IT Task Force Report for Power Sector

Submitted by

IT Task Force

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Foreword by the Chairman

Adequate availability and affordability of electric power is central to the industrial and economic development of India. Reliable power supply would accelerate the growth of energy-intensive and energy-dependent sectors such as agriculture and manufacturing.

The ongoing reform programmes in the Indian power sector requires Information Technology (IT) to play a dominant role in institutionalising the changes and improvements.

Moreover, in a best-in-class distribution utility, information technology serves a dual purpose. For one, it provides the platform for execution of business processes, and second, it creates the information base for timely, effective decision making at the operational and strategic levels.

However, we cannot afford to make long-drawn plans and wait for results to follow in due time. We need a plan that provides quick wins so that the short-term benefits and constructive feedback provide momentum and positive energy to the long-term strategic plan.

Application of IT at the grassroots level would make the Indian utility industry more efficient and effective through reduction of cost and enhancement of revenue.

The distribution utilities in India must take a holistic, structured approach to deploy and implement best practices in information technology. An overall approach and a broad roadmap are discussed in this report. Hopefully, this report will mark the beginning of a new chapter in the application of IT in the power sector in India.

As the chairman of the IT Task Force for Power Sector, I thank the Ministry of Power, all the Task Force members and my industry colleagues who worked with the task force for their valuable contribution towards this report.

Nandan M. Nilekani

Chairman,

IT Task Force for Power Sector.

Glossary

AMR	Automated Meter Reading
BOOT	Build-Own-Operate-Transfer
CTI	Computer Telephony Integration
EBPP	Electronic Bill Payment and Presentment
EMS	Energy Management System
FEMS	Financial Energy Management System
GIS	Geographic Information System
IS	Information Systems
IT	Information Technology
kV	Kilo Volt
kWh	Kilo Watt hour (unit of electricity usage)
IVR	Interactive Voice Response
MIS	Management Information System
MoP	Ministry of Power
MRI	Meter Reading Instrument
MW	Mega Watt (a million Watts of power)
OCR	Optical Character Recognition software
OMS	Outage Management System
PLF	Plant Load Factor
PMS	Plant Maintenance or Project Management System
SCADA	Supervisory Control and Data Acquisition System
SEB	State Electricity Board (State-owned power utility)
T&D	Transmission & Distribution
TCMS	Trouble Call Management System
WMS	Work Management System

Executive Summary

Introduction

While India has made impressive progress in the Power Sector since independence, it has not been sufficient. In terms of generation, while new capacity has been added, demand has far outstripped the supply leading to a widening gap. The primary reason of the widening gap lies in the distribution link in the value chain. The generation companies have not found it easy to recover their dues from their biggest buyers, mainly the State Electricity Boards (SEBs). SEBs suffer huge financial losses every year due to power theft and ineffective practices of billing and collection. The losses have reached an alarming Rs. 26,000 crore per year.

It is clear that the biggest fundamental issue hampering the viability of the Indian Power Sector is the sheer volume or level of Transmission and Distribution (T&D) losses that amount to 25%, a very high level by any standard. To make the matter worse, indirect calculations show T&D losses to be much higher in the range of 40-50%.

In addition, the distribution system in India is often characterised by inefficiency, low productivity, frequent interruption in supply and poor voltage.

Evidently, some fundamental changes are required in the working of the power sector entities to realise the vision of “reliable, affordable and quality power for all by 2012”. The reform process is in progress in several states under the overall guidance of MoP. It is aimed at bringing about sustainable improvements in the operations of the utilities and making them viable businesses. The reforms have brought about various improvements in operational structure, commercial orientation, transparency in operation and overall customer orientation in several states. However, there has been limited success in institutionalising these changes and sustaining these improvements over a period of time. Therefore, the need of the hour is to institutionalise the changes and bring about sustainable, pervasive improvements. Enabling the core business operation at the transaction level using information system would lay the foundation for sustainable reforms. This will ensure world-class practices and controls at the operational level and would enable substantial improvement in the overall health of the utilities. The overall quality of data will improve and thereby an overall improvement in the flow of information for decision support. Information technology (IT) would thus become the key enabler in the initiatives under the reform process. IT would not only enable the success of reforms process, it would also act as the catalyst by providing an information infrastructure essential to the reform process and practices.

With a view to use IT as a strategy to improve commercial and operational performance in distribution and for its effective implementation, the MoP has set up an IT Task Force for the power sector with a focus on distribution. The IT Task Force endeavours to develop a synergy between IT and the Indian Power Sector. The objective of this task force is to prepare a report defining the role of Information Technology in profitability improvement, improvement in quality of service, etc.

State of Information Technology

It has been observed by the Task Force that the approach of the various distribution utilities towards IT has been piecemeal with standalone applications deployed for a limited operational requirement. In other words, IT has been used as a tool to address a specific issue or two at a time and not as a long-term, holistic strategy. While Indian IT sector has helped numerous organisations around the globe derive substantial benefits from application of IT, there is plenty of room for IT application within the power sector in India. There is a need to look at the global practices in IT adoption in the power sector so that India can benefit from it.

The task force is of the view that the gap in IT adoption globally and in the Indian power sector is apparent and glaring and even the rate of overall technology adoption in India is on the lower side. Globally IT is being used to enable operations at a transaction level thus providing advantages like in-built process controls, workflow enabled transactions, single point of data capture and support for timely strategic decision making. On the other hand, in India, the core operations are still manual and therefore face issues like adhoc decision making, poor data quality, long decision making cycles and under utilisation of IT investments. In order to reap the benefits of IT, the wide gap between India and global best has to be bridged.

IT Roadmap

Globally, IT is approached in a very systematic and well thought out manner using the concept of an IT blueprint. The task force, therefore, recommends the creation of a comprehensive IT blueprint for the Indian power sector that incorporates the global best practices. The report provides a framework for its creation.

The task force suggests a 3 to 5 year IT implementation roadmap with both short term and long-term IT initiatives. For short-term IT interventions, priority should be given to the use of IT in commercial processes and in improving the quality of supply in selected high revenue areas. The key objective of the IT solution should be to minimise human interface in commercial processes to avoid human errors and chances of wilful mistakes. Having started on the short term-quick win areas, long-term areas would cover business processes. For instance, billing would be expanded to cover all customer types and grown into a comprehensive customer information system (CIS) and gradually the sophisticated call centre functionality would be added. Service connection and maintenance processes would be systemised and integrated with this CIS. Asset and work management, outage management and distribution automation would be implemented in parallel. Material management and support processes (such as HR, Finance, Accounts, etc.) would be IT enabled in this phase. The task force also felt that SEBs should also have an effective Management Information System (MIS) for decision support and improved decision-making.

This report also deals with different funding models for IT implementation that is a critical requirement to enable successful deployment of the recommendations of the task force. For implementation of IT initiatives, SEBs have to look at various business models. It would be difficult for an SEB to implement these initiatives based on only a single “project model”. The task force also recommends that SEBs / utilities should be facilitated in the process of selection of solution providers through an accreditation policy at the national level. A committee of experts in the field of technical, commercial, finance and project management may be constituted in consultation with NASSCOM to accredit various agencies to take up implementation.

Quick-win Pilots

In the report, the task force discusses two illustrative projects. One is the Integrated Billing System for the C&I customers and the other is an Energy Accounting System. The objective of the Integrated Billing System is to integrate meter reading, billing, payment and collection for C&I customers to eliminate tampering and manipulation and thus improve collection (C&I customers contribute more than 70% revenue). The objective of the Energy Accounting System is to calculate losses at 11/4 kV DT level, 11 kV feeder level, 33 kV feeder level and at the circle level. The cost and benefit of implementing these two projects are given in the report. The combined IRR for these two projects comes out to be 29%.

Mandate focus area 1 - MIS

The report discusses the benefits of MIS and some key attributes of MIS in the power sector. Structured and well thought out MIS practices can help the entities to move ahead without too much of restructuring and investment of time and money. The task force felt that benefits of a timely and robust MIS go without saying. A more focussed and target based monitoring mechanism can increase accountability.

Mandate focus area 2 - Customer benefit

Customer being a key focus, the report discusses certain applications in this context. As the customer is exposed to the global economics as well as the improved service levels in many sectors touching upon the daily lives of a common man like banking, insurance, etc., the expectation levels from the power sector are also high. This angle necessitated mandating the task force to focus on customer benefits while defining the IT roadmap to allocate higher priority to certain application for the benefit of customers. The task force has suggested few important areas in the power sector, where IT application can be adopted for customer benefits.

The task force feels that the implementation of IT initiatives, though not an easy task, will result in improvement in reliability and quality of supply, increased productivity, reduced technical and commercial losses, customer satisfaction and a fundamental change in the work culture. The computerised system will revolutionise the way that utilities conduct their business by reducing operating cost, improving customer service and increasing employee efficiency.

1

Introduction

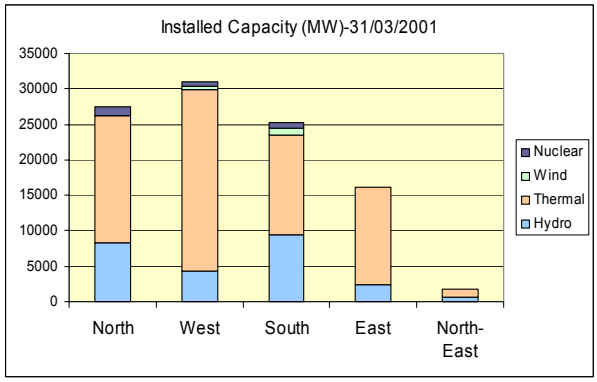
Adequate availability and affordability of electricity is central to the industrial and economic development of India. Reliable power supply would catalyse energy-intensive and energy-dependent sectors such as agriculture and manufacturing. It would further strengthen the growth potential for highly successful sectors like Information Technology (IT) and emerging sectors like IT-enabled services. Overall, it would go a long way in leading India to become a strong and developed nation.

Indian Power Sector – Evolution since Independence

The Indian power sector has grown manifold in size and capacity since independence. The generation capacity has increased from 1,362 MW in 1947 to 1,01,660 MW as on March 31, 2001. Meanwhile, the per capita power consumption has increased to approximately 384 kWh by 2000-01 as illustrated.

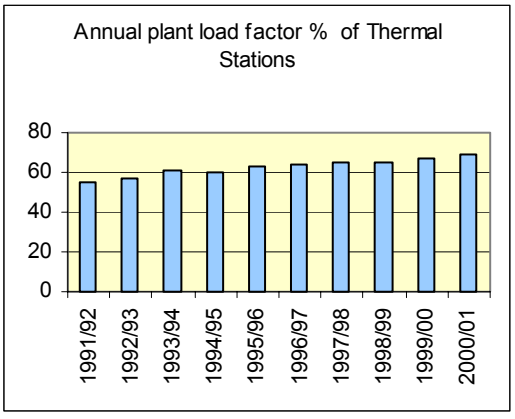
The access to electricity has improved tremendously with electrification of almost 87% villages and energisation of 65% pump sets. The capacity of transmission and distribution lines has also increased. The development of national grid is under progress with three regional grids already being integrated.

The growth in generation capacity has been witnessed across the regions and has been made possible by tapping into several energy sources. The distribution of installed power capacity, region wise and source wise, is given in the diagram.



Source: TERI Energy data directory and yearbook (2001-2002)

Thermal generation has the highest contribution in the overall generation. The efficiency of the thermal plants has improved over the years with the plant load factor (PLF) for thermal power plants at the national level improving to 69% during 2000-01 with approximately 530 billion units generation in the same period[1]. The improvement in annual PLF of thermal stations over the last 10 years is shown below.



Source: TERI Energy data directory and yearbook (2001-2002)

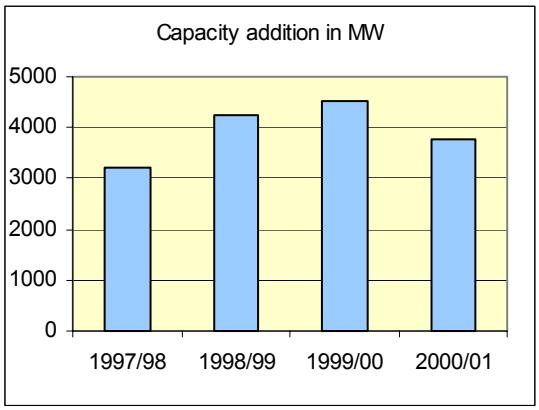
Factors Affecting Growth and Viability

While India has made substantial progress in the power sector since independence, the progress has not matched the rapidly growing demand for reliable and cost-effective supply. In terms of generation, while new capacity has been added, demand has far outstripped the supply leading to a widening gap. For example, during 2000-01, total energy shortage was 39,816 million units, i.e., 7.8% and peak shortage was 10,157 MW, i.e., 13% of the peak demand[2].

[1] Source: Annual report on the working of State Electricity Boards and Electricity Departments, Power & Energy Division, Planning Commission (2001)
[2] Source: CII report on energy (2001)

The Ministry of Power (MoP) estimates that the additional capacity requirement to meet these shortages is about 10,000 MW every year. This translates into an investment of about US$10 billion per annum (Source: CEA – Central Electricity Authority). However, the actual capacity addition has been less than half of the required as shown in the figure here.

In this context, the MoP has set a vision of "providing reliable, affordable and quality power for all by 2012".

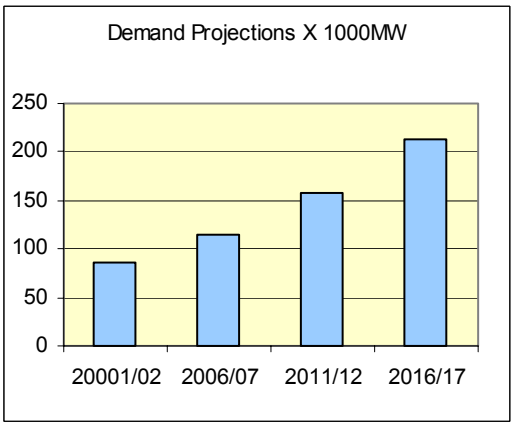


Source: TERI Energy data directory and yearbook (2001-2002)

From the facts above, it is clear that a huge generation capacity demand needs to be fulfilled. The MoP has estimated the demand for the next three 5-year plans as shown in the graph. This provides a tremendous investment opportunity in the Indian power generation market for both the public sector and the private sector. The opportunity is attractive as the returns for the potential investors are assured by the government, even more so in the present low-interest regime and the limited growth opportunities in the global energy market. The government has also liberalised the licensing to make it more attractive and easy for investors in the generation sector.

However, this opportunity remains unrealised. The primary reason lies in the distribution link in the value chain. The generation companies have not found it easy to recover their dues from their biggest buyers, namely the State Electricity Boards (SEBs). SEBs are under huge losses to the tune of Rs. 26,000 crore per year primarily due to power theft and inefficient billing and collection. Losses due to power theft alone are approximately Rs. 20,000 crore per annum. At the national level, only 55% (Rs. 62,000 crore) of the total energy generated is billed out and only 41% (Rs. 46,000 crore) is realised.

This has adversely affected the confidence of the private investors and the existing generation companies have their funds tied up in huge outstanding payments from the SEBs.



Source: TERI Energy data directory and yearbook (2001-2002)

High level of T&D losses

It is clear from the above analysis that the fundamental issue hampering the viability of the Indian power sector is the sheer volume or level of transmission and distribution (T&D) losses. Numerous published data and reports indicate T&D losses

to be near 25%, a very high level by any standards. Indirect calculations show them to be much higher at around 40–50%. By comparison, T&D losses in the developed countries are typically 7–8%. Even in developing countries such as China and Thailand, T&D losses are at a much lower level in the 8–12% range.

Commercial losses are approximately 2/3rd of the total loss in distribution. These losses are due to rampant theft and pilferage of electricity, meter tampering, unauthorised connections and unmetered supply. Almost all commercial losses take place at 11 kV and below.

