MIS ORGANIZATION FOR THE POWER SECTOR

A PROJECT THESIS BY

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CERTIFICATE

This is to certify that this work has been done by me and it has not been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

One of the main factors towards attaining the desired economic growth of the country is increase in per capita consumption of energy which is today widely accepted as an important indicator of the state of economic development of a country. This is still very low in the country compared not only to the developed countries but also to many developing countries.

Electricity is the most convenient form of energy for all production purposes of a country consumption of which is also very low in Bangladesh. It is believed that this sector will grow faster than any other sector of the economy Modern management techniques are essential to the desired goals.

Information network, specifically the MIS has been considered as the management tool for this work. An MIS organization has been proposed, which is expected to lead to the creation of a data base.

Recommendations have been given for the design and implementation of the MIS organization for making it compatible with the future development objectives of the power sector.

ABBREVIATIONS

MIS	-	Management Information System
BPDB	-	Bangladesh Power Development Board
GDP	-	Gross Domestic Product
GNP	-	Gross National Product
GWP	-	Gross World Product
KgOE	-	Kilogram Oil Equivalent
BOGMC	-	Bangladesh Oil, Gas and Mineral Corporation
TCF	-	Trillion Cubic Feet
LPG	-	Liquefied Petroleum Gas
GwH	-	Giga Watt-Hour
MW	-	Mega Watt
MWe	-	Mega Watt Electrical
KwH	-	Kilo Watt-Hour
TwH	-	Trillion Watt-Hour
IEA	-	Institute for Energy Analysis
OECD	-	Organization for Economic Cooperation and Development
IIASA	-	International Institute for Applied Systeme Analysis
MTOE	-	Million Tons Oil Equivalent
WAES	-	Workshop on Alternative Energy Strategies
MBDOE	-	Million Barrels per Day Oil Equivalent
DSS	-	Decision Support System
DPS	-	Data Processing System
DBMS	-	Data Base Management System
NEC	-	National Economic Council
ECNEC	-	Executive Committee of National Economic Council
CNG	-	Compressed Natural Gas
MMCM	-	Million Million Cubic Meter
BPC	-	Bangladesh Petroleum Corporation
ERL	-	Eastern Refinery Limited
REB	-	Rural Electrification Board
DESA	-	Dhaka Electric Supply Authority

IBRD	-	International Bank for Reconstruction and Development
ADB	-	Asian Development Bank
USAID	-	United States Agency for International Development
EMISU	-	Electricity MIS Unit
KV	-	kilo Volt
MVA	-	Million Volt Amperes
KM	-	Kilo Meter

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CHAPTER 1

INTRODUCTION

1.1 Information System of Energy Sector: an Overview

Overall socio-economic development of a country depends on the success in increasing quantity of national production, in improving its quality and in elevating the standard of living of the people. Development of an infrastructural sector like energy is considered as a pre-requisite for attaining such goals. Because of the overwhelming importance of energy, its per capita consumption is now widely used as an important indicator of development as regards to other economic parameters like GDP.

Relationship of the energy sector with development goals of Bangladesh is discussed briefly in Chapter 2. It is shown that the energy sector has to grow faster than other sectors in the process of overall advancement of the country. Analysis of the present energy scene of the country, as outlined, not only identifies that per capita consumption of energy in Bangladesh is one of the lowest in the world, but also asserts that non-commercial sources of energy feature predominantly in the energy supply-mix. Supply of such fuels, apart from being less effective and efficient in use for production purposes, has limits on their potentials towards increase in future. Thus most of the future increase in demand for fuels have to be met by commercial fuels and the development of the sector will also depend on the success in their conversion and penetration into all types of end user sectors. It is also established that in order to ensure the attainment of the development goals of the country proper energy planning is necessary both in long-term and short-term perspectives. In particular, the country will have to evolve an optimum energy-mix to ensure desired development of this sector. Evolution of a long term strategy on the fuel-mix has far reaching impact on the growth of the sector. Such a fuel-mix could consist of commercial sources such as oil, gas, coal and nuclear; non-commercial fuels such as bio-mass; and renewables such as solar energy, hydro-electricity, etc. For such and other crucial decisions to be made, a basis of appropriate technical and socio-economic considerations are required. The process of decision making for the energy sector is rendered difficult because, projects of this sector require long gestation periods and their economic and useful lives are usually longer than projects in other sectors. Such decisions depend on a complex set of input variables and factors. Availability of a proper data base and information system in this case can hardly be over emphasized.

Sophisticated contemporary management techniques have been applied profitably in many countries especially in the developed countries for making effective institutional arrangements for the creation, maintenance and development of a reliable data base leading to better decision making. One such management system is " MANAGEMENT INFORMATION SYSTEM (MIS)". The MIS has been described in details in Chapter 3. It is seen that the primary purpose of using MIS is to raise the process of management from the level of piecemeal unreliable data and isolated problem solving methods to the level of sophisticated data processing and systems information. MIS provides a system of information suitable for the creation of a reliable and exhaustive data base and is a powerful method for managerial decision making and problem solving. It is connected to the operating data base and passes on consolidated and upgraded information, selective reports for planning and control of operations, exceptional circumstance reports for planning, controlling and decision making to the appropriate level of management in the organization.

In view of the present weakness in data base and information facilities as related to the energy sector of the country and in consideration of its importance in the overall economy, it is felt prudent to improve upon this information system. This can be greatly facilitated if there exists an analytical and reliable data base and proper and useful management techniques necessary to create, maintain and develop such data base which would include data acquisition, processing, transfer, storage and retrieval are available. It may be added that the country has to depend on different agencies of external financing for materializing its development projects. This can be done by developing an appropriate and system oriented MIS for the energy sector.

A brief outline of the overall structure of the energy sector of Bangladesh is presented in Chapter 4. It may be seen that different organizations in the public sector are involved in the entire range of energy related activities. A review of their existing institutional structures revealed their weaknesses as related to information system. It was felt that the institutional as well as the inter-sectorial information base was required to be strengthened in order to make them compatible with future needs.

1.2 Problem definition

The energy sector is very complex in its structure, consisting of various technologies; fuels, having different sets of problems associated with conversion and transportation; the varied groups and categories of end users; different price structures and other variables. Electricity is a priority sector in energy and its future growth is expected to be higher than any other sector of the economy. Consequently, the need for the development of an appropriate information system for its management can be considered to be very important. As such development of such a information system has been considered in the present work.

The present organizational structure of the Bangladesh Power Development Board (BPDB), which is the focal agency of this sector has been analyzed from the point of view of information management. This is presented in Chapter 5.

1.3 Aims and Objectives

It is the aim of the present work to closely study the power sector development of the country by analysing the existing institutional structure, the existing mode of information gathering and the present state of the power sector database.Thus to asses their strengths and weaknesses from an entirely management point of view. With this in mind establishment of an MIS organization for the power sector of the country has been proposed so that the existing and future power related data can be properly organized with a view to creating a reliable and institutionalized database for use in strategic and policy decision making. It is also understood that if proper organizational arrangements for assessment, updating, and validation of the available data could be set up it would help in achieving the desired coordination and integration between the data sources and the users. This would also result in better decision making based on reliable information which in turn would lead to a more efficient development of the power sector of the country.

1.4 Brief outline of methodology

It has been sought in the present work to apply MIS for creation of an adequate, reliable and appropriate data base system for the electricity sub-sector of energy sector of the country the proposed MIS organization is be incorporated into the existing structure of the BPDB. This proposed organization is intended to act as the data base or data centre of the power related data of the country. Details of this proposed organization along with its information network and contents of the data base have been included in Chapter 6.

The development of a central MIS organization for the entire energy sector for the creation of the comprehensive energy data base is a possibility, but this could not be taken up in the scope of this present work due to various limitations. However, some guidelines for the future possible development of a MIS organization for the whole energy sector may be found in the recommendations and conclusion of this dissertation. It could be included in the scope of any further work in future.

CHAPTER 2

ENERGY AND ITS ROLE IN DEVELOPMENT

2.1 Energy and Development

Energy apart from being the fundamental element of physical and chemical activity is also considered to be a vital source of economic power. Role of energy in socio-economic development has been becoming predominantly important. The importance is manifested in the fact that energy is a vital prerequisite for not only alleviating the want but also raising the standard of living and improving quality and increasing quantity of production of a country. Influence of energy on development of a country has now reached such a level that its per capita consumption is widely accepted as an important indicator of development of a country along with other economic indicators.

The global energy - GDP regression analysis will indicate that there is a positive correlation between economic performance and energy consumption [1]. The need for a fast growth of energy in the developing countries is overwhelming because of the existing low level of consumption and also for catering to the need in a situation of fast growing industrial sectors of such countries.

Energy sources commonly in use are broadly classified into two groups, namely noncommercial and commercial energy. The former, which are renewable in nature and of bio-mass type in origin, can not be marketed in an organized way. These fuels are used mainly for living at a subsistence level and has but limited application in production related activities. The commercial sources, on the other hand, are most useful form of energy for industrial production, can be transported and distributed efficiently and technologies exist for their efficient conversion into useful forms of end-use. It is regarded that consumption of commercial energy, both primary and secondary, is more directly related to economic development of a country.

2.2 Energy and economy

The linkage between energy and economic development is a complex process and is often imperfectly understood. The basic and readily available denominator of economic growth, the Gross National Product (GNP), is now considered insufficient for fully measuring the productivity or development of any country [2]. Historical evidence shows that world energy demand has on the average increased at almost the same rate as Gross World Product (GWP) with some variations in different periods of time [3]. Cross sectional data also supports the view that there is an evidence of a close relation between energy consumption and GDP.

The economics of energy is concerned with the way in which relationship between economy and energy price changes through time and varies from country to country or from one geographical location to the others, and the way in which it may be affected by changes in energy prices and also by changes in other factors of production. Implications of availability of energy and uncertainties in future energy prices make the strategies for economic development difficult to formulate.

Sustainability of global economic development appear to depend largely on the global energy perspective. Energy coefficient, which is the ratio between per capita energy growth rate and economic growth rate may be used in assessing economic state of a country. It is, however, difficult to suggest a rigid or empirical correlation because this co-efficient depends on various conditions such as, status of development of a particular country under consideration, present energy consumption levels, resource potentials and / or constraints, national goals and objectives, international market, energy prices and availabilities, etc. As such, it is often deemed useful to compare the energy situation of a country with the past trend of development in different other countries , which have already passed through a similar phase of development and associated constraints.

In the industrialized countries where energy consumption has attained a near saturation level and most of the energy supply consists of commercial fuels, the energy coefficient is nearly unity. The situation is completely different in the case of the developing world where factors such as, need for rapid industrialization, decline in relative importance of agriculture and substitution of commercial by non-commercial fuels, lead to an increased energy co-efficient as presented in Table 2.1. However, with improvement in economic situation structural changes become slower, and so commercial fuels start to dominate in the supply-mix, and the coefficient tends to decline towards unity gradually.

2.3 Energy scene in developing countries

Energy scene in the developing countries is inherently complex and this limits evolution of strategies for development of this vitally important infrastructural sector. In the supply side, the fuel- mix is usually dominated by non-conventional fuels such as agricultural residues, plant bio-mass and animal wastes, etc. Supply of fuel is thus influenced by agricultural productivity. In view of the limitations and scopes for increasing agricultural production (Law of Diminishing Return), switch to high yielding

Table 2.1 GROWTH IN ECONOMY AND ENERGY DEMAND (1960-72) [4]

Region	Economic Growth (%)	Energy Demand Growth(%)	Energy Coefficient
OECD	5.00	5.00	1.00
USSR	4.50	5.40	1.21
East Europe			
Developing			
High	6.40	6.90	1.08
Middle	5.50	8.90	1.63
Low	3.80	5.20	1.37
All Developing	5.60	6.80	1.21

varieties of crops took place. This resulted in yielding of less bio-mass associated with such crops with shorter stem. A stage is thus attained at some point in time, when supply of such fuels can no longer match the increasing demand. This eventually has initiated deforestation as the gap between demand and supply is attempted to be bridged by increasing the use of wood and plant bio-mass. Such a situation would in its turn result in serious problems in maintaining the ecological balance and mitigating climatic adversities.

It is difficult at this point of time to ascertain the demand and supply of bio-mass and to develop a reliable data base for these fuels. Usually statistical data on supply or demand for such fuels are generated on the basis of sample surveys. This approach has its inherent limitations because true picture of the population could not be properly reflected. Consequently inaccuracy in data generated would remain. For example, according to different statistics, non-commercial fuels account for 60-80% of total energy consumption of Bangladesh [4, 5]. The resulting divergence in the form of such a wide range is explained due to lack of reliable data on supply of traditional energy sources.

Non-commercial sources of energy are used mainly for living at subsistence level and these have a limited application in production processes. Though these fuels are renewable, their supply is limited and they generally have a very low conversion efficiency. In the country, presently a whole range of such fuels are being used. In future their per capita availability could actually decrease due to population growth and attainment of the saturation level in the supply side. Experience of other developing countries who have already passed through such a phase, shows that the traditional fuels are usually replaced by commercial fuels, as the latter are more appropriate for increasing production, for improving the quality and life standard of the people [1]. Such transition (fuel-switching) in developing countries was made doubly difficult with the advent of the energy crisis of the 70's and 80's. This had ultimately resulted in serious impediments to the endeavours of such countries in attaining goals of economic emancipation.

2.4 Energy crisis and its effects

World development of the past two decades has been influenced strikingly by the increase in price of petroleum products in the international market. In effect, this had resulted in an unprecedented economic recession all over the world. This, in its turn, had led to a new global economic order. Two major price increases had occurred, one in 1973-74 and the other in 1979-80, which had forced many countries to re-adjust their strategies and plans of development [6]. Several other factors in association made this period a unique era in the recent history of interactions between energy and economic development.

Energy problems mainly stemmed from the wide gap between demand and supply. Drastic increases in price of fuels and the uncertainties in prices of petroleum products forced the developed and the developing nations to substantially reduce the growth in demand for energy. In the developed countries such measures were realized through a structural change in the pattern of energy use. Consumers in such countries were already using more energy per capita as a legacy of the days when the energy resources were cheap and abundant. Such countries thus had scopes for reducing certain portion of their indiscriminate end-uses. For example, in the past and especially when generation of electricity became cheaper due to the use of nuclear power, people in the United States were even thinking of heating their drive ways in the winter by electricity. Due to cost economic considerations many technologies of energy conservation and of improvement of efficiency of energy conversion suddenly became economically attractive. Thus by adapting new measures and techniques of better demand management, the developed countries were relatively successful in overcoming the initial difficulties. Infrastructural and technical bases available to such countries made it easier for them to adapt to the reality of finiteness of commercial fuels. In contrast to this, the developing countries with weaker technological bases and limited resources, found it more difficult to readjust to the crisis and had to drastically reduce their development targets. It is also equally true that alternative technologies like nuclear power also played a significant role in moderating the affects of energy crisis in the developed countries.

A comparison of per capita energy consumption levels in various categories of countries would testify to the inherent correlation between energy and economic performance. It is seen from Table 2.2 that in Europe, USA and Japan the per capita energy consumption is around 8,000-10,000 Kg Oil Equivalent (Kg O E) per year while in most developing countries energy consumption is less than 500 kg oil equivalent per year.

2.4.1 Energy crisis and its effects in South Asia

The situation in the countries of South Asia represents an interesting case study, which shows some similarity in the problems confronting them - namely, increases in oil import bill as a percentage of national exports (Table 2.3). The incremental cost does not however correspond to the growth in energy consumption over the same period. Shares of different primary energy sources in the total consumption of commercial energy on an

TABLE 2.3 PETROLEUM IMPORTS AS PERCENATGE OF TOTAL EXPORT (1973-1983) [8]

Region	1973	1974	1975	1976	1977	1978	AVERAGE	1979	1980	1983
BANGLADESH	6.8	20.7	25.1	30.1	45.5	32.3	33.3	27.0	17.0	20.0
INDIA	9.0	17.6	31.1	24.6	25.4	28.5	27.5	43.0	81.0	49.0
NEPAL	21.1	20.6	16.7	17.2	24.6	22.7	20.3	43.0	10.0	
PAKISTAN	6.8	13.7	32.0	32.4	35.1	33.3	33.2	33.5	52.0	49.0
SRI LANKA	11.2	25.8	21.9	24.1	20.9	18.2	21.3	47.0	45.0	40.0

oil equivalent basis in the five South Asian countries is given in Table 2.4. It is seen that these countries had made serious endeavours to switch fuels to overcome the problem of uncertainties in availability and price of petroleum products in the international market. This can be interpreted as a part of their strategy to ensure energy security in both short and long term perspectives. In case of Bangladesh, for example, dependence on imported petroleum products was reduced by replacing them with indigenous natural gas, with the result that relative positions of petroleum product and natural gas had more or less reversed between 1970 and 1983. Such strategy was undoubtedly successful in short term perspective as the country could increase its energy consumption base in spite of the serious global energy crisis. It is, however, to be seen how this strategy works in long term perspective because such a fuel replacement will reduce the reserve life time of the known gas reserves. Other countries also achieved reduction of dependence on petroleum in varying degrees with corresponding increase in use of natural gas, or hydro or nuclear power or a combination of them.

2.5 Indigenous energy resources of Bangladesh

Reserves of indigenous primary energy resources of the country can not be considered adequate to meet the ever increasing demand for energy. However, it may be noted that the present energy consumption base is very low, which has to attain fast growth. This is required for attaining the socio-economic goals. Exploration, appraisal and production of energy resources are in general capital intensive and bear high financial risks. This is partly impeding development of the indigenous energy resources. The geological formation and terrain of the country could also reduce possibilities of large scale harnessing of certain types of energy resources. The currently known energy resources of the

TABLE 2.4 SHARES OF DIFFERENT FUELS IN COMMERCIAL ENERGY (1970-83) [8]

COUNTRIES	1970				1978				1983			
	COAL	OIL	NAT. GAS	HYDR NUCL	COAL	OIL	NAT. GAS	HYDR NUCL	COAL	OIL	NAT. GAS	HYDR NUCL
BANGLADESH	3.0	57.2	38.2	1.7	10.5	50.5	37.5	1.9	2.8	36.4	59.1	1.7
INDIA	73.7	22.1	0.7	3.6	65.6	28.2	1.6	4.6	68.4	25.5	2.1	4
NEPAL	0.6	90.2	-	3.7	6.2	80.7	-	13.0	29.5	55.7	-	14.8
PAKISTAN	11.8	48.5	36.5	3.2	6.3	39.9	48.6	5.1	8.4	35.6	50.1	5.9
SRI LANKA	1.3	94.0	-	4.7	0.2	90.3	-	9.5	1.4	91.5	-	7.1

country include natural gas, coal, peat, liquid hydro carbon and hydro-electricity . Of these, only the reserves of natural gas are of some significance. Other resources are at various stages of exploration, appraisal and exploitation. One more peculiarity of the country is that it is divided into two almost equal halves by the system of rivers and their tributaries. These two zones, known as the Eastern and the Western Zones, are physically separated. The two zones are, however, inter-connected electrically by an electrical inter-connector. All the known reserves of gaseous and liquid hydrocarbons are located in the Eastern Zone, while Coal and this Peat occur mainly in the Western Zone. Such a distribution of energy resources had an effect on the historical growth of energy consumption and pattern of energy uses in these two zones. The Eastern Zone has developed on the supply side an energy-mix depending predominantly on indigenous fuels , while imported fuels are prominent in the the Western Zone. A brief account of the indigenous resources is given in the following sub-sections.

