Model for the deployment of the Information Technology (IT) systems in Power Generation Companies in India

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Abstract— There are many generic models and tools for facilitating decisions on capital investments in Information Technology systems in business organizations. These models need to be fine tuned to specific situations and industry segments. One such situation is the power generation industry in India. The research literature and the analysis of the status of Information Technology in the Indian Power Sector are not wide spread. There are different ways to decide on the deployment of Information Technology in an enterprise, when it is to make a decision based on the likely impact of investment on the performance of the enterprise. This paper puts together the characteristics and constraints of the power sector in India. It also highlights findings of the research work on assessing the impact of Information Technology investments on the performance of a power Generation Company in Karnataka. Using these inputs, the models for IT deployment in power generation companies in India is formulated. These models are derived from the generic models using the research findings and power industry characteristics. The IT deployment model proposed here brings out how to decide on IT investments in a power generation company, what type of investment would yield the best business results and how these investments need to be phased over time.

Key Terms: Deployment Model, Power Generation Company, IT investment.

I. INTRODUCTION

There are many approaches, models and tools to facilitate decisions on investments in Information Technology (IT) systems in business organizations. The earliest and most influential of these have been the ones by Michael Porter (1980, 1985). Michael Porter extended the five forces model and the value chain models to elaborate how Information Technology can influence the competitive position of a company or alter the value chain of the organization.

Michael Hammer (1990) elaborated how information technology investments should be used for creative redesign of the business processes of the organizations. There many more models and tools available today for managers to make investment decisions in information technology.

Most of these tools are generic in nature and because of that are widely applicable to many industry segments and under different operating conditions. However, what is critical while deploying these tools and models is to fine tune them to specific industry segments and specific operational conditions.

This article proposes the models for Information Technology deployment in power generation companies in India. While the basis for the model is the general IT deployment tools and approaches, the specificity of the model is driven by the convergence of the following inputs.

The characteristics of the sector: The model intends to address the power generation sector in India. This segmentation inflicts certain characteristics since the power generation, transmission and distribution is predominantly controlled by the government.

The research: The detailed research study conducted by the author to assess the impact of Information Technology investments on the performance of the power generation company in Karnataka provides great insights into what investments would work and why it would work.

The inputs and insights are applied to generic IT deployment model to formulate models for IT deployment in power generation companies in India. This model highlights what type of investments in Information Technology would yield what type of performance and how such investments should be made. The generic IT deployment models are formulated using extensive review of the literature in the field and the specific model for the Power Generation companies in India is the result of the research work.

II. POWER GENERATION COMPANIES IN INDIA: IT’S CHARACTERISTICS

A. The structure of Power Generation Industry

Increasing energy demands, ageing Power generation facilities and environmental complexities are driving the need for constant improvement in the operations of the power generation companies. The analysis of the strategic need based on the assessment of the structure of the power sector using the Porter’s Five Force Model indicates the following

The intensity of Competitive Rivalry- The intensity of competitive rivalry can be termed as medium as there is sufficient scope available in the industry for all existing players.

Bargaining Power of Suppliers- As the requirement of power is growing exponentially, the supply of resources can be met by importing and from domestic suppliers. Therefore, the
bargaining power of the supplier is medium enough to tackle in the current scenario.

**Bargaining Power of Buyers** - The Power sector has to be developed at a much rapid pace to cope up with the development activities which are in progress. Therefore, the bargaining power of buyers is more when compared with other sectors.

**Threat of Substitute Products** - A renewable power generation has low threat for substitute product. Wind Power Projects are also the most preferred bearing in mind the long coastline, which India possesses.

**Threat of new entrants** - As the power sector are highly capital intensive and involves large amount of commitment in terms of capital, assets and work force the threats of new entrants is low. The organizations, which have the required capabilities and are intent to take the risk, will enter the market.

### B. Internal and External factors

There are multiple reasons which drive the performance of power generation in India. These can be classified as internal and external. Typically, the internal relate to operational characteristics of the power sector and the external factors bring out the influence of government policy on this sector.

**Internal factors influencing the performance**

- **Excess manpower**: Typically in India it is highlighted that overstaffing occurs in all areas, with a typical 500 MW thermal plant employing 100 people in the US, 500 people in a central government Indian utility and 2,000 people at an SEB (State Electricity Boards – the State owned power utilities). This is most prevalent in support functions like finance, administration, accounts and HR and in clerical and secretarial departments.

