

Impact of IT Implementation in Power Distribution Sector

Amarpreet Singh¹ Dr. Gursewak Singh Brar²

¹Research Scholar ²Associate Professor

^{1,2}Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib, Punjab, India

Abstract— This paper underlines the particular of IT and business process requirement required to be implemented in the on-going implementations process in the power distribution utilities. This work described the major application need for better synchronization within current system and the upcoming IT solution. The objective of this work includes the study of current ongoing implementation under RAPDRP.

Key words: Power Distribution Utilities, Power Distribution Sector

NOMENCLATURE

- GPRS-General Packet Radio Service
- IT- Information Technology
- RAPDRP- Restructured Accelerated Power Development and Reforms Program
- GIS – Geographical Information System
- SG – Smart Grid
- CMRI – Common Meter Reading Instrument
- AMR-Automatic Meter Reading
- DISCOM- Distribution Company
- IVRS-Interactive voice response System
- GSM- Global System for Mobile
- MDAS- Meter Data Acquisition System
- MDM- Meter Data Management5

I. INTRODUCTION

The Power Sector in the country has grown manifold since independence and is most critical element in the economic growth. There is a continuous gap between the supply and demand, besides peaking shortage almost all times in a year. Despite of growth of sub-transmission and distribution sector, it could not match the investments in capacity addition. The economic growth greatly depends on a commercially viable power sector .However, the financial condition of the State Electricity Boards (SEB) had become a matter of concern considering that their aggregate losses had reached `26,000 crore during 2000-2001 which was equivalent to about 1.5% of GDP [1-2]. To bring the losses and make the distribution sector commercially viable, Accelerated Power Development Program (APDP) was launched in 2000-2001 as a last means [3]. Very clearly the former Accelerated Power Development and Reforms Programme has grossly underperformed as it has not been able to bring down the losses to 15 per cent by the end of 2007, as originally targeted in 2000-01.

The government renewed attempt to revive power sector reforms through Restructured- Accelerated Power Development and Reforms Programme (RAPDRP). The focus of the programme shall be on actual, demonstrable performance in terms of sustained loss reduction. Establishment of reliable and automated systems for sustained collection of accurate base line data, and the adoption of Information Technology in the areas of energy accounting will be essential before taking up the regular

distribution strengthening projects. The government realizing that its flagship power sector initiative with the objective of encouraging reforms, reducing aggregate technical and commercial loss and to improve the quality of supply of power. Power Ministry has appointed the nodal agency under the aegis of the R-APDRP [4].

