.
- ii. The sample size considered may not be homogeneous and may be small.
- iii. Partial productivity indices such as realisation per unit are unreliable indicators of efficiency.
- iv. The performance indicators of small and big utilities cannot be compared.
- v. Organisational structures and network design are two important factors that are not considered in benchmark analysis.
- vi. The data is sourced from utilities and might be old or audited.

### ANALYSIS OF BENCHMARKING OF QUALITY OF SUPPLY

#### Condition of Karond Area Before Takeover

Karond is an area administered under City Division (East) of Bhopal City. It is predominantly resided by lower and lower middle class gentry. The nature of consumers is mainly urban domestic and agricultural. Madhya Pradesh Madhya Kshetra Vidyut Vitaran Co. Ltd. (MPMKVV Co. Ltd.) have caused electricity network to deteriorate to a level where it cannot meet current demand or future growth and hence a massive rebuilding program was needed. When Agrawal Power Pvt. Ltd took over the Karond area in October, 2007, the condition of HT and LT networks was pathetic. The loose wires of LT lines could be seen hanging at unsafe distances from houses and on roads, the poles were mostly tilted or bent, the covers of most distribution boxes were either stolen or were open, burnt cut outs in distribution boxes were not replaced and loose joints could be seen getting red hot in night. The transformers were overloaded and neither oil topping nor filtration was done since they were installed. The distribution system has been expanded

on an ad hoc and haphazard basis without any scientific planning. Poor maintenance and workmanship also contributed towards increasing losses. There was rampant theft of power due to the shabby LT network and corrupt staff. People used to tap electricity directly from the nearest LT line and no one was stopping them. The consumers who had legal, metered connections were facing different problems. Their meter was not read regularly on monthly basis and they were getting exorbitant or inflated bills. As the residents were of low income in the area, they themselves tried to avoid paying the bills. The metered consumers also resorted to malpractices like totally bypassing the meters or by tampering the meter so that it could not record the consumption correctly. The meters that were reported defective were not replaced quickly. Prolonged disputes in billing, connivance of the staff, lack of consumer-friendly policies, fictitious billing, and incorrect identification of category were the order of the day. The consumers either received their monthly bills after the due date or they did not receive it at all. The cash counters opened only for a few days during the month and that too for only a few hours depending on the availability and whims of the cashier. There was a long procedure for providing new connections, which lead to delay. In short, it can be said that the inefficiencies prevalent in Karond area were similar to those present throughout the state owned utilities in India, as highlighted by Kannan and Pillai (2000).

### **Measures Adopted by Agrawal Power Pvt. Ltd. (APPL) for Improvement in Benchmarking Parameters**

The technical loss is inherent in all electrical systems as all electrical devices have some resistance and the flow of current causes a power loss. Every element in the distribution system offers resistance to the power flow and hence consumes some energy while

performing the duty expected of it. The total energy consumed by all these elements is called technical losses. They occur due to energy dissipated in the conductors and equipments such as transformers, lines, mid span joints and terminations, service cables, etc. Other reasons for greater technical losses in Karond were found to be overloading of existing lines and substation equipments, which in turn increases the distribution burn out rate and subsequent loss of energy. Secondly, the absence of upgradation of old lines and equipments caused heavy damage in terms of loss in energy and obsolete equipments rarely helped to obtain better energy transmission and distribution. Poor repair and maintenance of equipments and old lines, overloading of existing lines, low number of substations, non-installation of sufficient capacitors and finally, the low HT:LT ratio were the major reasons found for the heavy technical losses. Agarwal, Alexander and Tenenbaum (2003) stated that the low HT: LT ratio signifies that as compared to high tension lines, the low tension lines are quite few. The HT: LT ratio ideally should be 1:1. However, due to the extensive electrification of the domestic sector in Karond and the consequent expansion of LT lines, the ratio has now become around 1:7. This ratio can be improved only by drawing HT lines on a massive scale, which would require big capital investments, besides a strong political will to deal with public resistance against taking the overhead lines over private lands.

