CHAPTER I

INTRODUCTION

This chapter describes the background of the study and provides an understanding of power- its characteristics, generation and major developments of power generation. The performance of the power sector, the structure of power sector in India and in Karnataka are presented. The chapter also provides structure of KPCL along with the major power stations and different power projects through exhaustible and non-exhaustible resources. The chapter concludes with an explanation of the research study design.

1.1. Introduction

Ever since the emergence of Information Technology as a tool to carry out business transactions and analysis, and with every advancement in the field, it has increased its potential to make the value chain of an enterprise competitive. One of the earliest to point out this potential was Porter et al. (Porter and Millar, 1985). As highlighted by Porter et al. (Porter and Millar, 1985), the influence of Information Technology spreads across all the elements of the value chain of an enterprise. The primary impact of this is in improving the efficiency of the activities and in many instances in reconfiguring the activities (Porter, 1996). The first leads to what can be called “operational excellence” and the second leads to what can be called “strategic differentiation”. Overall the impact of Information Technology, on the performance of the enterprise is thought to be positive.

The impact of information Technology on different aspects of business performance has been the focus area of research for some time. The general trend has been to look at the impact at the firm level as well as at the sectoral or industry level. In some instances attempts have been made to even study the impact on the economy as well. The conclusions have been varying, with some bringing out the positive impacts and some indicating not so positive impacts. The underlying causes sited for these differences too have been many.
The power sector of India has been largely under the direct control of government for a long time. The power sector is considered very critical for the economic development of the country and there are attempts to liberalize this sector from government control. However, with the increasing liberalization of the core economic sectors and like most areas of government, the management techniques, approach to measuring the performance etc. of this sector has been under scrutiny of researchers and analysts.

The improvements in the power sector need to take place at multiple levels. As has been recognized widely, the most critical element would be at the policy level. However, it has been generally understood that although policy changes would drive operational improvements, it is equally important to encourage operational excellence of the power sector separately.

To understand the needs of bringing in operational excellence the first step would be to formulate or understand what would constitute operational excellence. It has been well understood that one of the drivers for operational excellence is the spread of Information Technology. So the second critical element of driving operational excellence would be to understand the penetration or adoption of Information Technology (IT) and its impact on performance of the power sector.

Over the past decade, the use of Information Technology in the power sector in general and in India in particular, has moved from a mere electronic data processing covering only certain areas of the operations, to automation of several activities and functions. IT is now increasingly being adopted as an integrated /interfaced enterprise –wide system touching almost all operational areas and using information and communication technologies for real-time management of networks and delivery system.

With this thought in mind, this research intends to bring in an understanding of what is operational performance in power generation companies in power sector, what are the measures of this performance, what are the possible areas for IT investment and how to measure the impact of this investment in IT on the operational performance of power generation companies.
1.2 Background of the research study

Development of the Power Sector is key to the economic development of a country. While the power is the basic driver of the economic growth, the competitiveness of the economy is dependent on the ability to generate good quality electricity at reasonable cost.

The planned development of Indian economy began in 1950s. Since then, Indian Power sector has recorded substantial progress with hydro-power and coal based thermal power have been the main sources of power generation. Nuclear power development which was introduced, in late sixties, is at slower speed of progress. From the early sixties, the power systems are operated on a regional basis crossing the political boundaries of states. However, the power supply/generation industry has been bearing the burden of the constant gap between supply and demand.

The Power Sector had been receiving adequate importance ever since 1950s. The Sector has been receiving 18-20% of the total Public Sector outlay in the initial five year plan periods. Extraordinary growth and progress have led to widespread use of electricity in all the sectors of the Indian economy. The installed capacity of Power Plants (Utilities) has increased since 1950’s to 1,73,636 MW as on March 31,2011(Power Line,2011) from 1713 MW in 1950, registering a multiple fold increase in more than fifty years. Similarly, the generation increased from about 5.1 billion units to 805 Billion units (Power Line, 2011) The per capita consumption of electricity in the country also increased from 15 kWh in 1950 to about 338 kWh in 1997-98, which is about 23 times. In the area of rural electrification and water pump set electrification, the country has made a remarkable progress. About 85% of the villages have been electrified except a few remote areas in north eastern states.

The Ministry of power has set an agenda of providing power to all by 2012. It is pursuing this agenda through a complete approach to power sector development through a strategy having interventions at the national, state, state electricity boards (SEB), distribution, feeder and consumer levels.

According to Electricity Act, 2003, as indicated by Ministry of Power, “Central Electricity Authority (CEA) shall execute such functions and duties as the Central Government may prescribe or direct, inter-alia, to promote measures for advancing the skill of persons
engaged in the electricity industry and promote research in matters affecting the generation, transmission, distribution and training of electricity.”

Indian power sector is separated into the following independent regional grids namely: the northern, eastern, western, southern, and northeastern regional grids. The major trouble confronted by the Indian power industry is the problem of leakage, transmission loss and revenue loss at the retail points. Indian power sector needs massive expansion to handle world-class energy. This needs extensive involvement and investment from overseas. Hence, the government has adopted different reforms in all the areas like generation, transmission and distribution.