- **Poor organization of functions and tasks**: This is a reflection of how the internal functions are managed in the Indian power sector. This is reflected in capacity utilization, deployment of manpower and cost to construct a plant.

- **Lower capacity utilization**: Overall, the plant load factor (PLF) for SEBs is 60 per cent compared to 71 per cent for private and central government-owned plants. The main reasons being:
  - Poor maintenance practices leading to more outages;
  - Relatively long time required for planned maintenance activities;
  - Inadequacy in sourcing the raw materials on time.

- **Inefficient deployment of manpower**: Poor internal organization also leads to lower productivity through overstaffing in operations and maintenance.

- **Construction overruns**: SEBs take an average of over 5 years to construct large coal plants, versus 3-4 years for best practice Indian plants. Lack of funds, delays in tendering and antiquated engineering, procurement and construction (EPC) practices are the main reasons for construction overruns.

  - **Lack of viable investments**: SEBs suffers from lower capacity utilization and less use of technology, resulting in the need for more manpower.

  - **Lack of viable scale**: This contributes three points to the productivity gap. Overall, 20 per cent of India’s plants are below 210 MW in size. However, they require the same number of people in the control room and other areas of operations, as do the larger ones. Similarly, there is a scale issue in maintenance and support staff. If these plants had been of 500 MW size, they would have required 25 per cent fewer employees, adjusted for size.

**External factors influencing the performance**

Poor corporate governance in the form of government ownership, primarily at SEBs, is the main external factor leading to low Total Factor of Productivity (TFP) in Generation, Transmission & Distribution (T & D).

In Generation, SEBs have the longest construction overruns and the lowest capacity utilization, leading to a capital productivity in generation of 57 per cent against best practice of 85 per cent of US levels. It also leads to thefts, surplus staff, construction overruns, over-engineering, poor management, lack of evacuation capacity and under-investment in T&D and maintenance.

Some secondary factors, such as government monopoly in the coal sector, excessive bureaucracy, and a non-level playing field for private sector capital goods producers, also contribute to low TFP.

Government ownership, especially in the form of a government department with political appointees, does not create pressure to avoid losses.

### III IMPACT OF INFORMATION TECHNOLOGY ON THE PERFORMANCE OF A POWER GENERATION COMPANY

The research work to assess the impact of Information Technology investments on the performance of a power generation company (in this case in Karnataka) is carried out on two dimensions:

- **User Perspective**: The structured survey of the Information Technology systems users to find out the impact on performance as perceived by them;

- **Business Results**: Collection and analysis of the data on performance of the organization over the years on different parameters and assessing their relationship to Information Technology investments.

The research methodology consisted of development of questionnaire and data collection formats and analyzing them to assess the relationship between Information Technology investments and business performance.
The other aspect of the methodology was development of framework to understand what constitutes Information Technology investment and identification of parameters to understand the performance of the business operations of a power generation company.

The exercise of identifying IT investment focused on

- Investments in software development;
- Investments in hardware and networking;
- Investments in training and change management.

Similarly, the exercise on identifying the areas of impact was concerned, looked at IT systems like

- The IT Systems covering the operational areas;
- The IT Systems for managing the finance related activities;
- The IT Systems for support activities/ functions.

The framework for the parameters for measuring business performance identified the following critical areas:

- The Operational Productivity;
- Maintenance Productivity;
- Financial Productivity;
- Operational Quality;
- Project Management.

The methodology of measuring the user perspectives consisted of

a. Questionnaire to be administered with the key users of the IT systems

b. Identification of the people at different levels in the organizational hierarchy and functional areas for interviewing

Findings of the research work

The findings of the research work of assessing the impact of IT systems on the performance of Power Generation Companies indicated that, the following type of IT investments had impacted the operations of the Power Generation company.

IT systems for automation of business processes;

IT systems which connect the different users through networking;

IT systems which achieve integration of business processes;

IT systems which achieve centralization of data – one source of data;

IT systems which were built with a direct business focus.