The various measures adopted by Agrawal Power Pvt. Ltd are as follows:

- Augmentation of conductor size
- Regular maintenance of network
- Better management of distribution transformers
- Improving jumpers and joints
- Increasing the HT:LT ratio/adoption of high voltage distribution system (HVDS)
- Bifurcation of feeders

- Sufficient availability of required material in the company store
- Special emphasis on metering, reading, billing and bill distribution
- Improvement in collection avenues
- Special drive for providing new connections
- Consumer indexing
- Energy audit and accounting
- Curbing power theft
- Renovation of existing connections
- Random check reading
- Customer relationship management
- Mass awareness drives for energy conservation

## FUNCTIONAL AREAS AND METRICS FOR BENCHMARKING

Benchmarking must include all areas of relevance such as cost of service, reliability, quality, losses, financial, employee productivity, safety and consumer satisfaction. Performance benchmarks must focus on those aspects of distribution functions where performance can be measured. The metrics for these functional areas should be developed taking into consideration the ability to conduct comparative analyses of utilities and in consideration of the availability of reliable and consistent data. The functional areas for performance benchmarking are taken as follows:

**Operational Performance:** the availability, reliability, and quality of power delivered to consumers; provision of maintenance and repair services; and level of technical and commercial losses.

**Consumer Service:** provision of key consumer services such as new connection services; handling of complaints; consumer education activities; and DSM activities.

**Metering, Billing and Collection:** percentage and accuracy of metering; billing practices; collection efficiency; and arrears.

For each of these three function areas, the activities where performance measurement would be valuable have been identified and a short list of proposed, quantifiable parameters has been developed. These are prepared on the basis of a literature review and experience with Madhya Pradesh Madhya Kshetra Vidyut Vitaran Co. Ltd (MPMKVV Co. Ltd.). The comparison of performance in the Karond area before and after taking over by Agrawal Power Pvt. Ltd will be done in order to find out if there is any improvement in the quality of service provided to consumers.

## Operational Performance

Operational performance benchmarks should measure and establish standards for the reliability of service, power quality, and ability to serve demand. There are a number of industry indices that are being used as benchmarks for service reliability. Benchmarks in three areas are proposed which are as follows: (1) measures of the quality of power delivered, (2) measures of distribution operating efficiency, and (3) measures of repair and maintenance performance.

## Measures of Distribution Operating Efficiency

The measures of distribution operating efficiency are considered to focus primarily on distribution losses. As per Cassaza and Delea (1999), distribution losses are an important indication of the state of a utility's performance, and of its metering and collection functions. In India, distribution losses are considered one of the most important indications of a utility's condition of health. The proposed measures include:

Aggregate technical and commercial losses (AT&C): this aggregate measure compares energy supplied to the utility with energy sold to consumers. The difference between these figures is the energy lost in distribution due to technical reasons (e.g., resistive losses) and commercial reasons (e.g., theft and unaccounted or unmetered sales).

Technical losses in distribution: this measure estimates technical losses; generally on the basis of load flow analysis and modeling.

Realisation per unit (RPU): this measure indicates the financial health of the utility. It is calculated by total amount of cash collected during the month divided by the input units during the same month.

Billing efficiency: it is calculated by total units billed during the month divided by the input units during the same month. It helps in calculating transmission and distribution losses.

Collection efficiency: it is calculated by total cash collected during the month divided by the total demand raised during the same month. It helps in monitoring the collection process. The comparison in performance on various parameters mentioned above is given in Table 1. It shows that performance of the franchisee (APPL) is better than that of MPMKVVCL.

### ***Measures of Repair and Maintenance Performance***

Maintenance and repair are critical functions that influence the overall quality of distribution service. In many parts of India, load shedding is frequent. This often reflects lack of generation or transmission deficiencies that are beyond the control of the utility. The measures of repair and maintenance performance need to focus as much as possible on outages that are caused on the distribution system and on the utility's performance in responding to unplanned outages.