2.5.1 Natural gas

There exists a wide range of opinion about the total reserves of natural gas in the country. In an earlier study of Bangladesh Oil Gas and Mineral Corporation (BOGMC) total reserve was estimated to be 13 Trillion Cubic Feet (TCF) from 14 on-shore gas fields in the Eastern Zone and one off-shore location at Kutubdia. The on-shore reserves are located at Bakhrabad, Beanibazar, Chatak, Feni, Habiganj, Kailashtila, Kamta, Rashidpur, Semutang, Haripur (Sylhet) and Titas. More appraisal and exploratory drilling are required in ascertaining the extent of the ultimately recoverable gas. According to a recent Planning Commission document, the total reserve of gas is 37 TCF of which 25.66 TCF is estimated to be ultimately recoverable [9].

It may be mentioned that gas reserve has been discovered over a period of 35 years and it is generally believed that more deposits can be found in course of time. To achieve such a prospect, huge investments have to be made in the entire range from gas exploration to its final exploitation and production if the information on resource base of the country has to grow. Such undertakings are capital intensive and have high financial risks. On the other hand, conflicting information on gas reserves not only hampers detailed project planning of gas development, but also affects setting targets for development of other complimentary sectors which use gas either as fuel or as feed-stock.

2.5.2 Coal

The role of coal in the energy sector is not very significant. The traditional end-users, like railway locomotives, brick burning, power production, etc. have generally switched over partly or totally to other fuels, such as petroleum and natural gas. Presently the entire required quantity of coal is imported, although there are deposits of coal in the northern part of the country at Jamalganj in Bogra district and Barapukuria in Jaipurhat district. The reserve of coal at Jamalganj is estimated to be 500-1000 million tons lying at a depth of about 1000 meters. It is believed that mining of this reserve is not presently viable technically and economically. The other deposit in Barapukuria with an estimated reserve of 300 million tons is considered to be more favourable for exploitation. The depth of the deposit is 160-330 meters. Potentials for annual production and its end-uses, including power production, will become clear after the completion of the detailed techno-economic studies, which are being carried out at present. Environmental aspects of mining and various end-uses need to be assessed properly before it can be exploited.

2.5.3. Peat

There are evidences of peat deposits in greater districts of Faridpur and Khulna . The reserve is estimated to be 133 million tons oil equivalent . There are some other smaller deposits scattered over a large area with an additional estimated reserve of 470 million tons oil equivalent. All these locations are fertile being used for agricultural activities and are inundated during the monsoons. As such reclamation of land after mining, drying of extracted peat, briquetting and logistics of handling, transportation and distribution of peat in various urban and rural locations need to be carefully considered before decision is taken for its mining. Peat is generally suitable for meeting demands at household level and also in small scale industries as a replacement for fire wood. Potentials for use of peat are being assessed keeping such constraints and advantages in view.

2.5.4. Liquid hydro carbon

Geological formation of the country, its neighbouring areas in Burma and India and the existence of natural gas indicate that there is a possibility of finding liquid hydro carbon in Bangladesh. Exploration activities have, however, been impeded by resource constraints. Recently a small deposit has been discovered indigenously at Haripur in Sylhet. The production well is providing about 600 BBL of crude per day. The total reserve of this field has not yet been estimated conclusively. The Government is encouraging production sharing arrangements with intending foreign companies for exploration of petroleum products in the country to share both the financial inputs and the associated risks.

In addition, some of the gas fields in Bangladesh have high content of associated liquid hydrocarbon in the form of condensate. Condensate in some fields are being separated and distilled to motor spirit. Moreover, efforts are underway to set up plants to recover Liquefied Petroleum Gas (LPG) from some of the gas networks. This will be made available to the rural and urban consumers for use for cooking as a substitute for Kerosene and different bio-mass.

2.5.5. Hydro-electricity

A huge volume of water flows through the plains of Bangladesh annually. However, this flow is not considered suitable as hydro-power because of the associated low head and thus lower potential energy. Presently the Kaptai site on the river Karnaphuli is being utilized for generating electricity. Though the catchment area of the dam is large, the annual generation is limited to only about 900 GWh. Enhancement of generation from this site is limited by ecological and social constraints. The total capacity installed at this site is 230 MW and the plant is being used as a peaking unit for facilitating better demand management of the national grid of the country. Exploitation of other potential sites is hindered by problems like displacement of people, ecological considerations and allocation of water for navigational and other economic activities down stream of the dam.

2.6 Energy Consumption in Bangladesh

The average per capita consumption of commercial energy in the developing countries is about one-twentieth of that of developed countries. It is even lower in the case of Bangladesh, about one-fortieth of the world average and about one-tenth of the Asian average [10]. Present total generating capacity in the country is about two thousand MWe and per capita generation is only about 63 KWh. Information on per capita GNP, commercial energy consumption and electricity generation in different countries for the year 1986 is shown in Table 2.5. It reinforces the view that per capita level of energy consumption in Bangladesh is very low, in fact one of the lowest in the world.

A look at the global energy balance indicates that 23 industrialized countries accounted for about 51% of the estimated 351 exajoules of primary energy consumed in 1987 [11]. In the same year these countries consumed 56% of the estimated 10,100 TWh of electricity generated globally. This is shown in Table 2.6.

There are legitimate explanations for such a low base of energy consumption in Bangladesh. Development during initial years of independence was hampered due to factors such as, need for emergency rehabilitation task following the war of liberation, global energy crisis and constraint of financial and physical resources. It has, however, still been possible to increase the generating capability of the national grid by 120 % over the last decade. It is believed that demand for electricity still remains suppressed due to the supply constraint.

2.7 Global Energy Demand

Growth in the demand of primary energy resources of the world was phenomenal during the period from the end of the second world war up to the 1970's. Cheap and abundant supply of fossil fuel, especially crude oil, triggered this unprecedented growth in demand for energy. It has been estimated that in the 1950's and 1960's energy demand grew at rates exceeding 5% per annum especially in the developed countries. This trend slowed down following the energy crisis, through austerity measures manifested in innovation and adaptation of various techniques of energy

Table 2.5. PER CAPITA INCOME, COMMERCIAL ENERGY AND ELECTRICITY CONSUMPTION (1986)

COUNTRIES	INCOME IN US $	COMMERCIAL ENERGY IN KGOE	ELECTRICITY IN KWH
BANGLADESH	160	48	49
INDIA	270	191	262
PAKISTAN	350	174	250
SRI LANKA	400	80	161
THAILAND	860	315	510
MALAYSIA	1775	733	1012
JAPAN	22825	2537	5533
USA	18557	6642	10906
ASIAN AVERAGE		482	649
WORLD AVERAGE		1328	2028

Table 2.6. GLOBAL BALANCE OF FOSSIL FUELS (1987) [12]

REGION	CRUDE OIL (MBD)			COAL (TRILLION BTU)		
	PROD	IMPORT	EXPORT	PROD	IMPORT	EXPORT
NORTH AMERICA	12.43	5.04	2.11	21720	2884	509
CENTRAL AND SOUTH AMERICA	3.70	1.68	1.40	590	228	385
WESTERN EUROPE	4.03	8.65	2.60	8970	466	3639
EASTERN EUROPE AND USSR	12.01	2.04	2.70	25440	1471	957
MIDDLE EAST	12.94	0.53	9.80	-	-	-
AFRICA	5.23	0.59	3.82	4330	1019	114
FAR EAST AND OCEANIA	5.97	5.91	2.03	29310	4058	4429
WORLD TOTAL	56.31	24.44	24.47	90360	10126	10126
TOTAL IN EJ	126.88	55.14	55.14	95.33	10.67	10.67
TOTAL IN MTOE	2971.00	1291.00	1291.00	2230.00	250.00	250.00

conservation and demand management [18]. Yet, the demand has not been static, and various projections indicate substantial increase in the next few decades. Some of the forecasts of projected global demand prepared by the various organizations are shown in Table 2.7. From the Table it can be observed that IEA/OECD, WEC, and IIASA have been almost unanimous in forecasting increase of total energy demand from 7000 MTOE in 1980 to 10000 to 12000 MTOE in 2000 AD. A further increase has been forecast for the period 2010-2020 AD. These reflect what these organisations consider to be low energy demand profile with only moderate increase in per capita energy use in industrialized countries. Moreover, along with this there would be considerable increase in energy conservation and efficiency of energy end-use.

The forecasts/projections in Table 2.7 suggest that increase in demand for electrical energy will outstrip the increase in demand for primary energy. If this is true for the developed countries, then for Bangladesh with its present low level of energy consumption this demand will have to be even higher so as to attain the desired economic advancement.

2.8 Electrical energy : current state

A major area of energy consumption and probably the most vital for economic development is the electrical energy. As mentioned earlier it is expected that increase in demand for electrical energy will be more than the increase in demand for primary energy. Electricity generation nearly tripled in the developing world during the period 1960-1975. This is expected to continue for quite a long time in future. According to the studies by the Workshop On Alternative Energy Strategies (WAES) the use of primary electricity is expected to increase from about 2.2 MBDOE (million) barrels per day of oil equivalent) to about 10.2 MBDOE

Table 2.7. FUTURE GLOBAL ENERGY DEMAND [13]

SOURCE /YEAR OF PROJECTION	1980	1990	2000	2010	2020
A. PRIMARY ENERGY (MTOE)					
IEA/OECD (1982)	6900	8230 8750	10500 1210		
CEC (1986)	7270		10800		
IIASA (1984)	6800	8000	9900		
WEC (1986)	7700	9400	11100	13300	15500
GOLEDENBERG ET. AL. (1985)	7800				8400
B. DEVELOPING COUNTRIES					
IEA/OECD (1983)	950	1410 1620	2320 2840		
CEC (1986)	1100		2270		
WEC (1986)	1950		3500		5000
GOLDENBERG ET.AL. (1985)	2220				4400
C. ELECTRICTY DEMAND (TWH)					
IIASA (1985)	8100	11000	16200	17500	
GOLDENBERG ET. AL. (1985)	8150			15600	

for even developing countries with low growth rate [14]. This is mainly because electricity is considered to be the most effective way to increase production.

The present share of electricity generation as percentage of total consumption of commercial energy is roughly 40 % in the case of Bangladesh. However, to achieve the goals of desired economic development this share is expected to increase in future. For this to be true the total generation capacity needs to be increased to about 5000 MWe by 2000 AD from the present maximum generation capacity of about 2000 MWe.

2.9 Electricity Sector in Bangladesh

Development of electricity in the two zones of the country took place almost independently until the commissioning of the East-West Inter-Connector. The Eastern Zone has all the natural gas deposits, and is also the location for the only the exploitable hydro-potential, while the Western Zone had to depend entirely on imported fuel to meet its peak and even a part of the base load. Therefore, the Western Zone has tended to lag behind in power development compared to the other zone. Generation of electricity in the Western Zone varied between 19% to 25% of the total generating capacity of the country between the years 1972 to 1982. Subsequently, the two zones have been connected by the East-West Inter-connector with a river crossing section stretching over 14.5 km of the Jamuna river. The inter-connector has a rated transfer capacity of 450 MWe.

The peak demand of the national grid increased from 183 MWe in 1972 to 1317 MWe in 1988. This indicates an average annual growth rate of about 13%. Maximum generating capacity increased four-fold in this period from about 500 MWe in 1972 to the present value of about 2000 MWe. The total length of transmission and distribution lines also increased from 10,000 Km in 1972 to more than 38,000 Km in 1990. The maximum generating capacity of the largest power plant in the system is 210 MWe, while there is as small a plant as of a 1 MWe capacity or even smaller. The shares of different categories of consumers of electricity are, domestic (22.%), agriculture (2%), small industries (8%), small commercial (11%), large industrial and commercial (41%), others (16%). The last category includes consumers under the rural electrification program accounting for about 10% of the total electricity consumed [15]. The load factor of the generating system in 1990 was about 58% . The system loss is about 34% according to 1990 estimate. Technical losses amounted to 20% of the gross generation and the rest were non-technical losses.

Though the annual average growth rate of peak demand has been about 13% since the emergence of the country , it is generally believed that the demand is still supressed by the, availability situation. The recent trend in growth of peak demand was matched by the increase in generating capability. However, the future growth in peak demand may be restricted by the energy supply situation which in turn is likely to be influenced by resource constraint, and demand from other competitive sectors of the economy.

2.10 Need for institutionalized energy data-base

It is only natural that developing countries should have policies, plans and institutional supports for increasing energy consumption and for facilitating attainment of the desired economic growth. The problem is further compounded for resource constrained countries , because maximization of benefits will require greater effort. For most countries energy and policies relevant thereto have become high ranking public and government concern only after energy crisis. Drastic increase of prices of oil in the international market and concomitant recognition of rapidly approaching limits of cheap and easily accessible hydrocarbon resources brought this into focus. In many countries energy policy has only been limited to development of electrical power programme.

Need for developing reliable data-base on energy in a country such as Bangladesh is thus clear and overwhelming. In view of local condition, socio-economic situation, and environment a developing country will have to pursue its own specific path. Adequate energy supply on its own can only be the essential precondition of progress and not be by itself an automatic guarantee of smooth economic advancement or social progress. It may be further noted that due to resource constraint it will be difficult for Bangladesh to increase the consumption of commercial energy rapidly. Energy-mix, at least for the next 2-3 decades will comprise of both commercial and non-commercial sources of energy. Moreover, penetration of commercial fuels, especially into rural locations shall require proper infrastructure, logistics and management capabilities.

Energy planning, its development and balance are rather complex problems which will require proper institutional arrangement so as to overcome the lack of reliable data-base and lack of up to date information. Due to absence of such institutional arrangements in Bangladesh it is therefore, imperative to arrive at a proper decision making strategy by helping to create a reliable data-base. To achieve this a system approach can be followed. With this in mind a reliable system such as MIS including the Decision Support System (DSS) can be considered so that under its framework a coherent strategy may be arrived at. Such use of MIS can ensure that energy planning and related decision making including strategic planning has the optimum effect on economic and industrial development of the country.

CHAPTER 3

INTRODUCTION TO MIS

3.1 Importance of Information

The magnitude of the information explosion has originated from the vast multitude of data required to be processed in an environment of complex interaction among various relevant entities. This eventually resulted in the need for a better understanding of what "information" was all about and also to ensure benefit from the useful part of the diversified resource of available information. In the past, when production and operation procedures were simple, most decisions used to be based primarily on solid facts and on their careful analysis or on intuition and guess based on experience. Today, decision making has become more complicated because of factors like multi- dimensional interaction of internal and external variables, increasing managerial involvement in decision making, uncertainties of the future, unprecedented pace of technological innovations, and growth and diversification of products. Events and technologies are now moving too rapidly for experience to cope with the situation. For example, the usual technique of extrapolation used for making projections on demand and supply has now been rendered less useful with the advent of more sophisticated mathematical tools like end-use analysis, input-output models, and various other mathematical, statistical and econometric methods . As such, reliable data base and other information have become indispensable for drawing up strategic plans suitable for meeting the goals and objectives of any futuristic operation. Consequently, timely, accurate and relevant information is of paramount importance in today's decision making process. Moreover, today's economy depends on the international situation and in the developed as well as developing nations, data base is used almost without exception for all types of operation and decision making. Such inter-dependence forces other countries to resort to improved information techniques in making their actions compatible with the overall global economic order.

3.2 Data and Information

It would be helpful to distinguish data from information. Data are statements, facts, figures that in their original form could have limited use in decision making. Data, when processed to conform to specific needs become information. Data are converted into information when pertinent portions are separated out and when inferences supported by them are available. According to Oxenfeldt [16] information serves five principal purposes, such as to describe, explain, predict, evaluate and innovate. These purposes as inputs have to be considered in designing information systems and in organizing managerial decisions. Information, therefore, explains the phenomena that deal with the complex issues. This is mainly carried out by developing models or systems meant to facilitate analysis, to indicate type of information needed, and to relate the information to past and future.

3.3 Categories of information

There are basically following three categories of information related to hierarchial levels and decision makers:

The first level is strategic information related to long term policies and planning. These are of direct interest to the higher strata of management. Information such as population growth, economic growth of a country, human resource development, energy use and financial profiles are examples of these type of information. It is maintained with the help of DSS.

The second level of information is managerial information. These are mainly meant for mid-level management and Department Heads. They are to be used in implementation and control. Annual statements, cash flow projections and demand analysis are typical examples of such categories of information. These information are mainly used for short and mid range planning. These are maintained mainly with the help of MIS.

The third level of information is operational information. These are required to meet the needs in short term or for daily operation purposes or to enforce routine rules and regulations. This category of information is mainly maintained by Data Processing Systems (DPS).

The relationship between Management level, and the corresponding system is shown in Figure 3.1.The level of a manager in an organization is another important factor in determining the type of information needed. If the manager is a part of low level management he will need detailed internal information for making relatively structural control decisions. If the manager is a part of higher level of management, he will require summarized information from a variety of sources to make judgmental policy decisions for meeting long range objectives. This is shown in Figure 3.2.

