INFORMATION SYSTEM FOR PUNJAB STATE TRANSMISSION CORPORATION LIMITED

-Er. Sahil Raj
Assistant Professor
SMS, Punjabi University, Patiala

Abstract

Transmission Company should be competent to add value to the consumer chain. The Transco should strengthen its existing system and plan for its expansion so as to appropriate returns to the investment. The data of the transmission company needs to be clear, and available to other departments and external agencies, as required. Example, Generation might need the transmission capacity to ensure dispatch of the electricity they produce. Similarly, Distribution might require information about transmission facility in order to meet the demands so that they can analyze the demand forecasting.

In this study an effort has been made to make dedicated information systems for key activities of PSTCL and then making overall design by highlighting the issues of Phases, Models, Tools and Method specifically for the PSTCL. The response has been taken from 100 respondents using stratified sampling technique. Statistical tools have been used for analysis. Strategic information system model has been developed for PSTCL, and for each of its important functions. The most suitable model suggested is 'Waterfall Model', most suitable tool is 'DFD' and most suitable method is '3 - Schema'.

Introduction

Power is an essential part of the infrastructure for the growth of any country or state economy. Acceleration in the economic growth will depend on the financial and commercially viable power sector that is able to attract fresh investments. The Indian power sector is changing significantly in the past decade with unbundling of the state electricity, deregulation, most recently privatization on and entry of new competitors. The electricity act 2003 should pave the way for drastic and significant changes, which will be more consumer centric, efficient operation and improve profits. After formal approval by the state Cabinet on April 15, 2010, Chief Minister Parkash Singh Badal passed an order dissolving the PSEB and replaced it with two state-owned companies. The decision, which has come seven years after the new Electricity Act, 2003, called for restructuring of the state electricity utilities along professional lines, has resulted in separation of transmission from generation and distribution functions.

The transmission will be looked after by Punjab State Transmission Corporation Limited (PSTCL), while the generation and distribution functions will be managed by Punjab State Power Corporation Limited (PSPCL). PSPCL has more than 65000 employees whereas PSTCL has 3500 employees. Wires transmitted electricity are divided into two categories

- Above 66 KV: falls in the category of transmission
- Below 66 KV: falls in the category of distribution

The generation capacity rose from 554MW and 6924 MW and energy consumption enhanced from 701 MUs to 32658 MUs whereas the number of consumers have increased from 6.07 lac to 69.17 lac. The per capita consumption is 1000 units compared to the National Average of 600 units. As shown in table no 1 and table no 2 below.

Table 1 : Consumer Mix (As on 31.03.10)

Type	Number	Load in MW	Consumption in MU's
General	56.94 lac	11321	9020
Industrial	1.14 lac	6879	10947
Agricultural	11.05 lac	7378	10469
Others	0.04 lac	353	2222
Total	69.17 lac	25931	32658

Table 2: Generation Capacity of Punjab (As on 30.09.10)

Particulars	Installed Capacity (MW)
Own Thermal	2620
Own Hydro	995
PEDA/Micro Hydel	85
Share In BBMB	1258
Share in Central Sector/IPP Projects	1966
TOTAL	6924

Power growth is abysmally low and the most alarming situation is that what ever the respective State Electricity Boards (SEB) are producing they are not even able to distribute it properly. There are at least 30% losses during the distribution process which means combined losses of SEB's will be whopping 70,000 Crores losses by 2014 (according to 13th Finance Commission Report). Majority of the losses are pilferage of electricity, improper billing and redundant technology. The following section throws light on the journey of power sector since independence.

- Power sector is mainly controlled by the state electricity boards. Until 1975 the state boards were primarily source of power generation. But to huge mismatch between the required and produced so in 1975 Electricity bill of 1948 was amended to provide the intervention of central government in the development of the power sector. According to this amendment, National Thermal Power Corporation (NTPC) and National hydro-electric corporation (NHPC) came into existence. Electricity was added to the concurrent list so now electricity came into the preview of both central and state government.
- Development of transmission was not up to mark during early years but during 80's the scenario changed and HT transmission got major boost when Power Corporation of India came into existence.