The 'Players in the Power Sector' section includes organizations such as central ministries, state power/energy departments, electricity regulatory commissions, state organizations-electricity boards/departments/generation companies/transmission companies/distribution companies, state nodal agencies for renewable energy resources, central sector utilities etc. During the early 1990s, power sector was among the first private sector to begin its operations. The initial drive of private investment was on power generation projects. Thereafter, private investments were allowed in other utilities as well.

The single largest fear for private producers is that they might not be sufficiently compensated for power generation. Greater part of the distribution utility is yet to come out of state control, by either the SEBs or their unbundled substitutes, having economic troubles.

1.3 Power as a Product

Power is the driving force behind a modern life and a lifeline of industries. Electricity is a general term encompassing a variety of phenomena resulting from the presence and flow of electric charge. The word is from the New Latin electricus, “amber-like”, coined in the year 1600 from the Greek ἠλεκτρον (electron) meaning amber (hardened plant resin), because static electricity effects were produced classically by rubbing amber. Electricity is not a human invention, and may be observed in several forms in nature. A prominent manifestation of electricity is lightning.
In general usage, the word “electricity” adequately refers to a number of physical effects. These effects can be understood by the following precise terms:

- **Electric Charge**: A property of some subatomic particles, which determines their electromagnetic interactions. Electrically charged matter is influenced by, and produces, electromagnetic fields.
- **Electric current**: A movement of flow of electrically charged particles typically measured in amperes.
- **Electric Field**: An influence produced by an electric charge on other charges in its vicinity.
- **Electric Voltage**: The electrical pressure at which current is delivered is termed voltage and is usually measured in Volts (V).
- **Electrical Power**: The electrical loading of a piece of equipment gives the rate at which it takes power from the electricity supply. Electrical power is measures in watts (w) or kilowatts (kW).

### 1.3.1 Definition of Electric Power

Electric Power is a form of power. It is a form of energy which is convenient for changing into heat, light or mechanical motion. It is defined as the rate at which electric energy gets transferred from one form to another. It is measured by capacity and is the unit of measurement is watts and kilowatts. The unit of measurement is named after James Watt, the discoverer of steam engine. The amount of power a power plant generates or customer uses is calculated in Kilo Watt Hours (KWh).

### 1.3.2 Major Developments of Power Generation

Electrical power is generated from the conversion of primary sources of energy such as coal, natural gas or other natural sources. Hence, we consider it as a secondary energy source derived from primary energy source. Benjamin Franklin developed a lightening storm by a kite flying in a storm. This experiment proved that lightening is a form of electricity. Invention of electric bulb was done in the mid-1800s by Thomas Alva Edison. This invention resulted in bringing electric power to indoor lighting. Till then, power of the electricity has
been used for outside lighting only. The milestone invention was using electricity to applications such as industrial machines as well as indoor lightening was done by Nikola Telsa. His discovery of usage of alternating current (AC) resulted in reducing the cost of transmission of electricity over long distances. George Washington developed transformer, a device for transmitting power over long distance. This invention has resulted in supplying power to business units and homes located at long distance from the power generating unit.

1.3.3 Electric Power Generation

Electric Power is generated using electric generator which converts mechanical energy into electrical energy. The process is based on the laws of physics defining the relationship between magnetism and electricity. An electric power station uses a turbine, engine, water wheel or other similar machine to drive an electric generator or a device that converts mechanical or chemical energy to power.

Figure 1 Transporting Electricity

![Transporting Electricity Diagram](source: science.dictionary.com)
1.3.4 Characteristics of Electric Power

These are some of the key characteristics of or parameters used to describe Electric Power. According to electrical engineering definitions,

- Voltage: Electric power plant generates voltage measured in kV.
- Frequency: Electric power plants usually generate alternating current (AC) at a frequency of 50 Hz to 60 Hz.
- Cost of electricity: The direct cost of electrical energy is the result of cost of fuel, capital cost of plant, operator labor, and maintenance. However, indirect or social costs include economic value of the environmental impact, or environmental and health effects of the complete fuel cycle and plant decommissioning.
- Blackout: A cutoff of electric power, especially as a result of shortage, a mechanical failure, or overuse by consumers.
- Brown-out: A reduction or cutback in electric power, especially as a result of shortage, mechanical failure or overuse by consumers.
- Total harmonic distortion: Is a measurement of the harmonic distortion present and is the ratio of the sum of the power of all harmonic components to the power of the fundamental frequency.