3.4 Information Systems

An information system may be defined as a set of devices, procedures, and operating systems designed around user based criteria. These are meant to produce information and to

Fig. 3:1 Relationship Between Management and Information levels in a Typical Organization [17]

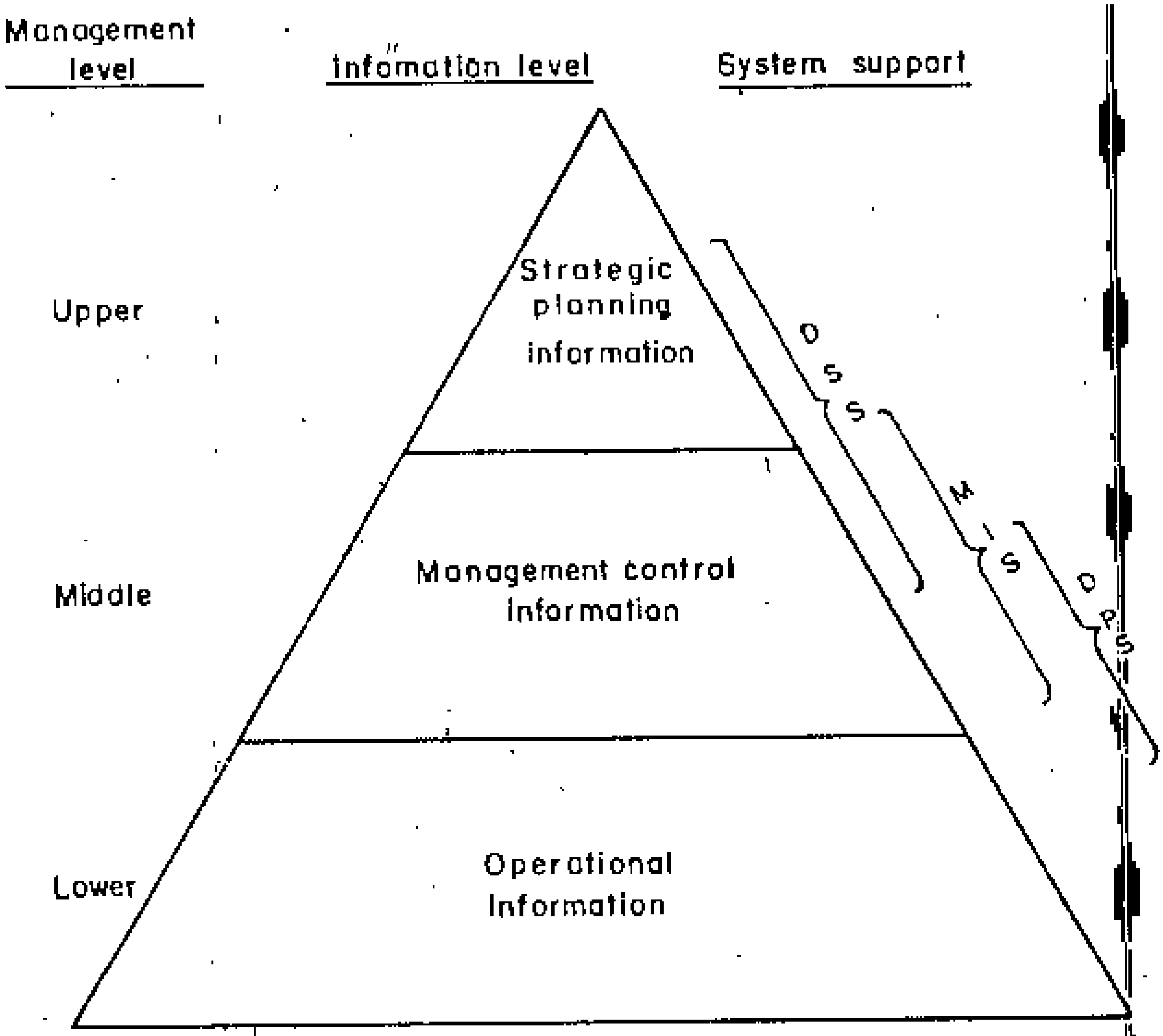
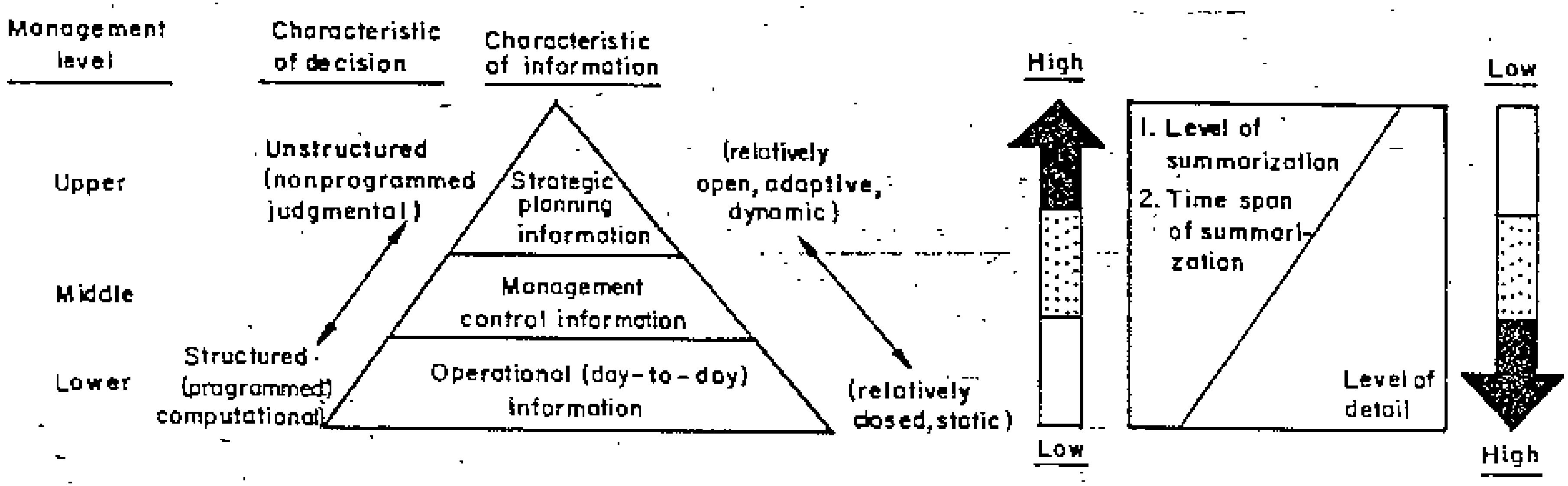


Fig. 3.2. Levels of Managers and corresponding Information Levels in an Organization.[17]



communicate it to the user for facilitating planning, control, and operation. Information system is, thus, the basis for interaction between the user and the analyst.

Information system is used for providing instructions, commands and feedback, and also for determining the nature of relationships among decision makers. An operation may have several information systems, each of which is designed for a specific purpose and contains components like data flow, communications, decision making and control. Major information systems may be one of the types like formal, informal and computer based.

3.4.1 Formal Information System

A formal information system is based on the hierarchial structure represented by the organization chart. This is a diagram showing different positions along with their interrelationship and defined levels of authority, responsibility and obligation. Information is formally disseminated in instructions, memos or reports from the top management to the appropriate personnel in the organization. It also allows feedback. This provides a bi-directional flow of information.

3.4.2 Informal information system

The formal information system being essentially a power structure is designed to achieve goals and puts emphasis on organization. It may, therefore, restrict flow of communication between employees to a certain extent. This gap is bridged by the informal information system which is employee based and is designed to meet personal and vocational needs.

3.4.3 Computer based information systems

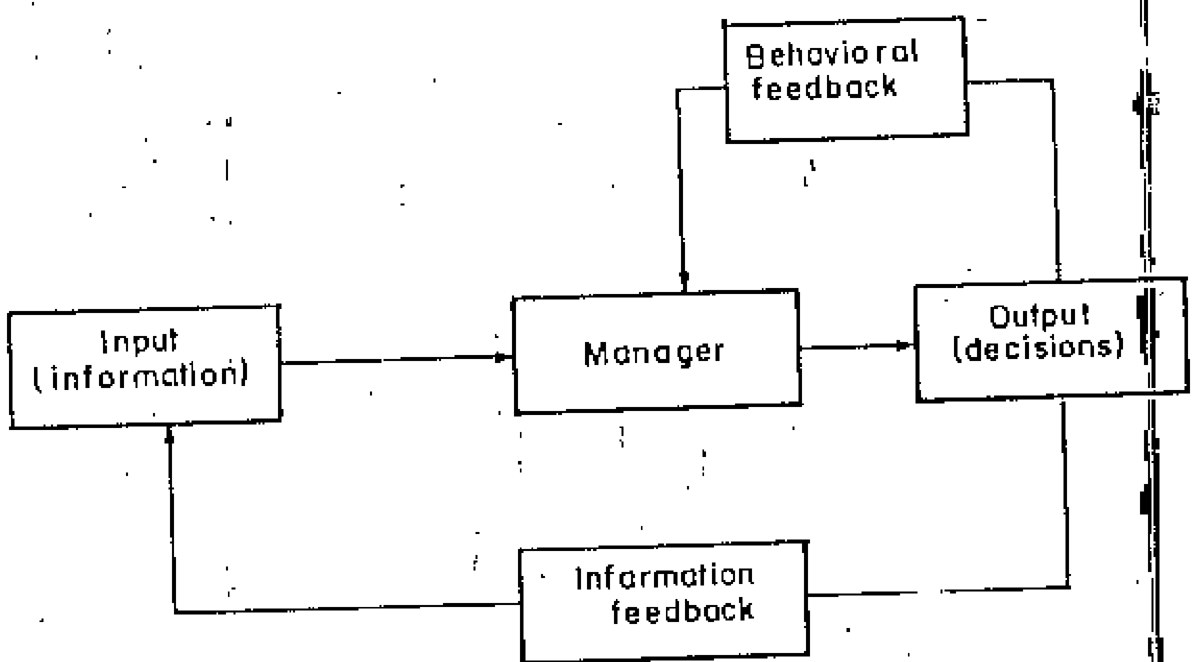
Computer based information systems rely on the computer as the source of information and for solving problems. With increasing access to computer facilities, a system, known as the MIS has been developed and is gradually becoming more and more popular due to its capability to meet the required information criteria.

3.5 Management as an Information- Decision Making System

Decision making is a fundamental aspect and requirement in the behaviour of mankind. Behaviour is generally goal oriented and man moves towards such goals by making decisions from available alternative courses of action. Selection of the best alternative solution to any given problem has now become a challenging task so as to maximize benefits from available resources. This, basically can be said to be the manager's job. All managerial activities may, therefore, be considered as some or other form of decision making. According to Simon " the two terms managerial activity and decision making are synonymous" [18]. It is, therefore, useful to treat management as an information-decision system. This concept can be analysed with the help of the model provided by Miller and Starr [19]. This model (Figure 3.3) shows that a manager uses the feed back information in making subsequent decisions.

Information is a key ingredient necessary for making decisions that will integrate activities towards objectives and maintain a viable dynamic organization. Therefore, any organizational decision should include appropriate information flows in a multi-directional environment.

Fig. 3.3: Miller and Starr model. [19]



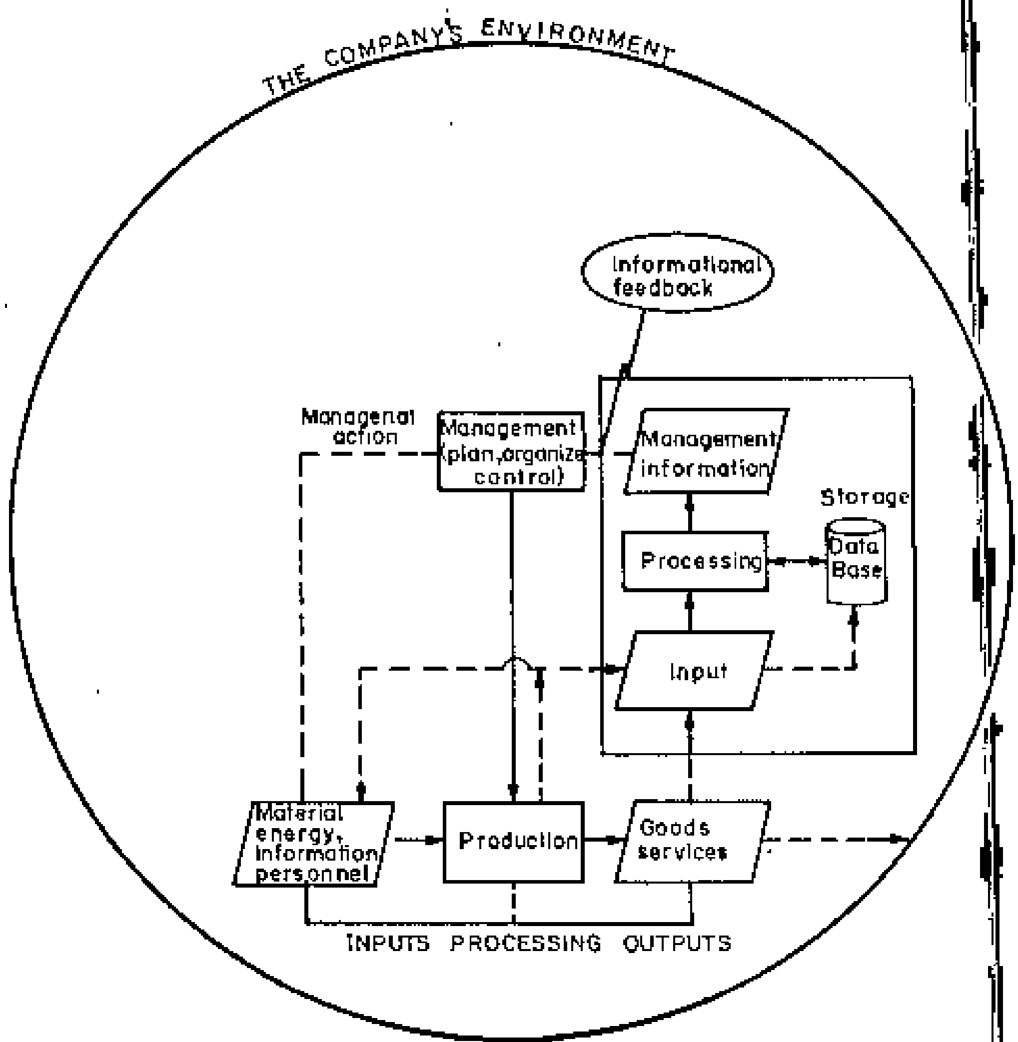
3.6 Management Information System (MIS)

3.6.1 Definition of MIS

There exist many different definitions of MIS by authors such as Kenavan [20], Ross [21], and Tomeski [22]. The central theme of these is that it is a system designed to provide managerial personnel with information needed to make sound decisions. In other words, the system for meeting the manager's needs is MIS. Management action is to be based on accurate, relevant, complete, concise and readily available information whenever required, and it is MIS which should help meet these requirements quickly and responsibly. MIS is a man-machine system with a highly integrated grouping of information processing functions designed to provide management with comprehensive pictures of specific operations. It operates in real time and handles problems as quickly as possible. Operationally MIS provides for file definition, file maintenance and updating, transaction and inquiry processing, and one or more data bases linked to organizational data base. Within the MIS, a single transaction is enough to simultaneously update all related data files in the system. In doing so, data redundancy and time taken to duplicate data are kept to a minimum, thus ensuring that the data always remains current. This is shown in Figure 3.4

A key element of MIS is the data base, which consists of a set of non-redundant and inter-related data that is processed through computer programmes and are made available to users. Sharing of common data means that many programmes can use the same files or records. Information may be accessed through a Data Base Management System (DBMS). It is the part of the software and handles virtually every activity involving the physical database.

Fig. 3.4. The total MIS system[17]



Main advantages of a Data Base System (DBS) may be considered as follows :

1. Processing time and the number of programmes to be written are substantially reduced

2. All applications share centralized files

3. Storage space duplication is eliminated

4. Data are stored once and are easily accessible when needed.

The main drawbacks of DBS are, among others, cost of specialized personnel required and the need to protect classified data from unauthorised access.

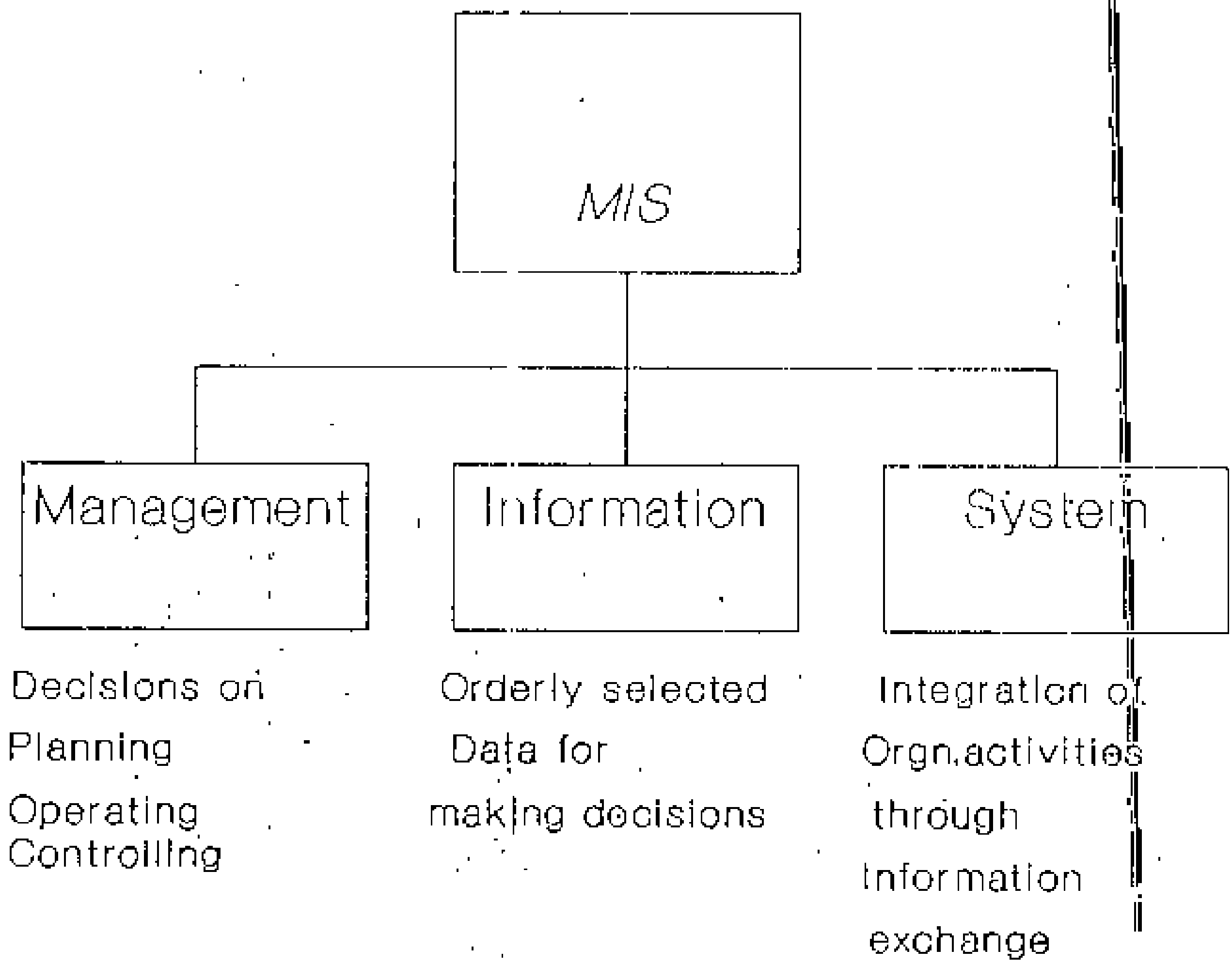
3.6.2 Purpose of MIS

The primary purpose of using MIS is to raise the process of managing from the level of sketchy information, intuitive guesswork, isolated problem solving, to the level of system insights, system information, sophisticated data processing, comprehensiveness and systems problem solving. It is therefore, a purposeful tool for solving problems and for achieving better decision making standards. The basic purpose of using a MIS is shown schematically in Figure 3.5.