The research work indicated that following are essential for Power Generation Companies to achieve enhanced benefits from IT investments:

Integration of business processes through IT to achieve one source of data across the organization;

Expansion of coverage of the IT systems to critical business operations;

Analytical enhancement by building capabilities to analyze vast amount of transaction data, for decision-making;

Application rationalization to ensure that the software solutions built on multiple platforms are rationalized to reduce the cost of maintenance and upgrading; &

Policy for standardization of software applications, interfaces between software applications, user accedes and security of data/information.

Functional and Operational Areas for IT Investments

The assessment of the IT systems indicated that IT systems could be used in the following areas and if used in these areas have potential to deliver business benefits:

IT systems to provide consistent and precise data on operational parameters;

Information Systems to generate performance reports based on the unique needs of the users;

Automation of the routine activities of civil, mechanical and electrical design activities using auto CAD, STADD;

Provisioning of information from remote sites on business operations in real time to decision makers;

Introduction of IT in different process control and equipment control thereby reducing the need for skilled manpower;

Application systems to store information for a wider time horizon than digital control systems.

Other than these the specific business areas where IT applications made difference to the business operations are:

Systems for managing the operations like Fuel Management, Stores Inventory Management, Plant Maintenance etc.,

Systems for managing the finance like Cash & Compilation Management, Fixed Asset Management, Stores Accounting, Bank Guarantee administration, Provident Fund Management;

Systems for support activities/functions, Human Resource Management, Hospital Management, In-house Training;

Systems for centralized activities like Corporate Planning, Project Planning;

Scheduling and Execution, Engineering, Procurement and Commissioning, Corporate Contracts and Purchases.
IV MODEL FOR INFORMATION TECHNOLOGY DEPLOYMENT

For the sake of bringing in clarity into the possible deployment models for the IT systems the possibilities of strategic and operational excellence are mapped into four quadrants. The possibilities offered by IT systems to influence strategic excellence and operational excellence too can be mapped accordingly into the four quadrants. For the sake of convenience the possibilities in each of the quadrants are named differently as shown in the figure 1.0.

Strategic Excellence: Some of the key characteristics of achieving strategic excellence through creative deployment of Information Technology are:

Creating a unique and sustainable, unbeatable market position with unique cost structure and customer base;

Radical Redesign of processes to achieve competitive positions;

Transform the organizational products and services through innovation;

Compelling vision, business plans, budgets etc.

Altering the industry structure by influencing the bargaining powers of suppliers and customers.

Operational Excellence: Some of the key characteristics of Operational Excellence using Information Technology as the tool to do so are:

Assimilating, attaining, extending & implementing best practices in operations;

Reengineer Processes around Information Technology;

Redesigning the Services around Information Technology;

Improvements in the quality of products and services;

Capacity building to enhance the skills of people and expertise available to people to do their job.

The four distinct possibilities for IT deployment are

Strategic Alignment – Achieving strategic excellence by crafting innovative strategies and backing them with excellence in operations as well.

Planning, Measurement and analysis – Developing creative and rigorous business plans based on measurement and analysis of the internal and external business performance, market positions, etc.,

Operations and IT systems – Focusing on managing the operational performance of the enterprise by excellent management techniques or deployment of IT systems for facilitating effective operations management.

Performance Improvement in Business Effectiveness – Deployment of continuous improvement in operational activities.

a. The requirements of Power Generation Companies:

• The Strategic Requirements

These things indicate that the business strategy at the power generation systems needs to be based on:

Business process redesign;

Organizational structure and processes;

Sustainability through environmental management practices;

Operational Excellence for managing cost structure;
Revenue growth through innovative pricing balanced against capacity.

- The Operational Requirements

  The operational requirements of Power Generation companies are broadly in the following areas:
  
  - Asset Management to ensure availability and renewal;
  - Capacity management to ensure cost effective operations;
  - Manpower deployment for efficiency and the right expertise;
  - Management of quality of operations by measurement, effective actions and continuous improvements.

b. Operational Challenges of Power Generation Companies

The operational challenges of the Power Generation companies can be summarized against the following broad categories.

- **Manpower utilization**: Excess manpower is attributed to influence the productivity performance badly.

- **Ageing Assets and Manpower**: Power generation is an asset-intensive organization where asset performance plays a vital role. Almost all state sector generation utilities have an ageing workforce, which affects the utility’s ability to changeover to new systems and approaches especially when new technologies (such as state-of-art Control and Implementation) are introduced.