**Table 1: Comparative performance of MPMKVV Co. Ltd and APPL w.r.t. operating efficiency**

Performance measure	MPMKVVCL (Oct 2007) (%)	APPL (Oct 2012) (%)
Aggregate technical and commercial losses	80.30	57.61
Technical losses	76.53	50.95
Billing efficiency	23.47	49.05
Collection efficiency	83.92	86.41

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

Measures of repair performance should focus on the utility's response time and the time required to restore service to consumers affected by a disruption. Some measures are proposed below, toward establishing benchmarks of maintenance services.

Percentage of unplanned outages to total outages: the level of unplanned outages is an indicator of the quality of the distribution infrastructure and maintenance performance. However, both load shedding that occurs due to insufficient generation and power interruptions sourced beyond the control of the utility represent outages that do not reflect on maintenance performance. They should be excluded for the measure of maintenance performance.

Service restoration time: this is the time elapsed from when an occurred disturbance is reported to the utility office until service is restored to consumers. This measure is more usefully expressed as a distribution than as a simple average. The distribution captures data on the service restoration time of each disturbance, divided into intervals to show, for example, the percentage of service restorations that occur within 3 h of power loss, the percentage occurring within 8 h of power loss, and the percentage occurring within 18 h of power loss.

Frequency of transformer failure: this measure is determined by the ratio of the number of distribution

transformers failed annually to the total number of distribution transformers in service. This measure is another indicator of maintenance performance and infrastructure quality. This measure would provide a valuable input for comparison to their peers and a basis to justify changes in practices. The comparison in performance on various parameters mentioned above is given in Table 2. It shows that performance of the franchisee (APPL) has an improvement over that of MPMKVVCL.

**Table 2: Comparative performance of MPMKVV Co. Ltd and APPL w.r.t. repairs and maintenance**

Performance measure	MPMKVVCL (Oct 2007)	APPL (Oct 2012)
Unplanned outages/total outages	27.16 %	19.54 %
Service restoration time in distribution	108 min	47 min
Annual replacement rate of distribution transformers (%)	13.74 %	8.02 %

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

### Measures of the Quality of Power Delivered

Measures of power quality mainly focus on the frequency of supply and duration of interruptions. Four of the proposed benchmarks are indices that are used commonly in the industry. The measures include:

SAIDI (system average interruption duration index): this measures the average duration of interruptions, as the sum of the durations of the consumer interruptions used for SAIFI, divided by total consumers. It is measured in hours or minutes.

$$SAIDI = \frac{(\text{Total duration of interruptions annually}) \times (\text{No. of consumers affected})}{(\text{Total number of consumers})}$$

As shown in Table 3, the SAIDI for a feeder which was 663.33 min in October 2007 reduced to 103 min in October 2012. Similarly, as shown in Table 4, SAIDI for consumer also reduced from 3980 in

October 2007 to 1030 in October 2012. This shows that the duration of fault in feeders reduced over the period. It also shows that importance was given by Agrawal Power Pvt. Ltd for quick clearance of faults.

SAIFI (system average interruption frequency index): this measures the average number of interruptions (outages) that a consumer experiences in a year. It is a ratio of the number of consumer-interruptions in a year to the total number of consumers. Consumer-interruptions are determined from estimates of the number of consumers affected by each interruption. It is measured in numbers.

$$SAIFI = \frac{(\text{Total numbers of interruptions annually}) \times (\text{No. of consumers affected})}{(\text{Total number of consumers})}$$

Due to proper maintenance of lines in the Karond zone and as brought out in Table 5, SAIFI, which was 29 in October 2007, gradually reduced to 11 in October 2012. This shows that proper maintenance of line is being carried out by Agrawal Power Pvt. Ltd.

CAIDI (consumer average interruption duration index): this measures the average amount of time in a year that a consumer's power service is interrupted, as the sum of the consumer-interruption durations as in SAIDI, divided by the number of consumer-interruptions (as in SAIFI). It is measured in minutes.

$$CAIDI = \frac{\text{Total duration of interruptions annually (SAIDI)}}{\text{Total number of interruptions annually (SAIFI)}}$$

Since both SAIDI and SAIFI have shown reduction since Agrawal Power Pvt. Ltd. took over the Karond zone, there is reduction in CAIDI from 137 min in Oct 2007 to 93.64 min in Oct 2012 as represented in Table 6. This shows marked improvement in quality of supply.