3.6.3 Origin of MIS

Management Information System had originated with the automation of accounting information and then proceeded to the automation of more complex applications. With software development and increased complex capability, outputs for different information needs became

Figure 3.5 Basic Purpose of MIS



easier. In the late 1960's emphasis in computer processing shifted to providing information for management's needs which in turn helped evolution of MIS. It was felt that planned information should be made available to managers as and when required. Therefore, a system of information linking planning and control by manager to operational systems of implementation developed. MIS is a combined result of these concepts.

3.6.4 Development of MIS

As development of MIS proceeded, the need for a corporate data base was felt. This required standardizing, defining and describing data so that computers could be used to store, retrieve and process to meet information needs. This led to the development of the DBMS.

Using a DBMS successfully was found to be a major undertaking as it involved not only the complexities of information processing but also intricacies of understanding the information needs and their use in the process of decision making.

Primary users of MIS are the middle and the top management, operational managers and support staff. Middle and top management use MIS for preparing forecasts, for making certain types of analysis and for preparing long range plans and periodic reports. Operational managers use MIS primarily for short range and periodic planning, and reporting. The support staff uses MIS for analysis of information and reporting to help the management in the process of planning and control. Functions of most levels of personnel conclude in providing data for use in MIS. Once it is entered into the system, the information is no longer exclusively owned by the initiating user. On the contrary, this becomes available to all authorized users. Early MIS were designed to support operational management activities in order to facilitate control of these activities. At present on the other hand, this is being replaced as a tool for facilitating strategic planning activities of top management. Now the emphasis is on achieving system success, defining the criteria of success, and measuring the return of investment. A successful MIS is thus considered to be an information system that can be profitably applied to almost all the hierarchial areas of an organization to improve the quality of its performance.

3.7 MIS for strategic planning

Several problems regarding implementation to achieve success of strategic planning cropped up during the development cycle of MIS. These included reports, which were historical and dated, data bases not being in line with user requirements, inadequate or incomplete updating of data base, and most importantly the limited support to top management for decision making. This led to the development of Decision Support System (DSS).

3.7.1 Decision Support Systems

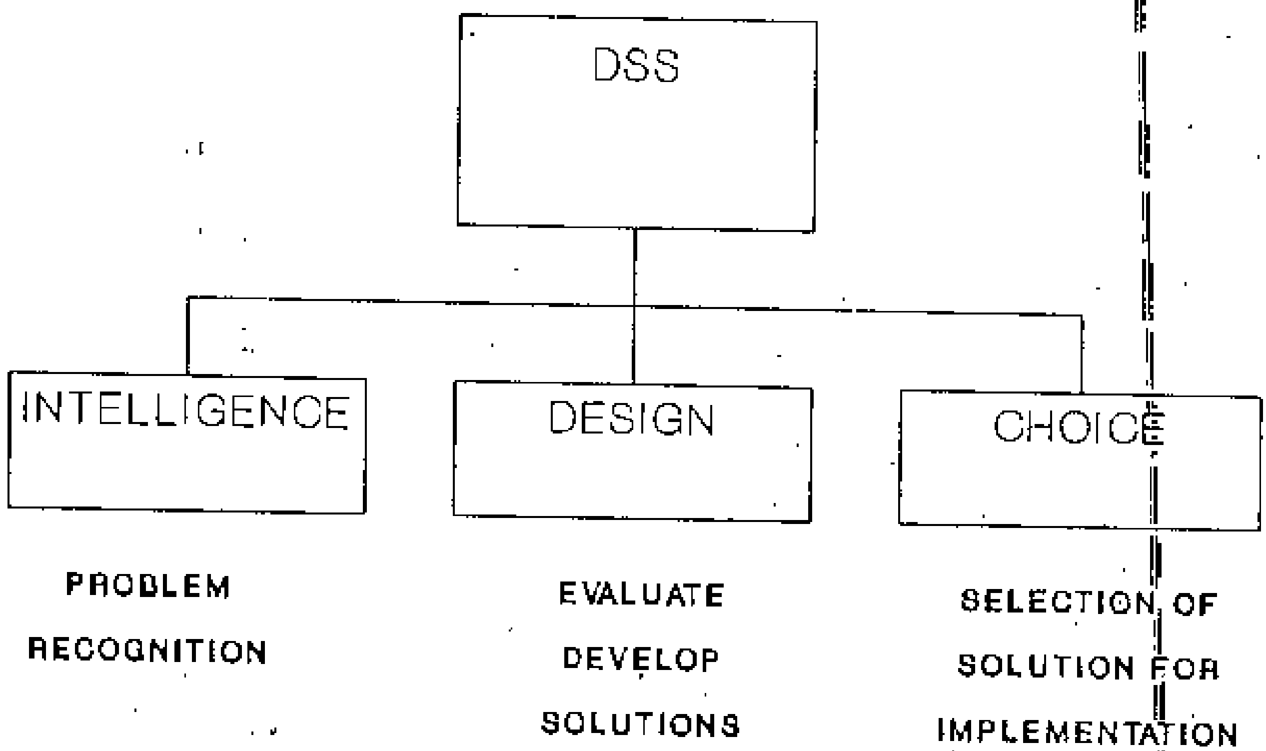
Authors today view DSS as an extension of MIS, alternatively view MIS as a sub set of DSS. Some even view DSS as independent of MIS. However, the commonly accepted view in the literature is that DSS is a second generation of MIS, resulting from addition of external data sources, accounting and statistical models and interactive query capabilities to MIS. The outcome is thus a system that is designed to serve all levels of management including the top management in dealing with a problem especially with relation to strategic planning and control. The field of DSS is still in a nascent stage. It generally provides information through retrieval and statistical packages. The design of a suitable decision making model for top management involves the evaluation of alternatives and actual selection of a solution for implementation. DSS is able to play a major role in this respect with the help of deterministic or stochastic models that may be used profitably in such situations. The DSS is represented schematically in Figure 3.6.

3.8 Future development of MIS

Trend indicates that future development will be characterized by MIS development being recognized as part of organizational strategy. That is, MIS affecting the way in which organizations will respond to changes, increasing use of integrated data bases with advances in hardware and software technologies, increasing fraction of computer system costs being devoted to system design and software, acceleration in automation of decision making and control of access to information.

In order to keep up with the pace of development and to be able to formulate a proper strategy, need for proper information system planning will be of vital importance.

FIG 3.6 DECISION SUPPORT SYSTEM



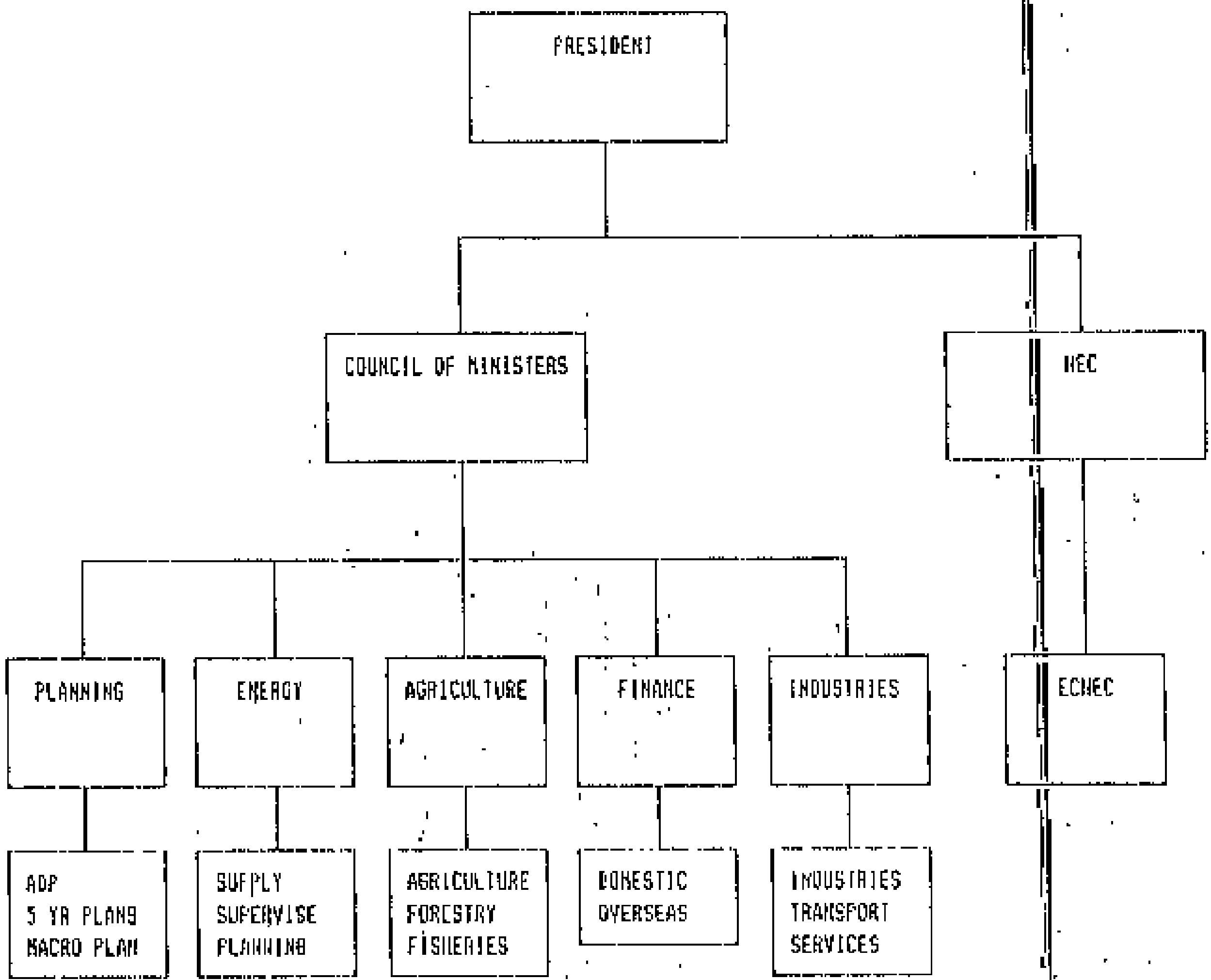
CHAPTER 4

STRUCTURE OF THE ENERGY SECTOR

4.1 Overall structure

The supreme body of planning and policy formulation in Bangladesh is the National Economic Council (NEC). It is headed by the Head of the Government and includes members of the Council of Ministers. Members of Planning Commission and Secretaries in charge of relevant Ministries/ Divisions are expected to be in attendance depending on the subject under consideration. The work of the Secretariat of the NEC is done by Planning Commission/Ministry of Planning. The functions of NEC include, guidance on long term planning (Five year plan), Annual Development Programmes and economic policies, approval and finalization of plans, programmes, policies, review progress of implementation of development programmes, decisions as may be considered necessary for socio-economic development. The executive committee of the NEC (ECNEC) consists of Minister for Planning as convenor, Ministers for Industries, Works, Commerce, and the other concerned Ministries as members. It has among others, responsibilities for approval of development projects of certain types, approval of investment projects in private sector exceeding an investment of Tk 150 million, review of the progress of implementation of projects, consideration of proposals for companies with participation of expatriate parties, reviewing performance of statutory public sector corporation, appraisal of rates, fees and prices of public utility services or products of public enterprises. The overall structure of the public sector in Bangladesh in so far as it relates to the energy sector is shown in Figure 4.1.

FIG 4.1 GOVT. STRUCTURE ON ENERGY [5]

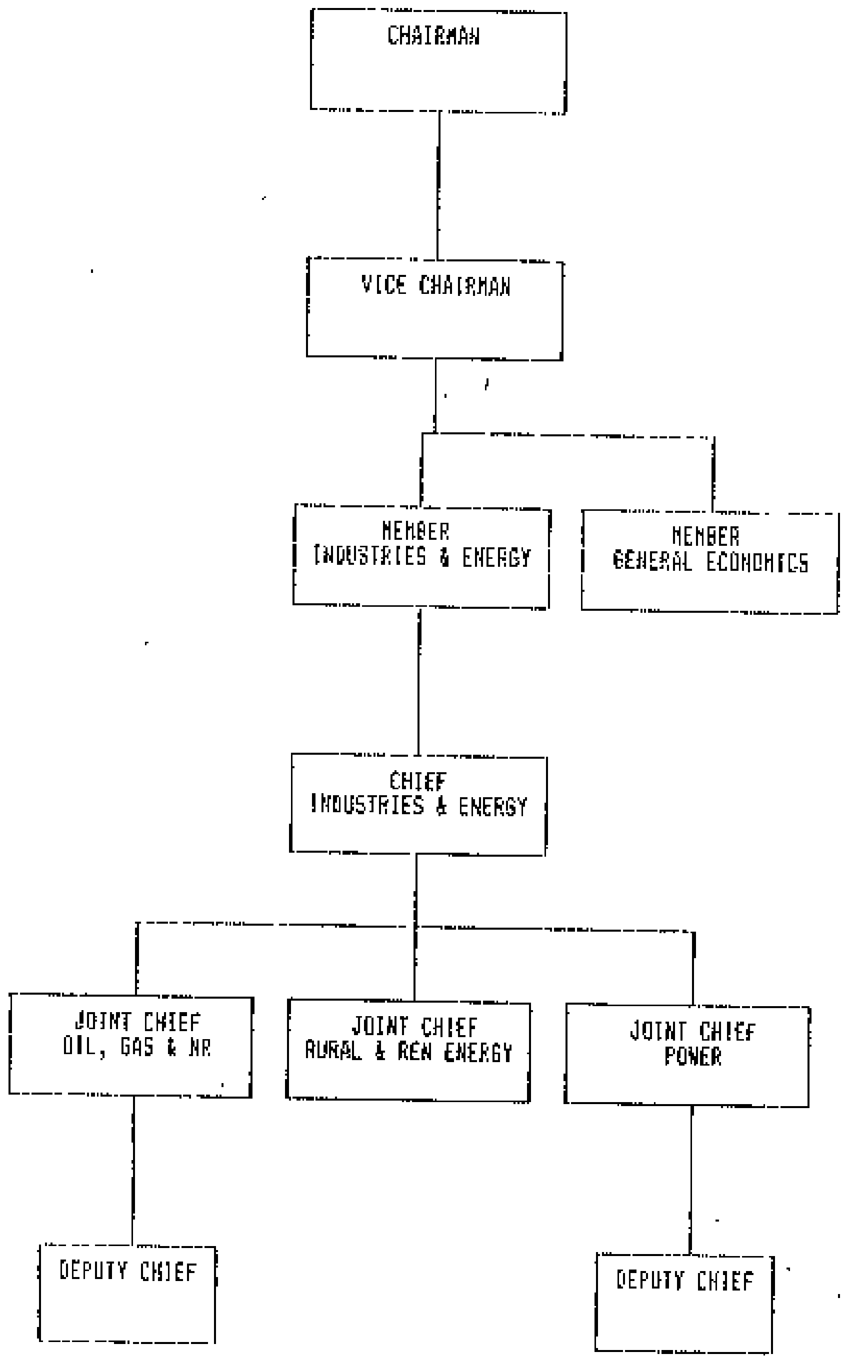


4.1.1 Energy Planning Structure

Planning Commission is one of the key agencies relating to energy planning and policy framing in the country. It has the responsibility for three fold involvement in development planning such as advisory, evaluationary and coordinatory as set out in the Planning Commission handbook. It is responsible for, among others, policy planning, short, medium and long term sectorial planning, programme planning, project planning, budget allocation, review and approval of projects, coordinating between sub-sectors and sectors, recommendations for approval by the ECNEC. The Head of the Government holds the charge of Chairmanship of the Commission and the Cabinet Minister for Planning acts as the Vice-chairman. At the policy level the Commission is headed by a Deputy Chairman and five Members who are in-charge of all policies and programmes relevant to the sector. This includes determination of priority, guidance of national plans, formulation of policies, etc. Each Member of the Planning Commission is assisted by a number of personnel of various categories such as Division Chief, Joint Chief, Deputy Chief, Assistant Chief and Research Officers. There are six Divisions each headed by a Division Chief. Two of the Divisions deal with general macro issues of the economy, while the other four Divisions deal with planning and policy issues of different sectors of the economy .

The organization structure of the Planning Commission as related to energy planning is shown in Figure 4.2. Sub-sectorial energy planning is carried out by Industries and Energy Division, through three sections, namely, Power and Energy Economics, Oil, Gas and natural resources, and rural and renewable energy. Integration of all the sub-sectors is achieved at the level of the Division Chief.

FIG.4.2 ENERGY PLANNING IN PLANNING COMMISSION



4.1.2 Administrative Structure

Ministry of Energy and Mineral Resources has an overall administrative responsibility for the energy related activities. It works closely with a number of public sector Corporations. These are responsible for commercial energy sector, both primary energy in the form of oil, gas, coal and secondary energy, mainly in the form of electricity. The Ministry is also responsible for normal legislative powers, representation in the Boards of Sector Corporations and government owned companies, provision of funds, receipt of duties, debt service of payments, and company taxation and dividends. The Planning Cells of the relevant Ministries and the Planning Directorates of the concerned public sector Corporations attached to these Ministries work with the Planning Commission to coordinate energy planning. The traditional and non-commercial energy sector, is however, not presently under the responsibility of any particular ministry even though this sector accounts for a large proportion of the final energy consumption of the country. It may be mentioned once again that this traditional non-commercial energy are consumed mainly in the rural areas.