II. LITERATURE AND RESEARCH SCOPE

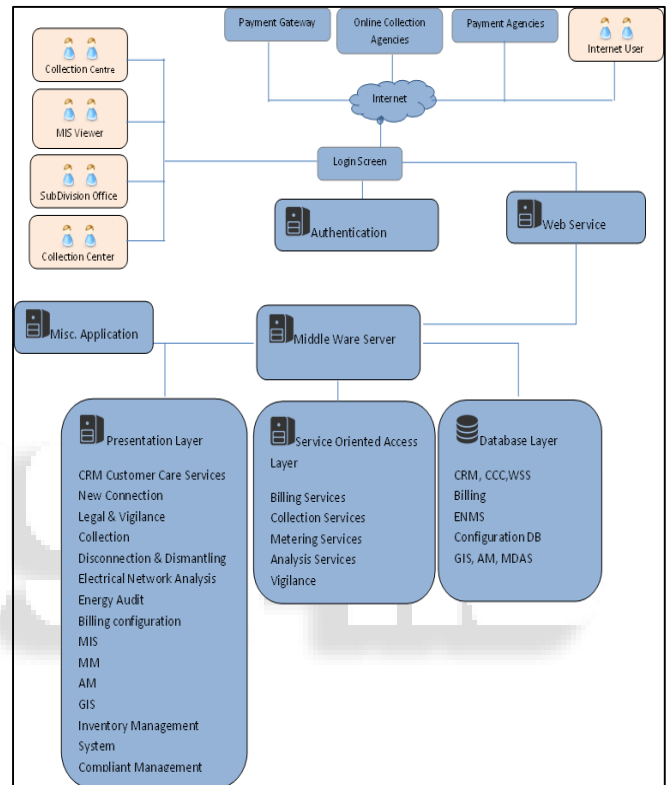


Fig. 1: IT Application - RAPDRP

The Alauddin Al-Omary et al. presented a low cost AMR (Automatic Meter Reading) system that measures and transmits the total electrical energy consumption to main server using GPRS (General Packet Radio Service) technology provided by GSM (Global System for Mobile Communications) networks [8]. Hari Kumar Naidu studied the advances in technology which offer SCADA (Supervisory Control and Data Acquisition) Power supply Distribution automation as a solution to improve power distribution efficiencies. They also studied of a developed prototype hardware and software model utilizing the latest embedded technology innovation for SCADA Power Distribution [9]. Jacobs and Whybark highlighted that ERP leads to information integration and provides the benefit of single data entry, immediate access, and common data. Data are updated in real time, meaning that when data is entered into the system, the changes are immediately available to everyone [10]. J. Simpande et al. presents their views on integrating the Internet and enterprise resource planning (ERP) systems in electricity utility companies. One key benefit of implementing ERP systems is to standardize,

streamline and organize information shared across the entire organization. The Internet makes it easier to share and communicate information across the entire organization [11]. Sharma, R.R.K. evaluated the use of ERP (Enterprise Resource Planning) systems in the organizations for information integration and aligning & streamlining their processes for delivering high value to the customers. They had investigated effect of ERP implementation on five dimensions of Manager's job (autonomy, use of power, delegation, people skills and privileged information), five dimensions of organizational structure (specialization, formalization, centralization, standardization and complexity of work flow) and on the flexibility of organization [12]. The study highlight the major application proposed under the program in order to improve the condition of State Electricity boards [5-7] and the challenge faced during implementation. The study also highlighted the impact of IT implementation on the overall performance of the distribution utility.

III. OVERALL SOLUTION OVERVIEW

In India, there have been many initiatives taken to establish the back bone for futuristic SG. Programs like Restructured Accelerated Power Development and Reforms (RAPDRP) aim to strengthening of the distribution network through the adoption of IT technology. Following are major modules

- Meter Data Acquisition
- Energy Audit
- New Connection
- Disconnection & Dismantling
- GIS based customer Indexing and asset mapping
- Centralized Customer Care Services
- Management Information System (MIS)
- Web Self Service
- Identity and Access Management system
- System Security Requirement
- Development of Commercial Database of Consumers
- Metering

A. New Connection

The proposed system aims to enhancing the convenience of prospective consumers to avail the electricity supply from the Utility, when an application for new connection is received. This system facilitates to the user for processing the requests of consumer according to defined workflow of the application. This system would ensure, through validation and checks, that the integrity of this data is maintained. The system should enable updating customer data to be captured in the GIS based customer indexing database in a reliable way. This module provides Registration of New Connection Requests

- Registration of requests related to existing consumer's
- Uploading key Documents
- Auto Generation of Application Fee and field work cost calculation etc.
- Issuing Notices to the applicants for further communication

B. Disconnection and Dismantling

The system is able to improving recovery through a disciplined disconnection and dismantling mechanism that would serve as a deterrent for defaulters. Disconnection and dismantling of the customer connection is the integrated workflow process which is the part of Request management, Revenue Management, GIS based Network Management, Field office engineer and Vigilance. The module has the provision of generating automatically list of disconnection notices as per utility defined criteria and follows all the business rules of disconnection and dismantling of the connection. The system should aim at improving recovery and collection efficiency through adisciplined disconnection and dismantling mechanism that would serve as a deterrent for defaulters.