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**Table 3: SAIDI for 11 KV feeders in the Karond area (in min)**

Benchmark	Oct. 2007	Oct. 2008	Oct. 2009	Oct. 2010	Oct. 2011	Oct. 2012
SAIDI for 11 KV Feeders	663.33	555.83	305	189.5	156	103

Source: Log sheet of MPMKVVCL and APPL

**Table 4: SAIDI for consumer in the Karond area**

Benchmark	Oct 2007	Oct 2008	Oct 2009	Oct 2010	Oct 2011	Oct 2012
SAIDI for consumer	3980	3335	2440	1895	1560	1030

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

**Table 5: SAIFI for the Karond area**

Benchmark	Oct. 2007	Oct. 2008	Oct. 2009	Oct. 2010	Oct. 2011	Oct. 2012
SAIFI	29	32	26	20	16	11

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

**Table 6: CAIDI for the Karond area (in min)**

Benchmark	Oct. 2007	Oct. 2008	Oct. 2009	Oct. 2010	Oct. 2011	Oct. 2012
CAIDI	137.24	104.22	93.85	94.75	97.50	93.64

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

### Consumer Service

Consumer service benchmarks should measure the quality and effectiveness of the utility's interaction with consumers. The principal points of interaction between the consumer and the utility occurs when a consumer (1) applies for new connection or a change of service, (2) receives his monthly bill and provides payment, or other communication related to billing, (3) contacts the utility to obtain information, review his bill, request that his meter be checked, or make a complaint, and (4) receives or participates in a service provided by the utility, apart from power supply (e.g., energy audit, DSM program, informational material, on-site testing, financing or instalment payment program). Apart from billing and collections, these aspects of consumer service are also addressed by the benchmarks proposed. The quality of consumer service is difficult to measure quantitatively, although this area has become one of the most important

functional areas and highest priorities in utilities of developed countries.

Benchmarks in three areas are proposed, as follows: (1) measures of performance in connection services, (2) measures of performance in complaint handling, and (3) other measures of consumer service. These measures are presented below:

#### *Measures of Performance in Connection Services*

Performance measures for connection services generally focus on the amount of time required for a consumer to obtain a new connection or other type of service related to his connection. In some poorly served areas, it may require months to obtain new connection for a new building, whereas in well-served areas a new connection may be obtained within 24 h. The proposed performance measures focus on service response times. The following list focuses on measures that many utilities are expected to track in some form:

Lead time to provide new connection: this is the time required to obtain power supply from the time that the consumer submits the application to the utility. From the utility's perspective, it is important to recognize that this should not include time lost if the consumer's application is not complete according to the utility's published requirements. Hence, the starting point should be when the application is recognized as complete.

Lead time to provide service upgrades or other changes to service: changes to service include changes from single- to three-phase, voltage supply upgrades, increase in allowed connected load, change of tariff, change of name, etc., which require applications to the utility. In most areas, the number of applications for changes to service exceeds the number of applications for new service. Hence from a consumer perspective, this measure may be more important than the preceding one.

Lead time to restore connection upon payment following disconnection: this is an important measure where utilities disconnect service when a consumer fails to pay his bills. The measure tracks the time required to restore power following the consumer's settlement of his account with the utility.

Lead time to test and replace meters in the case of complaint: many consumers complain that meter readings are faulty and in fact many meters require testing or replacement. The utility's performance on this measure reflects on its commitment to accurate metering and ability to improve collections, as well as on its consumer service.

The comparison in performance on various parameters mentioned above is given in Table 7. It shows that performance in relation to connection services of APPL is better than that of MPMKVCL.