Reforms Process – An Agent for Transformation

It is clear that some fundamental changes are required in the working of the power sector entities to realise the vision of reliable, affordable and quality power for all by 2012. Several states have undertake reforms process under the overall guidance of MoP and is aimed at bringing about sustainable improvements in the operations of the utilities and making them viable businesses. The ongoing reforms have improved operating structures, commercial orientation, transparency in operations and overall customer orientation. The key initiatives that enabled these changes include:

- Unbundling of integrated entities into generation, transmission and distribution corporates
- Setting up of independent authorities to regulate the sector
- Campaigns to enhance revenues, reduce losses, improve maintenance of networks and enhance customer services
- Substantial investments to enhance the quality of networks
- Designating Distribution Circles as centre of excellence under Accelerated Power Development and Reform Programme (APDRP)[3]

However, there has been limited success in institutionalising these changes and sustaining the improvements over a period of time. The impact of these initiatives has been limited to small areas and it has not been institutionalised across the organisation. As a result, the operations continue to have issues such as revenue leakages, poor customer focus and inefficient operations leading to increased losses.

The need of the hour therefore is to institutionalise the changes and bring about sustainable and pervasive improvements. This requires improving the operational processes by leveraging best practices and best-of-breed technologies.

Institutionalise Improvements Leveraging Technology

Enabling the core business operations with information systems at the transaction level would lay the foundation for sustainable reforms. This will ensure world-class practices and controls at the operations level and would bring about sustainable improvements in the overall health of the utilities. This will enhance the overall quality of data, thereby improving the flow of information for decision support. Information Technology (IT) would enable sustainable changes in the operations increasing controls at a transaction level, improving the efficiency of the operations and increasing transparency across the organisation. The figure below depicts how IT would enable the creation of reliable data at the grassroots level. This information would then flow to the managerial level for tactical decisions and further up to the strategic level. This would facilitate the change of culture towards information-based decisions sought by the reforms process.

[3] Blueprint for Power Sector development, MoP (2001)

Benefits of Information Flow across the Organisation

Information Technology would thus become the key enabler of the initiatives under the reform process. In addition, it would act as a catalyst by providing an information infrastructure essential to the reform processes and practices.

Here, it is essential to clarify that IT is not the panacea to all problems. It does not substitute the fundamental changes and activities under the reforms process. It rather plays the role of an enabler providing strategic support.

The MoP has already identified IT as a strategic enabler to improve performance in the distribution sector. With a view to use IT as a strategy to improve commercial and operational performance in distribution and for its effective implementation, the MoP has set up an IT Task Force for the Power Sector with focus on distribution.

IT Task Force – To Create IT Adoption Roadmap for the Distribution Sector

The IT Task Force is formed to lead Indian power sector towards the vision 2012 by creating an approach and overall roadmap for deploying IT in distribution business in the utility sector.

As electricity distribution is the weakest link in the power sector value chain in India, the focus of the Task Force is the distribution sector. The objective of the Task Force is to prepare a report defining the role of IT in the following aspects of distribution.

- Profitability improvement through
  - Revenue enhancement
  - Cost reduction
  - Shortened consumption to collection time
- Improvement in quality of service
  - Stable voltage and frequency
  - Enhanced customer experience

- Other gains
  - Flattening of peak demand curve by better load management
  - Optimal operation through tap setting/capacitor switching
  - Operational efficiency through effective decision support

Please refer to *Annexure 1* for list of members and invitees of the IT Task Force.

IT Task Force – Terms of Reference

The terms of reference of the IT Task Force committee are as follows:

- To review existing practices of use of IT in the Indian Power Sector
- To identify new developments in the IT sector for the power sector, especially in the area of electricity distribution
- To prepare the structure of an MIS for the power sector
- To identify few pilot projects to demonstrate the benefits of use of IT
- To assess few specific IT applications for the benefit of customers
- Any other issues

This report provides a roadmap for the application of IT in the distribution sector. It establishes a framework and approach for effective leveraging and deployment of technology in distribution organisations. The report thus starts the journey on effective application of IT by presenting the overall approach culminating in creation of IT strategies and detailed blueprints by respective distribution utilities.

The report has been structured as under:

- Introduction to the Indian power sector, IT Task Force and this report
- Global practices and current usage of IT in distribution businesses
- Overall approach and roadmap for distribution sector
- Selected key projects
- Mandated focus areas – MIS and customer benefit applications

2

Global Practices and Current Usage of IT in Distribution Businesses

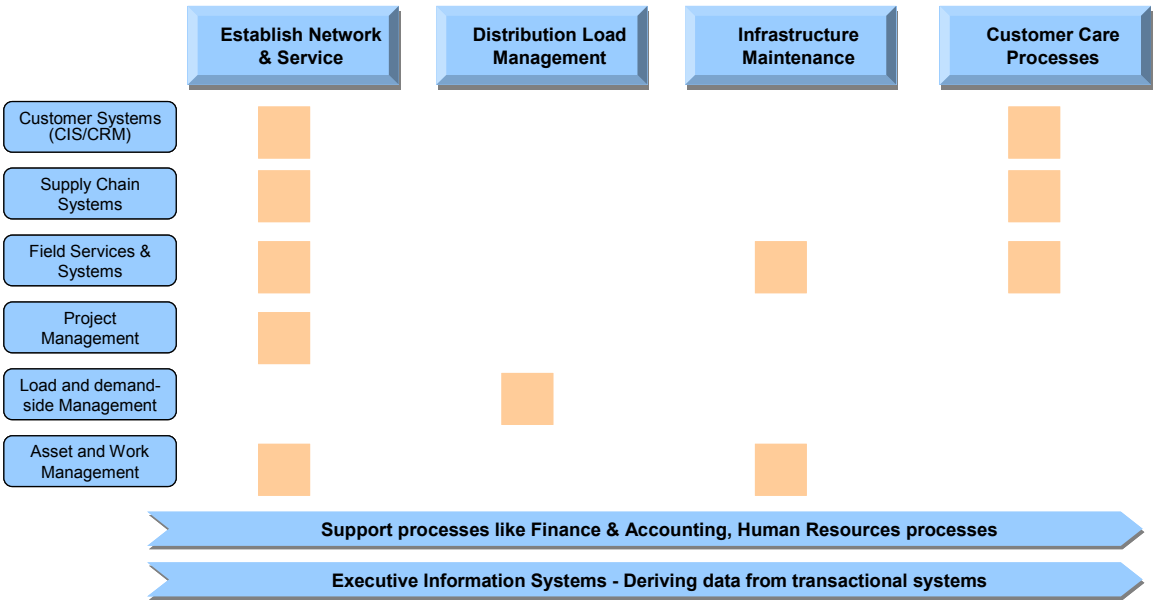
Information Technology plays a central role in a best-of-class distribution utility as the platform for execution of business processes and as the information base for decision making at operational and strategic levels. The following key practices are of particular relevance to the context of this report.

Global IT Best Practices in Power Distribution

- **Integration of business and IT strategy** – Information technology investments and implementation is driven through a structured and comprehensive IT strategy and IT plans. The IT strategy is aligned with the business strategy taking into account changing business needs and emerging technology trends. While the IT implementation plan is phased taking considering priorities and business benefits, the interfaces and integration between different applications is well-established and predefined. The business direction and IT direction drive each other. A synergy is established to maximise benefits from IT investments and to best serve the business needs. A business case is established for every IT investment. Effectiveness of IT investments is monitored on an ongoing basis.
- **IT as the operations execution platform** – Operations are enabled by IT and technology is deployed to conduct transactions. This provides the inbuilt benefits of workflow enabled transactions and single point of data capture. It minimises transaction time, enables built-in process controls, enables audit trail, and provides appropriate and reliable information for decision support. The level of manual entry and processes are optimised to maximise benefits from IT. Information needs are inbuilt and people could focus on analysis to provide strategic decision support.
- **Integrated systems over a robust IT infrastructure** – The IT applications are well-integrated to achieve high level of business process integration. This accelerates business transactions and optimises sharing of information across business processes leading to better decision-making.
- **Best-of-breed solutions** – While packaged applications are the norm in support functions, custom-built applications are more prevalent in core functions. There is increasing use of best-of-breed solutions and increasing shift towards off-the-shelf packaged solutions. Packaged applications have provided reduced time to market at reduced cost and with industry's best practices providing assured results. Greater investments by vendors to continuously upgrade solutions anticipating change in business requirements and evolving industry structures have made the packaged solutions increasingly popular across functions.
- **Well-defined IT organisation** – IT is a large and important entity at global utilities. Usually there is a CIO or a similar executive reporting directly to the CEO who is responsible for the effective performance of the organisation's IT assets.
- **Outsourcing** – There are strong trends around the globe to outsource IT infrastructure, management of IT operations, and even business processes.

While these best practices can be observed in utilities across the regions, there is tremendous diversity found in the IT application landscape, infrastructure used, business models, etc. The global IT market for the power distribution sector provides a wide range of technologies and solutions. These solutions address the entire business value chain in power distribution – from setting up distribution network and service connection to distribution load management, delivery of power and customer facing processes. These IT solutions serve diverse regulatory market models ranging from monopoly markets to highly competitive ones. The range of IT products serves a wide range of organisation sizes – from small utilities to global energy majors. Overall, the IT products market is an evolved one, if not the most evolved as compared to sectors such as financial services or manufacturing. There is a large share of custom developed IT solutions also in use, primarily in business applications and very little in IT infrastructure.

The following figure depicts the core business value chain of a distribution utility (on top) and typical IT applications (on left) as a matrix. The multiple intersection points show that many applications address requirements across the value chain and thus, as stated earlier, it becomes critical to plan the interfaces upfront. Several product vendors today provide end-to-end solutions as well as point solutions. In selecting products, compatibility with the other products in the current context as well as in the changing context needs to be considered.



Distribution business value chain and typical IT applications

Current State of IT in the Indian Power Sector – Initiatives, Approach and Issues

IT adoption examples

The operation of distribution business in the utility sector are characterised by manual and cumbersome processes, inadequate controls, insufficient commercial focus, limited transparency and lack of reliable information. As a result, the operations are highly inefficient with substantial revenue leakages and poor customer orientation.

The use of IT has been low and in pockets. The several standalone applications have limited ability to effectively interface and integrate either with other applications or with potential applications to be deployed in the future. Although the level of deployment of IT varies significantly across the utilities, the key applications have been in multilevel aggregation of data or large-scale data processing.

Though the state of IT adoption is low, there are a number of instances of IT adoption. Major organisations including SEBs have considered IT and have made some use of it. The following table provides an illustrative list of IT deployment in the distribution business.

Business / Application Areas and Initiatives	Organisations
Use of distribution automation such as SCADA, substation automation and data acquisition technologies	APSEB (Hyderabad City), BSES, CESC, KSEB (Thiruvananthapuram city), RSEB (Jaipur City), TNEB (Chennai City), WBSEB (Jalpaiguri Circle)
Automated Meter Reading (AMR)	AP Transco (pilot basis), BEST, BSES, MSEB, Tata Power
Use of handheld devices in the field	APSEB (CESCO), BSES, MSEB, UPSEB
Customer Information System	AEC, AP (CESCO), BSES, CESC, MSEB
Call Centre System	BSES, CESC, APSEB (Hyderabad City)
Billing System	Most SEBs
Energy Accounting System	MSEB (in urban areas)

Illustrative list of IT deployment in Indian power sector

In addition, most SEBs are using in-house developed support applications for accounting and payroll.

The list is only indicative. A full-fledged survey is necessary to learn more about IT initiatives and best practices in adoption of IT in the Indian power sector.

Piecemeal approach and issues

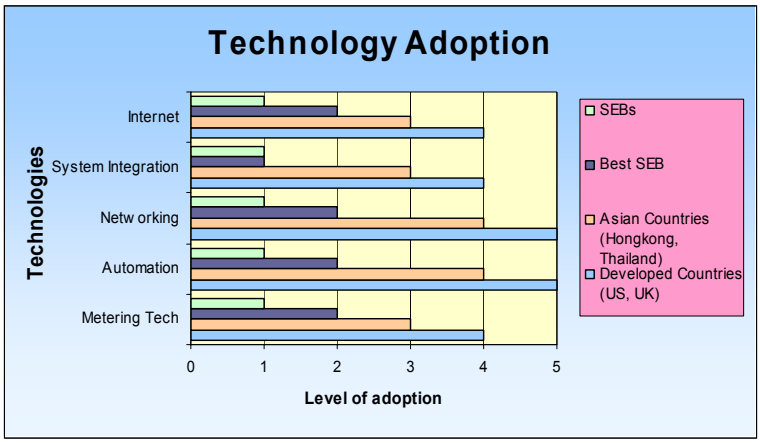
It is observed that while some organisations have made more progress than others, most have a long way to go. Most organisations have had limited application of IT except a few who have looked at more business processes for applying IT. An observation across the organisations is that the approach towards IT has been piecemeal with standalone applications deployed for a limited operational requirement. IT has been used only as a tool to address a specific issue or two at a time without a long-term or holistic strategy. This approach has resulted in issues such as:

- Standalone systems – Coverage to limited geographical areas
- Systems in place are largely aggregators or processing tools
- Basic transactions are still manual without inbuilt controls
- Limited integration of systems
- Duplication and/or under-utilisation of resources
- Absence of a standard architecture or database
- High cost of maintenance
- Inadequate interface and integration with other applications

These issues have adversely affected the returns from IT investments. Incoherent technology strategy leads to situations where incompatible options are selected and large sums of money are wasted in attempts to integrate them. The bottom line is that the business performance has not improved.

While Indian IT sector has helped numerous organisations around the globe to derive substantial benefits from application of IT, there is plenty of room for IT application within the power sector in India. There is a need to look at the global practices in IT adoption in the power sector so that India can benefit from them.

The extent of deployment of IT in the distribution sector in India is lower when compared on similar attributes in other countries. A representation of the technology adoption on select parameters is provided below:



Legend

Level of adoption:

1. Absent
2. Initial stage
3. Intermediate stage
4. Advanced
5. Very advanced

Comparison of technology adoption in a few illustrative areas – An analysis

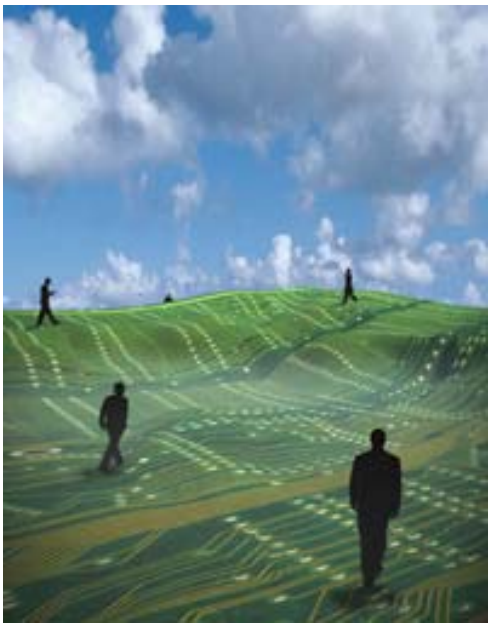
Clearly, there is a long road to leverage achievements comparable to that of global companies. However, Indian companies can learn from the experience of their global counterparts and leverage such learning to effectively reduce the time of adoptions and to get better returns in shorter periods.

As discussed earlier, to institutionalise and sustain the improvements of the reforms process, it is essential to deploy IT at the transactional level. This enables basic operations to leverage the best practices that IT provides. This approach would transform the quality of operations and will serve as an excellent platform for providing all information for strategic decisions.

It is, however, important that the deployment and implementation of information technology is driven by a strong information systems (IS) strategy and a comprehensive plan. The IS strategy and plan is driven by business needs and is aligned to the changing business strategies and plans. This will enable structured deployment of IT focusing on key business issues and maximising business benefits.