C. Geographic Information System

GIS consists of a system that capture, stores, validate, integrating, and display the geo data related to utility electrical network i.e. positions coordinates of assets details and consumers. The GIS mapping to pre-defined scale, generate electrical network maps and super imposing them on the land base with exact coordinates. This system is a convenient tool for utility to manage the geospatial data and display it on a geographical map. The system has following main functions

- Customer indexing and asset mapping
- Integrated network analysis module
- Integrated Energy Audit and Accounting
- Create Single Line Diagram (SLDs) of electrical sub transmission network starting from 66 kV/ 33 KV to LT feeders and LT poles.

D. Electrical Network Analysis

This application is one of the most viable, analysis and simulated application for Power Distribution sector. It is mainly developed to analyze the balanced or unbalanced single-phase, two-phase, and three-phase systems which are operated in radial, looped, or meshed configuration. It allows operating the electrical network, and controlling it efficiently in order to cope with technical & commercial losses and complexities in power distribution system. Some of the glimpses of the application are as follows:

- It consists of various independent modules to cater your diverse requirements, improve the Aggregate Technical and Commercial (AT & C) losses, and at the same time, helps in increasing the revenue as well.
- It enables to generate 'Single Line Diagram' based on 'Graphical Interface System' surveyed data of electric lines and different equipment's in order to monitor the electricity consumption up to the end-user. It enables HT/LT network analysis for system study on computer that renders the location of pole, transformer, distance between poles etc.

E. Metering, Billing and Collection

This module contains all the business processes related to Metering and Billing. This module is the key module covers the major functionalities for managing the revenue which generates from the power distribution. This module manages the consumer's attribute changes by executing the various

business processes related to meter change, tariff change, change of connection ownership, change of load etc.

This module has the feature of capturing the meter readings of consumers solely or in group. The meter reading can be captured manually, using Spot Billing Machine, using AMR and CMRI. The module has integration with the Meter Data Management repository. The meter reading is processed after validation and such validated data is passed to the Billing Module.

The bill processing is done after meter reading collection. In the billing system the bill processing is internally divided into different parts for making the bill processing fast, effective, and error free. The Collection module allows the key user to manage the in and out of the financial transactions. The module provides the facility to collect the amount from consumers against the energy bills or other charged amount as well as also allows the user to make payment of collected amount. In collection module the actual billing amount is collected using modes like Cash, Cheque, Demand Draft, Internet Payment etc.

This module also has the feature for processing

- Orders required for Change of Meter
- Disconnection of Connection
- Recovery Order
- Reconnection Order
- Details of consumer
- Energy meter history
- Meter reading
- Energy consumption
- Payments etc.
- Integration with GIS database

F. Inventory Management

Inventory module contains processes related to managing the store operations of the Field office engineer. This module is used by roles like Store Keeper, Engineer and Office In-charge. The users of the Inventory module can use the features like Create Indent, Receive Items against Indent, Check the stock availability, Issue Items to Employees, Issue Items against the Work Orders, viewing of reports like Item Stock Register, Item Movement Register etc. This module has the inbuilt capability of integrating with any other store management application runs on the higher level of company's/DISCOMs hierarchy. Apart from this, the module works for electrical, non-electrical and all other items used in field offices for running the operations. This module has integration with the Asset Management module.

G. Energy Audit

- Energy supplies and its consumption are the fundamental tools for our life and standard of living. Energy Audit systems ensure that the energy audit data is accurate, timely, and beneficial for management to make the correct decisions. The Energy Audit report can be used effectively as the starting point for Feasibility Studies, Energy Management Plans, Updating Existing Systems, and Developing Designs for new Energy Efficient Processes.
- The module has the facility to handle the admin / Town Hierarchy.