**Table 7: Comparative performance of MPMKVCL Co. Ltd. and APPL w.r.t. consumer service**

Performance measure	MPMKVCL (Oct 2007)	APPL (Oct 2012)
Lead time for new connections	24 days	6 days
Lead time for change in service	60 days	30 days
Lead time to restore disconnected connections	24 hours	6 hours
Lead time to test/replace meters in the case of complaint	45 days	14 days

Source: Log sheet of MPMKVCL-Oct 2007 and APPL-Oct 2012

### *Measures of Complaint Handling*

Complaint handling is an important function of consumer service and is a key indicator of service quality. Yet many utilities have no formal mechanism to record, process, or respond to complaints. The Electricity Act, 2003, includes a specific provision that orders states to create a forum for consumers to express their grievances. It is an indicator that many Indian utilities have insufficient means of complaint expression. The following measures are proposed:

Complaint response time: this is the time from submission of the fault complaint to an action by the utility toward resolving the complaint to the satisfaction of both parties.

Consumer care staffing level/100 consumer: this is an indicator of the effort and resources devoted by the utility to consumer service, which must be carefully differentiated from other services such as maintenance and repair.

The comparison in performance on various parameters mentioned above is given in Table 8. It shows that performance in relation to complaint handling by APPL is better than that of MPMKVCL.

### **Metering, Billing and Collection**

In India, this area is known to have many examples of deficiencies. The benchmarks must clearly establish

**Table 8: Comparative performance of MPMKVV Co. Ltd. and APPL w.r.t. complaints handling**

Performance measure	MPMKVVCL (Oct 2007)	APPL (Oct 2012)
Response time from fault complaint to service visit	80 min	25 min
Consumers per consumer care personnel per	623	318
Employees providing special services	Nil	2

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

both targets for improvement and expectations for reasonable performance. The objective of the measures is to establish standards for performance throughout the revenue collection process. That includes benchmarks for measuring consumption accurately, transmitting meter data to the utility billing department, bill processing and dispatch, revenue collection and payment processing. Benchmarks in three areas have been proposed, as follows: (1) metering effectiveness, (2) billing effectiveness, and (3) collection effectiveness. They are presented as follows:

### ***Measures for Effectiveness of Metering***

The consumer meter is the most critical element for utilities, as it enables both internal accounting of losses on the distribution system and proper accounting of sales to consumers (Irwin and Yamamoto, 2004). Metering deficiencies are common throughout the world and even in developed countries. In India, consumption is typically not metered for large numbers of consumers (particularly rural consumers), who may pay a highly subsidized flat rate tariff based on the rated capacity of the connection. Installation of meters at all consumer sites is a basic prerequisite for effective tariff reform and progress toward financial sustainability for these utilities. Malfunctioning and tampered meters are also common problems that cause inaccurate recording of sale units resulting in

insufficient revenue collection. The proposed measures include:

**Metered consumers:** the measure is expressed as the ratio of all consumer accounts for which electricity consumption is metered divided by the total number of consumers. This measure quantifies the amount of work yet to be done for 100% meterisation.

**Meter replacement rate:** this measure may be expressed as a turnover rate, as the number of meters replaced in a year as a portion of the total meters in service. It gives a fair amount of insight on the quality of meters purchased.

**Frequency of meter and seal inspection:** this measure may be developed from the number of inspections as a percentage of the total meters in service.

**Frequency of meter testing:** this may be measured as the number of on-site testing performed in a year divided by the number of meters in service.

The comparison in performance on various parameters on metering is given in Table 9. It shows that performance in relation to effectiveness of metering by APPL is better than that of MPMKVVCL.

**Table 9: Comparative performance of MPMKVV Co. Ltd. and APPL w.r.t. metering**

Performance measure	MPMKVVCL (Oct 2007)	APPL (Oct 2012)
Metered consumers/total consumers	98.24%	99.37%
Meters/meter reader	2311	1682
Frequency of meter/seal inspection	Annually	Quarterly

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

### ***Measures for Effectiveness of Billing***

The major contributors of an effective billing process are: (a) accurate transmission of meter reading data and correct application of tariff, (b) short data

processing time, (c) reliable and timely delivery of bills, and (d) understandable bills (from the consumer's perspective). Of these, performance benchmarks can only address processing time and billing accuracy. The measures include the following:

**Frequency of billing:** many utilities do not read consumer meters every month, but estimate consumption accordingly from historical patterns and bill bimonthly and in some cases even trimonthly. Errors that result from this practice are self-correcting once the meter is read, but the practice causes temporary inaccuracies and disturbs consumers. The measure may be expressed as the portion of bills on average basis or as the number of billing cycles that are averaged.