There is also constant mismatch between the demand and supply of electricity. In 2010-11, the requirement is 9399 MW and supply is 7880 MW as shown in the table below. So there is considerable mismatch between what is required and what is being generated.

Table 3: Demand and Supply

Year	Demand (MW)	
	Unrestricted requirement	Met With
2007-08	8672	7340
2008-09	8743	7428
2009-10	9786	7407
2010-11	9399	7880

Apart from this mismatch there are whopping 23.59% losses in Transmission and Distribution network. As per latest reports, the total commercial losses are 9713 crores and transmission and distribution losses are whopping 24%.

Table 4: Transmission and Distribution Losses

Commercial Losses	9713 crores
Total Loans (Long term, Working Capital and GOP Loan)	15164 crores
Revenue Gap	40 paise/KWhr
Transmission and Distribution Losses	Above 24% (09-10)

The government of Punjab is constantly endeavoring to enhance the generation capacity but the transmission network is most neglected area. In 2009-2010 the losses were 22.12% and for 2010-11 the transmission and distribution losses are 23.59%. It conveys an important message that at least whatever is being generated, PSTCL should distribute it properly.
To start new generation plant it will take considerable time. The need of the hour is to control these alarmingly high transmission and distribution losses.

Table 5: Transmission and Distribution losses Past Profile

Year	Loss (%)
2008-09	19.92
2009-10	22.12
2010-11	23.59

Transmission department/ Transco require IS to ensure that all activities are carried out using all resources optimally. There are several missions critical an activity that transmission utilities have to perform and these activities can be performed using 'IS' as an enabler. Transco would need to develop IS on an enterprise wide application rather than a stopgap basis. The system should be standardized throughout the company so as to form a seamless integrated application.

Scope of the Study

This study primarily focuses on the transmission network. The aim of the study is to streamline the operations in the transmission network. For PSTCL to be cost efficient, it has to be able to streamline its operations, reduce downtime, reduce input and carrying cost, reduce wastage, analyze losses and realize

revenue. During the course of the study in depth interviews were conducted at various levels to understand the business processes of all the units. Information gathering phase included extensive brainstorming sessions to understand the working of the Sub Division, Division, Circle, Zones and Head Office, documentation of the information flow and collection of the reports and statements. The study highlights all the salient features of the proposed information systems in the PSTCL. PSTCL today find itself in a period of transition as it is undergoing restructuring which is converging with the electricity act 2003. Development in the power sector is compelling utilities to place greater emphasis on the asset utilization in order to operate more efficiently and render better service to consumers. Recognizing this, PSTCL is planning to invest in IT infrastructure and computerization.

Review of literature

- Avinash Kumar and K.S.Rajput (2006) has pointed out the use of IT in metering started with the advent of static energy meters. These meters were microprocessors based. Gradually the new technology which various power utilities are implementing is the IS. It is a process of digitally noting the energy meter readings. This process eliminates the traditional pen and paper and errors associated wit the manual reading.
- Steven Alter in his study "A Work System View of D.S.S. in its Fourth Decade" 2002, (Eighth American Conference on Information Systems) forwarded a Nine work system elements, which can improve the Decision making in any organization. He has also proposed possible solutions to improve that elements functioning.
- Mihir A. Parikh and Buan Fazlollahi in their work "An Empirical Examination of The User Satisfaction System Effectiveness Interrelation" (2002) says that for the success of any system there are two forces behind it. Named System Use and the System Effectiveness. If one of them will be missing then success of system is doubtful. The effectiveness of system depends upon the factors like decision quality, user learning, decision time, Cost benefit advantage, System reliability, and system responsiveness. The system use depends upon the factor that what is the intention to use and the actual use which further depends upon the factor like System usefulness, ease of use, user confidence, information relevance, playfulness user training, presentations user experience and skills, user expectations, organizational support, user involvement and responsiveness.
- Arvind Kalia & D P. Goyal, Analysis Models for Developing Information System 2002: Has found that, for judging the requirement analysis that out of Questionnaire, Interview, internal records, onsite observation and interview are best suited for studying the requirement analysis in both through the users and the developers view point. Among them the first choice goes to Interview method, second to the internal records and the third one to the onsite observation.