1.3.5 Uses of electric power

In spite of the significance in the daily lives, it is impossible to think about life without electricity. Even then, modern man tends to take electricity for granted like water and air. The invention of a practical incandescent light bulb in the 1870’s was one of the first publicly available applications of electric Power. This discovery has led to the growing market for electrical lighting. Heating effect of electrical energy is being used for refrigeration. The use of electrical energy for telecommunications was demonstrated in 1873 by Coke and Wheatstone. Advances in optical fiber and telecommunications technology also made use of extensive electrical energy. Electrical energy is also used as a fuel for public transportation as well as in electric cars and trains.
1.4 Power Sector in India

Indian Power sector has made remarkable growth in size and capacity since planned development of the economy began since 1950s. The installed generation capacity has grown from 1,362 MW in 1947 to 1, 80,358 MW during the year 2011. The installed capacity of state owned Power sector is 47%, Central Power sector has 31% installed capacity and Private Players have generation capacity of 21%. Thermal capacity has the dominant share at 65%, followed by hydro, renewable and nuclear. (Power Line, 2011)

1. Growth of the Power Industry

In the year 2010-11, the power generation was 809,495 million units and the Plant Load Factor (PLF), which is a measure of efficiency of the power plant, reached 75.08% in thermal plants. In spite of such growth in the sector, there was an overall shortage of 8.5% and a peak supply shortage of 9.8%. (Power Line,2011) Despite such tremendous growth, the per capita consumption of electricity is about 704 kwh per annum which is much lower than the world average of approximately 2,500 kwh.

Note 1: Demand Supply Gap of Electricity in India is presented in Annexure-1

2. Initiatives of the Power Industry

The government had plans to increase the power generation capacity by adding 78,700 MW during 11th five year plan. This addition in power capacity is expected to be achieved by using exhaustible and non-exhaustible energy sources. According to the reports on the Indian Power Generation sector, thermal fuel contributes to 64%, hydro contributes to 25% and nuclear power contributes to 3%. The concept of Ultra Mega Power Projects (UMPP) is initiated by the Ministry of Power with the agenda to set up power plants with the active participation of private and government sector. There have been a lot of initiatives relating to the induction of renewable energy technologies such as wind, biomass etc and presently, it contributes to 8% of the power generated. The country has exclusive Power ministry and it is the only country in the world to have such distinctions.
3. Change in the structure of the Power Industry

Public utility industries such as energy, transportation and communication have been under the control of Indian government for most part of the last century. The intention of regulation and control is to alleviate public fear that if allowed to be operated by the private sector, such firms in may use market power to have pricing decisions, thereby hurting the consumers and economy. But, many of the utility industries exhibited economy of scale leading to lowest cost of production. In recent years, most of the developed market showed a change in the industry structure. The change in the structure of Indian Power sector is given in Annexure-3.

1.5 Power Sector Reforms in India

Indian Power sector is expected to undergo significant transformation in the coming years. According to the Prayas report (2001), this change is driven by the needs of economic growth, needs of addressing climate change and the inherent complexities in the system.

- Need of growth- If India has to achieve its intended economic growth of 8-9%, consistently over the next decade, the power sector is likely to be the critical constraint and a driver. It is estimated that it a needs growth of 4-5 times over the current size of installed capacity, more to meet the growing demand of the utility.

- Climate Change- The large scale power generation in the conventional form of coal based thermal stations, is likely to impact the environment adversely, both on the mining side as well as on the utilization of coal for firing the thermal stations. It is critical for the sector to look at a variety of small and low carbon generators to encourage environmental protection. There may be an increasing need for mixing traditional fuels such as coal, hydro, oil, nuclear with low carbon generators.
The complexities in the system- The power sector has inherent complexities due to policy regime, the structure of the industry etc. and these complexities are enhanced due to technological advances in the area of generation, management, distribution etc.

The reform programme has adopted a phased approach with an intention of avoiding a possible large scale disruption due to sudden changes. The focus of the reform in each of the different phases of liberalization is:

- Phase one- Opening up of power generation to private players.
- Phase two- Initiating structural changes by establishing independent regulatory commission and restructuring the state electricity boards as independent utilities for generation, transmission and distribution.
- Phase three- Imitating operational changes by improving distribution through accelerated power developments and reform programs.

1. **Electricity Act, 2003**

The central piece of the power sector reforms programme was the Electricity Act, 2003. The key provisions of this act and the intended outcomes of these provisions were:

- The licensing for power generation- The Electricity Act, 2003 aimed to give a boost to power generation by freeing the generation utility from the requirements of obtaining licenses. This act encourages setting up of captive power plants which also resulted in many industries setting up power utility. The time taken for setting up the utility from proposal to the commission stage was significantly reduced.

- Non-discriminatory Open Access- While encouraging captive power generation in the country the Electricity Act, 2003 facilitated the generation of power by any industry for its own consumption. It also made provisions for such generation companies to sell the power to potential customers. By providing the non-discriminatory access for power transmission by payment of transmission charges for using central transmission system it facilitated the transmission of the power from a generation point to a captive consumption through existing network of power lines. With provisions for one to one or one to many or many to many generation consumption relationship, it aimed to meet the demand of multiple industries and trading between captive users and consumers.
Open access for captive Power generation- The electricity Act, 2003 also encourages captive power generation by allowing them to bypass Power Generation utility and sell power to potential users/buyers by paying the wheeling charges.