- **Deployment of expertise**: In any power station, huge amounts of operational data are generated on an ongoing basis, which needs to be stored properly for future reference, analysis and feedback.

- **Operations Management**: Operations management involves managing day-to-day operations at the optimum level, reviewing operating instructions and tailor them to site specific requirements.

- **Manpower Deployment**: Poor internal organization also leads to lower productivity through overstaffing in operations and maintenance. This is prevalent in SEBs and to a lesser extent in central government plants.

- **Operating Practices**: Establishing efficiency management is a thrust area through setting up the efficiency monitoring cell and institution ling procedures for performance testing, auxiliary energy management, root-cause analysis of trips.

Using this understanding, the model is formulated. This model intends to address the following three questions:

A. **Deployment Strategy** – What IT systems should be deployed for achieving different business objectives;

B. **Deployment Approach** – How the IT systems should be deployed in terms of coverage, processes and approach;

C. **Deployment Phasing** – When the different IT systems should be deployed in terms of what should come first and what next.

A. Deployment Strategy

If the idea is to drive the IT investments based on the strategic objectives of the company, the four grid model of relationship between operational excellence and strategic excellence is used for identifying the deployment models and the possibilities are grouped accordingly. It should be noted that these are not mutually exclusive areas but collectively completing thoughts. This model provides an overview of what type of IT investments have potential to impact what aspects of the strategy of the organization. The focus can be either to achieve strategic excellence or operational excellence by using IT systems. The four possibilities are:

- **IT systems for Strategic Alignment** – identifies the possible IT investment areas, which could facilitate defining differentiated strategy for the organization based on strategic and operational characteristics;

- **IT systems for performance improvement** – identifies the operational areas, which could be improved by using the IT systems;

- **IT systems for Measurement of Performance** – identifies the areas which facilitate better planning and measurement using IT systems; &

- **Operational IT systems** – identifies the processes and functions, which could be automated using IT systems.
**The IT systems for Strategic Alignment**

**Redesigning the organizational functions and tasks:** The critical focus of the IT systems will be to facilitate changes in the organizational structure with emphasis on core operational activities rather than support activities. The IT systems should be used to automate routine activities both in the support functions like HR, Finance, Procurement etc and core functions of maintenance, operations and so on.

**Managing effective Capacity utilization:** The focus of the IT systems for managing the capacity utilization will be in managing the demands, matching the demand to capacity, building capability for quick response to changes, managing the availability conditions effectively etc.

**Ensuring the Right Engineering:** It is expected that creative use of IT systems in different functional areas especially related to core operations will facilitate effective balancing of capacities at different points of the plant and under different operating conditions.

**Managing the Projects for Timely Completion:** The deployment of IT systems for managing the construction, erection and commissioning activities has the potential to influence the strategy of the enterprise:

**Effective Project Management:** IT systems for linking the procurement, resource allocation, material/equipment management, time management and financial management through deployment of IT systems;

**Contract Management:** Managing the different contractors and coordinating between them. Utilities rarely appoint a turnkey contractor, preferring instead to give different packages to separate sub-contractors. One large utility used to give 40-50 packages to different subcontractors leading to co-ordination problems in execution.

**Capacity and demand Management:** Although the Power Generation plants are built with fixed capacity of power generation, the fact is that small variation in demand can influence their operational performance and variation in capacity due to operational problem can influence the distribution and pricing. This factor can be exploited effectively through innovative IT systems to create strategic advantage by aligning the demand management, pricing strategy, and capacity management and managing them together to create unique positioning in the market.

**Costing and Pricing Management:** The costing system shall entail setting up a costing framework at the plant along with relevant cost codes and centers. The implementation arrangement shall consist of creating a cost database, populating it with one time cost data and conducting training for utility personnel on the same. The costing driven by variations in demand, capacity management and dynamic operational parameters could be used effectively for innovative pricing of power by using IT systems.

**Creating Business Focus:** Like in all other businesses, the Information Technology investments in power sector vary from company to company. However, these investments can be categorized into three general areas. These general areas for IT investment in the power sector with a focus on creating strategic differentiator will be for:

**Performance Improvement:** Performance Improvement areas include reducing cost inefficiency across all the areas of operations and for enhancing customer satisfaction;

**Meeting management and regulatory requirement:** IT can fulfill management and regulatory requirement areas in terms of effective MIS for decision making, accountability and service and building a strategic approach to regulatory management along with the collection and management of data; &

**Servicing the changing industry structure:** The changing industry structure in terms of unbundling and network management emphasis also requires the intensive use of IT.