Objective of the Study

- To develop dedicated Information System for each strategic activity in the Transmission Network of PSTCL
- To identify the key application areas of the proposed Information System in the Distribution Network of PSTCL
- To identify Requirement and pre-requisites for the successful implementation of Information System in the Distribution Network of PSTCL
- To develop a model for the Information System in the PSTCL

Research Methodology

For the purpose of the study the entire SDO's, XEN's, SE's and Chiefs of the Transmission network of PSTCL formed the universe of the study.

Out of this universe a stratified sampling has been done and response has been taken from 100 respondents.

Table 6: Sample Distribution

SDO	XEN	SE	Chiefs
55	35	8	2

Analysis and Discussion

6.1) Finance and Accounting

Finance and Accounting includes the financial management and accounts management

Requirement and functionality

- The main function of the system is to maintain financial records, cost and entry according to the chart of accounts
- Integrate with other modules of the Enterprise solution and support applications
- Prepare budget and providing monitoring and control reporting

6.2) HR Management

HR management includes payroll management, performance appraisal and HR tracking and development as sub-modules

Requirement and Functionality

- Manage the personnel resources through the processes of recruitment, hiring, training, promotion, workforce, utilization, resource planning, payments and retiring
- Defining the roles and responsibility, reporting structure to maintain role based system. It helps to maintain the security of the application.
- Tracking of each history and claims to meet all the requirements and compensation commitments.
- Management of vacancies and applicants for the recruitment process,

6.3) Material Management

Materials management includes procurement, stores, inventory control, e-tendering, vendor management etc.

Requirement and Functionality

- Manage purchase order details, print purchase orders, display purchase order status and transfer payment details to the Finance and accounts system
- Maintain vendor/supplier details and have ability to assign vendor/supplier to stores items, display contact renewal date, and maintain the history of purchased price.
- Tenderingactivity e-tendering

6.4) Work Management

Requirement and Functionality

- Ability to track project, work request work permit
- Planned cost, maintain history of equipments
- Ability to create compatible units consisting of Materials, Labour, Plant and other financial and components details applicable to the construction and/or repair of network assets

6.5) Project Management

It includes Project Planning, Monitoring and Resource Allocation.

Requirement and Functionality

a. Project Planning-

- Resource Allocation
- Budget Allocation
- Activity Schedule Chart
- Baseline(CPM)
- Gantt Chart

b. Project Monitoring

- Stock Details (Integrated to Material Management)
- Resources (Integrated to HR Management)
- Managing Equipment
- Progress
- Slippage
- Expenditure
- Cost over-run

6.6) Facility Management System

It includes Transmission Network Management System, Inventory and asset management and maintenance solution

Requirement and functionality

- Network and facilities maintenance management is essential for Transco to trace and track its maintenance work. It also helps in identifying breakdowns, outages and failure along with their causes and impact. Trend analysis and preventive steps minimize unplanned outages and frequent maintenance. Some of the key facets of the solution include-
- Inventory and Asset Management- The system would enable optimal utilization of assets and also help control and track inventory of spare parts, electrical equipments etc.

6.7) Network Planning System

It includes Transmission Capacity Availability, System Studies for System Expansion and Loss Assessment Solution

Requirement and Functionality

- As per the Electricity Act 2003, Transco has to provide open access to its transmission system for use by any user. To achieve this, the Transco has to implement a system that determines and plans capacity of the transmission network.
- Transco has to conduct system studies(load flow/short circuit/voltage profile) to determine power carrying capacity
- The operations of transmission system can be optimized by using a series of such system studies. This would help in reducing transmission system losses.
- Network simulation techniques can help in planning future scenarios for expansion/augmentation of the network and assessing impact of the same.