Non-discriminatory open-access – Potential users/consumers can avail non-discriminatory open-access to transmission/distribution utility by payment of surcharges for meeting the cross subsidy level and wheeling charges. With this, the consumers can benefit from choice of suppliers and availability of reliable quality of electricity.

Stand alone utility in rural areas- The act permits the setting up of generation/distribution utility in rural areas. This has resulted in potential private entrants into the business which enhances customer service and power quality.

Mandatory purchase from non-renewable energy source- The act is expected to encourage non-renewable energy sector by enforcing mandatory purchase by non-renewable energy source.

Multiple Players- This act brings competition in the sector by abolishing single player model. Competition among different players encourages efficiency and customer satisfaction.

2. National Electricity Policy, 2005

The electricity act was supplemented by the National electricity Policy 2005. Some of the key provisions of the National Electricity Policy, 2005 and the intended impact of these provisions are:

Universal Access to Electricity- Electricity is recognized as one of the key factors for the growth in the economy. The target was to provide electric power to all the consumers and locations by 2012. But, 44% of the population does not have access to electricity. In order to meet the above target, significant growth in generation and expansion of transmission and distribution was envisaged in the policy.

Availability of Power- Due to inadequacies in generation, Indian Power generation is facing a drift between supply and demand. High level of transmission and distribution losses has compounded the demand supply gap. The policy envisages improving the transmission and distribution losses and ensuring financial/commercial sustainability.
of power utilities through better pricing, controlling leakage to unauthorized users and enhancing the recovery.

- Supply of reliable Power- The policy envisages the supply of reliable and quality power to consumers in efficient and reliable manner.
- Protection of consumers- The policy encourages competition with appropriate control by regulations. It envisages that enhance competition would benefit consumers by facilitating uninterrupted quality power supply.
- Widespread use of information technology- The policy recognizes that the Power sector needs to follow information technology standards, network management systems and customer database for its operation. It recognizes that the applications of information technology can lead to better operation and control. Hence the policy envisages widespread use of information and communication technology which could lead to efficiency of operations and reduction in costs.

3. Accelerated Power Development and Reform Program (APDRP)

The follow up of the recognition of the role of Information Technology in power utilities and the recognition for faster adoption of these technologies in National Electricity Policy 2005, was the formulation of the APDRP. This programme was formulated with the following objectives:

- Funding the information technology related investments to network management, grid management, loss of reduction, customer billing management, modernizing the network etc.
- Rs 11.36 billion or 6.67 percent of the planned out lay for power generation/power utilities, was envisaged to be used for funding IT related investments.
- Special emphasis on projects to use IT for energy accounting and audit etc.
- Rs 100 billion was allocated for IT related projects across the entire spectrum of power utilities – power generation, power transmission and distribution, to meet the objectives of National Electricity Policy, 2005.
4. The Sector Setup

It is a well recognized fact that the subject of electricity is covered under the concurrent list in the constitution of India. This means that both the central and state governments have the power to make legislation concerning this sector. As a result, in the true spirit of the federal structure of the country’s political set up, all major issues affecting the power sector require concurrent action by the central government and state government. (Reliance Review of Energy Market, 2004)

1.6 Performance of the Indian Power sector

McKinsey Global Institute has studied and analyzed the Indian power sector from multiple perspectives – from policy to operations to engineering. According to McKinsey Global Institute (MGI) Report (2004) “India’s total factor productivity (TFP) is 34 per cent of the US in generation and 4 per cent in T&D. Overall TFP is 19 per cent of US levels, which is substantially lower than the potential productivity of 55 per cent at current factor costs. Some calculations show that India could achieve a potential TFP of 86 per cent of US levels in generation and due to much lower demand per consumer, 42 per cent in T&D at current consumption levels”.

The report brings out the fact that multiple factors contribute to the lower performance of Power sector. These reasons are categorized as internal and external factors. While the internal factors bring out the operational characteristics of the sectors, the external factors relate to influence of government policy, regulation and structure of the sector.

This report by MGI is one of the most detailed studies of the power sector and lucidly brings out the challenges facing the industry. A reading of some of these findings is essential for any research on Indian power sector. Some of the key findings of MGI report (2004) about Indian Power sector are:

1.6.1 Internal factors

Indian Power sector is influenced by some of these key internal factors:
1. **Excess manpower:** Excess manpower is attributed to influencing the productivity performance of the power sector badly. 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. 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. Overstaffing also exists in areas like security, where there are often over 100 people per plant compared to five persons in a US plant. Further, each Indian worker and operator in shift operations also has a “helper”, a redundant function that adds nothing to productivity.

2. **Poor organization of functions and tasks:** This is a reflection of how internal functions are managed in the Indian power sector. This is reflected in capacity utilization, deployment of manpower and cost to construct a plant. It is believed that the best of the plants in the Indian Private sector companies are as well organized as US plants. However, the SEBs have a low capacity utilization, are overstaffed and over engineered and often suffer from construction time overruns.