- Various reports can be generated at various voltage / admin levels, like in Discom Zone wise, Circle wise, Division wise upto downwards DT wise.
- Reports can be generated with or with-out including previous month's arrear amounts.
- Reports can be generated Monthly, Periodic (Bi-Monthly or more), or Cumulative.
- Substation & Feeder Energy Loss Report
- AT&C Losses Report
- T&D Losses Report

H. Technical and Commercial Complaint Management

Complaint Management module pertains to all the complaints (technical or non-technical) of consumers and non-consumers. Consumer or non-consumer can file a complaint regarding the technical issues, distribution line related issues, theft of connection and commercial requests. This module has feature to register the complaints, assigning complaints to the Fault Removal Team, capturing feedback of complaints, and update of Complaint Status from Consumer.

I. Management Information System

Management Information System (MIS) module provides various reports to top management, middle management and respective offices. Reports are based on data generated through the various modules. MIS has capabilities to integrate into existing environments. MIS include dashboards, report viewing, customized report designer. So users at all levels are able to get information quickly and easily for decisions making at the lowest overall cost to the organization.

- MIS provides a role-based dashboard that is easy to analysis and easy to use.
- The dashboard displays graphical information as well as detailed consolidated information at a glance to help users monitor anything that drives organizational performance.
- MIS allows users to view reports in browser with user defined parameters (if any).
- MIS has also facility for define the right on report as level base as well as user base. It also provides drill-down capabilities, print and export to PDF, Word, and Excel etc.
- MIS has capabilities for creation of user based customized reports. Administrator or specific users can build such reports and centrally manages the administration of report viewers.
- Information capturing
- Information processing
- Information management
- Information based decision making & reporting.

J. Call Centre

Centralized Call Centre is installed at central level, accessing the central Data Centre database and to manage the consumer related activities, operation & maintenance activities of the Utility field office. Call Centre Executives (CCE) are available to handle the consumer's queries 24x7. Consumers can lodge their complaints and register their requests through there corresponding .Discom's Call Centre which are then updated to the central database.

The consumers can either register their requests or complaints via:

- Making a call to the Customer Care Executive (CCE) or by visiting Discom's Call Centre
- Sub-Division Office (SDO)
- Web (online)
- IVRS

K. Web Self Service (Customer Portal)

The Web Self Service (Customer Portal) provides a bridge between customers and utility executives. A user friendly portal will make it easy for them to communicate with the utility though the web instead of direct phone calls or visits. This in turn will improve customer satisfaction and reduce work load on the utility employees. Through portal customer can initiate following activities:

- Current Energy Bill
- Consumption History
- Previous Payments
- Register power outage complaints
- Register Grievance
- Tracking Status
- Online Payment
- Online Payment Details

L. Meter Data Acquisition System

The main objective is to acquire meter data from System and Select consumer meters automatically from remote avoiding any human intervention, Monitor important distribution parameters, use meter data for accurate billing purposes and generate exceptions and MIS reports for proper planning, monitoring, decision support and taking corrective actions on the business activities by the management. Automatic Meter Reading (AMR) based Data Logging System using any of the available Communication Technologies like GSM, GPRS, EDGE, CDMA, PSTN or Low Power Radio covering all the Feeder Meter, DT Meters and select Consumer Meters in the entire Utility area.

M. Asset Management

The system shall have the ability to identify a business entity/district to which the equipment/assets belongs and also should be able to reorganize divisions, office codes, etc. in the case of organizational changes. The system shall have the ability to track from fixed assets to movable assets, line assets (cables, conduits) to underground assets, which run across business entities. The system should able to create and define multiple asset grouping for each type of asset e.g. poles in a group of LT pole, 11 KV pole etc and again PCC Pole, Rail pole etc. The user should able to classify the asset as per the defined asset groups. The system shall be capable to record condition assessment calculation (condition analysis) as well as root cause analysis of failures (FMEA studies). Along with the risk factor (probability of failure), the consequence factor (criticality of the failure) should also be captured for each asset.

N. Maintenance Management

For better planning and co-ordination of various maintenance activities, reduce breakdowns by inculcating the culture of preventive and predictive maintenance, to maintain maintenance history, to review and control

maintenance costs and providing a feedback to management for timely decision making. Ability to provide a means to coordinate various maintenance works being planned (e.g. corrective, preventive, breakdown and predictive maintenance related work). Ability to print shutdown notices for potentially affected customers and integrate with Customer Care System, which can send SMS to such customers automatically. System shall also have ability to print excavation permits for underground works for the purpose of attending cable faults and related maintenance activities.