6.8) Energy Management

It includes Load forecasting and System studies

Requirement and Functionality

- Analysis of historical data, current policies and regulation, transmission system availability and capability to project short term and long term generation and demand for future expansion and planning for system strengthening
- Load forecasting and system studies are necessary for optimizes system operations with higher system stability, minimum technical losses and maximum power transfer capabilities
- System studies are used for system expansion planning, determination of firm and non firm capacity planning and determination of incremental transmission loss.

6.9) SCADA and Energy Management System(EMS)

Requirement and functionality

- The purpose of Supervisory Control and data Acquisitions System is to monitor and control overall grid in real time. It also facilitates several other functions like real time generation-load balancing, real-time congestion management, operational scheduling, economic load dispatch, optimal power flow, system studies, contingency analysis etc.
- SCADA has two important systems: Data Acquisition System and Energy Management System. The data acquisition system mostly dealing with real time data acquisition from the field through communication network and EMS, the brain of the SCADA system providing analysis and decision support system

6.10) Energy Accounting System

It includes metering and data collections at interface

Requirement and Functionality

- Accurate and timely energy accounting critical to the revenue cycle of any utility. This process requires adequate infrastructure in terms of accurate and advance energy meters, reliable communication systems at the various metering interface points and central data collection and analysis system. The existing infrastructure in most of the utility is inadequate and does not meet many regulatory requirements. Online remote metering will meet these needs and have multiple benefits in the present(ABT), emerging (open access) and future business environment
- Metering system shall be comprehensive including energy meters, data downloading system, data communication system, and data uploading system at central location, data processing and analysis system. Properly defined processes, data flow and adequate training to utility staff will be key to the successful implementation and sustained operations. This system should also be suitably networked to provide information to the other key players.

6.11) ABT MANAGEMENT(Availability Based Tariff)

It includes day ahead scheduling, ABT monitoring in real time and ABT settlement

ABT Monitoring Solution, which shares data to all key parameters in real time is absolutely essential for efficient and faster management of generations

Now on the basis of the response taken from the various respondents, the results are interpreted in the following manner:

Phases

Table 7

Phases	Average Score Max =5, Min= 1	Standard Deviation Max =5, Min= 1
Feasibility analysis	3.05	0.69
Requirement analysis	4.27	0.52
System analysis	4.07	0.73
System design	2.71	0.82
System implementation	2.51	0.77
System testing	2.12	0.62
System maintenance	2.08	0.59

Hence it is concluded that Feasibility analysis, Requirement analysis and System analysis are the most critical phases for the designing of Information System in PSTCL.

Model

(*System Development Life Cycle, **Variation of Waterfall, ***Object Oriented Approach)

Table 8

Development models	Average scoreMax=5, Min=1	Standard Deviation
Waterfall Model	4.42	0.23
SDLC*	3.01	0.34
V-Model**	3.15	0.45
Structured	3.05	0.47
OOA***	2.01	0.67
Case	2.89	0.79

Hence it is concluded that Waterfall Model will be the most appropriate modeling for the designing of Information System in PSTCL.

Tools

Table 9 (* Data Flow Diagrams)

Development Tools	Average scoreMax=5, Min=1	Standard Deviation
DFD*	4. 12	0.23
Data Dictionary	3.01	0.34
Decision Table	2.15	0.45
Structured English	2.05	0.47
Decision Tree	2.01	0.67

Hence it is concluded that DFD will be the most appropriate tool for the designing of Information System in PSTCL.