3. **Lower capacity utilization:** Overall, the plant load factor (PLF) for SEBs is 66.72 per cent compared to 86.12 per cent for central government-owned plants (Power Line, 2011). Three reasons in particular are put forward to explain the low PLF of SEBs:
   - Poor maintenance results in more frequent plant outages, especially partial outages at SEBs. While a large part of the partial outage is due to a lack of funds for R&M. Poor management also plays a vital part.
   - The time taken for planned maintenance at SEBs is higher than that for central government utilities. For example, it was higher by 50 per cent in thermal plants in 1997.
   - SEB managers are often unable to get coal on time while managers in many central government and private sector plants are able to do so, despite the labouring under similar constraints.
The poor management of SEBs was highlighted when a leading central government utility took over the management of three SEB plants. Without changing the workers and with only limited investments in plant renovation, the PLF in these plants rose by over 40 per cent instead of the expected 5-7 per cent.

4. **Inefficient deployment of manpower:** 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.

   - 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 does not happen often.
   - In maintenance, people are organized rigidly by function e.g., electrical, mechanical, control and instrumentation. The well managed 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.

5. **Over-engineering:** Redundancies and an absence of standardized plant designs are the two main examples of over engineering. Many of the plants in India have redundancies such as boiler feed pumps (either 2 x 100 per cent rating or 3 x 50 per cent rating, versus 2 x 60 per cent used internationally), ID pumps, FD fans, main pump, transformers and instrumentation equipment. Further, most Indian companies do not use a standardized plant design, which is both cheaper and more reliable. Instead, input parameters such as paint thickness, flue gas velocity in boiler, material to be used in chimneys etc. are specified in detail.

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

   - Lack of funds, primarily at SEBs, leads to suppliers delaying construction until arrears are cleared. In 1997, Panipat Station IV in Haryana, GHTP Station 1 in
Punjab, Suratgarh in Rajasthan, Rayalseema Station 2 in Andhra Pradesh and Tenughat Station 11 in Bihar, all cited paucity of funds as the reason for delays.

- Both state and central government utilities often delay tendering or order re-tendering, sometimes due to vested interests e.g., both Rihand and Ramagundam stations have witnessed long delays in the finalization of tenders.
- Finally, utilities rarely appoint a turnkey contractor, preferring the provision of different packages to separate sub-contractors instead. One large utility used to give 40-50 packages to different subcontractors leading to co-ordination problems in execution.

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

- Investments in Repairs and Maintenance (R&M) would help in a significant improvement of approximately 20 per cent (measured in terms of Peak Load Factors - PLF) of the capacity utilization of Indian plants.
- The lack of modern control and instrumentation results in the need for more staff. In addition to the control room for the main plant, the majority of the plants in India have local control rooms for auxiliary plants such as the circulating water pump room, compressor room, coal handling plant and ash handling plant. In fact, even within the coal handling plant, the wagon tippler and stacker are not controlled from the local control room. Each of these local control rooms needs to be manned.

8. **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.
1.6.2 The external factors

Poor corporate governance in the form of government ownership, primarily at SEBs, is the main external factor leading to low TFP in both generation and T&D. In generation, SEBs have the longest construction overruns and the lowest capacity utilization, leading to capital productivity in generation of 57 per cent against best practice of 85 per cent of US levels. Similarly, they employ an average of four persons per MW, compared to 1 person per MW at even the old private sector plants. In T&D, as mentioned earlier, thefts from SEBs are about 20-25 per cent compared to 2-3 per cent in best practice private sector companies. A poor regulatory framework, coupled with poor implementation, is the second factor responsible for low productivity.

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.

1. Government ownership leading to poor governance of SEBs: This leads to thefts, surplus staff, construction overruns, over-engineering, poor management, lack of evacuation capacity and under-investment in T&D and maintenance. SEBs, on average, performs much worse than other entities facing similar regulations. For instance, capital productivity in generation of SEBs is 57 per cent compared to 75 per cent at central government utilities, although both face a cost plus regulation. Similarly, T&D losses and thefts are approximately 35 per cent in India versus 11 per cent at best practice private companies. This is due to a lack of profit pressure, a lack of government funds for investment and a set of political and social compulsions.

- Lack of profit pressure/poor oversight by shareholders. Government ownership, especially in the form of a government department with political appointees, does not create pressure to avoid losses. Thus large scale theft continues, with some states having losses as high as 50 per cent. T&D losses and thefts also have other consequences. They are the primary reason for the SEBs going bankrupt and not investing adequately in maintenance and in T&D. Moreover, the lack of profit incentive also encourages over-engineering and construction cost over-runs, as the investment cost is not linked to the
benefits accruing from over engineering. As a result, the SEBs in 1999 suffered losses of over $2 billion.

The central government generation plants are better run because they are corporatized (as compared to the SEBs, which are departments of the state government), and there is less interference from the government. For example, an independent body called the Public Enterprise Selection Board (PESB) appoints the senior managers of the central government public sector units.