**Bill processing time:** this measure is the average number of days that transpire from the date of meter reading until the bill is delivered to consumer's premises. The time elapsed must be as short as possible.

The comparison in performance on various parameters on billing is given in Table 10. It shows that performance in relation to effectiveness of billing by APPL is better than that of MPMKVVCL.

**Table 10: Comparative performance of MPMKVV Co. Ltd. and APPL w.r.t. billing**

Performance measure	MPMKVVCL (Oct 2007)	APPL (Oct 2012)
Meter replaced/meter in service	0.01%	0.01%
Percentage of bills that are estimated	8.39%	2.96%
Time lag between meter reading and bill dispatch	7 days	6 days

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

### ***Measures for Effectiveness of Collection***

Collection efficiency refers to the utility's ability to collect payment in a timely manner against the energy bills it issues to the consumers. Performance is adversely affected due to utilities' restricted actions for non-payment or delayed payment: limited legal provisions

to recover unpaid bills, inability to write-off bad consumer debts or negotiate payments in instalments, inability to effectively disconnect non-paying consumers (e.g., for political reasons or geographical difficulties). Apart from these challenges, the measures should also reflect best practices toward streamlining the collection process. For example, the traditional approach to revenue collection is that the utility issues a bill and waits for the consumer to pay in person at the nearest cash counter or zonal office. Many utilities have made bill payment much easier for consumers in an effort to reduce the collection period, such as by accepting payment at other locations such as bank branches, post offices, ATMs, at selected merchants, by credit card, over the internet or telephone, etc. as brought out by Dixit, Chitnis, Kadam and Sant (2009) in their research paper.

The measures include the following:

**Average level of consumer arrears:** this measure, expressed in days, would be more useful to utility managers if the consumer distribution were segmented into groups, like particular 11 KV feeder, and the average arrears reported for each group.

**Collection efficiency:** this measure highlights shortfalls in collections, expressed as the utility's average monthly revenue collected divided by average monthly billings.

The comparison in performance on various parameters on revenue collection is given in Table 11. It shows that performance in relation to effectiveness of collection by APPL is better than that of MPMKVVCL.

**Table 11: Comparative performance of MPMKVV Co. Ltd. and APPL w.r.t. collection**

Performance measure	MPMKVVCL (Oct 2007)	APPL (Oct 2012)
Average level of arrears (per consumer)	Rs. 4058.00	Rs. 5215.00

Source: Log sheet of MPMKVVCL-Oct 2007 and APPL-Oct 2012

## Findings

*Network operation:* it consists of planning of network for load management, proposed location of 33/11 KV substations, reconfiguration of high-tension and low-tension feeders and reduction in length of lines for better voltage regulation. The neglect by MPMKVV Co. Ltd. has resulted in unplanned extensions of the distribution lines, overloading of the system elements such as transformers and conductors and lack of adequate reactive power compensation. Maintenance was neglected, leading to inefficiently working equipment. The various measures adopted by Agrawal Power Pvt. Ltd. were augmentation of conductor size, regular maintenance of network, better management of Distribution transformers, improving jumpers and joints, adoption of HVDS and bifurcation of lengthy feeders, which improved the network operation effectively.

*Customer relations:* this segment deals with activities related to customers. MPMKVV Co. Ltd. failed miserably in solving day-to-day problems of consumers such as problems related to metering and billing, hurdles in getting new connections, load enhancement, tardy metering, inflated billing, insufficient collection avenues, etc. The various measures adopted by Agrawal Power Pvt. Ltd. were providing special emphasis on metering, reading, billing and bill distribution, improvement in collection avenues, special drive for providing new connections and consumer indexing. This gives credence to the view of Anil Sasi, (2008) about advantages of franchisee model.