3

Overall Approach and Roadmap for Distribution Sector

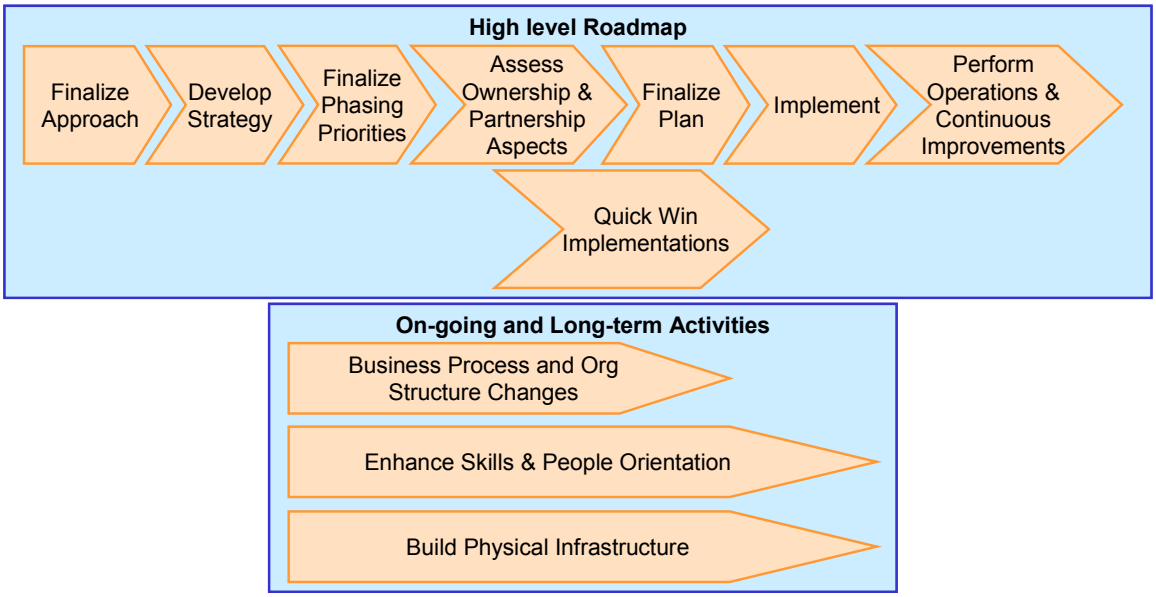


As discussed in the previous chapter, the distribution utilities in India must take a structured approach to deployment and implementation of information technology. An overall approach and a broad roadmap is provided and discussed in this chapter.

Overall Approach and High-level Roadmap

The investments in information technology would be necessarily through a comprehensive strategy and plan. The investments would need to be phased and prioritised taking into account business criticality, organisation readiness and value to business. Each distribution utility would assess the extent to which the:

a) Ownership of infrastructure and internal management of operations will deliver strategic advantage and the extent to which it gets improved benefits, if such ownership and management of operations is provided by a professional strategic partner.



Overall approach and high-level roadmap

b) Implementation of information technology would be long-term, and the time, benefits and advantages accrue only through disciplined usage. In order to gain confidence and commitment of the users, several short-term, high visible quick wins must be delivered with clearly measurable benefits.

c) Effective deployment of information technology by distribution companies would largely depend upon:

- Sustained leadership commitment
- Leveraging best practices and realigning the business processes
- Improving the responsiveness of the structure and aligning to changed processes
- Improving the overall quality of data used for implementing the systems
- Securing commitments and ownership of people to the changes and making them accountable for implementing and operating the new systems
- Providing adequate training and enabling people to enhance their skills
- Promoting data oriented decision making environment

IT Strategy and Plans

A structured and comprehensive IT strategy and plan will help the distribution utilities to derive the benefits from information technology. The IT strategy and plans will need to consider several aspects including:

- The overall business strategy and needs
- Potential changes to operations
- Potential changes to industry structures (e.g. disaggregation of distribution business into wires business and information technology)
- Leveraging existing IT infrastructure and applications

The phasing of the investments will need to be driven by the business priorities and the return on investments.

The IT strategy and plan will include details on:

- Application architecture
- Data architecture
- Infrastructure requirements – hardware and network
- IT organisation, processes, policies and standards
- List of business–IT initiatives or projects and implementation plan for the applications to be used by the organisation over a period of time
- Investment requirements and their phasing

The above will form the blueprint for IT investment.

From an overall view of the distribution sector in India, the direction of the business and the nature of the issues and challenges are similar across different companies. It is therefore possible, under the overall guidance of MoP, to prepare a common IT strategy and overall plan. This common IT strategy and overall plan can then be adopted by individual utilities, customising it for their specific needs, taking into account their investments and business.

As a next step, functional specifications for all key applications need to be developed taking into account current practices and potential business changes. Again as case of IT strategy and plans, the functional specifications could be developed for all the business with each utility making specific changes for meeting this unique requirement.

Phasing considerations

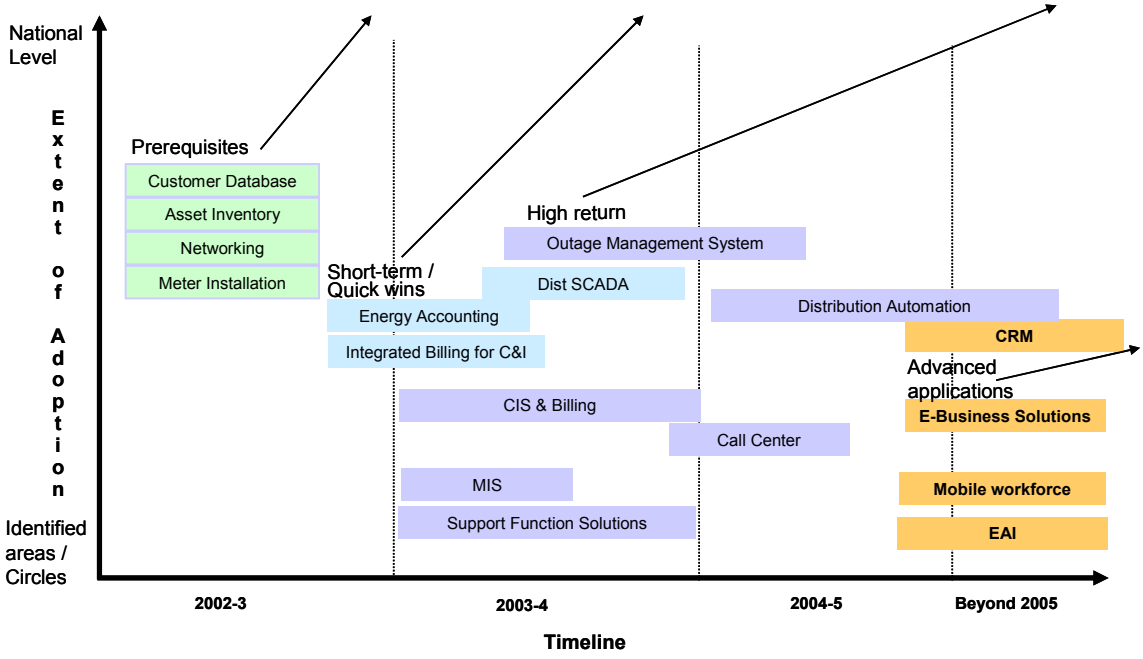
Given the enormous magnitude of the effort involved and the long timeline in the implementation of IT roadmap, there is a clear need to phase the entire implementation. The approach to phasing would be to derive maximum returns from investments that would mean prioritising the initiatives in order of ROI and picking the top ones to start with. This would also provide the quick wins essential for the long-term success of the programme.

The Task Force suggests a 3 to 5 year IT implementation roadmap with short-term and long-term IT initiatives. The IT applications have been divided into the following four categories:

- Prerequisites – To be established first to allow implementation of subsequent IT applications
- Short-term – Quick wins
- Medium-term – High return

- Advanced applications

The following figure provides an indicative roadmap for applications under the four categories. The arrows indicate the direction to be followed along the two dimensions – time and extent of deployment in the geography.



Notes:

1. *The classification is done for a typical SEB and some SEBs could move faster on implementation of these applications.*
2. *The specific scope or implementation approach for each SEB has to be decided on a case-to-case basis.*
3. *An integrated financial and costing backbone is a key area to support all the other applications that would be taken up in the future.*

Prerequisites

The following are the preferred base requirements:

- Development of customer database to provide information to various applications
- Meter installation in a phased approach starting with 11 kV feeders followed by C&I and then domestic customers
- Network connectivity implementation in a phased approach linked to IT implementation phases
- Asset inventory and GIS mapping in parallel for implementing medium to long-term IT applications

Short-term – Quick wins

For short-term IT intervention, priority should be given to the use of IT in commercial processes and improving the quality of supply in selected high revenue areas. The key objective of the IT solution should be to minimise human interface in commercial processes in order to minimise human errors and chances of wilful mistakes. Priority must be given for:

- Integrated metering, billing and collection systems
- Energy accounting system to conduct energy audits
- Distribution automation for metro cities and high revenue earning industrial areas

The first two are discussed in detail in *Chapter 4*.

These applications can be implemented in a phased manner and will require less initial investment in metering and communication systems.

Medium-term – High return

Having started on the quick win areas, the long-term areas would cover core business processes. For instance, billing would be expanded to cover all customer groups, growing further into a comprehensive customer information system. Gradually the sophisticated call centre functionality would be added. Service connection and maintenance processes would be systemised and integrated with this CIS. Asset and work management, outage management and distribution automation would be implemented in parallel. Material management and support processes (such as HR, Finance& Accounts, etc.) would be IT enabled in this phase.

Advanced applications

The advanced applications can be built only after establishing a strong foundation in the preceding phases. For instance, mobile field force solution can be built only after establishing a system for management of field service orders (and customer and service databases even earlier). E-business solutions such as customer self-service and e-procurement require the CIS, SCM, etc., to be in place.

By this time, the typical application portfolio at a distribution utility would look something like this:

<table>
<tr><th colspan="2">Distribution</th><th>Retail /
Customer Services</th></tr>
<tr><td colspan="3">Customer Information System (CIS), CRM</td></tr>
<tr><td colspan="3">Billing and EBPP, Complex Billing</td></tr>
<tr><td colspan="2">Meter Info. System</td><td>Self Service Internet site</td></tr>
<tr><td colspan="3">AMR, Prepaid metering</td></tr>
<tr><td colspan="2">OMS / TCMS, WMS</td><td>Call center / IVR / CTI</td></tr>
<tr><td>PMS</td><td>GIS, SCADA, EMS</td><td></td></tr>
<tr><td colspan="2">Mobile Workforce</td><td>Sales Force Automation (SFA)</td></tr>
<tr><td colspan="3">ERP – Fin & Acc, HR, Procurement, EAM, Decision Support</td></tr>
<tr><td colspan="3">Data Warehousing, Workflow Management</td></tr>
</table>

Phasing illustration

Each application selected for implementation could be further phased, prioritising the high impact areas first and gradually extending it to other areas. Such a phasing can be done along several dimensions including:

- Application functionality
- Geography
- Customer type

An illustration of possible phasing along various dimensions is provided below.

Dimensions of Phasing	Phase 1	Phase 2	Phase 3
Geography	City	Town	Rural
Customer Type	High value		Agricultural
Infrastructure	Core	Additions	Additions
Business Processes	Core processes	Support processes	Enterprise
Functionality	Core transactions		Enhanced
Customer Applications	Billing and CIS	Customer self-service	CRM
Database	Data model and core	Additions	Additions
Systems Integration	Core transactions	Department	Enterprise

Illustration of IT implementation phasing using customer service as an example

Programme Management Framework

Key implementation issues require a clear and consistent direction. The entire implementation should be based on a well-articulated business and IT strategy plan, and the entities should have a holistic view to create synergy between business and IT. Emphasis should be laid on adopting a holistic approach towards the standardisation of the following IT areas:

- Architecture
- Applications
- Network
- Hardware
- IT management

These areas should be globally standardised for easy and efficient deployment, integration and maintenance.

The implementation issues such as IT architecture, build vs. buy, the business model and service models are discussed below:

IT Architecture

The committee recommends that open architecture should be the norm in selecting software and hardware applications in order to realise effective integration and quick adoption. The other recommended features are:

- Robust and scalable to support large volume of transactions
- Deployable in manageable pieces depending on the ability of the SEBs to absorb the pace of implementation

- Highly granular applications that are scalable and extensible with the help of reusable components
- N-tier architecture for easy modifications to business rules, high scalability and multiple user interfaces
- Platform-independent, self-contained application components for easy migration to new platforms
- Adaptive data infrastructure for vendor independence and addition of new functionality
- Consistent infrastructure to support collaboration, communication and interoperability
- Optimum integration architecture to minimise the impact on existing systems
- Network architecture based on open and vendor neutral protocols to meet changing business requirements
- Authentication and authorisation based access to the network, independent of location
- The communication protocol of meters is a major issue. The committee recommends that some standards should be developed for communication protocols for meters.
- To support the best practice applications SEBs can deploy LAN, WAN, VSAT and optical cable fibre network, as per requirements.

Data preparedness

Data preparedness has two aspects, namely data model conceptualisation and implementation and actual data population. For example, while looking at customer management systems, the key requirement is to collate the customer information from existing systems or files as a one-time data migration operation. The data may also have to be reviewed and updated. The quality of data across the utilities is not up to the standards. The process of review and updating may require substantial one time effort.

The recommendations on database are as follows:

- The data deployment strategy should aim for an integrated information backbone with no duplication of data across various components
- Design of customer database should be governed by requirements of billing, collection, energy accounting, outage management, etc. The database design can be standardised. It is common in the developed countries for several utilities to have consistent and common customer database.

Ownership considerations

As a part of finalising the IT strategies and plans, the distribution companies may need to assess the ownership options relative to various components including:

- Application licenses
- Infrastructure – Network and hardware
- People and skills

The companies need to assess to what extent they will buy, deploy and operate the solutions on their own. Several factors need to be assessed while making these decisions, including:

- Implications on cost
- Control and security issues
- Ability to manage the solutions
- Commitment of vendors
- Time for implementation
- Ability to manage vendors
- Service requirements

Business Models for IT Implementation

This section deals with different funding models for IT implementation, which are critical to successfully deploy the recommendations. As it would be difficult for any SEB to implement these initiatives based on only a "project model", it is recommended that SEBs refer various business models.

In these conditions, SEBs and IT companies need to develop innovative business models to implement these initiatives. The "Business Viability Model" as against "Project Model" of IT implementation can result in a win-win situation for both SEBs and IT companies. However, the financial implications of these models have to be analysed in detail before embarking upon any of them. It may also require consortia to be formed by various solution providers to deliver some of these models, as no single agency would typically have all the required capabilities.

Some possible business models to be explored for IT implementation are discussed below.

Service model

SEBs could outsource certain services like meter reading and billing. Service companies would invest in IT applications for performing these activities. SEBs could make payment on a per customer basis. IT companies could also perform these functions by implementing the required systems and applications.

The contract would be based on service levels and not on improvement in revenue and hence provides less incentive for service companies to invest in systems. Service companies might invest on their own in systems to reduce cost of operations and improve efficiency.

Investment model

SEBs could ask IT companies to implement IT systems to share the benefits of improved performance. The returns for IT companies are likely to be more in this case but there could be financial risk due to non-payment of dues. IT companies have to build-in legal clauses in the contract to mitigate risk against non-payment or disruption by affected persons.

This model is self-sustaining for SEBs because any extra revenue generated from these initiatives could be used to implement other IT initiatives.

BOOT model

This model is similar to BOOT model being used in infrastructure projects. Here, SEBs could invite companies for performing complete customer service related functions like metering, billing and collection. IT companies could participate in this model and could make investment to get the returns over a longer period. This would be more applicable to Greenfield projects.

Certain level of internal or external funding would still be required to manage the entire programme. This requirement has today become a business imperative and in view of this, committee suggests that SEBs/ utilities should invest at least 5 % of their annual revenue on IT. In case of external funding, the committee suggests that funding agencies such as PFC, World Bank, etc., should link performance gains through IT initiatives to the fund disbursement. This would result in better commitment from SEBs and to that extent, the implementer's risks would be mitigated and getting access to funds would be easier and aligned with the returns.

Organisation Plan

A key issue to be addressed in the entire IT roadmap and transition would be the organisational and process change management. Any change of this magnitude depends upon the following pillars:

Identifying internal champions and stakeholders consensus

Changes of this magnitude will need the catalytic power of "Champions" who are both respected and powerful. "Champions" will need to be identified amongst the process owners. The key would be to secure commitment and ownership from these champions and encouraging them to secure commitments of ownership from the larger part of the organisation.

Sustained leadership commitment

Leadership has to provide sustained commitment through the entire course of the implementation and change. Commitment has to be shown towards building a high performance organisation and best-in-breed processes. The organisation should be able to attract and retain the best of the IT and managerial talent to manage and take forward this transition.