- **Lack of government funds.** Due to shortage of government funds, the state government does not recapitalize the losses of SEBs, which are primarily caused by theft. This prevents the SEBs from investing to upgrade existing plants or the T&D network.

- **Social/ Political compulsions.** The government’s social objective of providing employment leads to overstaffing and constrains capital investments. Further, it forces the SEBs to write off dues from farmers and other sectors such as the power loom sector.

2. **Poor regulatory framework:** Poor tariff regulation and implementation has led to low productivity and, thereby, high prices for paying consumers. In India, regulations do not force SEBs and central government-owned generators to compete with private players for setting up additional capacity. Further, the lack of independent regulators, until recently, allowed SEBs to pass on any level of operating costs and the costs of losses and thefts to the consumer.

3. **Poor implementation of existing regulations:** The lack of an independent regulator at both the central and state level is the primary reason for regulations being poorly implemented in India. Even when a regulator does exist, there is minimal pressure from the regulator to reduce prices.

Since their entry in 1999, the regulators at both the central and state level have not been able to bring down costs or increase efficiency substantially. For example, T&D losses are still above 40 per cent in states like Orissa or Delhi. Further, the norms for employee to MW ration still remain at one.
4. **Non-level playing field for private sector capital goods suppliers:** Purchase preference allows ill-qualified PSUs to match bids made by private firms, and to win contracts. Often these PSUs do not deliver on time. Similarly, Central PSUs get a 10 per cent price preference in all tenders, which add to the cost of a project.

5. **Indirect encouragement for intra-state, non-pithead projects:** The lack of clearly-defined wheeling agreements, the difficulty in setting up interstate projects and the benefits of using central government funding to set up power plants within a state encourage each state to vie for power plants. This leads to the setting up of more expensive non-pithead plants, and causes bottlenecks and delays in the transportation of coal because the already overburdened railways find it difficult to cope with.

6. **Factors limiting output growth:** All productivity barriers impact output indirectly, as raising productivity leads to a specific good becoming less expensive in real terms. In addition, some of the barriers mentioned above impact output directly. Government monopoly on distribution, for example, limits new generation capacity, as private players are loath to sell to bankrupt electricity boards. Thus, financial closure is extremely difficult to obtain. Similarly, poor governance of the government-owned SEBs causes large financial losses; the net impact is that the SEBs have no money to build new plants. Finally, the lack of a regulator leads to uneconomical tariffs. This last factor has also partly contributed to the poor financial health of some of the SEBs.

1.7 **Power Sector in Karnataka**

As Power generation scenario in Karnataka, (KPCL sources) Karnataka Power Sector has been recognized as the pioneer in the country in unbundling of the power sector. Karnataka electricity Board (KEB) was established in 1957 for the purpose of transmission and distribution and Karnataka Power Corporation Limited was set up in 1970 for managing the power generation activities. Many firsts to its tribute are

- The state has been a pioneer in the field of hydro electric power generation. The state was the first to recognize the potential of hydro power and carried out a survey of hydro power resources as far back as 1898.
The state was the first to have the largest hydro power station in Asia in 1902 at Shivanasamudram on the banks of river Cauvery.

The state was the first to have the longest transmission line in the world at that point in time from Shivanasamudram to Kolar Gold Fields, a distance of 147 km.

Karnataka is the first state in the country to conceive and set up a Corporation, which is efficiently managed. Karnataka Power Corporation Limited (KPCL) has the responsibility to plan, construct, operate and maintain power generation projects in the state.

One sixth of Karnataka is the Malnad Mountains (Western Ghats) possessing the two crucial requirements for hydroelectric power generation. They provide the following benefits for Power Generation – Heavy Rainfall and Sharply descending rivers. Both the east and west flowing rivers of the state take birth in the higher ranges of the Western Ghats. The west flowing rivers when compared to east flowing rivers are short in length and descend rapidly from great heights making them highly suitable for Power Generation.

The installed Power capacity in Karnataka is 9245 MW (As on 12-04-2010). Installed Capacity and Availability for 2007-08 and 2008-09 are shown in Table 1.

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<tr>
<td>KPC-Thermal</td>
<td>1598</td>
<td>1257</td>
</tr>
<tr>
<td>Private Producers</td>
<td>329</td>
<td>259</td>
</tr>
<tr>
<td>Central Generation</td>
<td>1270</td>
<td>958</td>
</tr>
<tr>
<td>NCE</td>
<td>1694</td>
<td>1765</td>
</tr>
<tr>
<td>Total</td>
<td>8302</td>
<td>5509</td>
</tr>
</tbody>
</table>

Source: KPCL Report, 2010

All units in MW
The installed power generation capacity has not been adequate to meet the increasing demands of industrialization and agricultural requirements of the state. The state has been purchasing power from central Thermal Station as well as from neighboring states to meet the excess demand. Even though the state is having a hydro potential, due to environmental issues, resettlement problems and Inter-state River water disputes, the substantial portion of the potential remains unexploited.