**IT systems for Performance Improvement**

**Efficient Deployment of Manpower:** This is most prevalent in support functions like finance, administration, accounts and HR and in clerical and secretarial departments. For example, there is one support staff per MW in India compared to 0.1 per MW in the US;

In operations, despite having a control room, workers are placed in each area of the main plant e.g., boiler, turbine, and boiler feed pump. Similarly, operators can easily be shared between different units but this often does not happen;

In maintenance, people are organized rigidly by function e.g., electrical, mechanical, control and instrumentation. Best practice Indian plants, on the other hand, have organized multi-skilled crews by area. Further, employees handling breakdown maintenance can easily be shared between multiple units and neighboring plants in the coal-producing region. This is currently not the case.

**Productivity Improvement:** The keys areas of improved productivity are optimizing business operations using IT, effective acquisition and control processes, leveraging Customer Relationship Management for increasing debt recovery narrowing the gap between the volume billed to the utility and that to the consumer, managing unbilled and ghost accounts. Productivity improvement involves managing employee costs and staff deployment ratio in terms of fieldwork and office work:

In generation, while operations management, Management Information System (MIS) and asset management have seen considerable IT intervention. The areas that need to be covered are fuel and environmental management. The areas that could further use IT are demand forecast, system studies and facility management.

The key issues in the use of IT in power generation relate to inadequate research and maintenance focus on plant control systems, non-existent operational performance systems, poorly used control system data for performance analysis, low commercial orientation despite high data availability , and strategic focus. There is a need for a comprehensive IT strategy
to address performance improvement and cost effectiveness in the emerging context. Process improvement and change management for more effective use of IT in generation is also required.

**Knowledge Management:** In any power station, a huge amount of operational data is generated on an ongoing basis, which needs to be stored properly for future reference, analysis and feedback. Moreover, significant data is also regularly churned out by supporting departments like stores, procurement, finance, environment, human resource etc. A proper knowledge management system will help in efficient and smooth functioning of power plants. Knowledge management system is a customer-facing view of data that enables non-technical and business users to interact with the data. Business users focus pre-defined tables and views for inventory, equipment and work management. It would also enable on demand reporting and access to useful information – not just raw data.

**Operating Practices Enhancement**- making the operational information available to the people as and when required is the focus of IT systems. It would involve redesign of Operation & Maintenance Manuals, along with the development of equipment procedure and conducting training for O & M personnel.

**Proactive Maintenance**- Creating an asset database to be populated with failure history, performance characteristics, design data, which shall enable analysis of failure mode and effects. This will lead to development of a proactive maintenance plan along with the condition monitoring schedules and reliability assessment matrix. Designing and setting up a decision support system linking the costs to reliability along with equipment level operating limits and checklists, which shall enable the utility to pre-empt failures and utilize cost/reliability information to substantiate refurbishment/replacement decisions. The power plant can benefit by a computerized Maintenance Management System (CMMS) at the plant.

**Organizational Culture and Climate**- Developing performance management system by designing the job description for all positions along with formulating Key Performance Indicators (KPI) and Key Results. The system need to be complemented through a KPI monitoring mechanism with a baseline study and establishing targets and review principles. Improving the existing system of training and development through conducting training needs analysis exercise, formulating the training scope and strategy along with developing training course materials and conducting Training for the Plant personnel.

**Operational Efficiency**- A good operational efficiency strategy employs optimum mix of energy, equipment and operations that result in increased productivity. This involves proper design of infrastructure and regular maintenance, management of emission along with the appropriate management of fuel. Operational efficiency needs to be attributed greater focus at both corporate and plant level. It is essential that elements of detailed shortfall analysis, partial loss analysis and inputs from energy audit report to be utilized for the preparation of year-ahead plans. However prior to initiating the same, the utility may also require formalizing an energy audit and performance review plan for the asset portfolio.

**Infrastructure Reliability**- Infrastructure reliability includes maintaining equipments like boiler, turbine, Electrical, Civil, Coal handling and ash handling units. Standardize resource utilization for different works, Formulation of quality points for different works and spares procurement.