Realigning responsibilities and authority

IT implementation will allow centralisation of certain tasks and activities. For example, meter reading and billing can be centralised at the Circle level. Divisions and sub-divisions may only be responsible for meter installation, change in meter, disconnection/connection, and maintenance activities. This will require change in responsibilities and authority and hence change in power equations within the organisation. Management of this change would be a critical dimension for success.

Change management

Large scale IT implementations bring about a change in the way the employees work, the way they are evaluated and deliver service to customers. A fundamental change in mindset is required for successful IT implementation. A well-designed and well-implemented system will give managers the information they need to take good business decisions, but in the end, the decisions will have to be taken by the managers using the data. People at all levels would have access to robust, integrated

information that would enable them to provide better service to the consumer but they need to be aligned to use the data for decision making.

Competency building

IT alone is not adequate in business performance improvement. A lot of emphasis has to be placed on building competencies and skills as well as shaping mindsets. Processes have to shift to a world–class gear. People should be re-skilled not only for initiating the transition but also for sustaining it.

Solution Provider Selection and IT Governance

The Utilities should be facilitated in the process of selection of solution providers through an accreditation policy at the national level. For this, a committee of experts in the field of technical, commercial, finance and project management may be constituted in consultation with NASSCOM to accredit various agencies that could take up the execution work. The solution providers should be accredited depending upon the type of business model and solution providing capabilities they wish to participate in. The expert panel would be free to decide norms for accreditation. However, the committee suggests that the solution provider should have:

- A minimum experience of 3–5 years in utilities
- Quality certification such as ISO, CMM, etc.
- Industry knowledge
- Proven implementation methodology
- Change management methodologies and proven credentials

The committee recommends that in view of the high technical content, the bidding norms should have higher weightage for technical capabilities.

Any SEB/ utility could then invite quotations from the accredited agencies for specific work and immediately award contracts based on bid evaluation. This would save considerable time and effort in pre-qualification, etc., and would facilitate uniformity of terms of reference and work content.

It is observed that experience of SEBs in IT is limited and they lack internal capabilities as of now in the following areas:

- Detailing scope of work
- Developing contract framework
- Assessing the level of competency required of solution provider
- Evaluation of IT based bids
- Project management capabilities

There is a need to establish an efficient process for solution provider selection, open bidding systems, rigorous scope management and complex programme management capabilities.

The implementation partner should benchmark various processes and set clear and measurable process objectives. It should identify the gaps and weaknesses in the processes before implementing IT solutions. Alternatively, SEBs should use the concept of “IT-enabled process reengineering” where standard processes are incorporated as part of the IT solution.

The committee suggests that some kind of review mechanism involving experts/ planners in the field be included in the report for various actions and implementation strategies that are being advised in the report.

Operations and Maintenance

Having deployed the IT solutions, there is a need to sustain, maintain and effectively run the same. This can be done in-house or can be outsourced. In either of the cases, there would be a need to create an organisation with capabilities to attract and retain the relevant IT and managerial skills. One of the key concerns could be the ability of the utilities to attract and retain IT professionals. In order to address this, the utilities may consider setting up a common entity, which will support and service all the companies.

4 Selected Key Projects

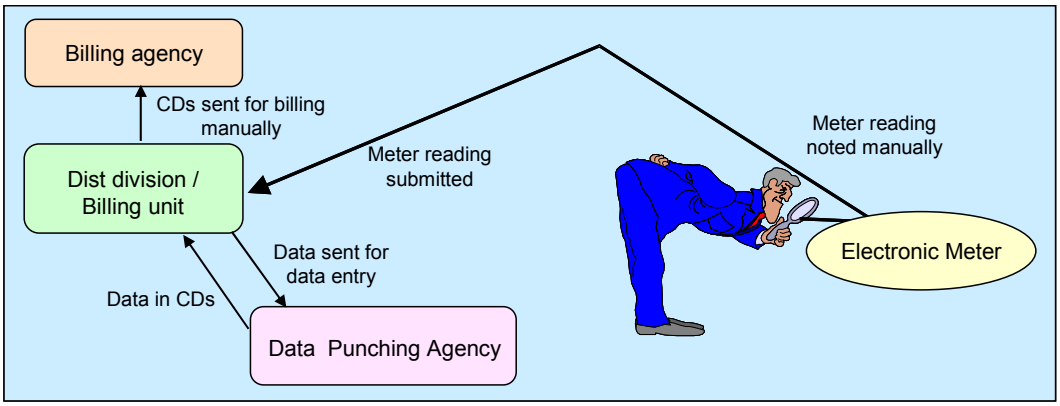
This chapter details two illustrative projects – Integrated Billing System for large C&I customers and Energy Accounting System.

Integrated Billing System for Large C&I Customers

The objective is to integrate meter reading, billing, payment and collection for C&I customers to eliminate scope for tampering and manipulation and thus improve collection (C&I customers contribute more than 70% of revenue).

Current system and its limitations

The following figure shows a typical current billing system:



Current billing system

The limitations of the current billing system include:

- Human intervention at many places in the process leading to scope for manipulation
  - Electronic meters are installed at many C&I customer premises but are of different makes and batch, hence reading by a single MRI is difficult
  - Reading is taken manually at most places and leaves scope for manipulation. Even if reading is taken through MRI, the output is printed and then data is entered manually for billing due to incompatibility of billing applications with MRI
  - Appropriate billing engine is not available to take data directly from MRI for bill calculation. In many places, bills are calculated manually
- Longer cycle time for reading, billing and collection due to lack of process automation
- Update of payment information is delayed and receivables report takes a long time (almost 30 days)
- Poor tracking of receivables due to manual systems
- Restricted reporting and analysis capabilities due to manual systems
- Lack of information roll up to decision-making levels

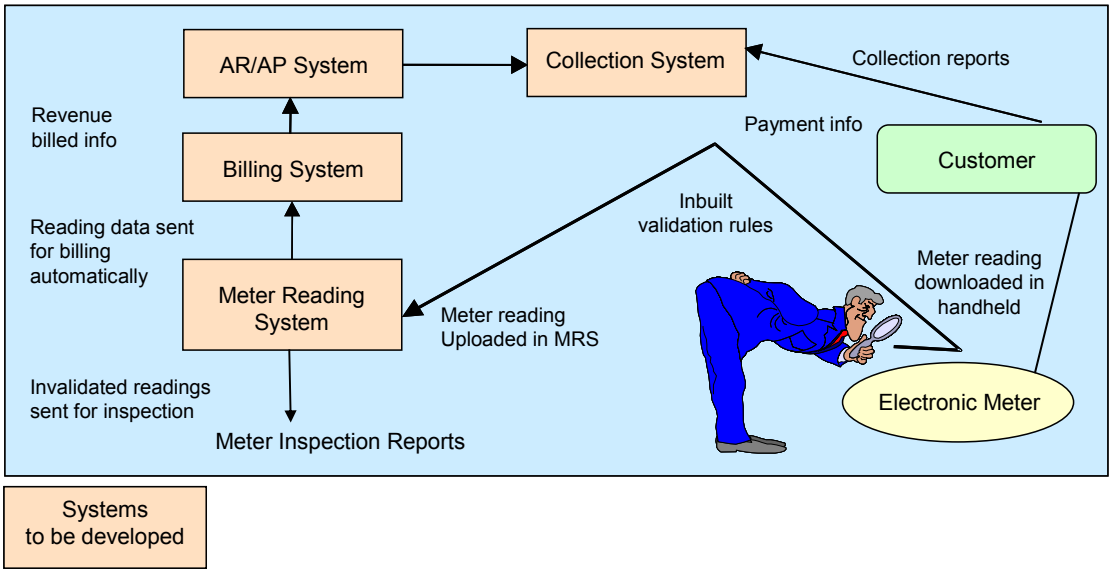
Proposed system

Objectives

- Integrate meter reading and billing for C&I customers to eliminate scope for tampering and manipulations
- Reduce theft and increase revenue
- Reduce receivables and improve cash flows
- Reduce the process cycle time

- Provide non-tamperable transparent records. High-level executives can also access information to monitor performance and minimise corruption, power theft, etc. It will provide accurate and timely information for decision-making, and cross-area comparisons can be used for motivational purposes.
- Improve customer service
- Facilitate differential pricing by load factor, time-of-day, day-of-week, peak consumption, etc., to even out consumption and minimise peak loads. It will shift the onus of load management to consumer with benefits to all parties.

The proposed system is illustrated below:



Proposed billing system

Scope

Part 1 – Meter installation and networking

- Installation of electronic meters with optical port for all C&I customers
  - Start with installing meters for more than 10 kW customers
  - Follow with installing meters for less than 10 kW customers
- If appropriate meters are already installed, then, regroup them according to their similarities in a location for meter reading ease through MRIs
- Networking – Connectivity between division offices and circle office

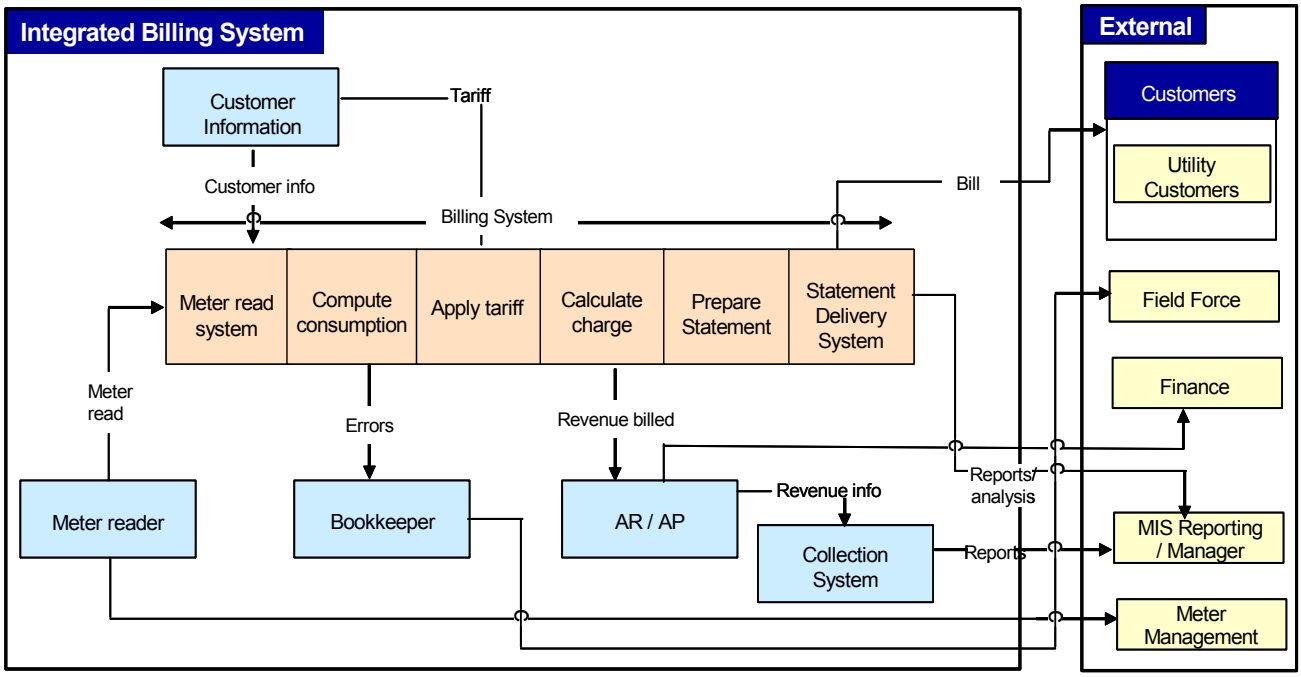
Part 2 – Integrate billing system

Software development/ Solutions implementation (Integrated Billing System for C&I customers)

- Develop an inventory of meters, locations and prepare a meter reading route plan
- Develop database of customers with name, location and address
- Develop billing engine to generate and print bills
- Develop AR/AP system

- Develop collection system

The business interaction diagram of the proposed system is given below:



Integrated Billing System

Project plan

Phase 1	Phase 2	Phase 3	Phase 4
Rollout: Month 6	Rollout: Month 9	Rollout: Month 12	Rollout: Month 15
CORE FUNCTIONALITY			
Metering System An inventory of meters and their current deployment	**Meter Reading System** Handheld device loading/ unloading, validations and interface to billing	**Billing Engine** Meter reads to usage, usage to charge, charge to final presentable bill	**Collections** Collection alerts and reports
PREREQUISITE FUNCTIONALITY			
		Customer information database with mailing addresses	Payment system (AR and AP)
ACCOMPANYING DATABASE			
Meter Inventory, Meter Locations (Addresses)	Meter Reads, Validation Rules	Usage, charges, bills	All financial transactions, collection rules

Project plan for an Integrated Billing System

Assumptions:

- Rollout date assumes a program start date of Month 1
- Meter installation, connectivity and hardware purchase by Month 2

Energy Accounting System

Current system and its limitations

- Meters are installed at 33 kV feeders and at some places on 11 kV feeders
- Meters are not installed at DT levels
- Total energy input to a Circle is known accurately but not the total energy sold, because many of the customers are unmetered
- Energy losses at different stages of sub-transmission and distribution are not known
- Energy accounting has started manually in some places, but with inaccurate data
- Due to lack of information, the control is ineffective and responsibility can not be fixed

Proposed system

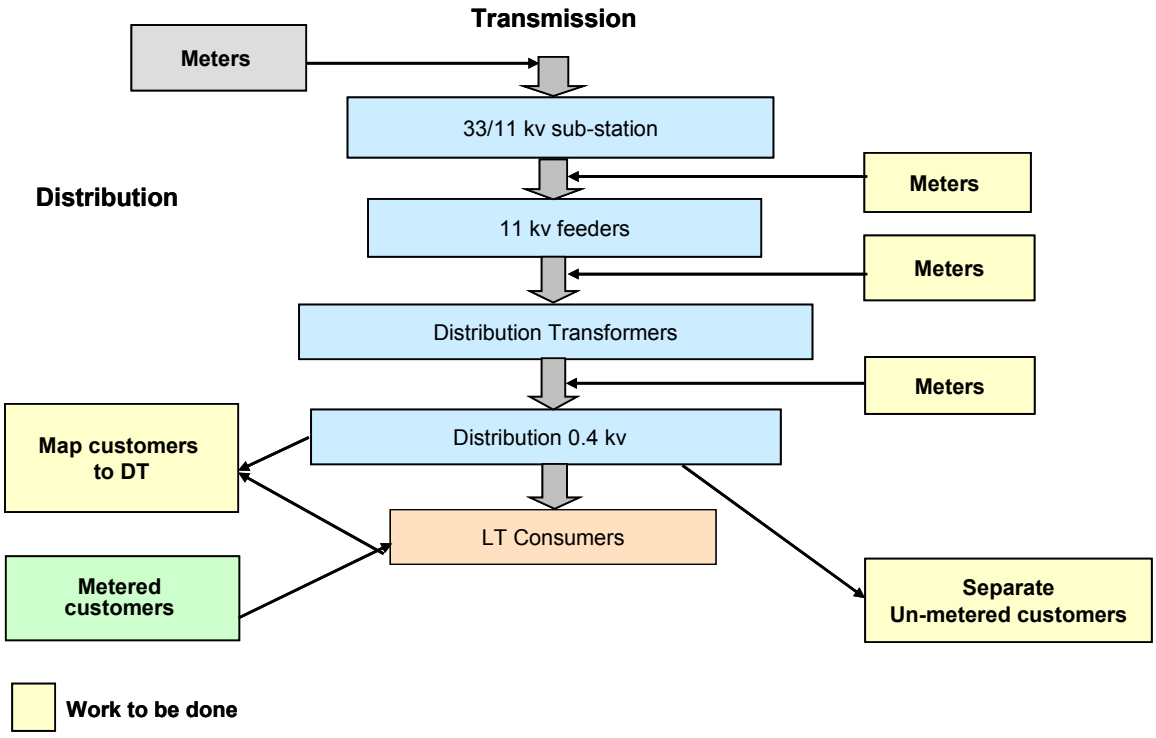
Objectives

- Obtain information about energy input and energy sold at various stages of sub-transmission and distribution
- Identify areas of high losses (theft) for follow-up action
- Secondary objective:
  - Use information on loading, voltage and consumption at different levels for network management and reduction in outages