In the late sixties, the phenomenal demand for electricity necessitated systematic efforts by the state to increase the availability of electric power. This resulted in the inception of KPC in July, 1970. Karnataka has the distinction of being a pioneer, the first state in the country to conceive and institute a professionally named corporation to own, construct and maintain power generation projects. Karnataka Electricity Board is mainly vested with the function of transmission and distribution of electricity. Within 30 years of inception, KPCL has proved that it is a front runner in power generation by fulfilling 75% of the State’s power requirements.

1.8 KPCL(Karnataka Power Corporation Limited)

Karnataka has been pioneer in the country to form a separate utility for power generation. Called Karnataka Power Corporation Limited (KPCL), the utility was set up in 1970 with the mission of maximizing Power Generation by identifying and developing opportunities in power generation and establishing and operating power plants. Previously, Karnataka state owned electricity organization was known as Karnataka Electricity Board (KEB) which was responsible for all aspects of the power sector in the state.

Karnataka has access to vast water resources. As a result, hydro power accounts for two-thirds of KPCL’s operational capacity of 5,009 MW, making it among the top five state generation companies in terms of installed capacity.

Note 4: Major hydro power station in Karnataka is presented in Annexure-4
By 2017, KPCL plans to almost triple its installed capacity, of which 7,500 MW would be coal based. It currently owns and operates 20 dams and 25 power stations across the state, including Vishveshvaraya Vidyuth Nigama Limited’s four hydro stations which total 226 MW and the 128 MW Yelahanka DG plant, that were transferred to KPCL in 2006-07.

Since KPCL has exploited most of the state’s large hydro potential, it is now looking at adding thermal capacity to meet the increasing demand, driven primarily by industrial growth. During the Tenth Plan Period, KPCL added 500 MW of hydro and coal based capacity as against a target of 1,000 MW. It has planned 1,980 MW of new capacity for the Eleventh Plan period. This could be scaled up to 3,340 MW if the Bidadi gas project is completed during the plan period. For the Twelfth plan period, it has firmed projects totaling an additional 2,600 MW. But the key challenges in developing new coal-based capacity could be securing timely and adequate linkages of quality coal and water, land acquisition and dealing with resistance from environmentalists.

**KPCL Power projects in Karnataka**

The following are the different power projects being built and managed by KPCL

Note 5: Major Power Stations and KPCL Power Projects are presented in the Annexure-5 and Annexure-6

KPCL has the vision to generate power through diversified portfolios. The following section deals with power generation through exhaustible and non-exhaustible resources.

**Power Generation through exhaustible resources**

- **Thermal Projects**: KPCL’s first thermal plant – Raichur Thermal Power Station (RTPS) – was set up in 1985. Currently, it has an installed capacity of 1,470 MW. The last unit (RTPS Unit 7) was commissioned in 2006-07 in a record time of 25 months. The corporation has added Unit 8(250 MW), which is commissioned in October 2009.

For fuel, KPCL has supply linkages with Singareni Collieries Company Ltd. (Andra Pradesh), Western Coalfields Ltd. (Maharashtra), Mahanadi coalfields Ltd., Talcher
(Orissa) and South Eastern coalfields Ltd. (Chhattisgarh). Coal receipt during the year 2007-2008 was 72.41 lakh tones to ensure PLF at 84.22%. The coal required to operate all seven units, at full load, is around 23,000 MT per day.

In terms of performance, RTPS has been generating over 10,600 MU s on an average, during the past three years. With the commissioning of Unit 7, the plant load factor (PLF), improved to almost 90 percent in 2006-7, compared to 71 percent in 2005-6. In 2007-08, RTPS recorded a PLF of over 84% with the generation of 10.875MUs. During the past four years, auxiliary consumption has been hovering at over 8 percent, which is close to the national average. KPCL is trying to achieve 100 per cent fly ash utilization by the end of the eleventh Plan period.

Bellary Thermal Power Station (BTPS) – BTPS is located at Kudatini, Bellary District. The first-ever 500-megawatt Bellary Thermal Power Station, was synchronized on 2008. It has been generating over 500 MW. BTPS has been allotted mines in Nagpur to meet the coal requirement of the plant.

- **Hydro Projects**: The Corporation’s biggest hydro project is the 1,035 MW Sharavathi project which generates around 5,000 MUs annually. The corporation operates Sharavathi as its master station to control all peripheral stations including the 55 MW Linganamakki and the 240 MW Gerusoppa stations, to optimize generation through systematic integration of several reservoirs. On the river Kali, the corporation operates 100MW Supa, the 150MW Kadra, 120 MW Kadasalli and 150MW Nagjhari project. Varahi hydro Electric project comprises of two units of 115MW each. In order to augment the peaking capacity, implementation of the Varahi Hydro Electric Project Stage II (2X115MW) is taken up.