**Management of emission**- Implementation of standard norms of water and steam into day-to-day practice is very vital. Similarly, monitoring of environmental factors such as particulate matter and other effluents as per relevant guidelines is also important.

**Rising Fuel Costs**- Rising of fuel costs is critical to the overall economy of power production. Monitoring and control of fuel supply contract is critical business driver. Accordingly, power generation industry uses accounting functions for fuel purchase, transportation costs and coal inventory values.

**IT systems for Planning Measurement and Analysis**

**Generation Planning and Budgeting**- Includes activities like realignment of existing practices with the future market scenario, establishing a Techno-commercial cell at the plant along with integration with generation based planning, setting up of procedure for equivalent availability factor, year ahead planning integrated with energy audit and parallel loss analysis.

**Balanced Score card Based Measurement**

Financial Perspective measures the various costs involved in electricity production. The Key Process Indicators (KPI) included are operational expenses, maintenance cost, fuel cost and percentage change in total cost.

Operational Perspective measures % increase in production capacity, % increase in capacity utilization, equivalent forced outage factors and amount of carbon dioxide generated. Operation perspective is responsible for the performance of operations or processes that result in growth of the firm.

Customer and Environmental Concern is accountable for the measures taken by firms to satisfy their customers and to comply with the environmental policies. It consists of KPIs like % of sales targets met, number of reality measures, % of change in customer density and number of regulatory penalties.

Employee and Training Perspectives ensure that processes are safe for the employees and there are no hazards to their life. This perspective consists of KPIs like number of injury incidents, number of technical training sessions, number of processes related training sessions and number of employee benefits schemes available.

**Planning, Measurement and Analysis**

**Management Information System**- The MIS system at the utilities shall require varying levels of intervention based on the existing system with the utility and shall range from improving existing systems through additional functionalities to
developing an IT policy, establishing a full fledged IT and MIS system along with procuring an MIS system bid route.

Integrated MIS Policy -for the organization should be formulated for the implementation across the headquarters and the various plants, covering all aspects of the functioning of the plants – Operations, maintenance, stores, purchase, human resource, safety, environment etc.

MIS interface with Digital Control System- of the power plant for automatic generation of management reports. The DCS captures data in real time without much human interface directly from the various instruments installed in the power plant. This information can be fed into the ERP/MIS system directly.

IT Systems for Operations Management

Plant Operations: To maintain the database of the equipment parameters and to assist the operational personnel, power generation companies need Plant Operations System. The system must capture unit tripping details, loss of generation details, unit start up details and probably cause of system outages. Presently, this information is captured and stored in Excel sheets in project locations.

Plant Maintenance System- Plant Maintenance System can be developed which has a facility to define maintenance years to keep track of maintenance activities. Preventive maintenance and inspection details are automatically generated during period opening once maintenance records are defined. Facility to assign maintenance planners to each equipment location to approve work request on equipment.

Breakdown Maintenance (forced outages) – Automatic triggering of existing complaints that can be handled due to breakdown of equipment. Facility to capture indirect costs due to outages such as revenue loss due to loss of generation.

Purchasing and Stores- Review and redesign of existing procurement procedure: Institutionalizing Quality Assurance(QA) systems in the procurement cycle by setting up QA cell at the plant, developing a quality assurance program(QAP) and setting up checks and controls within the Procurement Contracts. This will also require training for Plant Personnel in QA related aspects.

Optimization of inventory levels releasing idle working capital through review of inventory holding, reorder levels, creation of a high value spares bank by inventory pooling, standardization of store items, automatic procurement protocols on reorder level; basis for fast moving consumption items.

Asset Management: Mainly provides management for equipment and infrastructure. This will enable to manage information on equipment model, serial number, and suppliers, date purchased, spare parts information, services performed, recalls and many more.

Operations Management: Operations management involves managing day to day operations at the optimum level, reviewing operating instructions and tailor them to site specific requirements, identifying factors resulting in low availability, high partial loading and deviation of critical performance parameters from standard norms and take corrective actions.

B. Deployment Approach

While deploying an IT system whether for strategic excellence or operational the approach adopted needs to address two decision areas:

How the IT solution should be deployed – the solution strategy;

What processes the IT system should cover – the process or functional coverage.