Scope

Part 1 – Install meters, asset inventory and customer mapping

- Install meters at 33 kV feeders, 11 kV feeders and 11/.4 DTs
- Separate unmetered customers and supply them from different transformers
- Supply point identification – Map customers to respective DTs
- Build communication channels to transfer data from the meters to a central meter reading control system



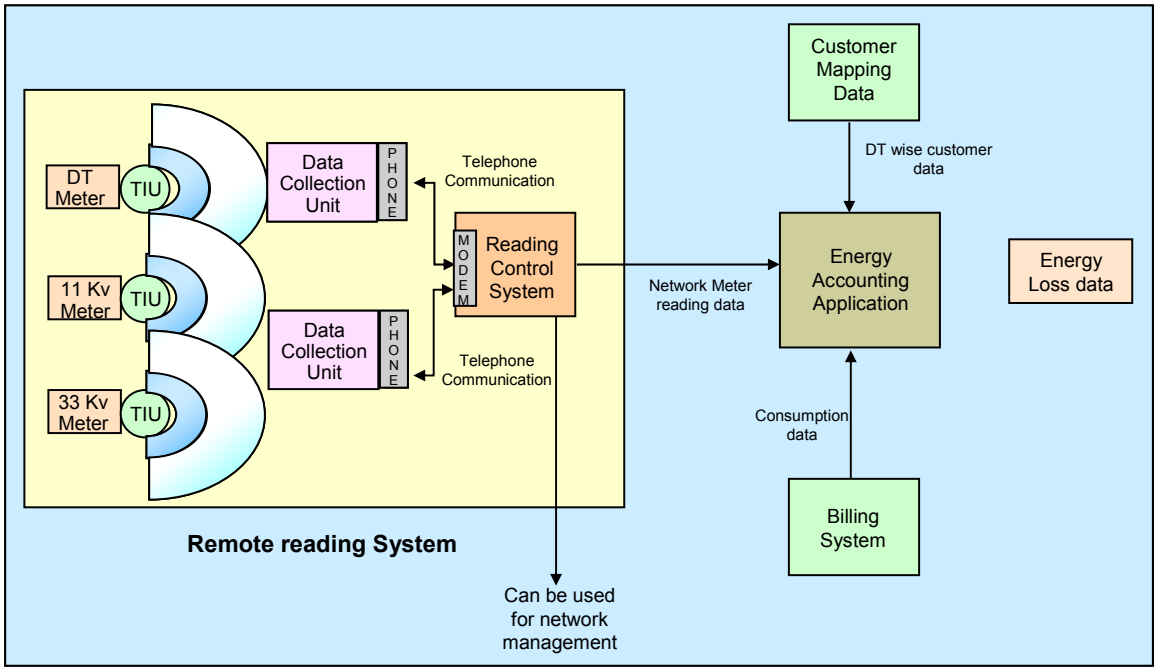
Transmission & Distribution

Meters and communication system

- Install meters on all the 33 kV and 11 kV feeders with real-time communication facility (R485 port), if existing meters do not have this port facility and vendor support for upgradation is not available
- Existing meters can not be used because:
  - Upgradation of existing meters is not easy
  - Data format and make vary across meters
- Remote reading is preferred over download facility through handheld device
  - Remote reading provides dynamic as well as real-time pictures while handheld device can give only snapshots
  - Remote reading provides facility for time stamping, making synchronous energy information available
  - Remote reading provides real-time information that can be used for network management and in distribution automation

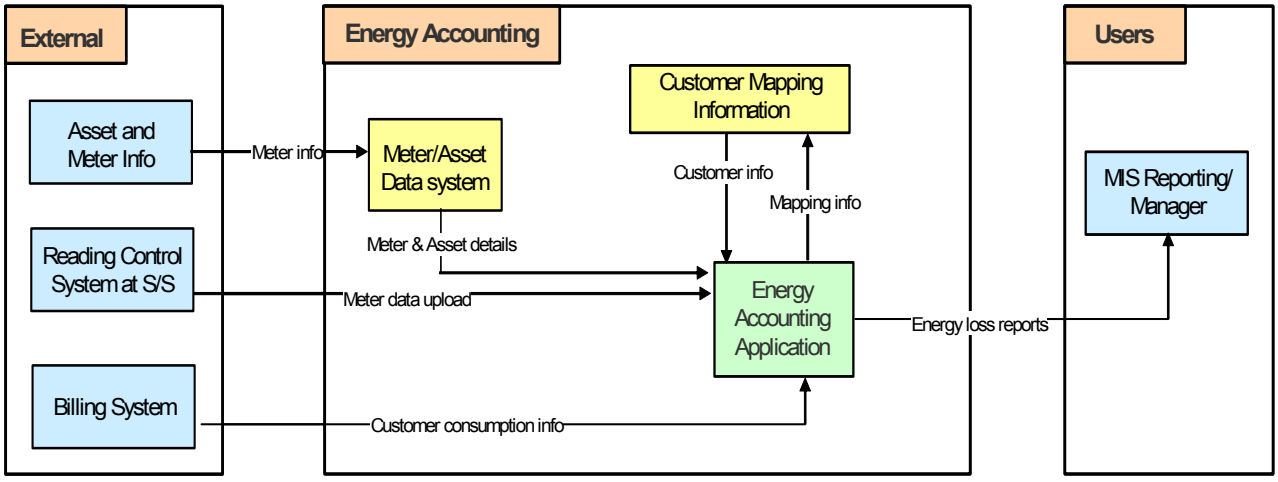
Part 2 – Energy accounting application

- Develop energy accounting system to calculate losses at 11/.4 DT level, 11 kV feeder level, 33 kV feeder level and at the Circle level
  - Energy accounting system must take data automatically from the billing system, energy input data at various levels from central meter reading control system and supply point identification system (customer mapping system)
  - Based on this data, energy accounting system must provide information about losses at different levels



Energy accounting system

The business interaction diagram for the proposed system is as follows:



Extended business interaction diagram

The rollout plan

Phase 1	Phase 2	Phase 3
Rollout: Month 6	Rollout: Month 9	Rollout: Month 12
CORE FUNCTIONALITY		
Electricity distribution inventory Inventory of wires, transformers, meters and customers linked to meters	**Energy Accounting** Detect revenue leakage based on metering & Interface to old/new billing systems	**Enhancements to energy accounting rules**
PREREQUISITE FUNCTIONALITY		
Metering system and database	Meter reading system and database	Basic energy accounting system
ACCOMPANYING DATABASE		
Asset inventory and customer database with wires mapping	Rules for energy accounting, usage information for all customers	

Rollout plan

Assumptions:

- Rollout date assume a program start date of Month 1
- Meter installation, connectivity and hardware purchase by Month 2

Cost–Benefit Analysis

The cost and benefits of implementing these two illustrative projects is provided in *Annexure 7*. The combined IRR for these two projects is 29%.

The figures of cost, benefits, IRR and payback are indicative and are based on available information and assumptions. *Annexure 7* also discusses IRR and payback under different scenarios. The returns are subject to administrative/ technical actions taken by SEBs based on the information available from these systems.

5 Mandated Focus Area 1 – MIS

This chapter discusses the criticality of an efficient Management Information System (MIS) for the power sector, detailing the benefits, structure of information flow and recommendations.

Management Information System (MIS) for the power sector should provide relevant information at various decision-making levels. The MIS should be able to cater to the needs of both internal and external information requirements. It should generate information for grid management and control, for monitoring agencies like regulatory commission and other central agencies like CEA and PFC, and for internal management of SEBs.

For SEB management, MIS should provide relevant information at each level of the organisation in a timely and accurate manner. The timeliness and accuracy of information improves decision-making. For MIS, information flow is required from lower level to higher levels partly in real-time and in batch mode. The real-time information flow requires networking within the organisation.

Benefits of MIS

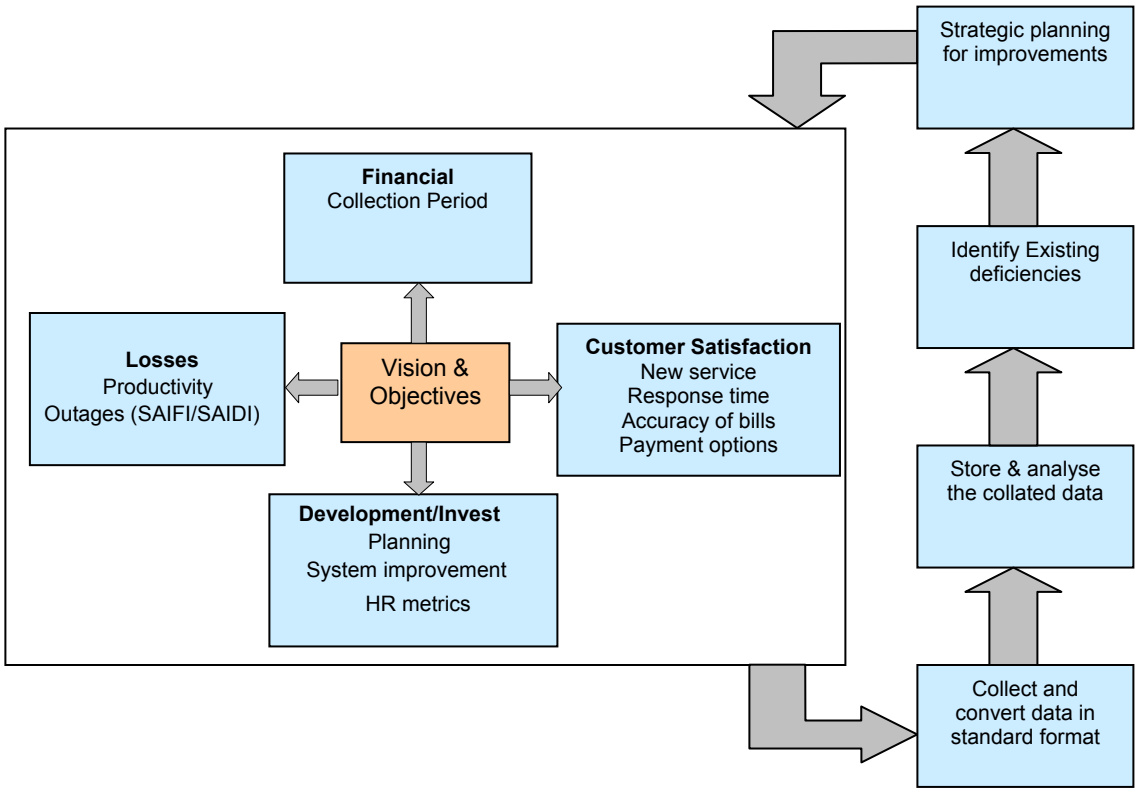
- Availability of accurate and timely information
- Effective mechanism for decision support
- Enables proactive decision-making (such as load planning and demand management)
- Identifies possible areas of energy loss (through analysis of consumption and billing patterns)
- Target based monitoring mechanism for increased accountability
- Transparency in administration
- Aids strategic planning in areas such as tariff structuring and management
- Develops 'what if' scenarios such as analysing the impact of changes in tariff plans on the revenue and financial health of the organisation

MIS for the Power Sector

MIS should take care of the varying information requirements for monitoring and decision-making at different levels in the hierarchy. Otherwise, huge data generated from MIS will not be of any significant use. MIS should not only cover the financial information but also other major aspects of the business. MIS for power sector will include information on finance, operations, customer satisfaction and development/ investment including that of human resources.

The structure of MIS should be SEB-specific to address the differences in organisational structures and responsibilities at various levels, but at the same time should be generic enough to provide standard information at the national level. A generalised framework of an MIS is presented here, which can be tailored to suit the needs of a specific SEB.

Figure below shows a high level view of the MIS requirements and the flow towards these requirements from the business imperatives. It also shows the requirements for effective use of the MIS.



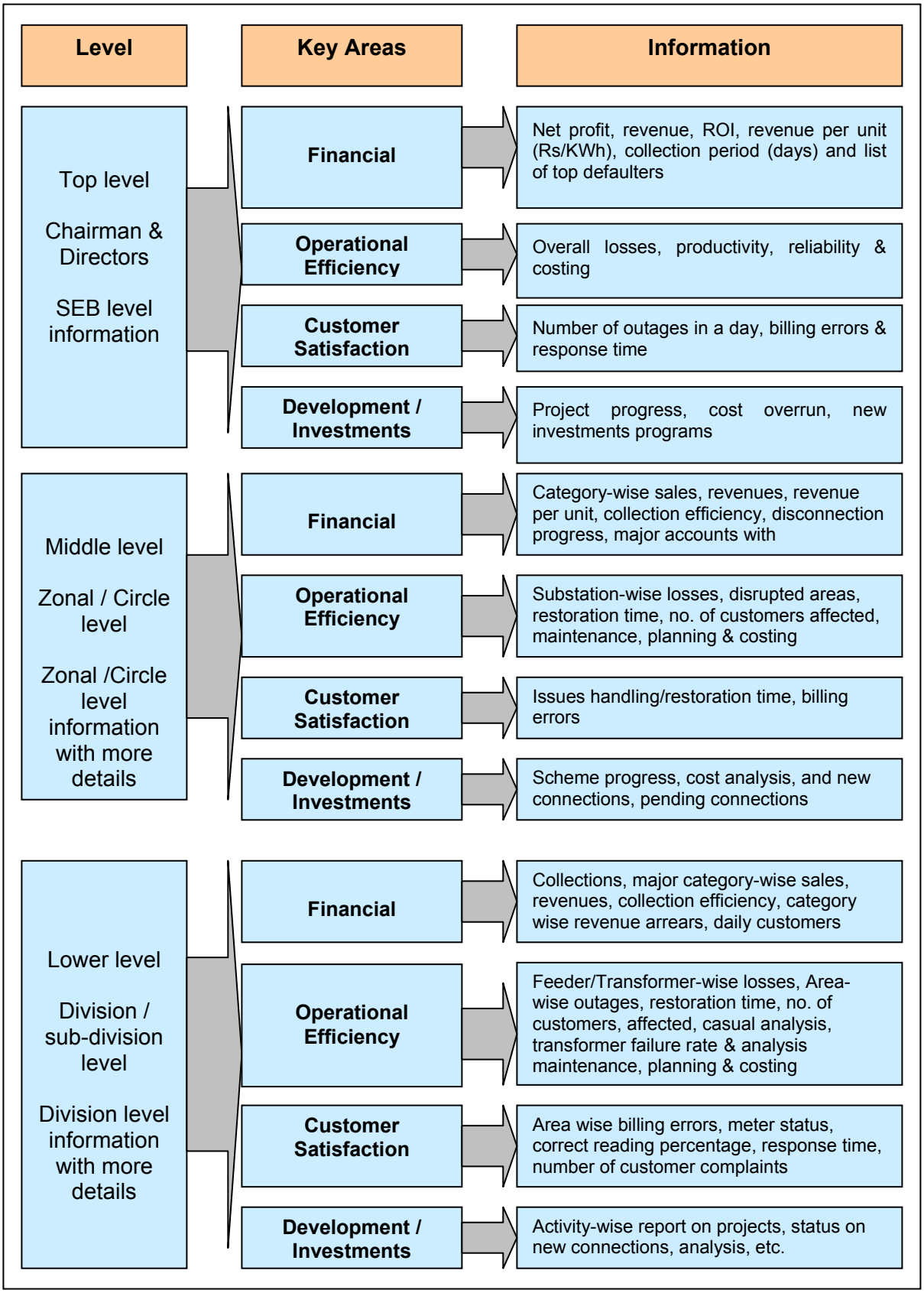
Note: The suggested MIS structure is for information related to electricity distribution only and hence does not contain MIS requirements for generation and grid management. However, the substation level information can be same and should be used for grid MIS also.

Information Requirements for SEBs / Utilities

For providing information, we need to distinguish between the different levels, their requirements and the periodicity with which they need to see the information. Figure below gives the information requirements for some key areas for different levels of management in SEBs. A typical periodicity diagram for this information is also shown below.