The current infrastructure in the sector consists of various projects which have been entrusted to different government organizations such as the Bangladesh Council of Scientific and Industrial Research (BCSIR), Bangladesh Atomic Energy Commission (BAEC), Bangladesh Agriculture Research Council (BARC), Bangladesh University of Engineering and Technology (BUET), etc. In addition, many Non-Government Organizations (NGO) are also carrying out rural energy projects. The Ministry of Forestry is involved in planning and implementation of forestry projects. These projects are entrusted with various Departments within the Ministry and also with other agencies. Although the Ministry of Agriculture has some connections with traditional sources of energy through its programmes on agricultural productions, there is little specific consideration of overall energy implications in its activities.

4.1.3 Structural Limitations

The problems of traditional fuel supplies in the rural areas have only recently attracted wide public attention even though they pose a threat to the future prospects of developing countries. The threat is likely to be linked with the population growth and the resultant pressures on environment to provide food and fuel. The possibilities for increasing the supply of bio-mass fuels in future are limited. The anticipated demand in the rural areas are likely to be met by commercial fuels and / or through conservation. Widespread deforestation and its consequences like flooding, erosion and siltation are the main symptoms of the problems of mass scale use of bio-mass fuels. Other problems that can occur include removal of tree cover within agricultural areas, shift to more ecologically damaging fuel collection practices such as increased use of crop residues and dung. In human terms, efforts are spent in obtaining fuel for the basic needs which constitute a major burden on a large part of rural population. This could be measured in terms of time spent daily for collecting fuel. Proper infrastructure is, therefore, required to ensure that appropriate policies are developed and proper projects are taken up for implementation. This would require as recommended that this sector is integrated into the overall energy sector of the country.

At present, however, there is no administrative responsibility assigned to any agency or Ministry for this very important sector. In this regard neither the Planning Commission nor the various energy agencies and relevant Ministries such as Forestry and Agriculture are at a very firm footing as yet. This has caused difficulty in developing a proper infrastructure for the rural energy sector and hampered its integration into the overall energy sector of the country.

In theory, required interaction of various energy sectors could be achieved by close cooperation and liaison between the involved organizations, especially between the planning cells at all levels of Planning Commission, relevant Ministries and agencies; but in practice it is quite difficult for such a degree of intercompany and interministerial cooperation to be sustained.

4.2 Institutional Structure in the primary energy sector

4.2.1 Organizational Structure

Oil, gas, coal and other mineral resources such as limestone and hardrock, etc. are entirely possessed by the public sector. The whole range of activity such as planning, exploration, exploitation, drilling, production, transmission, distribution and marketing is controlled by BOGMC, a public sector enterprise under the Ministry of Energy & Mineral Resources. This corporation is an umbrella organization and contains seven operating companies as follows:

a. Bangladesh Gas fields Company
b. Sylhet Gas Field Company,
c. Bakhrabad Gas Systems
d. Titas Gas Transmission and Distribution Co. Ltd,
e. Jalalabad Gas Transmission & Distribution Co. Ltd
f. Bangladesh Petroleum Exploration Company Ltd
g. Rupantorito Prakritik Gas Co. Ltd.

Titas Gas Transmission & Distribution Company, Jalalabad Gas

Transmission & Distribution Company and Bakhrabad Gas Systems Ltd. are responsible for gas distribution and marketing; while Bangladesh Gas fields Company and Sylhet Gas Fields Company are responsible for exploitation and production of oil and gas. The Bangladesh Petroleum Exploration Company is responsible for exploration of new sources of oil and gas and the Rupantorito Prakritik Gas Company is responsible for the operation of a Compressed Natural Gas (CNG) pilot plant for its likely production, distribution and commercial marketing. In addition to the above mentioned companies, BOGMC has a number of development projects such as:

a. New gas field development
b. Installation of gas transmission line
c. New connections for commercial and industrial enterprises
d. Prospecting for new oil fields
e. Feasibility study for exploration of coal, hardrock and limestone.

These activities are carried out by a number of Divisions within BOGMC and its companies. In the fiscal year 1988-89, the total volume of gas produced and sold were 4363.46 MMCM and 4156.35 MMCM respectively. Of these, quantity of gas sold for electricity production was 1854.69 MMCM. System loss in gas exploitation and production was about 4 % of the total gas exploited in 1988-89. This system loss occurred mainly due to illegal connections, leakage and experimental use of gas.

The BOGMC also has a MIS Division. This Division is presently giving out mainly operating information such as, financial statements including companywise income and expenditure of operating companies, sales statements, sectorwise use of gas, sectorwise connection, installation of gas pipe lines, etc.

Information on development activities and plans is limited to progress statement of development projects. These MIS statements are prepared manually.

Under the Ministry of Energy & Mineral Resources there exists another public sector Corporation dealing with primary energy sector named the Bangladesh Petroleum Corporation (BPC). The BPC is responsible for importing and refining liquid hydrocarbon (crude oil). This Corporation is headed by a Chairman and has a Board of Directors nominated by the Government. The only oil refinery of the country, located at Chittagong, is also under the administrative control of this Corporation and is operated by a public sector company, namely the Eastern Refinery Limited (ERL). The operation of the refinery plays an important role in the energy scene of the country as its throughput corresponds to over one third of the total commercial energy consumption of the country. The nominal refining capacity is about 1.5 million tons of crude oil per year. The ERL refines the crude oil provided by BPC on a fee basis. This method of operation was established in 1979. Fees received by ERL have two components, a management fee and reimbursement of operating expenses.

End products of ERL are transferred to the distributing companies for marketing to industrial and domestic consumers. There are presently three such government owned marketing companies namely, Jamuna, Meghna and Padma Petroleum Ltd. These companies are also under the administrative control of BPC.

4.2.2 Limitations of Organizational Structure

Some weaknesses seem to exist in the present organizational structure from organization and management points of view. The main weaknesses include overcentralization of support services, overlapping of responsibilities between the corporations and operating companies on one hand and between the relevant Ministry and Corporations on the other hand, lack of proper and credible management information network, inadequate authority at different operational levels. These shortcomings tend to hamper activities both at the policy planning level and at the operational level.

4.3 Institutional Arrangements of the electricity sector

4.3.1 General Structure

The main power sector organization in the country, the Bangladesh Power Development Board (BPDB) was created in 1972 through bifurcation of the erstwhile Bangladesh Water and Power Development Authority. It had the responsibility for generation, transmission, distribution and marketing to all consumers of electricity in the country until 1977. At this time a separate board namely, the Rural Electrification Board (REB) was created. Now the BPDB is responsible for generation, transmission, distribution and marketing of electricity except in the rural areas, where the REB is responsible for the distribution and marketing of electricity through its own network. The REB carries out its operation through cooperatives, known as the Palli Biddut Samities (PBS), where the rural consumers are the paying members. These PBS purchase power from the BPDB at bulk rate at 33 KV level. The PBS offer credits to their members at soft terms and conditions in order to accelerate penetration of electricity into rural locations. Tariff of electricity for rural consumers are fixed by the government in consultation with Ministry of Energy and REB. The overall generation and transmission responsibility still lies with BPDB. Both the BPDB and REB are public sector corporations.

4.3.2 Organizational structure of BPDB

The BPDB consists of a Chairman as the chief of the organization and Members responsible for different disciplines and functions namely, planning and development, generation and transmission, distribution, finance and administration. The next tier of management consists of Chief Engineers/Additional Chief Engineers for various technical disciplines such as planning , distribution and generation and Controllers for nontechnical disciplines such as administration, accounts and finance. The third tier of management considered as the mid level management consists of Directors of various sub-disciplines like System Planning, Project, Design, Audit and Accounts, etc. and the Managers of various power plants. These Directors/Managers are generally of the rank of Superintendent Engineers who are directly responsible for supervision of the personnel for operational activities. These operations management personnel are generally of the rank of Executive Engineers who are directly responsible for carrying out operational activities. The organogram of BPDB is given in Figure 4.3.

4.3.2.1 Main activities of BPDB

The Bangladesh Power Development Board at the end of 1989 operated a total of 16 power plants as part of the National Grid with a total installed capacity of 2377 MWe. However, because of the derated capacity of older units the generation capacity stood at 2062 MWe. Plantwise generation of BPDB alongwith installed capacity, generation capacity, gross energy generation is shown in Table 4.1. The management of generation in these power plants and their subsequent transmission and distribution are thus the main functions of BPDB.

Fig. 4.3.

ORGANISATION CHART OF BANGLAOESH POWER DEVELOPMENT BOARD [15]

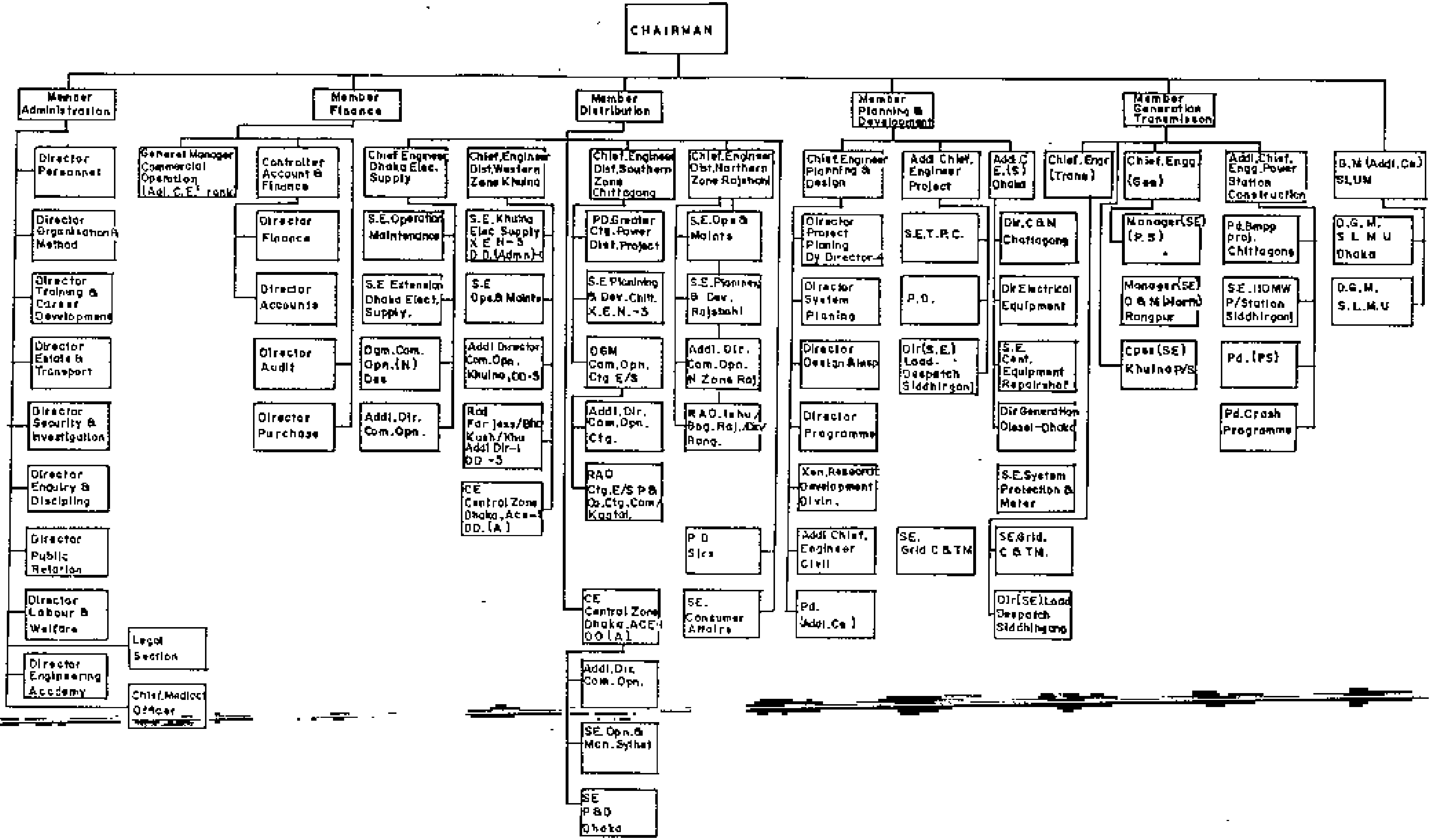


Table 4.1. GENERATION OF ELECTRICITY PLANT-WISE (1989-90) [15]

(FIGURES IN GWH)

NAME OF POWER PLANT	NUMBER OF UNITS	INSTALLE CAPACITY (MW)	GENERATIO CAPABILITY (MW)	GROSS GENERATIO (GWH)	ANNUAL PLANT FACTOR(%0
KARNAPHULI HYDRO	5	230.00	230.00	920.36	45.68
ASHUGANJ STEAM TURBINE	2	128.00	128.00	289.59	25.83
ASHUGANJ STEAM TURBINE	3	450.00	450.00	1595.70	40.48
ASHUGANJ COMBINED CYCLE	1	90.00	85.00	458.99	61.64
ASHUGANJ GAS TURBINE	1	56.00	_	0.001	_
SHAHJIBAZAR GAS TURBINE	7	96.00	45.00	186.73	47.37
SYLHET GAS TURBINE	1	20.00	20.00	69.08	39.43
GHORASHAL STEAM TURBINE	2	110.00	110.00	536.68	55.70
GHORASHAL STEAM TURBINE	2	420.00	420.00	1516.96	65.97
SHIDDIRGANJ STEAM TURBINE	1	50.00	_	0.00	_
SHIDDIRGANJ STEAM TURBINE	3	30.00	15.00	89.94	68.45
SHIDDIRGANJ DIESEL	1	5.23	2.00	0.13	0.74
HARIPUR GAS TURBINE	3	99.00	99.00	447.36	51.58
CHITTAGONG STEAM TURBINE	1	60.00	51.00	319.11	71.43
CHITTAGONG GAS TURBINE	2	13.00	9.00	8.36	10.61
CHITTAGONG BARGE MOUNTED	2	56.00	28.00	93.39	38.08
KHULNA STEAM TURBINE	1	110.00	110.00	181.75	18.86
KHULNA STEAM TURBINE	1	60.00	53.00	134.63	29.00
KHULNA BARGE MOUNTED	2	56.00	42.00	87.18	23.69
KHULNA GAS TURBINE	1	12.75	8.00	1.30	1.86
KHULNA GAS TURBINE	1	10.25	8.00	6.98	9.96
KHULNA DIESEL	7	7.84	2.00	0.04	0.23
BHERAMARA GAS TURBINE	3	58.74	36.00	33.21	10.53
THAKURGAON DIESEL	7	10.50	3.00	3.60	13.71
SERAJGANJ DIESEL	5	4.34	2.00	0.76	4.36
SAIDPUR DIESEL	3	11.25	6.00	4.67	8.88
SAIDPUR GAS TURBINE	1	20.00	20.00	16.94	9.67
RAJSHAHI DIESEL	3	4.70	1.80	2.59	16.46
BOGRA DIESEL	4	5.20	1.50	2.18	16.58
BOGRA GAS TURBINE	1	8.00	6.00	0.03	0.06
BARISAL GAS TURBINE	2	40.00	40.00	73.25	20.90
BARISAL DIESEL	9	12.54	2.25	10.04	50.92
RANGPUR GAS TURBINE	1	20.00	20.00	14.24	9.78
TOTAL(GRID)	89	2365.34	2053.55	7105.81	39.50
ISOLATED EAST ZONE		2.57	1.00	1.57	
ISOLATED WEST ZONE		9.71	8.00	7.48	
TOTAL(SYSTEM)		2377.62	2062.55	7114.85	

Generation-mix of the country consists of Steam Turbine (60%), Gas Turbine (24%), Hydro (9%), Combined Cycle (4%) and Diesel (3%). Figure 4.4 presents pictorially generation of electricity for the years 1981-82, 1986-87, 1988-89 and 1989-90 .

Energy balance for electricity in 1988-89 is shown pictorially in Figure 4.5. Natural gas accounted for 78.7% of the energy used for generation while hydro accounted for 12.9 % of the energy used for generation. The total system loss amounted to about 34 % of generation of which station use accounted for 5.6%, thus the consumers received about 66 % of the energy generated. The mix of fuel in generation for 1990 is given in Figure 4.6.

It has not always been possible to operate all the generating plants of the National Grid simultaneously. A few of them remained out of operation from time to time. The interruptions in National grid in 1988-89 alongwith their reasons for failure is shown in Table 4.2.

The total length of transmission lines of 230 KV and 66 KV stood at 2625 KM, while the total length of the distribution lines comprising of 33 KV/11 KV and and 11/0.4 KV lines stood at about 36,000 KM at the end of 1989. There are various generation, transmission and distribution projects at implementation stage. On the distribution side there is a proposal to create a separate company in the name of Dhaka Electric Supply Authority (DESA) to be responsible for power distribution of Greater Dhaka. This has however not been given any institutional shape as yet.