Method

Table 10 (*Hierarchy Plus Input Process Output, **Nassi-Shneidermann Chart)

Development Methods	Average scoreMax=5, Min=1	Standard Deviation
3-Schema Approach	4. 29	0.23
Structured Design Methodologies	3.52	0.34
Coupling and Cohesion	2.15	0.45
Transaction and Transformed		
Centered Design	2.05	0.47
HIPO*	2.01	0.67
NS Chart**	2.48	0.47

Hence it is concluded that 3-Schema Approach will be the most method for the designing of Information System in PSTCL.

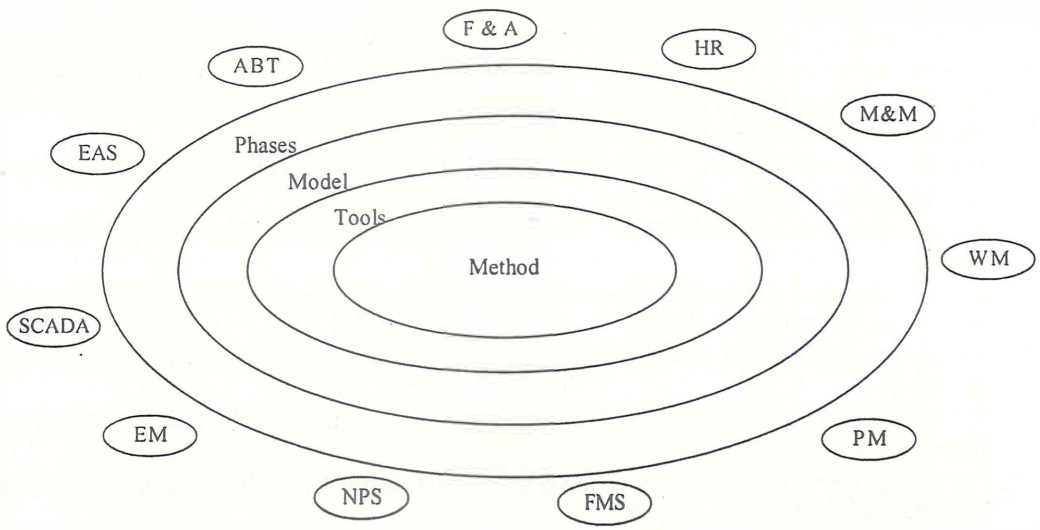
Final Design for Strategic Information System

Key Elements

- F&A - Finance and Accounting
- HR - HR Management
- M&M - MATERIAL MANEGEMNT
- WM - WORK MANAGEMENT
- PM - PROIECT MANAGEMENT
- FMS - FACILITY MANAGEMENT SYSTEM
- NPS - NETWORK PLANNING SYSTEM
- EM - ENERGY MANAGEMENT
- SCADA - SCADA AND ENERGY MANAGEMENT SYSTEM(EMS)
- EAS - ENERGY ACCOUNTING SYSTEM
- ABT - ABT MANAGEMENT(Availability Based Tariff)

Phases: Feasibility, Requirement and System Analysis
Model: Waterfall Model
Tools: Data Flow Diagram
Method: 3-Schema Approach

Strategic Information System Model For PSTCL



1. Conclusion

- There is dire need of Information system in the PSTCL; presently there is no concrete structure of information system in the PSTCL.
- On the basis of various important functions performed by the transmission, various information systems are developed namely
  a. Finance and Accounting
  b. HR Management
  c. Material Management

d. Work Management
e. Project Management
f. Facility Management System
g. Network Planning System
h. Energy Management
i. SCADA and Energy Management System(EMS)
j. Energy Accounting System
k. ABT Management(Availability Based Tariff)

- From the response taken from various officials of PSTCL, it was concluded that out of various phases the most appropriate phase for the PSTCL are Feasibility, Requirement and System Analysis
- From the various models available the most appropriate model for the PSTCL is Waterfall Model
- From the various tools available the most appropriate tool for the PSTCL is DFD
- From the various methods the most appropriate method for the PSTCL is 3-Schema
- In the end the final design is made in the following way which represents all the elements that are found during the research

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