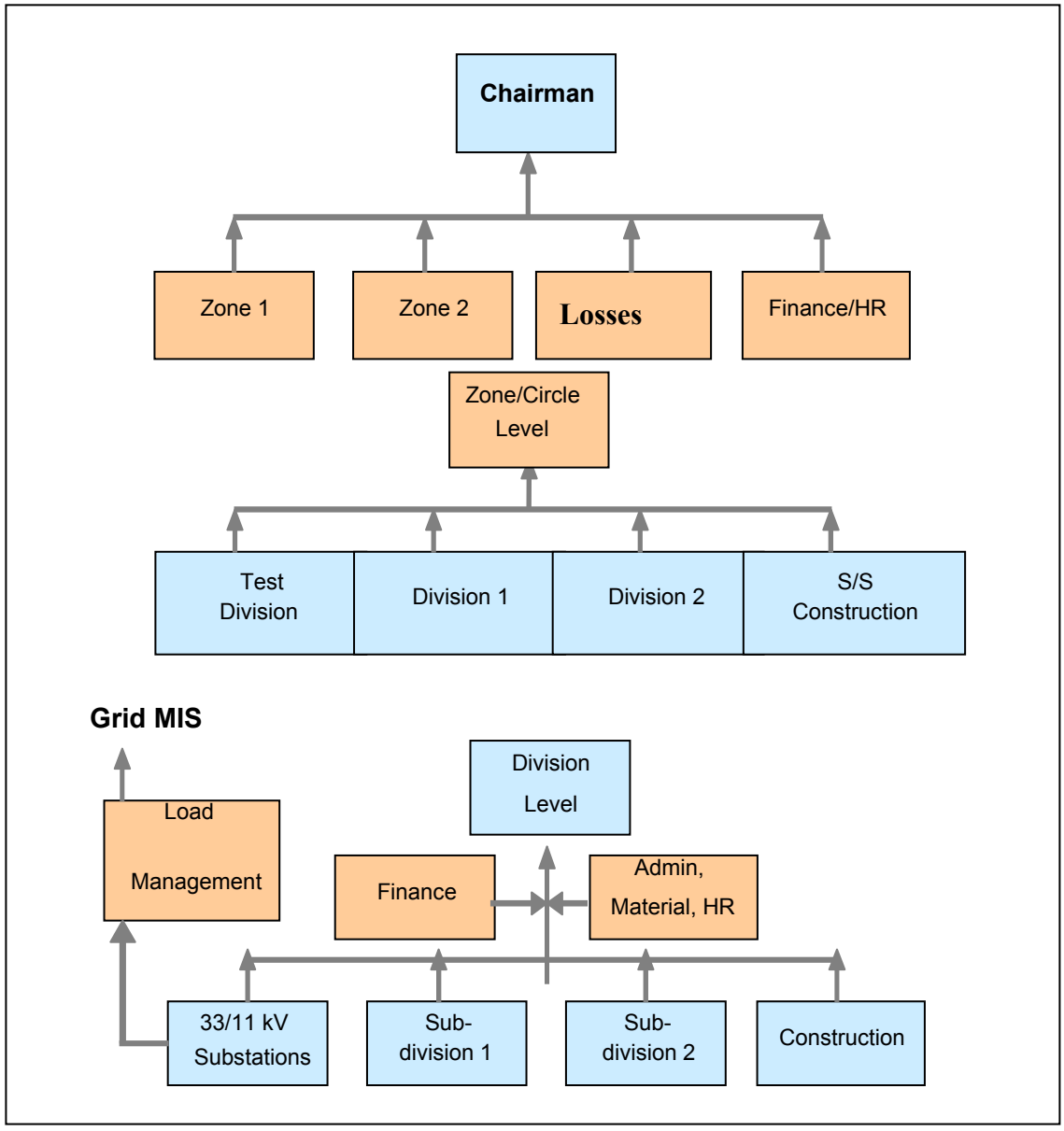
	Lower level	Middle level	Top level
Financial	Daily	Daily / weekly	Monthly / quarterly
Operational Efficiency	Daily / weekly	Daily / weekly	Monthly / quarterly
Customer Satisfaction	Biweekly	Weekly / monthly	Monthly / quarterly
Development/ Investment	Weekly	Weekly / monthly	Monthly / quarterly

MIS is meant for both the internal and external users. Some examples of external users of MIS are Regulatory Commission and central agencies like CEA and PFC. The internal customers are the different levels of people in SEBs. The following figure shows typical information requirements:


Level
Key Areas
Information
Top level
Chairman & Directors
SEB level information
Financial
Net profit, revenue, ROI, revenue per unit (Rs/KWh), collection period (days) and list of top defaulters
Operational Efficiency
Overall losses, productivity, reliability & costing
Customer Satisfaction
Number of outages in a day, billing errors & response time
Development / Investments
Project progress, cost overrun, new investments programs
Middle level
Zonal / Circle level
Zonal /Circle level information with more details
Financial
Category-wise sales, revenues, revenue per unit, collection efficiency, disconnection progress, major accounts with
Operational Efficiency
Substation-wise losses, disrupted areas, restoration time, no. of customers affected, maintenance, planning & costing
Customer Satisfaction
Issues handling/restoration time, billing errors
Development / Investments
Scheme progress, cost analysis, and new connections, pending connections
Lower level
Division / sub-division level
Division level information with more details
Financial
Collections, major category-wise sales, revenues, collection efficiency, category wise revenue arrears, daily customers
Operational Efficiency
Feeder/Transformer-wise losses, Area-wise outages, restoration time, no. of customers, affected, casual analysis, transformer failure rate & analysis maintenance, planning & costing
Customer Satisfaction
Area wise billing errors, meter status, correct reading percentage, response time, number of customer complaints
Development / Investments
Activity-wise report on projects, status on new connections, analysis, etc.

Flow of Information in the Power Sector

For achieving various MIS requirements of SEBs, the figure below illustrates how the information should flow between the different stakeholder organisations in the power sector for MIS.



For grid management, information from 33 kV or 11/.4 kV substations regarding current, voltage and load on 11 kV feeders, outages and transformer status are required. From substation, this information will be sent to grid control for grid management and grid MIS. The grid management is taken care at the load dispatch by transmission companies, and distribution companies are charged with the responsibility of managing the voltage profile as well as the load management.

MIS implementation requires data management and entails the following:

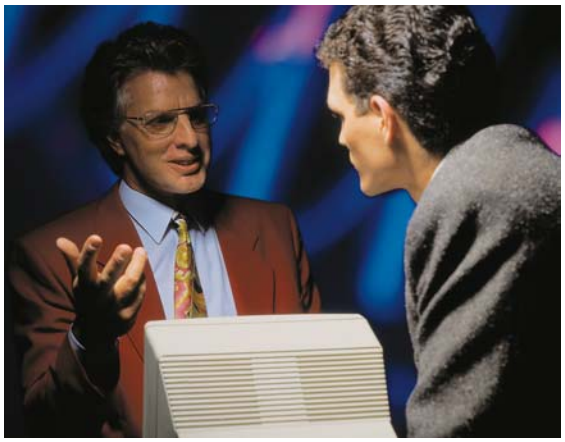
- Periodically collect, collate and convert data into a standard format
- Store and analyse the collated data
- Identify deficiencies in the existing system by analysing the data
- Strategic planning for bringing improvements in the system

Recommendations for MIS:

- There should be a common framework for the MIS for ease of consolidation, review and for transparency at the national level. MIS should also generate information required by other agencies like regulatory commission and other central agencies like CEA and PFC. However, the system should also cater to the specific reporting requirements of each SEB. Data sources for all the reports should be the same to avoid duplication of efforts and inconsistency.
- The performance measurement parameters mentioned are indicative and not exhaustive. Each utility should design right of measures based on its specific requirements. The selection of the set of performance measures also depends upon the maturity of the organisation. For example, measuring billing errors may be a key area in the initial stages. As the IT systems improve, measuring billing errors, while still required, may not be as important as managing bad debts.
- Data acquisition should preferably be without human intervention as far as possible. The data should be collected only at the lowest level and from the same source and in the standard formats.
- The information at substation should be acquired directly from RTUs to avoid manual intervention and for processing of huge amount of data. The relevant data in the prescribed format should be sent to grid management for grid MIS.

6

Mandated Focus Area 2 – Customer Benefit Applications

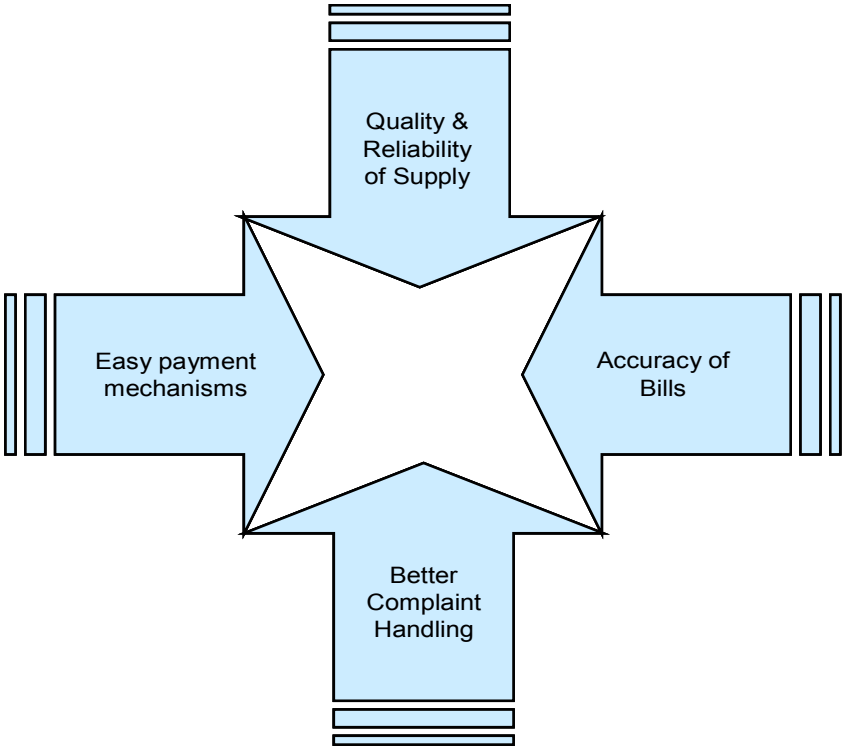


As the customers get exposed to global economies as well as improved service levels in many sectors touching upon the daily lives of a common man like banking, insurance etc., the expectation levels from the energy sector also become high. This angle necessitated mandating the task force to focus on customer benefits while defining the IT roadmap to allocate higher priority to certain applications for the benefit of customers.

Discussions under this chapter intend to look at the important issues and demands of the customers and how IT can be applied to meet those demands.

What Does the Customer Want?

The key needs of the customer are depicted in the figure below. These need to be the focus of the IT applications.



The focus of IT applications for customer benefit

The service levels to customers in the areas mentioned in the figure could be improved by monitoring the following parameters:

- Quality and reliability of supply
  - Scheduled and unscheduled outages
  - Communication from SEBs on possible outages and outage time
- Accuracy of bills
  - Inaccurate meter reading or no meter reading
  - Meter reading taken but not reported
  - No posting of collection
  - Changed meter status
  - Split between cycles
  - Wrong calculation
- Payment mechanisms
  - Bill not delivered in time to make payment
  - Waiting time for bill payment
  - Preferred vs. available mode of payments

- Compliant handling
  - Demand vs. provision of new connections
  - Responsiveness to bill queries
  - Preferred vs. available facilities to log complaints

Applying IT to Meet Customer Needs

Based on the preceding discussion on understanding customer needs and the key elements to be addressed in order to fulfil customer needs, the applications that can help the SEBs to move in this direction can be arrived at. These are discussed below.

The implementation of these initiatives is divided into different time and priority buckets to enable SEBs to achieve quick wins in the short run.

Quality and reliability of supply

Quality and reliability of supply can be improved with proper system maintenance and faster action on outage complaints. For this, electric flow in the system should be monitored on a real-time basis. The real-time information ensures that the official concerned (distribution point) is aware of any breakdown / disruption at the same time as the consumer. The customers affected with any outage should be immediately identified and informed of the outage or a possible outage as well as the approximate duration. This results in prompter action and better customer relationship. Following are some of the IT applications, which can help in this:

- SCADA to start with and then progressing to distribution automation
- Outage and work management system including trouble call management system for faster restoration of outages
- GIS (Geographical Information System) for identifying area and equipments
- CIS (Customer Information System) using Internet, phones, call-centres, etc.
- IVR for complaints and call back on restoration of supply

Accuracy of bills

Accuracy of bills can be improved by implementing better metering technologies, taking accurate readings, by avoiding manual intervention and automating the billing process. The following IT applications can be used for this:

- Download devices for meter readings
- Meter reading interface with billing applications
- Billing applications

Payment mechanisms

Payments are currently made in person in most of the places. Only in few places, payments can be made online or through the ATM. SEBs should adopt other payment mechanisms such as:

- Electronic payments, including direct debit payments
- Prepaid metering
- Bar coding facility even when payment is made in person, for faster payment
- Multiple payment locations and not restricted to a particular division or sub-division

For providing electronic payments, use of IT would be required for providing interfaces with entities like banks and building Internet-based payment processing.

At present, SEBs allow only full payment and the system for providing credit facility (part payment) is quite ad hoc. SEBs could put a system in place for providing credit and monitor it. SEBs could also provide various payment options such as budget payment (average payment) and seasonal payment depending on the customers' preference and credit rating. This requires credit analysis of customers and segregation of "good paying customers" from "bad customers".

Complaint handling

At present, consumers find it very difficult to log their complaints. In most cases, they have to go to the substation for supply related complaints and the concerned offices for bill related complaints. Contact centres can reduce this kind of trouble for customers. SEBs/Utilities should have:

- Call centres with IVR for outages and bill related complaints
- Call back from IVR on restoration of supply or redressal of any bill related complaint

New connection is a major problem in all the SEBs. There is no suitable system in most SEBs for availability of information or monitoring of application status. SEBs must implement a system to enable the customers to know the status of their applications in a transparent manner. On the process side, regulators could set standards for SEBs in terms of timelines to provide new connections. All the basic information for new connections should be easily and publicly available to the customers either through a website or other communication channels.

Applications suggested in the IT roadmap and relevance to customer benefits

The figure below shows the applications that meet the objective of realising customer benefits as suggested in the IT roadmap.

Short Term – Quick Wins	Medium Term – High Returns	Advanced applications
APPLICATIONS		
Integrated billing for C&I customers	CIS and billing for all customers Call centre Outage management	Mobile applications E-business CRM applications
BENEFITS		
Timely and accurate billing Reduction of instances of disconnections due to wrong information	Faster resolution of customer complaints, improved service quality and better information access for customers	Superior service quality

Customer benefit–IT applications

7

Annexure

Annexure 1 comprises a list of Members and invitees of the IT Task Force. Annexure 2 to 6 discusses some of the IT practices adopted in the distribution sector in India. Annexure 7 has the cost-benefit analysis for the illustrative projects while Annexure 8 details an example for Operational Management.

Annexure 1: IT Task Force for Power Sector

The Ministry of Power, Government of India, has set up a task force to develop synergy between Information Technology (IT) and the Indian power sector.

The IT Task Force under the Chairmanship of Shri. Nandan Nilekani, CEO, Infosys Technologies Ltd., comprise:

1. Shri. Kiran Karnik, President, NASSCOM
2. Prof. Sachidanand, Director (designate), Central Power Research Institute
3. Shri. C. M. Bhogal, Chief Engineer, CEA
4. Shri. J. Haque, Executive Director, PGCIL; Shri. Guljit, DGM, PGCIL; Shri. N. K. Jain, PGCIL
5. Dr. R. P. Saxena, DDG, NIC
6. Shri. V. P. Baligar, CMD, KTPCL; and Shri. S. Pratap Kumar, Chief Engineer, KTPCL
7. Shri. S. D. Tyagi, ED (EDP), NTPC
8. Shri. P. M. Kothare, Chief Engineer, MSEB
9. Shri. Arvind Jadhav, Joint Secretary (Distribution), MoP - Member Secretary
10. Shri. T K Sarkar, Director, Department of Information Technology
11. Capt. V.W. Katre, Chairman, Seahorse Group and Member, Executive Council, IEEMA
12. Shri. Sri Kumar Tadimalla, Assistant Vice President, IDFC
13. Dr. Vijay P. Bhatkar, Chairman, Dishnet DSL Ltd., Pune

Annexure 2: Practices in Metering Technologies and Meter Reading

Annexure 2 to 6 present examples of IT practices adopted in distribution sector in India. As stated earlier, these are not comprehensive in nature. The organisations that provided these inputs to IT Task Force are the ones included here without filtering for presenting only the best practices or recommended practices. These are presented to provide a sample of Indian practices for comparison with global practices.