4.3.2.2 Limitations in proper functioning of BPDB

The current practice of generation transmission and distribution planning at BPDB can be said to point to a project approach rather

FIGURE 4.4
INSTALLED CAPACITY BY TYPE(1981-89)

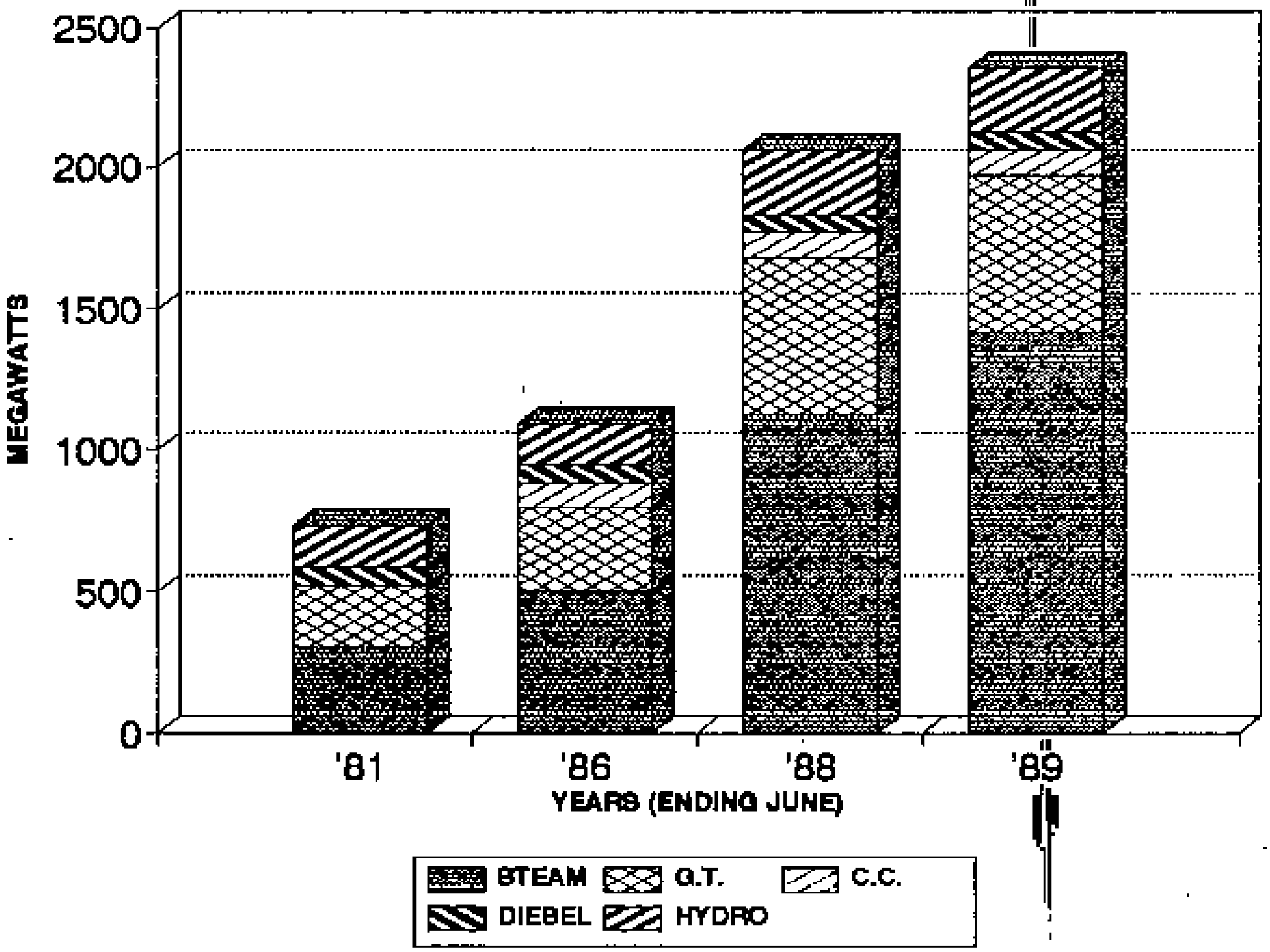


Fig. 4.5. Energy balance (1988-89) [15]

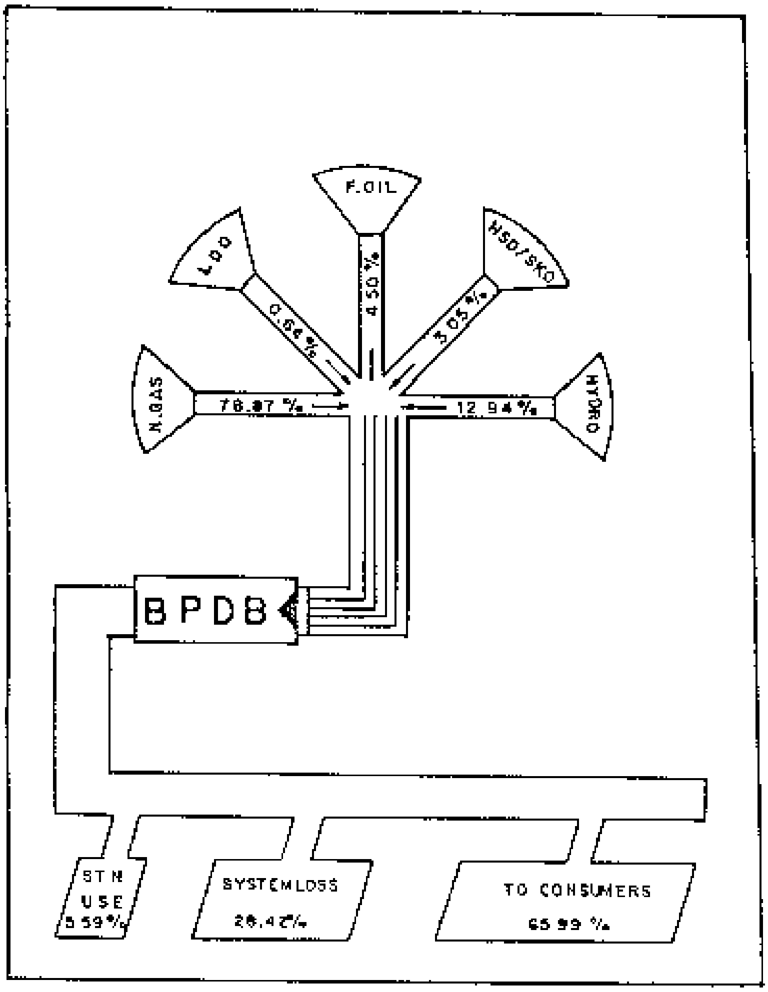


FIGURE 4.6.
FUEL - MIX IN GENERATION (1990) [15]

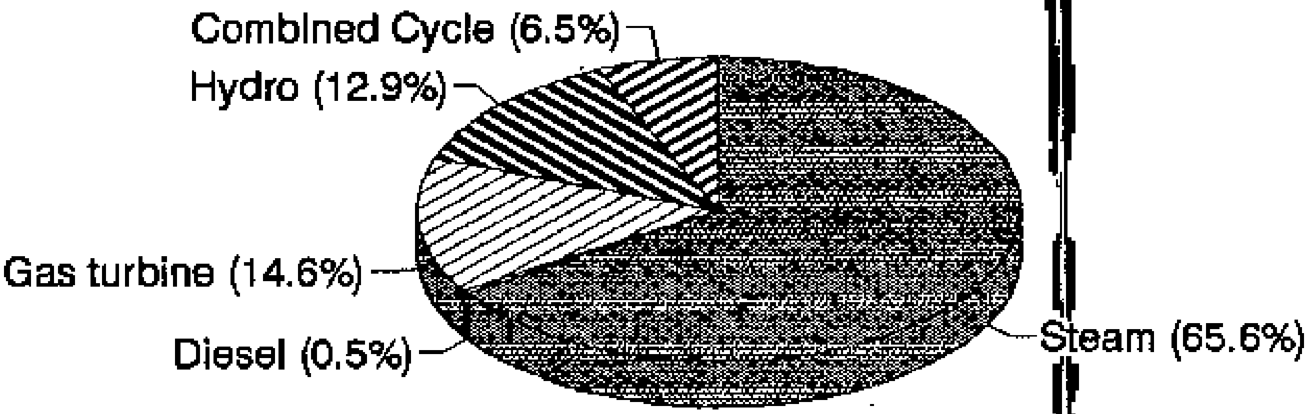


Table 4.2. INTERRUPTION OF NATIONAL GRID (1988-89) [15]

TYPE OF FAULT	TOTAL NO. OF FAULTS	TOTAL DURATION HOURS	MINUTES
1. PARTIAL POWER FAILURE DUE TO GENERATION FAULT/ LOAD SHEDDING	80	132	52
2. PARTIAL GRID FAILURE DUE T TRANSFORMER/BREAKER FAUL	38	91	25
3. PARTIAL GRID FAILURE DUE TO TRANSMISSION FAULT	68	70	26
4. PARTIAL GRID FAILURE DUE STORM/LIGHTNING	4	46	30
5. PARTIAL GRID FAILURE DUE E-W INTERCONNECTOR FAULT	4	10	20
6. TOTAL GRID FAILURE	NIL	NIL	NIL

than a systems approach. When a deficiency in generation is predicted on the basis of load forecast and available generation, a given size of a generating plant is selected in order to meet the deficiency. After the size of the proposed plant is determined, feasibility studies are carried out to select the type and location of the generating plant. All the work is done on a project basis primarily by expatriate consultants. The inherent disadvantage in this approach is that a similar or even in cases the same type of study is duplicated each time a new generating plant is planned. This does point to a lack of credible information to the management for decision making. The main reasons for this lack of information is perhaps the absence of an adequate and appropriate data base.

There exist a number of uncertainties in power development of the country such as load growth, transmission and distribution network expansion, fund availability, fuel availability and price, and system losses of both technical and nontechnical types. A data base incorporating such factors need to be created. At this point anticipating that power generation capacity is expected to grow rapidly in future, it would be worth to study the uncertainties which make the management and planning process complex.

a. Load growth: As in many developing countries load growth in Bangladesh is supply limited. Loads are not independent but a function of where and how the generation (supply) is available. For example in 1984-85 the peak load served was 760 MWe. However, considering the energy served and the annual load factor the peak load was calculated to be 807 MWe. Thus, the traditional approach of extrapolating the historical load growth may not give a good indication of future load if the supply situation improved. In effect it has been observed that in the country whenever the supply situation has improved the demand has registered a noticeable increase. At present only a small percentage of population is directly benefited by electricity. Thus one can easily say that demand for energy especially electrical energy is enormous even if the people are to live at subsistence level. With the expected development in small and medium sized industries in the country, the percentage of electricity in nation's energy supply will continue to grow.

b. Generation Expansion: The current generation plan of the BPDB is based on the criteria that major generation conditions of the East Zone will be based on natural gas. Firm generation capacity, calculated by subtracting the 1st and 2nd largest units from installed capacity will be available to meet peak load. The West Zone firm generation capability will be available to meet zonal peak load in case of any failure of the Inter-connector. Uncertainties that are likely to be built in such planning include generation plant mix, energy dispatching between eastern and western grids, available reserve and availability of the East - West Inter-connector.

c. Reliability: Careful planning and coordination as a whole is an important step towards attaining the desired reliability of the power system by ensuring what capacities of which types of plants to install. The present grid system of BPDB consists of various types of generating plants such as Hydro, Steam Turbine, Gas Turbine, Combined Cycle, Barge-mounted, Diesel, using different categories of fuels such as natural gas, HSD, LDO, furnace oil and tend to have differing degrees of reliability. In addition, some of the plants are reaching the end of their life cycles and consequently their reliability has also decreased. With the expected retirement of units and the setting up of new units the uncertainties regarding the optimum combination of different technologies, the proper time to incorporate them into the system, the location of new equipments, is likely to demand more complex solutions.

d. Transmission & Distribution Network Expansion: The transmission network is expected to increase alongwith corresponding increase in distribution network in future in addition to the expansion planned by REB. These plans are supposed to concur with the expected load growth and planned additional generation. Uncertainties at this point would include any unexpected event or unusual development.

e. Fuel Availability: The two main indigenous sources of energy for power production in the country are natural gas and to some extent water head. The thermal power plants would consume about 5 TCF or 50 % of estimated reserves of natural gas within their life cycles. If the current pace of natural gas-based industrial development and large scale use of gas for cooking is continued, constraints may arise in future. The prospect of the use of coal is also very limited. Peat reserves are available but no definite plans have been achieved as yet. The use of nuclear power is also uncertain. Thus, uncertainties regarding availability of fuel remain and in fact may thus grow in future.

f. Funding Availability: Major portion of the funds for development in the power sector comes from donor countries. Like most of the other developing countries, funds come from a variety of sources. These include cash and commodity credit, barter arrangements with foreign governments, agency and foundation loans, commercial loans, etc. Naturally, international policies and financial market conditions determine the availability of such funds. Uncertainties associated with these situations are generally high.

g. Internal Resources: Internal resources of the BPDB are generated by revenue collection from the tariffs set on different categories of consumers. There are different rates of tariffs set for the different categories. There are, however, uncertainties in the collection of the due revenues because of bills pending from many a bulk consumers for quite a number of years. In future these pending bills are likely to accumulate further thus leading to increasing uncertainties about their collections.

h. System Loss: About 35 % of energy generated by BPDB is lost. The amount consists of both technical losses in the lines, transformers, and nontechnical losses such as unmetered supplies, inaccurate metering, theft, fraud etc. It is seen that BPDB does not get any revenue for about a third of its energy output. This is a hindrance to the ability of load management particularly in the light of future expansion plans.

CHAPTER 5

ANALYSIS OF THE EXISTING MIS IN THE ELECTRICITY SECTOR

5.1 Required Information of the Electricity Sector

Once the basic goals and wider objectives of energy plan are decided, the next important step is to identify the information required for the decision makers. The information required may be broadly divided into two categories, namely detailed technical information and decision making information.

Detailed technical information is required by the planners to carry out analysis and evaluate the available alternatives. Such information could include engineering information such as thermodynamic efficiency, reliability and performance characteristics of systems in one hand and capital and operating costs on the other . A different set of information is required by senior managerial personnels who are also the decision makers. If the information is available in a form that is unintelligible to decision makers, very little can be achieved even with the best of information. Therefore, the need for a institutionalized and objective data base development is essential.

The data base should be designed to integrate all the necessary information required for the proper and effective operation of the electricity sector in the country. This is a major undertaking because of the diversity and large volume of such information involved. However certain difficulties may be encountered in developing the data base. It is often found that due to lack of a proper information management system certain data are sometimes nonexistent or unreliable in quality, or bear marginal relation to actual practical conditions.

5.2 Present Status of the Information Network in BPDB

The present organizational structure of BPDB shows that there is no formalized institutional structure for information management. This results in that the information tends to be localized to departments which are directly responsible for the relevant operations. For example, most of the generation data is kept by the Generation Division and same is the case with the transmission data which are kept by the Transmission Division. Some information is passed on to the Systems Planning Division of BPDB, but there seems to be no formal guide lines for this information being used to create an effective information management data base.

Presently a mainframe computer and several micro-computers are in use by the BPDB. The main frame computer is envisaged to be used for billing purposes mainly. As for the microcomputers, there does not seem to be any formal structure to facilitate data sharing.

Existing arrangement of information management of BPDB is analyzed in this chapter keeping in view the basic features of a system approach of which the MIS forms a very important part.

5.3 Electrical System Technologies Information

The technologies available for generating electricity range from commercially available systems to advanced systems and from large centralized facilities to small decentralized equipments. The types of electricity generating systems are given in Table 5.1. In addition to generation equipment, transmission and distribution facilities also need to be considered.

Table 5.1. TYPES OF TYPICAL POWER PLANTS

GENERATION SYSTEM	FUEL TYPE
BOILER-STEAM TURBINE	OIL COAL NATURAL GAS NUCLEAR WOOD URBAN WASTE BIO-MASS
GAS-TURBINE	DISTILLATE OIL NATURAL GAS
COMBINED CYCLE	OIL NATURAL GAS DISTILLATE OIL
DIESEL GENERATOR	DIESEL FUEL
HYDRAULIC TURBINE	WATER : STORAGE DAM WATER : RUN-OF-RIVER WATER : PUMPED STORAGE
OTHERS	SOLAR PHOTOVOLTAICS SOLAR THERMAL WIND OCEAN THERMAL ENERGY CONVERSION (OTE WAVE POWER TIDAL POWER GEO-THERMAL

Electrical system information encompasses a broad collection of activities stretching over several time horizons and can be generally divided into categories such as demand and its management, generation, transmission and distribution. Each category of information may have different time frames as illustrated in Figure 5.1. The differences in time frame can lead to differences in approach. For example, studies of the generating system in the immediate future would involve limited options for changing the system such as deferring retirement of a unit or adding a base load power plant, which could require several years to build. It is often seen that the problem is solved by undertaking a contingency plan such as erecting a gas turbine, which is essentially a peaking plant. On the other hand, evolution of generating system for the next 20 years would involve substantial changes in composition of the system. Different levels of data details would be required for these two types of studies.

5.4 Analysis of the Information Network of BPDB

From the management point of view all the electricity data could be best divided into two broad categories,namely present and future data. According to the data prism shown in Fig.5.2, the present data would include resources and systems data, generation and supply data, demand and consumption data, while the future data would include construction data and projection planning data.

5.4.1 Resources and systems data

These types of data would include the installed capacity of the system along with the details of the sub-systems such as generators, turbines, transformers, HT lines etc. The BPDB has provisions for gathering data on both the installed capacity and generation capability of the system on a station-wise basis. The

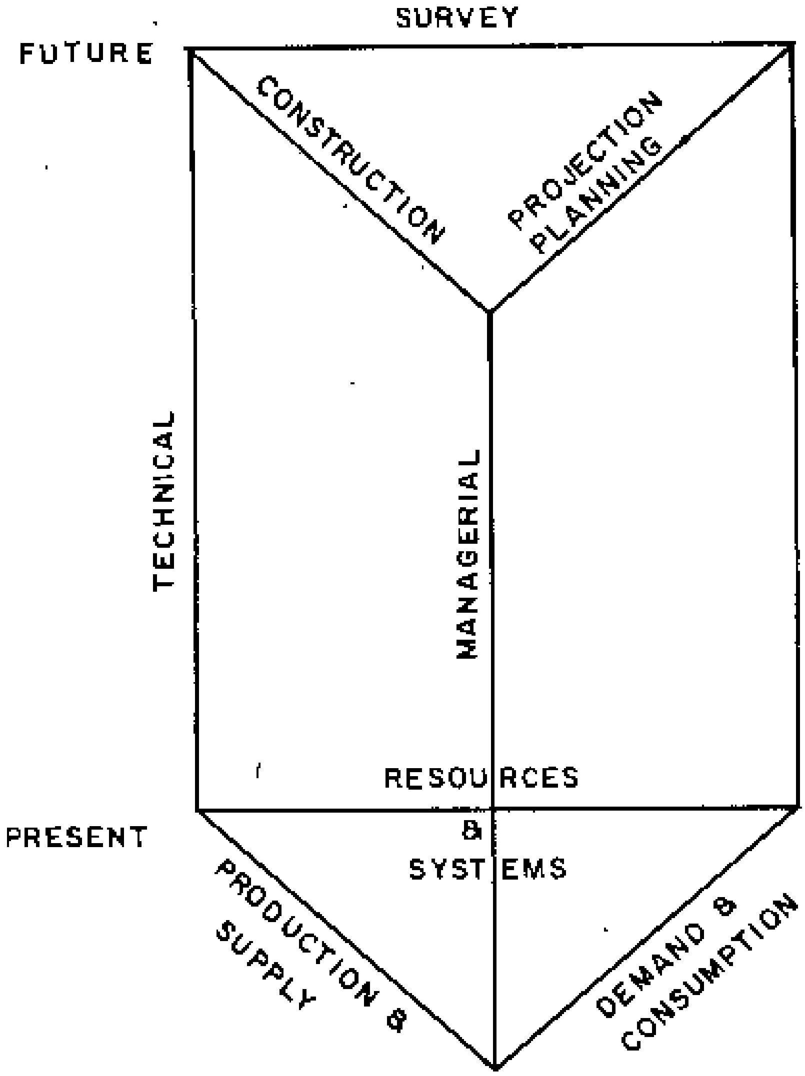
Fig. 5.1 . Categories of electric system planning and time frames for analysis. [23]

TIME FRAME

← Increasing Time →

CATEGORY OF ELECTRIC SYSTEM PLANNING	Short (<5 years)	Medium (5–10 years)	Long (>10 years)
Demand			
Generation			
Transmission			
Distribution			

Fig. 5.2. Electricity data prism [24]



stations are divided on the basis of their locations, namely the East Zone and the West Zone. The data also include information on the number of units at each station, the type of unit including date of commissioning, expected life and expected date of retirement, country of manufacture and type of fuel being used. Summary is also prepared showing installed capacity (MWe) and generation capability (MWe) on a plant type basis such as for steam turbine, gas turbine, hydro, diesel, combined cycle for both the Zones, and finally for the total system. The details of the various sub-systems are kept by the Design Division and little design data are available with the Systems Planning Division which is the main data center. There is also a lack of information about the captive generating systems, which are built by industries to act as stand-bye units for ensuring reliability. Countries with weak grid systems usually have more self generation equipment. Another information that could be included is about co-generation equipment. These are built for catering to the need for industrial steam for certain types of industries.