Solution Strategy

Integration: Integration is a shared outcome of information technology investments and business outcome with the process of aligning IT and organizational needs. The focus of integration is to integrate the different processes of the organization through IT systems. The possibilities of integration of processes through IT systems are many – right from customer interfacing to costing to maintenance to finance to procurement and inventory management. The integration needs to be carefully planned to take the advantages offered by IT systems. Focus also will be to integrate the operational systems with business systems like the condition monitoring of the equipment with maintenance management system.

Centralization – Benefits of integration can be best derived if centralization of IT application also is one of the features of the solution strategy and deployment model since, centralization would facilitate better control over the standardization of practices, deployment of best practices and management of resources across the organization.

Expansion: Even if the deployment model addresses the areas of immediate concerns, the solution strategy should keep in mind the future expansion requirements, the expansion in terms of solution coverage, scale of business operations and increase of solution foot print.

Structure: Appropriate IT organizational structure should be developed. Separate MIS and IT cells would be required at each location. MIS should look after data collection, compilation, and report preparation while the IT cell will be responsible for taking care of the technology/hardware related issues. There has to be a single departmental interface for reporting and information archival.

Infrastructure: Plant wide and companywide IT infrastructure development to deploy the IT systems to cover all essential functions and manage them effectively, is the key requirement of the solution strategy. All the users at the plant should be provided with IT infrastructure with Local Area Network (LAN) connectivity in the plant and Wide Area network (WAN) connectivity across all plants and headquarters, a central data center to house the IT applications and monitor the performance of network and applications and adequate mechanisms to address the requirements of disaster recovery should be part of the solution strategy.
**Functional Coverage**

The functional coverage of IT systems for strategic excellence and operational excellence are many. It is important to decide what functional areas should be covered and how they should be covered. Some of the key functions that can be covered and the key features to addressed are:

**Core functional areas**
- Maintenance of plant and machinery
- Materials and Stores Management
- Procurement of materials, goods and services
- Operations of the Plant
- Business Planning
- Integration with real systems of plant control and management.

**Support functions**
- Finance & Accounting
- Costing and pricing
- Customer relationship and supplier relationship management
- Project Management
- Human Resource Development
- Environment, health and safety management
- Knowledge management

**C. Deployment Phasing**

The rapid growth of the economy will place a heavy demand on electrical power system. As discussed in the previous section, reforms in the power sector have been under way for several years. They have bought several important institutional changes, which were required to make the Power sector more efficient. The State government must plan to bring down the aggregate technical and commercial loses from the current level of 40% to at least 15% at the end of the 11th plan. The opportunities of IT application can be classified into the following three phases.

**Value Addition Phase** - The IT applications can provide quick immediate business benefits. The applications are categorized into Operations and Maintenance and Business Support:
- Operations and maintenance support can be achieved through Plant Performance and Systems Integration Systems, Reliability Centered Maintenance System, Employee Safety and Environmental Compliance Systems; &
- Business Support is done through Business Planning, Financial closing cockpit, Access control, Supplier Relationship management, Talent Visualization.

**High –Value Addition Phase** - IT investments in this phase focuses on strategic solutions to take the utility to the next level of growth. Major IT investments in this sector are on:
- Power Purchase Agreements, Tariffs and ABT billing
- Online recruitment tool
- Enterprise Learning
- Linear Asset management
- Regulatory Financial Statements compliance XBRL(Extensible Business Reporting Language) submission and IFRS (International Financial Reporting Standards)

**Value++ Phase** - This phase is applicable to the scenario with multiple commissioned plant. IT systems are responsible for the following activities.
- Economic Dispatch
- Fleet Performance Management System
- Fuel Management
- Vendor invoice Management

**CONCLUSION**

The major contribution of the research work is the formulation of IT deployment model that would facilitate rigorous approach to capital investments in IT systems in Power Generation companies in India. The uniqueness of the model is that it is derived from the assessment of actual impact of IT investments on the performance of Power Generation Company and using the insights of that work to fine tune the existing models for IT deployment. The model developed for Power Generation is comprehensive, accurate and holistic, which will address the IT investment questions and gives value-proposition to Power Generation system.

**Bibliography**

AUTHORS PROFILE

The author is a Research Scholar, Symbiosis International University (SIU), Pune. The author expresses her grateful thanks to the research guide, Dr N S Viswanath and the authorities of SIU for their support & encouragement.