## Hypothesis Testing

In this study, the null hypothesis taken for significance goes as – the methods adopted by the franchisee at Karond has not made any significant difference in terms of quality of supply and consumer satisfaction. The Karond area, which was incurring an increasing

loss during pre-franchisee years 2006–07 and 2007–08 made a significant turnaround due to the model and policies adopted by Agrawal Power Pvt. Ltd. This hypothesis has also been analysed by Student *t*-test as significance of data can only be analysed by means of statistical tools. Hence, Correlation and Student *t*-test have been applied whose formula is

$$t = \frac{r}{\sqrt{1 - r^2}} \times \sqrt{n - 2}$$

where

*r* = correlation and *n* = number of items

In this case, *r* = + 0.98; *t* = 8.53 (calculated value and *t* 0.05 = 4.6 (critical value)).

Since *t* > *t*<sub>0.05</sub>, the null hypothesis is being rejected. Therefore, it is apparent that the methods adopted by the franchisee at Karond have made significant difference in the working. The comparison of performance of quantifiable parameters in functional areas of Karond before and after taking over by Agrawal Power Pvt. Ltd was done and was found that there is significant improvement in the quality of service provided to consumers.

## Suggestions

1. A time bound programme shall be chalked out for checking the meters and replacement of defective meters with tested meters.
2. A hassle-free policy for providing new connections to prospective consumers shall be put in force.
3. An extensive vigilance and enforcement activities shall be carried out, which will force the non-consumers involved in theft of electricity to become legal consumers.
4. Random check reading programme, shifting of meters to call bell switch locations, installation of tamper proof meter boxes and replacement of

**Table 12: Recommended benchmark metrics for power distribution utilities**

Area	Performance measure	Effect measured	Data source
Operational	SAIFI	Frequency of outages	Substation log sheet
Performance	CAIDI	Duration of outages	Substation log sheet
	Aggregate technical & commercial losses	Effectiveness in minimizing unrecoverable energy cost	Substation meters and billing department
	Technical losses	Efficiency of distribution infrastructure	Substation meters and billing department
	Unplanned outages/total outages	Effect of outages on consumers and system	Substation log sheet
	Service restoration time in distribution	Responsiveness of maintenance	Fuse off call registers
	Annual replacement rate of distribution Xmer (%)	Condition of transformers and their age	Transformer maintenance registers
Consumer Service	Lead time for new connections	Responsiveness of connection services	Consumer account records
	Lead time to test/replace meters in the case of complaint	Commitment to metering accuracy	Consumer account and meter service records
	Response time from fault complaint to service visit	Effectiveness of complaint response	Consumer account and service records
	Consumer per consumer care personnel	Adequacy of consumer service resources	Employment records
	Employees providing special services	Provision of value-added services to consumers	Employment and special program records
Metering, billing and collection	Metered consumers/total consumers	Ability to bill consumers accurately for energy consumption	Billing records and consumer account records
	Meters/meter reader	Adequacy of meter reading staff	Employee records
	Frequency of meter/seal inspection	Control of tampering and maintenance of accuracy	Enforcement activity records
	Meter replaced/meter in service	Quality of meters procured	Billing records
	Percentage of bills that are estimated	Billing accuracy	Meter reading/billing policy
	Time lag between meter reading and bill dispatch	Billing efficiency	Billing reports and records
	Average level of arrears	Collection efficiency	Collection records

service line by fully visible armoured service cable shall be carried out.

5. Proper meter reading, timely replacement of stopped-defective meters and proper consumer indexing may be enforced.
6. For increasing collection, proper distribution of bill, immediate or quick correction of bill, proper disconnections of defaulters, analysis of consumption pattern, many avenues of collection, etc., shall be carried out.

Thus, following benchmark parameters are recommended which should be monitored by electricity distribution utilities in order to improve the quality of supply, improve consumer satisfaction and maximize profit.

In competitive markets a change from public to private management is expected to lead to cost cutting and efficiency improvements which are driven by the profit motive. This dynamic of cost savings, improvements in service quality and increases in labour productivity has traditionally been among the strongest arguments used by the proponents of privatisation. However if private electricity distribution utilities such as Agrawal Power Pvt. Ltd. are able to improve their benchmark parameters through shrewd strategies, then the same strategies can be adopted by others to improve their working. There is a need of electricity distribution utilities in India to determine and share their experiences and lessons from corporate decline so that all of them can learn from each other's experience.

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