5.4.2 Generation and supply data

These data would include information on gross and net energy generation, including the station use, generation scheduling, and station-wise outage position of transmission lines. The BPDB presently has a data base consisting of a summary of monthly power plantwise energy generation data along with the yearly total and half yearly totals. There is also information on monthly energy generation for both the East and West Zones. Information on plantwise monthly station use is also available along with half yearly and yearly totals. Information is also available on a yearly basis for generation capability, gross energy generation, fuel consumed and fuel cost, station use, annual plant factor, per unit generation cost, average heat rate, and efficiency. There is no system for recording the net generation, on the contrary only the gross generation data is available. Information about generation scheduling of the various power plants is sketchy. In fact, this is mainly carried out by the Load Dispatch Center on the basis of intuition and experience rather than on any objective information.

The records of the station-wise outage data is kept by the Generation Division. However, certain information is kept by the Systems Planning Division. This not done in a comprehensive or an appropriate manner, rather these are kept in raw form. Analysis of this data and its linkage to generation scheduling data is not being practised.

5.4.3. Demand and Consumption data

The electrical demand and consumption data is one of the most important components of an electrical system analysis. The data that ahould be included in this section are as follows:

a. Load forecasting
b. Generation availability and load shedding
c. Monitoring of area-wise peak demand
d. Energy consumption patterns
e. System loss
f. Annual average plant factor of power plants

The load forecasting data has been prepared by the BPDB for the period up to the year 2000 AD based on the present and historical data. The data includes summary of expected generation balance by type of data, both total, and for the East and the West zones. The statistics also contain the fuel consumption and fuel costs for both the zones and the total cost. The average generating cost based on the cost of fuel only has also been included. The other costs such as operating and maintenance costs, and the system loss have not been considered in compiling the average generating cost. This points to a probable lack of reliable information.

Information about the generation availability of the power plants are not recorded institutionally as such. Load shedding information is given out in the form of daily reports sent by the Load Dispatch center to the Systems Planning Division and are mentioned as routine, partial grid failures, total grid failures. However, no information is kept specifically on load shedding and analysis on it is not performed to ascertain its effects on generation of the system. Peak demands are monitored in the form of raw daily data and are kept by the Load Diepatch Center while the daily peak demand is graphically illustrated and sent to System Planning Division. There is, however, no reliable data base available to perform analysis of these data.

The data on energy consumption pattern are stored substation-wise and possible demand has been calculated up to the year 1995. There is, however, no arrangement for creating a structured database with a view to getting ideas about effective and efficient management of demand. There is also a lack of analysis or analytical modeling for this purpose. The relationship of trends of energy demand and supply with the socio-economic conditions of the country is not included in the data on demand management. For example, no analysis is performed on the effect of energy consumption on the economic performance both in the domestic and the industrial sectors. These lead to difficulties in demand management both in the selection of new power plants, ascertaining their capacities and types, and also the upgradation of existing power plants. A detailed database on the urban and rural distribution is also lacking . For example, system losses could be broken up into technical losses such as power system auxiliary plant loss, transmission line loss, distribution loss, faulty metering loss etc., and non-technical losses such as meter tampering, meter reading errors, unauthorized connections, etc. The relative percentage of these losses could then be compared with similar losses in other countries for assessment and evaluation.

5.4.4 Future data

Futuristic data include the load survey and projection and planning data. Loads survey data include the detailed data collected from domestic and industrial users regarding their capacity, and possibility of expansion. The present load survey status of BPDB is limited to the collection of data for the purpose of setting rates of tariff. Consumers are identified as domestic, agricultural, commercial and industrial. Projection and planning data would mainly be required for the accurate projections of load and for energy forecasting. The time span of such projections and forecasts could be immediate (3-6 months), short-term (12-24 months), medium term (3-5 years), long term (5-10 years). The main issues for short and medium term would be to improve operation and maintenance to reduce outages, and more efficient demand management, increased efficiency by reducing system losses economically, maximizing benefits of the East-West Interconnector by transmitting required amount of gas based power from the East Zone to the West Zone, better scheduling of routine maintenance, etc. The main issues in the long term projection and planning would be, types and sizes of the future plants and fuel mix, effect of load factor on economic performance of the system and demand management, improvements in annual load factor of the system, possible introduction of low cost power to more and more rural locations, etc.

Presently BPDB's short, medium and long term planning activities are being carried out on the basis of recommendations of various studies, including the report of the Power System Master Plan, which was prepared in 1985. However, it is observed that focus and priorities of the donor agencies play a predominant role in the process of making decisions. Donors' decisions are also hindered by the lack of data base.

5.5 Conclusions

As seen from the analysis of the present state of data management system being practised by the BPDB, there exist a number of shortcomings such as ,

a. acquisition of the current data
b. Data integration
c. data storage and retrieval.

For effective decision making as has been mentioned a number of times before, it is essential to get the data base properly organized. Maintenance of all the relevant data as well as their expansion to include additional data and values of explanatory variables on electricity use would also be a major requirement for effective Management Information Planning and Control Network.

Analysis of the present state of MIS in BPDB shows that most of the data base tends to be localized to the relevant Departments/Divisions. For example, as mentioned in Paragraph 5.2 most of the generation data are stored in that Division, the same is the case with the data on transmission , design ,etc. The Systems Planning Division gets some data from some of these Divisions, but the flow of information are not controlled in a manner conducive to creation of a comprehensive data base for use in effective management decision making as required.

The only area in which there are plans to create a comprehensive data base is Commercial Operation. There has not been much development in the other sectors such as planning, design, generation, transmission, etc. thus making effective management decision making difficult. A further problem encountered is in getting agreement on certain data items, particularly costs. In a sense there is too much and conflicting information because of the existence of numerous equipment manufacturers with different ideas on costs, performance, etc. It is therefore important to have a information structure capable of sorting useful information from the available data.

The changing technological characteristics of the capacity to be added is another important fact to be considered while the need for an appropriate data base is being studied. A major portion of the new capacity may be more complex. Technological problems will require solution as improved process control and environmental protection is required, along with the need to improve the quality of service. This would influence all areas of power generation, transmission and distribution. Another complexity arises from the stochastic nature of the electricity supply and demand system. Electricity supply can be affected at any time by random break downs of generating equipment and on a longer time scale by the availability of adequate generating resources.

CHAPTER 6

PROPOSED MIS ORGANIZATION FOR BPDB

6.1 Introduction

An appropriate MIS organization for BPDB would help to promote the smooth and effective flow of information from the sources of data like power stations, load dispatch center, to data users such as Systems Planning Division, Design Division and higher management levels such as its Board of Directors, the related Ministry, and the Planning Commission. The linkage of flow between the data generators, collectors and users needs to be established and formalized in making the MIS functional. It is proposed that a MIS organization be incorporated under the present set up of the electricity sector, namely the BPDB. It will function as the focal point for electricity related information of the country. The proposed organizational structure and its functions are detailed in this current chapter.

The purpose of such a system would be the availability of accurate data, efficient data collection system, and a functional structure to better meet the needs of the data users. Emphasis is proposed to be placed on producing a comprehensive data base of use not only to BPDB but also to other related organizations and agencies. Such a system is intended to facilitate management decisions including efficient demand management, improvement of quality of services through increased system reliability, evolution of differential tariff structure, scheduling of maintenance, evolution of fuel mix leading to least cost expansion plan, determination of role of indigenous fuels, optimization of spares and consumables, transportation and storage of fuels, fuel security and emergency stock, and for gradual increase in domestic participation in future construction of power plants.

6.2 Focal Agency for Power Sector MIS

At present, power generation, transmission and distribution are in the domain of public sector, with a few minor exceptions such as, captive power generation in some of the industrial enterprises. However, before the creation of the REB, the entire range of activities in the electricity sector was under the responsibility of the BPDB. Now different International Development Financing Institutions, such as IBRD, ADB, USAID, etc. are advising all developing countries, including Bangladesh, to gradually involve the private sector at all possible phases of the electricity sector. In cases, financing of projects are linked with the conditions to divest, at least partially, the public sector undertakings. This is one of the reasons why Dhaka Electric Supply Authority (DESA) was conceived. Distribution and sales in other major population centers were to be separated out from BPDB in phases. It is often suggested that privatization effort will help reduce pressure on scarce internal resources. Privatization of this sector in developing countries have however, certain weaknesses or even controversies, as follows:

a. Energy and electricity is an infrastructural sector and the government should preferably have sufficient control over its growth and must keep the national perspective in view.

b. The primary purpose of the electricity sector in the country is perceived to be providing necessary service to the people to help improve standard of living rather than purely generating revenue or making the sector profitable as is the primary purpose of the private sector.

c. Power sector development is highly capital intensive and contains a greater amount of risk compared to other industrial activities. Under the prevailing conditions it is uncertain that the Development Financing Institutions will have the requisite confidence in the private sector for investments of the size and scale required.

d. The development of the rural electrification, with its inflated peak demand characteristics would tend to make the power supply economically weak and difficult in terms of demand management. Privatization of this sector will therefore impede the growth of the much needed rural electrification network.

It can thus be said that for the foreseeable future, the power sector particularly the generation and bulk transmission and a part of distribution would remain a public sector undertaking and the BPDB may be considered as the focal agency for all practical purposes.

The power sector is a complex system, consisting of a number of variables, both external and internal to the system. As such it is deemed useful to follow a system approach in developing the MIS for power sector to ensure a smooth and effective flow of information from the data generators to data collectors and finally to data users of various levels. It is felt that in the proposed the MIS set-up the linkages among the data generators, collectors and users should be established and formalized using a system approach. Such a system approach is likely to give this set-up a comprehensive structure covering the entire range of activities of the power sector. It is proposed to name this organization as " Electricity MIS Unit (EMISU)". Structure and salient features of this organization are now given in details.

6.3 System approach to the power sector

An electrical system comprises of a very complicated stream of events and involves an ensemble of variables which are, diversified, may be external to the system and in cases inter-dependent. The prime concern of the system is to ensure "adequate" quality of services to be manifested in reliable supply of electricity. These variables affect the performance of the system and the networks in the short, medium and long term perspectives in addition to day to day operation. As such, the whole range of activities needs to be taken into account in establishing the proposed MIS. A flow chart of such activities starting from the primary fuel level up to the consumer level is given in Figure 6.1. The information network would thus begin with the primary fuel and end with the consumers and contain all the related information on various variables at the different intermediate stages of the network, such as transformation from primary to secondary energy, generation in power stations, grid substations, distribution substations, distribution transformers, and consumers of all categories. The information on the variables for which a proper data base will be required would include, transportation (by rail, road, water), the allocation of the percentage of total energy for the power sector, pipe line transmission, refining, and information on power plants , fuel , transmission systems, demand, distribution systems and consumption pattern.

6.4 Information required to set up the data base

The categories of technical, commercial and organizational information which are to be stored in the proposed MIS unit as input data are given in the following sub-sections.

6.4.1. Generation system

Electricity generation being the basic component of this sector is naturally a very vital aspect to be considered in any electricity information network. The relevant information are installed capacity, including details of capacity added every year of the planning horizon, fuel-mix including their calorific values, the number of identical units and for each unit minimum operating level in MWe, heat rate at different levels of load, admissible overload as percentage of full load, allowable spinning reserve, maintenance scheduling requirements in days per year, fuel cost, non-fuel operation and maintenance cost, date of commissioning of units, expected economic lives of the units, estimated capital investment, reliability criteria such as availability, forced outage rates, etc. should be included. These information shall be collected from the Design, Systems Planning Division and the Generating stations and shall be used for taking decisions on generation planning, such as development of a least cost expansion plan and determining their loading orders.

6.4.2. Transmission system

Information on the existing interconnected systems and committed, planned expansions including their main characteristics, for example: voltage (KV), length of transmission lines (Km) and thermal limit (MVA) are considered important. This would be used for the further development of transmission network and the allocation of transmission and distribution to respective rural and urban areas. Records on scheduled and unscheduled losses, and transmission losses are deemed useful in future designs of the transmission lines, their power ratings, in particular during assessment of reliability of the transmission network.

6.4.3. Projection of Demand and Demand Management

The forecasting of electrical demand is one of the most important components of generating system analysis. The forecast must typically be made for power, energy and load variation for time periods within a year, such as a month or a season, for all the years of the planning period. The uncertainty associated with projection of demand is that the forecast may be too away (high or low) from reality. Low estimate would result in a generating system with low reliability and inability to serve a portion of the demand and overestimation would result in excess generating equipment imposing incremental costs on the system. Future capacity addition will also be decided based on this projection of demand. One redeeming feature of demand projection is the analytical methods used for the purpose and the data required for the same. This would require inputs from all end-users' sectors and matching projections of growth. The task is rendered difficult in case of the country because part of the existing demand is constrained by the supply situation and absence of mathematical models for projecting growths in other sectors. Therefore, these set of information have to be made reliable in order to get realistic projection of demand. The economic performance of the system will also depend on the success of demand management. For example, if the load duration curve may be flattened by introducing differential tariffs, then it become easier to meet the peak demand by having a lower reserve margin for the system.

Demand management is very important because of the possibility of load shedding and its relationship with generation availability. The circumstances affecting generation availability will include weather conditions, locations of stations in case of hydro electric plants, estimate of indigenous resources available for future electricity production, definition of alternative imported sources of energy, amount of import and export of power through the East West inter-connector, setting up of differential tariff, peak load requirement.

6.4.4. Fuel Information

Relevant data in this context would be indigenous fossil fuels specifying a) past and projected fuel consumption, b) current and projected costs of fuel delivered, c) policy regarding fuel use for power production such as environmental considerations, strategies and policies on end use of fuels for different purposes. Data on imported fossil fuels specifying past and projected import of fuels for power production, transportation and delivery cost shall also be included. These data shall be obtained from generating stations, Systems Planning Division and also from external organizations like BPC, BOGMC and Planning Commission. The development of the ideal fuel-mix for the electricity sector would ensure more efficient and reduction of wastage. It would also help to create an idea about the future fuel-mix strategy. Another aspect of fuel data is to incorporate the governmental strategies on fuel security, reduction of dependence on import and risk associated with availability and price of such fuels.

6.4.5. System Loss Information

It is observed that the system loss is quite high. This is detrimental to the system cost and hampers planning. Even the financing institutions tag their funding commitments with the need to reduce it to an acceptable level. Another aspect of system loss in so far as decision making is concerned is the marginal cost of reducing system loss. Many variables are needed in determining such marginal costs. These could include, among others, information like system losses on a yearly basis including both technical losses such as transmission, distribution, power station auxiliary plant losses and non-technical losses such reading errors, meter tampering, unauthorized connections, etc. These information shall be obtained from the generation, transmission and distribution departments of the BPDB, and shall be used for analyzing the causes of such losses with a view to minimizing them and consequently get a more efficient electricity system.

6.4.6. Background information

As stated earlier, electricity sector is very complex and its development cannot be affected in isolation from the other sectors of the national economy. Such data would include, among others, past and projected population growth, past and projected GNP, available national energy resources such as fossil fuel, uranium, hydroelectricity, renewables etc., past and projected total energy consumption broken down by sectors like industrial, commercial, domestic, organizational structure of the power sector. These data shall be obtained from the Planning Commission, the relevant ministries. These information are not directly electricity related, but are of vital importance in any strategic planning and development activities such as, projection planning, electricity economy linkage, etc.

6.4.7. Commercial Information

These category of information will include data on differential tariffs, power market data like energy sales, meter reading data, consumer information cards, unallocated payments, disconnection and termination notices, revenue data such as monthly and yearly billing, monthly and yearly revenue collection, and accounting statements. These information shall be useful for improved commercial operation of the system.

6.4.8. Human Resources Information

This would include information such as availability of manpower, functions, duties and responsibilities including responsibilities for transmission, distribution, power plants, administration, accounts and others. These shall be taken into account while developing the MIS organization and during the planning process. Such data would also be linked with the state policy on gradual increase in local participation in implementation of projects, R & D, human resources development, etc. The need for human resources development cannot be overemphasized in view of its importance in increasing local participation at all phases of development of the sector.