1. Electronic meters for accurate consumption recording and reducing theft

At present, in SEBs, most of the consumers have been provided mechanical meters. Due to manual reading systems and prevalence of malpractices, it is not possible to know the cause of exact loss, i.e., theft, meter tampering, faulty meters, transmission / distribution loss, etc.

This is changing now with SEBs installing electronic meters for most of its C&I customers. Various companies have launched Electronic Energy Meters. These meters are compact, reliable, accurate and tamper-proof. They have several advantages and pose limited challenges as given below:

Advantages	Challenges
Lower operating cost with almost zero maintenance	Difficulties and lack of facilities in calibration and testing of electronic meters
Accurate consumption recording and hence accurate customer billing	Difficulties in repair, calibration, spare parts.
Provide tamper information	Fast changing technology in electronic metering and limited guaranteed life of meters
Remote meter reading	
High reliability due to calibration through optical port	
Consistently accurate	

2. Digitisation of meter reading

MSEB has introduced the concept of digitising meter reading for the domestic, commercial and L.T. Industrial Consumers in four divisions of Pune Urban Zone on a trial basis. Around 144,000 consumers are covered under this pilot.

In this process, the meter reader takes digital photographs of all the energy meters, which are to be read during a particular cycle. The camera records the meter reading along with the physical status of the meter, i.e., position of terminal cover seal, meter body seal, etc. It also records the date and time of reading. At the end of the day, the meter reader downloads the digital photographs from the digital camera to the server. Photographs are then processed through software (OCR category) and the same is converted into an MSEB defined format for onward submission for bill processing. This work is done by a private agency on contract basis. The agency claims that one person can handle up to 300 meter readings in a day. In addition to meter readings, the following reports are also generated:

- List of meters having duplicate number
- List of faulty meters

- List of dial type meters
- Route-wise missing meter reports
- Wrong address of the consumers
- Changed meter reports

MSEB conducted an exercise to analyse the benefits of digitisation of meter reading. In this exercise, parallel runs were conducted by taking manual readings as well as readings using digital camera for the same meters. This was done within a time gap of 1–2 hours without the knowledge of the meter readers to eliminate any possibility of manipulation. The results of this exercise showed 39–41% increased consumption by digital meter reading over manually recorded consumption.

MSEB feels that a detailed study of the project needs to be done due to the high cost of reading in rural areas and IPR issue of OCR software. The cost per reading in an urban area is about Rs. 10, while that in a rural area is 3 to 4 times more. The IPR issue is that the agency is not willing to part with the software and wants to retain the source code with itself.

3. Handheld devices for meter reading

MSEB is using handheld devices for meter reading in the Kothrud division of Pune Urban Zone. Kothrud is one of the most rapidly expanding areas of Pune. With the use of 'RAMCRAM – Meter Reading Recorder' system, this division has totally switched over from the old, paper-based, manual reading recording system to the new paperless office.

RAMCRAM is an indigenously designed, battery operated, compact, ergonomic and truly portable handheld datalogger. It can be customised for various applications involving recording of data from the field. RAMCRAM is currently customised to work as a 'Meter Reading Recorder' and has been programmed to gather meter readings via manual entry of electromechanical meters and electronic meters (without optical port interface). The features, security mechanisms and other details of RAMCRAM system can be obtained from MSEB.

The main advantages of this system are as follows:

- Online annunciation of errors to meter readers –- Minimisation of erroneous readings and blunders during data gathering
- Improvement in revenue flow due to accurate meter reading
- Cost reduction due to saving on time needed for data entry, validation, etc.
- Analysis of data and implementation of other management solutions become easier
- Increase in meter reader productivity due to reduction in time required to take a reading
- Reduction in customer complaints due to accurate readings
- Improvement in customer relations
- User interface of RAMCRAM is customised for ease of operation
- User interface of RAMCRAM is customised and not programmable at the user end, hence tampering of data through software manipulations is not impossible

MSEB has realised the following actual advantages after implementing RAMCRAM:

- Increased efficiency – Reduction in number of meter readers from 15 to 13 to take reading of increased number of customers from 97,000 to 1,10,00. The services of private agencies for meter reading activity are no longer required.
- Reduced 'Readings Not Taken' (RNT) cases from around 5% to less than 1% (In some cases to 0%)
- Increased billing due to reduced RNT cases
- Reduced meter reading complaints
  - Errors due to 'current reading less than previous reading' have reduced from 2.48% (recording on paper) to 0.08% (recording on RAMCRAM)
  - Errors due to 'current consumption very high as compared to average consumption' have reduced from 8.57% (recording on paper) to 3.8% (recording on RAMCRAM)
- Other benefits such as cost savings on stationary

4. Online metering

Tata Power is using advanced meter reading techniques to measure energy supplied to BEST. Tata Power supplies electricity to BEST in bulk at 110 kV / 33 kV / 22 kV. Static Trivector meters, type Quantum - 121, (Schlumberger make) with 0.2 Class accuracy are installed at the above places for registering energy supplied to BEST. In all, there are 12 meters (three each at Carnac, Backbay and Dharavi and one each at the remaining locations) used for billing BEST.

The meters have optical ports to which a handheld unit (HHU) can be connected to retrieve billing data. HHU is then connected to a PC loaded with MINIMAX software (Schlumberger make) and billing data is downloaded to a PC. Alternatively, meters can also be connected to a PC directly using its RS-232 port. Meters have an internal modem that can be connected to a telephone line and billing data can be downloaded to a PC at a remote location by dialling the meter. When there are more meters at one location, they are connected in a daisy chain and it is possible to dial each meter, one at a time.

A PC loaded with MINIMAX software is located at the Testing Department, Trombay. An external dial-up type modem is connected to the PC and a microwave exchange at Trombay. Internal modems of meters at various locations are connected to respective microwave exchanges. Each meter is dialled up, one at a time, to download the billing data in a PC and to determine the coincident demand.

Annexure 3: Improving Billing and Revenue Collection

1. Consumer Monitoring System (CMS)

MSEB has developed a new software system called Consumer Monitoring System for managing metering–billing–collection cycle at the sub-division level. It consists of the following modules:

- Consumer personal ledger – Consumer related information, i.e., personal details, billing details and static parameters
  - Master data for static information –- Static information regarding the billing such as tariff, duty, sanctioned load, connected load, MERC code, etc., and data entry facility for modifying /entering information on name, address, meter change, average consumption, etc.
  - Billing information –- Information regarding meter reading, billing details indicating all the components such as energy charges, electricity duty, fuel and other charge adjustments, collection, arrears position, etc. This also has provision for monitoring disconnection and reconnection of all consumers. The customer complaints can be handled at the sub-division level and corrected bills can be issued.
- New service connection – New service connection details such as name of the consumer, consumer number, address, PC, route, cycle, sequence, sanction load, connected load, quotation number, receipt number, etc.
- Metering lab – Details of the meter attached to the consumer
- DTC-wise consumer analysis – DTC-wise analysis like consumption analysis, receipt analysis, connected load analysis, meter reading performance, etc.

MSEB achieved the following benefits from CMS implementation in Mandai Sub-division under Parvati Division of Pune Urban Zone:

- Faster replacement of faulty meters
- Identification of inaccessible consumers
- Increase in revenue from 28.5% to 40% in certain DTCs due to DTC-wise analysis and replacement of the meters
- Increase in revenue by 11% for sub-division billing within 4 months (Increase in revenue from Rs. 1.8 crore to Rs. 2.05 crore)

2. Billing and Collection System

KPTCL has computerised the process of issue of consumer bills and collection in Bangalore city for the past two years. This has been extended to the surrounding areas of Bangalore city subsequently. KPTCL is planning to extend it further to other parts of Karnataka.

The system has a client-server type of architecture. Each of the sub-divisions has been provided with a server and sufficient numbers of PCs. Bar coding of bills has been implemented. The cash collection centres have also been provided with PCs. The approximate amount spent on each of the sub-divisions for the hardware and software is around Rs. 9–10 lakh.

With this system, KPTCL has achieved the following benefits:

- More number of installations are billed on a regular basis
- Easier to identify installations for which readings are not being obtained
- Increase in accuracy of bills

- Increase in revenue in sub-divisions by Rs. 10–30 lakh per month. Hence, the money spent on the hardware and software has been recovered in less than a month in cities and in a period of 2–3 months in rural areas.
- Easy identification of defaulters and timely information to initiate action to disconnect their installations. This has drastically reduced the outstanding dues from the consumers.
- Reduction in waiting time for customers in queue by 60% due to bar coding of bills and scanners. In addition, erroneous entries have been eliminated.

KPTCL also provides electronic clearing for direct debit from consumers' bank account and online payment of bills, wherein the consumers can view their bills on the Internet and make payment. This facility is introduced in Bangalore city.

3. Revenue Realisation Monitoring System (RRMS)

The RRMS software implementation was taken as a pilot project at Sikar district of Rajasthan in 1994 and was implemented at all the divisions of Rajasthan State Electricity Board in 1996. This project continued for a few years but progress became slow after RSEB was unbundled.

An advanced version of the same software (Computerised online Billing System – CBS) was developed in Oracle and was implemented at BSEB in 2001. In this system, billing is being carried out at the Divisional level office whereas the collection of data is being done at the BSEB HQ. The Circle office and Area Board offices access data from BSEB HQ server using RF network and the website (the details of hardware and software can be obtained from NIC). For this, NIC is responsible for hardware selection, procurement and installation, licensed system software procurement, installation, and configuration apart from application software design, development, and implementation.

4. Customer database

The database on consumers can help citizens to find the status of their electricity bills, consumption, consumers' dues, etc., online, and to make online payment of bills. For this, there is a need of building a consumer database in all electricity boards.

In Bihar State Electricity Board, a system has been implemented by M/s. NICSI, which helps in improving the productivity and efficiency of services using IT for the common man. The system is likely to be installed at 10 locations including Patna city, Gulzar Bagh, Kankan Bagh, Raipat, Rajinder Nagar, Garchani Bagh, Patliputra, Danapur, Dak Khana, New Central Office and Vidyut Bhavan. All these locations are likely to be connected by RF connectivity.

The implementation of the above will benefit both the electricity board and consumers, will increase revenue, and reduce reconciliation time considerably.

In view of this, the revenue collection and monitoring may be done online using distributed database under client/server architecture, which will minimise human errors. Database access may be provided right at the desk of the SEB officials, which will help in quick disposal of consumers' grievances.

Annexure 4: Energy Accounting Practices

1. Financial Energy Management System (FEMS)

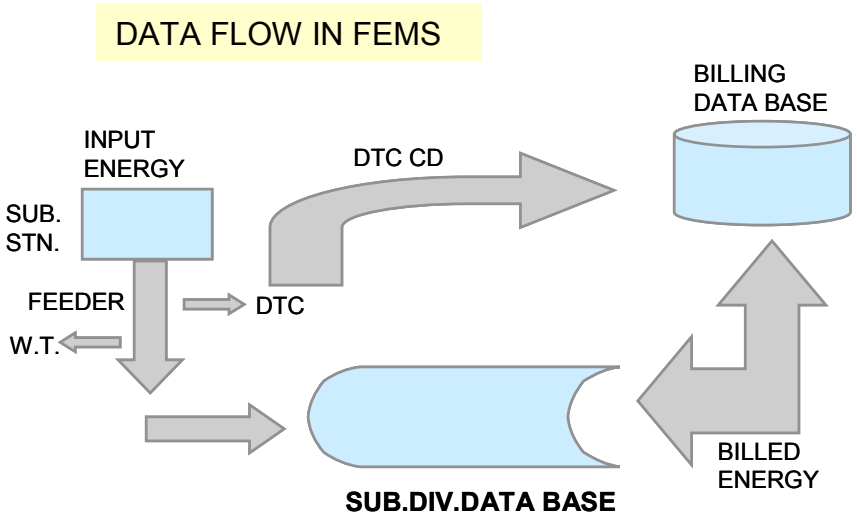
MSEB has implemented Financial Energy Management System (FEMS) in urban areas for energy accounting. FEMS is a database management system developed in FoxPro 2.6. Now it is being converted into Oracle. FEMS has the following modules:

- Energy Audit Module
  - Sub-division / Substation-wise input / output energy management
  - Meter analysis
  - Energy audit balance sheet
- Consumer Analysis Module
  - HT consumers
    - Consumption, maximum demand, power factor
    - Comparison for similar categories
    - Arrears
    - Meter status, meter seal details
  - Industrial and commercial consumers
    - Transformer-wise distribution report
- Interruption Analysis Module
  - Category-wise
  - Actual reasons
- Equipment Failure Analysis Module
  - Power transformers, circuit breakers, CT, PT, and LA, etc.
  - Distribution transformers
- Performance Monitoring Module
  - Based on four modules
  - Comparison with previous year

The implementation of FEMS requires the following:

- Meter provision on incoming and outgoing feeder bays and T/F bays at substation
- Meter provision at all crossover points between sub-divisions
- Meter calibration at substations
- Meter calibration at crossover points between sub-divisions
- Codification of all substations
- Codification of all feeders
- Codification of all Distribution Transformer Centres (DTCs)
- Mapping of L.T. consumers with respect to DTCs
- Data logging of DTC code in billing database
- Billing data transfer interface
- Feeder and crossover point consumption from substations and sub-divisions
- Changeover period logging from main to alternate feeders in respect of H.T. consumers and DTCs
- Interruption data logging

FEMS can accept billing data from the billing computer centres in the form of Flat Text Files and can process the data to convert it to database format with due validation. The data flow in FEMS and its linkage to the billing database is illustrated in the figure below.



In FEMS, it has been assumed that there are only two types of consumers on a feeder, one is High Tension (H.T.) consumer and the other is DTC. For getting billed energy, the billing computer centre gives the billed energy for H.T. consumers and DTC-wise billed units for the Low Tension (LT) consumers. In order to enable the billing computer centre to compute DTC-wise billed energy, each L.T. consumer is identified with respect to DTC, and each L.T. consumer data in billing computer centre has been updated with its DTC code. This has enabled network-wise identification of consumers.

FEMS provides the sub-division wise distribution transformer capacities and the billed energy on these distribution transformers. It also indicates the comparison index, kWh billed per kva for one-month data. In case of variation in kWh/ kva in different sub-divisions, the Divisional Engineer can focus his action areas for the sub-divisions with lower values. In order to analyse the action area problems further, FEMS also gives complete details of the L.T. industrial and commercial consumers available. The analysis based on the above can be further extended to a Distribution Transformer wise break-up in a particular area.

MSEB is intending to link FEMS with Network Information Management System (NIMS). The integration with NIMS will provide bifurcation of energy losses to technical and non-technical losses.

Annexure 5: Distribution Automation Practices

1. Distribution Automation System – WBSEB

WBSEB has implemented Distribution Automation System in Jalpaiguri Circle and is fully operational. As a part of this, three Distribution Control Centres (DCCs) are functioning at Jalpaiguri, Coochbehar, and Alipurduar. A total of 17 33/11 kV substations have been automated under these three DCCs. Each DCC controls about 5 to 6 substations (maximum radial distance from DCC to any substation is about 50 km). Data communication between each substation and DCC is through 900 MHz UHF radio. The system also has a VHF-based voice communication facility. This system has the following overall technical features:

- SCO Unix and SCOUNIXWARE based DA – SCADA
- DA application functions like:
  - Load analysis
  - Scheduled power cuts
  - Emergency based load shedding
  - Facilities management
  - Load survey and energy accounting
  - Remote feeder control

2. Distribution Automation System – KSEB

This project is being implemented to cover the entire Thiruvananthapuram city in two phases. Phase I of the project has already been completed and Phase II is in progress.