IV. RESULT AND ANALYSIS

Table 1 depicts the losses incurred. Fig. 2 clearly shows that the percentage of losses incurred decreased every successive year. This decrease in AT & C losses has helped to improve the financial profile of unit.

Sr. No.	Description	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
1	Energy Loss (MUs)	814 2.8 5	606 3.93 8	723 5.1 2	730 6.7 0	761 9.9 6	723 7.4 3
2	% age of T & D Losses	20.12 %	18.71 %	17.42 %	16.78 %	16.95 %	15.19 %

Table 1: AT & C losses

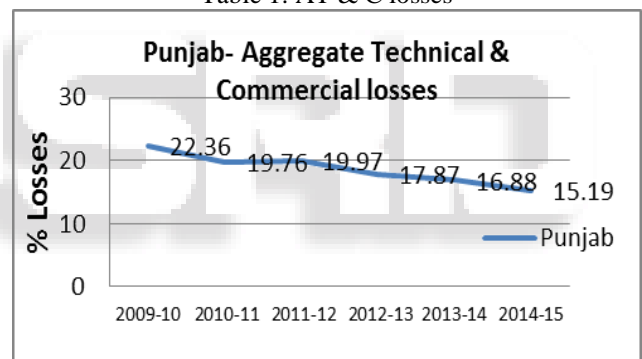


Fig. 2: Punjab AT & C Losses

Manpower to manage the operations in power sector is of great concern these days. Fig. 3 shows that the adoption of IT in power sector has resulted in significance reduction in the number of employees required per thousand consumers. This is due to the reason that the most of processes are getting automated and IT has built up the gap between the supplier and end user.

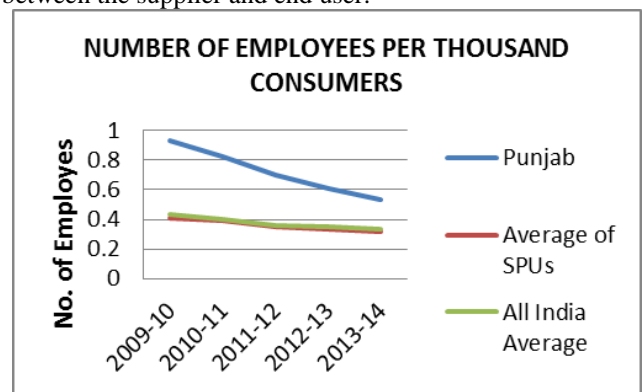


Fig. 3: No. of Employees per thousand Consumers

V. CONCLUSION

- IT projects have faced some challenges; the levels have varied from some projects experiencing huge difficulties to some with negligible issues. It is widely recognised that the biggest challenges faced were with the implementation of GIS and AMR/MDM/MDAS and these were mainly due to the capacity of the utilities and implementing agencies and the time frames permitted for completion of the project
- The time allocated for implementation of certain modules such as: GIS, AMR, MDM, MDAS is insufficient
- Lack of sufficient training for utility staff on project requirements, specifications and benefits from the project leads to unnecessary resistance and delays
- R-APDRP has led to an increase in workload with no immediate benefits in sight
- Lack of involvement and ownership by all stakeholders in the project. It is important ownership for the task is at the operational level not at the central level
- Awareness training about the project scope, benefits and processes to be followed etc. should be given at the start of such a big project and repeated during the project.
- DisComs need to understand that to ensure success of the program and reap the expected benefits, they should be more involved in the project planning process.
- There should be strict coordination between AMR implementation and metering upgrades in the field
- When the teams visited the sites they found that modem installation was not possible at many locations as many of the distribution transformer/substations were unmetered and meter installation was progressing at a very slow pace

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