- **Diesel Generation Projects**: The Diesel Generation (DG) Plant has generating capacity of 127.92MU.
Non-Exhaustible Energy Resource

- **Wind Power Projects**: The various renewable energy sources, generation of power from wind energy is assuming great importance. Tapping of wind energy earnestly started during the seventies and the development has been encouraging in this field. Karnataka has made significant progress in this field in harnessing wind energy sources. Wind power generation in Karnataka is supported aggressively by policy mechanisms. Karnataka State Regulatory Commission has stipulated a minimum of 5 percent and a maximum of 10% of electricity to be sourced from renewable sources.

The wind power generating station at Kappadagudda which is 2.5 Km stretch of Kappadagudda hills has 4.55Mw capacity. The station is situated at about 30 kilometers from Gadag city of Gadag District, Karnataka State.

- **Solar Projects**: KPCL operates solar projects at Yelasandra Solar PV Plant, Kolar Dist and Itnal Solar PV Plant at Belgaum District having installed capacity of 3 MW each. The 3MW solar photovoltaic plant has the distinction of India’s biggest solar plant in the country as per the year 2010. KPCL has plans to establish 10 solar power plants at Shimoga, Kaginele, Mandya, Bijapur, Haveri, Mysore and Tumkur, under the Jawaharlal Nehru Solar Mission. (Santhanam, 2010)

1.9 Context of the research

The electricity supply industry in India operates under government control. The financial and operational performance of the down stream transmission and distribution activities, since they are under heavy government influence, is one of the biggest challenges facing the electricity supply industry. The electricity distribution function is prone to varying degrees of political interference with populist objectives influencing day to day operations as well as tariff setting.
Despite the economic reforms introduced in 1991, India’s power industry has not been able to reach an adequate level of electricity supply. In 2003-2004, India had an energy shortage of 7.1% and a peaking shortage of about 11.2% and in 2010-2011, peak electricity supply fell short by 9.8% and there was an overall shortage of 8.5% in supply.

While India’s installed power generation capacity was 1,80,358 MW as on July 31, 2011, the country still needs an additional 100,000 MW to meet the growing demand for electricity over the next 8-10 years. According to industry estimates, domestic and foreign private companies will need to invest a total of about $100 billion in power projects to bridge this deficit.

As mentioned earlier, the power sector has to address both the internal factors and the external factors to enhance its performance. The internal factors would lead to operational excellence as mentioned earlier. It is quite evident that the external factors would generally lead to more competition, regulation and investment. However as Michael Porter highlights, competition alone would not enhance the productivity and competitiveness of an industry in a country. So it would be very critical to look at the mechanisms to enhance the productivity of the power sector in India through operational excellence as well.

Research literature and the analysis of the status of Information Technology in the Indian Power Sector are not wide spread. Although there have been substantial investments in the IT related areas by the power Sector, it is not clearly evident whether these are accompanied by a clear strategy for enhancing operational efficiencies or enhancing customer satisfaction.

What type of Information Technology investments can lead to performance improvements and how to measure the effective usage of Information Technology remains one of the key research topics. This understanding is critical in the formulation of strategy for Information Technology investments. The essential thing would be to relate the usage of Information Technology to increase the business performance. This has been addressed differently for different sectors. This understanding is essential for any exercise of formulating an Information Technology Strategy.
Some of the key research questions to be answered in the process are:

- Has the usage of information technology influenced the productivity and performance of power generation?
- Has the usage of information technology in the power generation resulted in quality and project management?
- What is the current use of information technology that would result in efficient performance of operations in the generation side?

This research study intends to find answers to these questions in a systematic fashion by developing frameworks, gathering data, analyzing them and formulating the conclusions based on data and research findings.

1.10 Research Study Design

The following are the key activities and milestones of the research project

- **Literature Survey** - The literature survey is intended to look into the different frameworks used to understand the Information Technology Investments and the impact of the investments on the company performance. Since this area is covered extensively by the researchers of Information Technology Strategy, the literature survey is likely to concentrate on this area.

- **Formulation of Hypotheses**: The key output of this activity aims at formulating a set of hypotheses on the impact of Information Technology on the performance of power Generation Company.

- **Formulation of questionnaire**: The output of this activity is a set of questionnaire, checklist and schedules to collect data on power Generation Company.

- **Data collection**: Collection and compilation of data / information on Generation Company, in a structured fashion.

- **Data analysis**: The data on the power generation company is analyzed based on key parameters developed earlier, to assess the impact of Information Technology.
- **Formulation of conclusions**: This phase focuses on formulation of conclusions based on the results of the analysis and formulating guidelines which will help policy makers as well as organizations in policy making and strategy formulations.

**Chapter Summary**

This chapter described the background of the study and the performance of the Power Sector. The chapter provides description of electrical power as a product and sector. The structure of Power sector in India, Karnataka and KPCL in particular are studied. Based on the understanding of the sector and the background, context of the research and research design are formulated.
References

15. McKinsey Global Institute, various reports on India and its different sectors.