In Phase I, three 66/ 11 kV substations have been automated through a Substation Control System (SCS). Besides, 20 Distribution Transformer Locations (switched by Ring Main Units with SF6 circuit breakers) have also been automated by placing micro remote terminal units. The substations and remote locations are in continuous communication with the Central Control System (CCS) through UHF (900 MHz radio control). The overall system features are:

- Distribution automation SCADA
- Feeder reconfiguration through control commands from CCS
- Power flow analysis
- Geographical Information System (GIS)
- Network control function (fault detection and restoration)
- Feeder reconfiguration studies/ analysis through GIS
- Short-term load forecast
- Simulation and operator training

In Phase II, five more 66/ 11 kV substations in the city are being integrated into the system through SCS and another 100 remote locations (DT locations) are also getting integrated into the system, which will make a complete DA system for the entire Thiruvananthapuram city.

The total project cost including both the phases is about Rs. 8 crore (includes only the cost of DA related items and not electrical items like RMUs), which is partially supported by Department of Information Technology.

Annexure 6: Building Stakeholder Consensus

Consumer Education and Research Society (CERS), Ahmedabad, started receiving a number of complaints from consumers of Ahmedabad Electricity Company (AEC) since it commenced replacing energy meters from the old electro-mechanical to the new type of static/electronic meters. According to AEC, the old-type electro-mechanical meters are facing ageing problem due to its rotating mechanism, gears, etc. Moreover, due to inertia they did not record initial minimum power (like 15W night lamp or even 40W bulb).

CERS discussed this matter with AEC officials and began an exercise for joint inspection of random meters with electrical engineers from Chief Electrical Inspector-CEI (Government of Gujarat), AEC and CERS. At the moment, this is being operationalised once a week. Meters to be checked are selected at random and are checked and tested in the presence of consumers at their premises. This has inspired confidence in consumers who are also being educated by the aforesaid representatives for minimising the bills and on conservation of energy.

Problems related to meters such as information to consumers before changing the meters, criteria for changing the meters and educating consumers on conservation of energy are of prime importance for CERS which they have taken up with AEC and the Government of Gujarat. It has also been decided to have a meeting of all the three organisations once in a month to update and review the problems/ difficulties of the consumers.

During the year April 2001–March 2002, 28 joint visits were organised to inspect the meters on a random basis. Out of 282 meters checked during these visits, 40 meters were found defective beyond the permissible limits prescribed by the Bureau of Indian Standards (BIS). Of these 40 meters, 11.43% were electronic and 16.90% electro-mechanical meters. The defective 40 meters were replaced at the earliest. The initiative was appreciated and the same system is to be implemented across the SEB.

Annexure 7: Cost–Benefit Analysis for Illustrative Projects

The task force has decided to take Circle as the implementation unit and cost–benefit analysis has been done at the Distribution Circle level. This is appropriate in view of the APDRP initiative of MoP, where Circle has been considered as a responsibility centre. Both these initiatives can be implemented at substation level also, but we have to think in terms of economies of meters, meter installation, software implementation, and finally organisation structure to reflect responsibility, authority and control.

Base information for a Circle

Base Data Assumption

Customers (no)	**400,000**
Annual energy Input to circle (MU)	1,200
No of 33/11 kV S/S in a circle	20
33 kV incoming feeders in a 33/11 kV S/S	2
No of outgoing 11 kV feeders in a 33 kV S/S	10
No of .4 kV DTs on a 11 kV feeder	50
Other assumptions	

Other assumptions are marked in colour in base assumptions.

Base assumptions: commercial information

	Residential	**Small C & I**	**C&I**	**Agriculture & Others**	**Total**	**Tech. Losses**
Customers (%)	60	8	4	28	100	
Customer (No)	240,000	32,000	16,000	112,000	400,000	
					0	
Consumption (%)	20	15	15	30	80	20
Consumption (MU)	240	180	180	360	960	240
Tariff applicable (Rs/kWh)	2	4	4	0.5		
Revenue (Rs Million)	480	720	720	180	2100	
Consumption (Actual/Technical losses assumed in %)	30	20	20	15	85	15
Difference with reported (Theft/overestimation)	10	5	5	-15		-5

Revenue loss at present technical levels

	Residential	Small C&I	C & I	Technical Losses	Total
Theft	10	5	5	5	25
Tariff applicable (Rs/kWh)	2	4	4	3	
Annual revenue loss due to theft (Rs Mn)	240	240	240	180	900

Cost estimates for Integrated Billing System project

Assumptions

Basic data assumptions	
No. of installations of more than 10 kW	16,000
No. of installations of less than 10 kW	32,000
Average cost of meter of .2 accuracy for more than 10 kW load (Rs)	15,000
Average cost of meter of .5 accuracy for less than 10 kW load (Rs)	10,000

- Similar type of meters with the same data format to be installed
- Existing meters can work after regrouping, but may take more time; so these meters can be installed for other customers
- Installation of new meters for all relevant customers
- Work to be done on turnkey basis
- C&I customers of more than 10 kW will be covered in the first year
- All remaining C&I customers will be covered in the second year
- Installation costs are approximately 20% of meter costs and cover all costs of installation including accessories
- Cost of meter reading per meter will be the same as present
- Meter costs will be upfront while installation costs will be spread over the project
- Cost of maintenance is assumed as what is incurred today
- Cost of software includes cost for developing customer information, billing, payment and collection system
- Project to start in Month 1

Cost Estimates			
	Initial Cost	Year 1	Year 2
	0	1	2
Meter costs (Rs Million)	240	320	
Installation costs	24	56	32
Software costs	10	35	5
Hardware costs (including MRI)	6	6	
HW & SW maintenance		1	1
Total Costs (Rs Million)	**280**	**418**	**38**

Cost estimates for Energy Accounting System project

Basic data assumptions	
No. of meter installations on 33 kV feeders	40
No. of meter installations on 11 kV feeders	200
No. of installations on 11/.4 kV DTs	10,000
Average cost of meter for 33 kV feeder (Rs)	50,000
Average cost of meter for 11 kV feeder (Rs)	30,000
Average cost of meter for 11/.4 DT (Rs)	15,000
Installation cost of meter on 33 kV feeder (Rs)	15,000
Installation cost of meter on 11 kV feeder (Rs)	9,000
Installation cost of meter on 11/.4 kV DT (Rs)	4,500
Cost of data converter/concentrator	2,500
Cost of telephone modem for DTs	5,000
Per call rate (Rs)	0.8

Assumptions

- Similar type of meters with the same data format to be installed
- Existing meters on 33 kV and 11 kV feeders can work, but may involve huge costs
- Installation of new meters for all DTs
- Work to be done on turnkey basis
- Phase I will cover installation of meters on feeders and DTs and daily reading in the first year
- Phase II will cover reading with an interval of 1 hour
- Installation costs are 30% of meter costs and cover all costs of installation including accessories
- Communication system for feeders will be RS-485 bus and a telephone/ GSM-based system for DTs. Two transformers can be put to one data converter/ concentrator and one modem
- Cost of meters will be upfront, while installation costs will be spread over the project
- Cost of maintenance is assumed as what is incurred at present
- Cost of software includes cost for developing energy accounting system and customer identification

Cost Estimates						
	Initial Cost	Year 1	Year 2	Year 3	Year 4	Year 5
	0.00	1.00	2.00	3.00		
Meter costs (Rs Million)	158.00					
Installation costs	23.70	23.70				
Communication	18.75	18.75				
Software costs	5.00	15.00	5.00			
Hardware costs	1.00	1.00				
Meter reading costs (Rs Million)		1.46	35.04	35.04	35.04	35.04
HW & SW maintenance		1.00	1.00	1.00	1.00	1.00
Total Costs (Rs Million)	**206.45**	**60.91**	**41.04**	**36.04**	**36.04**	**36.04**

Benefits and Return on Investment (ROI)

Assumptions

- Reduction in technical losses are not taken and only theft reduction is considered
- In the first year, theft reduction of 50 % has been envisaged from C&I customers of more than 10 kW
- In the second year, theft reduction of 90% taken from C&I customers of more than 10 kW and 50% from remaining C&I customers
- In the third year, 90% theft reduction has been assumed from all C&I customers and 10% from overestimated technical losses
- In the fourth year, 25% theft reduction from domestic customers and 40% from overestimated technical losses
- In the fifth year, 50% theft reduction from domestic customers and 80% from overstated technical losses
- The cost reduction in billing and meter reading efforts is not taken here assuming it might be offset against increased cost of meter maintenance/ replacement
- There might be reduction in costs due to transformer outages, but is not considered
- The intangible benefits like improved customer satisfaction and reduced outages are not considered

Benefit Estimates						
	Initial	Year 1	Year 2	Year 3	Year 4	Year 5
	0.00	1.00	2.00	3.00		
Theft reduction for more than 10 kW C&I customers (% of input energy)- 5% theft at present		2.50	4.50	4.50	4.50	4.50
Theft reduction for less than 10 kW C&I customers (% of input energy)- 5% theft at present		0.00	2.50	4.50	4.50	4.50
Theft reduction for domestic customers (% of input energy)- 10% theft at present		0.00		2.50	5.00	5.00
Theft reduction in higher technical losses (% of input energy)- 5% theft at present		0.00			2.00	4.00
Increased Revenue (Rs Million)		120.00	336.00	492.00	624.00	696.00

ROI						
	Initial	Year 1	Year 2	Year 3	Year 4	Year 5
	0.00	1.00	2.00	3.00		
Cost of Initiative 1	280.00	418.00	38.00	1.00	1.00	1.00
Cost of Initiative 2	206.45	60.91	41.04	36.04	36.04	36.04
Increased Revenue	0.00	120.00	336.00	492.00	624.00	696.00
Net Cash Flows	-486.45	-358.91	256.96	454.96	586.96	658.96
IRR	**29%**					

Sensitivity analysis

Assumptions

Scenario 1: Meters to be installed at all C&I customers and losses are 40% with actual technical loss of 15%. Loss reduction is from 40% to 22% with 15% technical loss.

Scenario 2: Meters to be installed only at 50% of C&I customers and losses are 40% with actual technical loss of 15%. Loss reduction is from 40% to 24% with 15% technical loss.

Scenario 3: Meters to be installed only at 50% of C&I customers; meters costs are 20% less than assumed in Scenario 1. Losses are 40% with actual technical loss of 15%. Loss reduction is from 40% to 24% with 15% technical loss.

Scenario 4: Losses are only 30% and loss reduction is possible to 19.2% with 15% technical loss.

The IRR and payback period under all the scenarios is given in the following table:

	Scenario 1	**Scenario 2**	**Scenario 3**
IRR over 5-year period	29%	49%	60%
Payback	3.2 years	2.6 years	2.3 years
Scenario 4	6% & 4.2 years (IRR and Payback)	30% & 3.6 years (IRR and Payback)	39% & 3.2 years (IRR and Payback)

IRR and payback

Annexure 8: Example of Integration for Operational Management

Electric utilities rely on multiple applications to address their business needs. Customer Information System (CIS) is the main application that usually includes billing and accounting functions. The other typical applications are Outage Management Systems (OMS), Work Management Systems (WMS), Mobile Workforce Management (MWM), Interactive Voice Response (IVR) systems, Automated Meter Reading (AMR), Geographic Information Systems (GIS), and Supervisory Control and Data Acquisition (SCADA).

Integration of operations related business processes with commercial and engineering processes would reduce restoration time, improve operational efficiency and safeguard workers and the public. For this, IT applications can be tightly integrated within concerned business operations and across the operational sphere.

Applications	Role
Asset Management/Facilities Management / Geographical Information Systems (AM/FM/GIS)	Provide unified view of spatial (geographical) and aspatial (asset attributes) information for enhancing operations management
Outage Management System (OMS)	Managing planned and unplanned outages while reducing restoration timeframes and safeguarding workers and public
Distribution Planning Systems (DPS)	Planning and simulating scenarios while designing Distribution System
Work Management System (WMS)	Project management and execution for all system enhancement projects
Mobile Workforce Management (MWM)	Managing, coordinating and optimising field workforce while reducing outage restoration and system enhancement timeframes

IT applications and their role in integration context

In addition, other business information systems such as SCADA, CIS, AMR, IVR, etc., can be integrated to provide an accurate and real-time view of the electrical model's current conditions. The application functionalities that an integrated suite offers leads to adoption of IT-enabled best practices in the operational sphere of a typical distribution utility to achieve the following benefits:

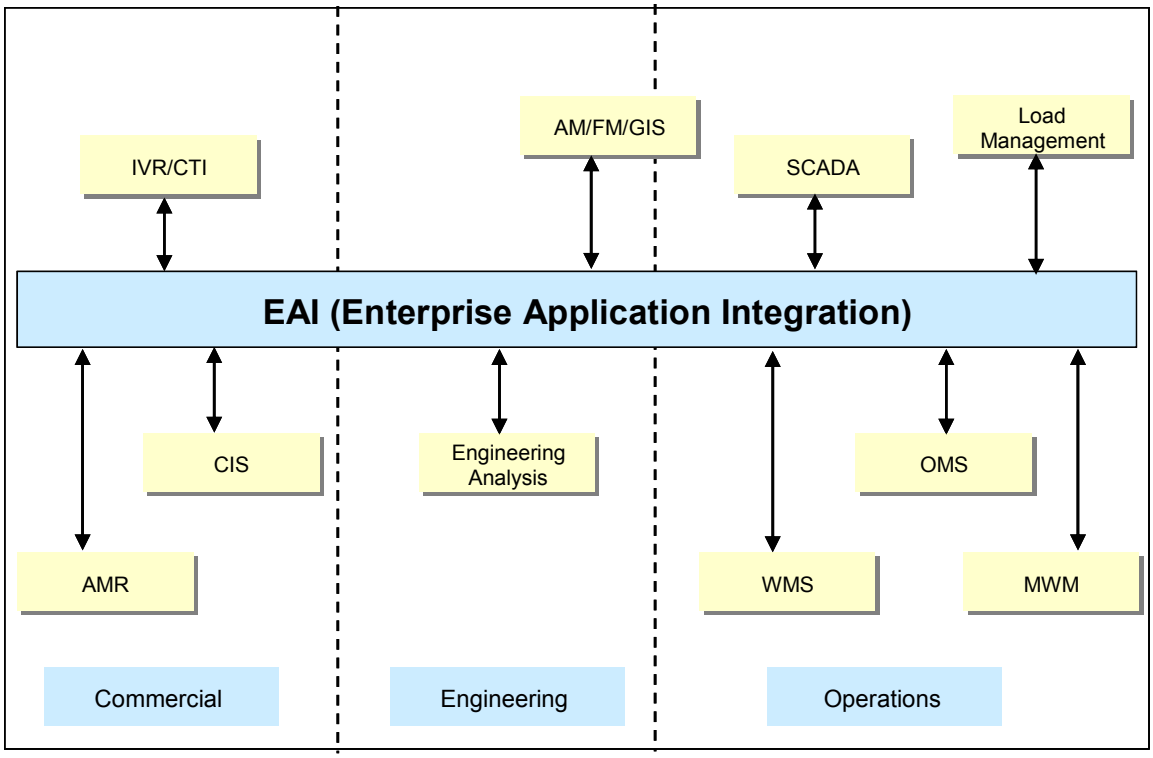
- Quick fault diagnosis and rectification
- Unified view of network across the organisation
- Improved operator efficiency
- Enhanced asset utilization
- Faster and coordinated system enhancements
- Improved customer satisfaction
- Reduced cost of maintenance
- Improved field crew productivity
- Improved decision support

The prerequisite for implementing this kind of integrated suite is a spatial database normally achieved by implementing a GIS solution. However, the key lies in ensuring that the data model implemented for the GIS solution has been developed after considering the needs of various applications to be integrated. Failing this will require

a utility to develop multiple data models for each application and hence leading to increased integration and consolidation efforts which will still not achieve the goal of maintaining a single, unified data model.

Enterprise Application Integration (EAI) is one such technology for integrating various applications. EAI technologies provide data transformation and routing of information across various deployed systems in a well-defined, consistent manner, based on configurable business rules that map the business processes of the utility.

The following figure shows the various utility systems with the interfaces being implemented using an EAI framework. This approach of using EAI frameworks to manage XML-based information flows significantly reduces complexity and cost of developing and maintaining the interfaces, as new systems are deployed and business rules change.



Information flows between IT systems using an EAI framework

The benefits of adopting an EAI framework and defining an interface architecture early in the IT implementation lifecycle is that this approach is scalable, consistent, and once implemented for the first set of systems can be consistently replicated for future system deployments. An EAI framework would also be the basic technological building block to provide an MIS for an SEB.