6.5 Set up of the proposed organization

The place of the proposed MIS organization, the Electricity MIS Unit (EMISU) in the existing organizational structure of the power sector of the country is shown in Figure 6.2. The proposed information flow paths are also shown in the Figure. It would receive electricity related information from the operational levels such as generating stations, transmission and distribution sub-stations, load dispatch center etc. The multi-dimensional flow of information could be complex and may involve many agencies. An example of this is given in Figure 6.3, which shows the envisaged information linkage between the proposed EMISU and the Systems Planning Division of the BPDB. Similar linkages would be required for other components of EMISU. It would receive feedback information from the higher management levels of BPDB, from the related Ministry, Planning Commission, and also from outside agencies directly related to the sector such as Rural Electrification Board (REB). It is also proposed that related information from users in public and private sectors be received

FIG 6.2 PROPOSED ELECTRICITY MIS

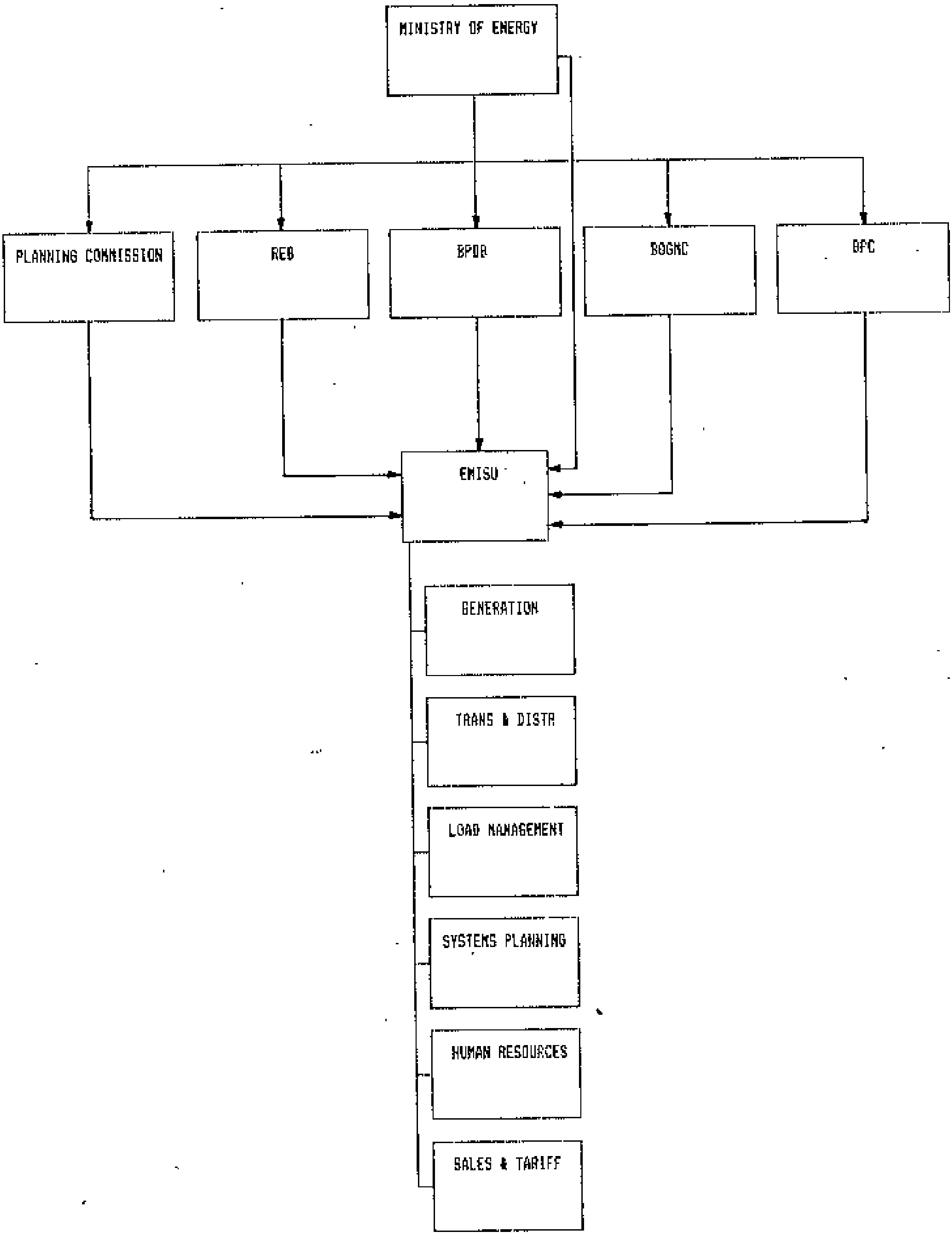
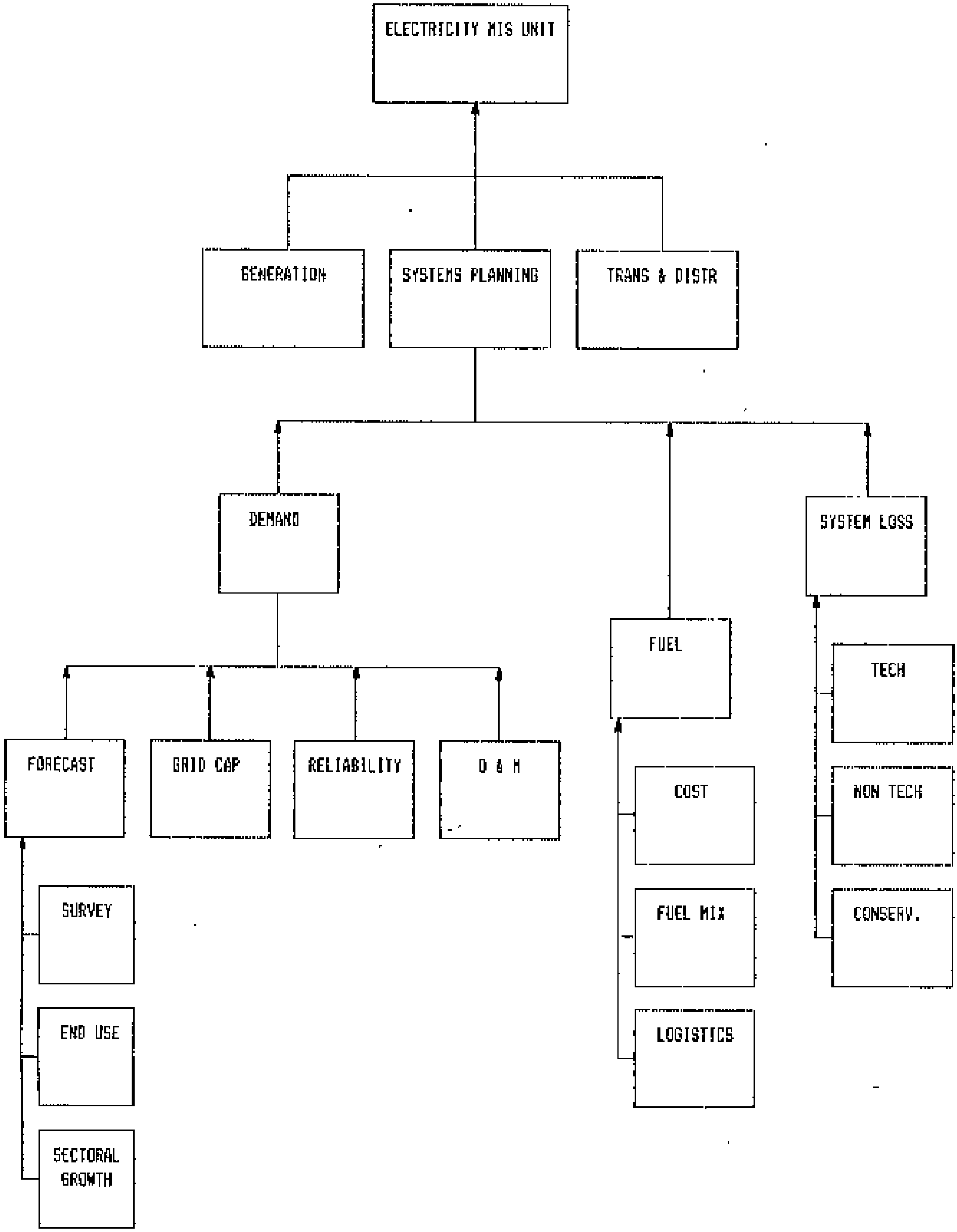


FIG 6.3 EMISU AND SYSTEMS PLANNING

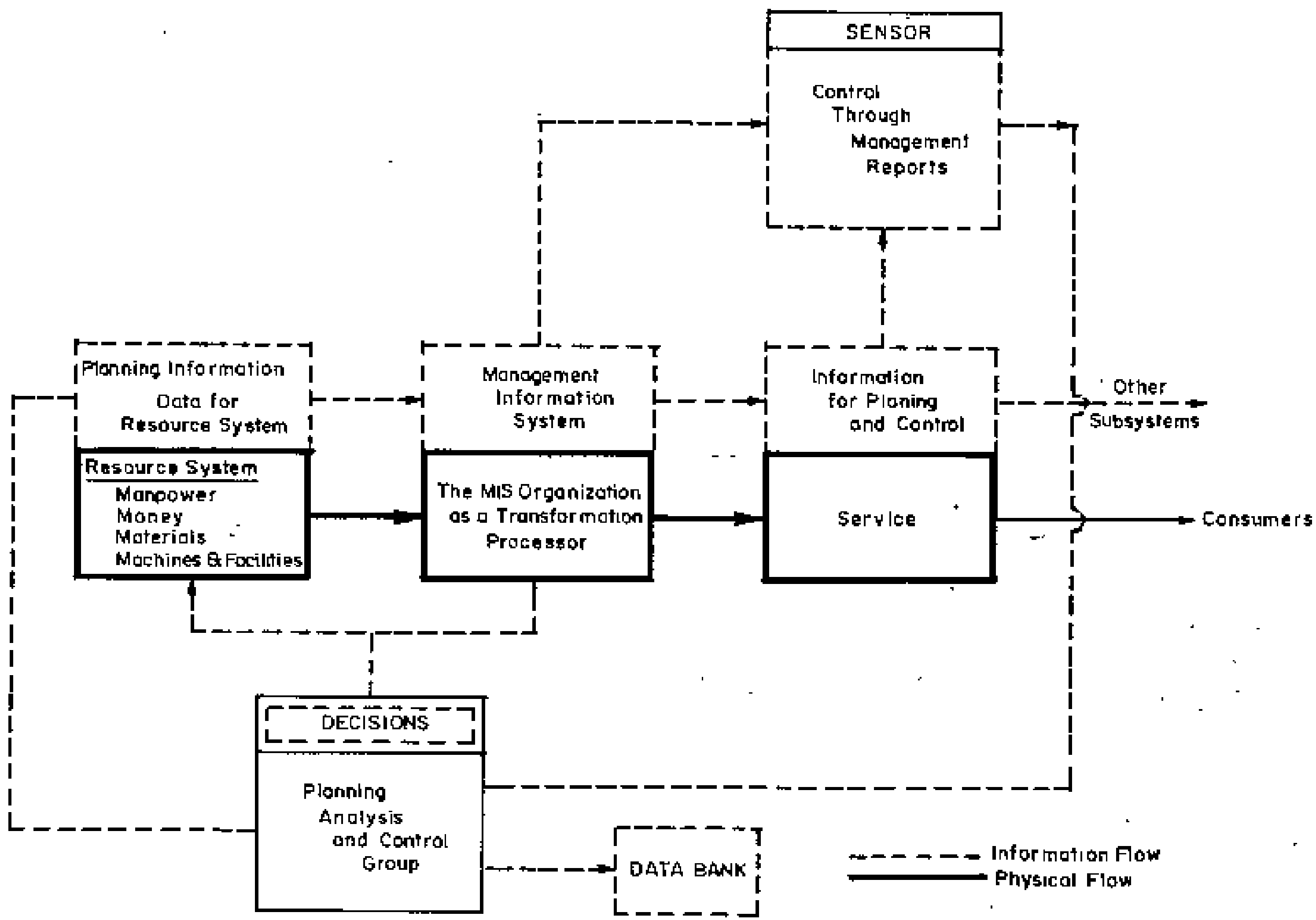


by this proposed MIS. The organization is to compile and classify the data according to the data prism mentioned earlier, for easy storage, suitable accessibility keeping in mind the needs of various categories of the information users, and differing information needs of various users. The information received is therefore, to be divided into two broad categories, namely the present and the future data. The storage period of these data would be determined according to the relative importance of the information and its possible use, that is whether the stored information is of short term, medium term or long term influence. Typically, short term data could be stored for 1-2 years, the medium term data for 3-5 years and the long term data for 6-10 years. Examples of short term data are the operational information like generation, transmission, supply schedule, etc., medium term data consists of load survey, demand management data, etc., while the long term data would consist of information related to projection and planning, like demand projection, fuel-mix, growth of the sector, etc.

6.6 Functions of the proposed MIS organization

The proposed MIS organization shall integrate the three main management sub-systems, namely planning, controlling and operating. The basic flow of information for the operation of the integrated system is shown in Figure 6.4. The planning system will receive as input the objectives from which the output will be the management plan. These plans shall in turn provide input to the operating system which will utilize them in an attempt to achieve the implementation of the plan. Information concerning the performance of the plan is the basic output of the operating system and shall in turn act as input to the control system. Feedback on performance shall be obtained to the control system which monitors the operating system, as well as to the planning

Fig. 6.4. Basic flow of information in operating the proposed MIS unit [21]



system. Decisions are to be made to make necessary changes and to correct deviations based on these feedbacks. The concept of how the MIS unit will operate in the context of the total system in BPDB is presented in Figure 6.5. The planning information and data for the specific system shall provide inputs that are transformed by suitable processing into an output whose objective is to provide the necessary information to the relevant levels of management. The top management shall require the strategic plan which is specific in nature . The strategic plan shall be based on the long term goals. The development which shall focus on growth through internal or external expansion shall be of use to the mid level management. The operations plan shall be required by the operational level management personnel and will include immediate goals linking the functional plans with project plans. If the results being obtained in the system do not conform to the required standards then improvements shall be suggested by the top management.

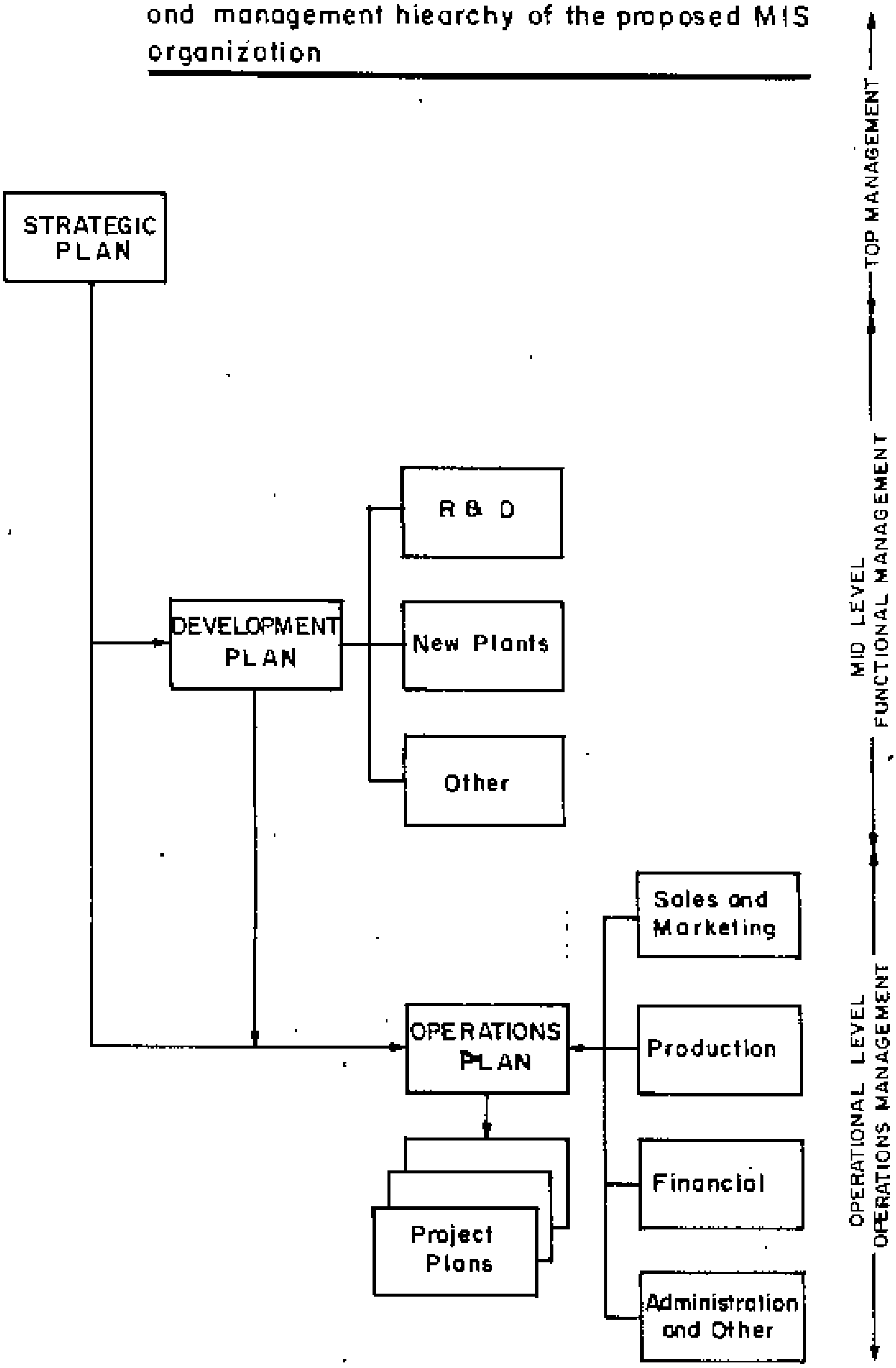
6. 7 Advantages from the proposed Organization

The basis of having a central MIS organization within the electricity sector is to create a proper and adequately structured database. Direct and indirect benefits expected from the proposed MIS are ,among others, as follows:

a. Helping achieve a reliable information network so that these information can be effectively and timely used for preparation of periodic reports, short range and long range planning , responding to special analysis requests, preparation of realistic forecasts.

b. Reduction in the number of separate computer programmes to be written and corresponding saving in time for processing.

Fig. 6.5. Concept of operation of the systems approach and management hiearchy of the proposed MIS organization



c. Savings in storage space. The information stored once would be easily accessible when needed to all the possible data users for access to the pertinent information, since once information is entered into the system it becomes available to all authorized users.

d. Increase in inter-departmental and inter-agency cooperation and optimization of project schedules.

e. Realistic projections of demand in keeping with the requirements of the users.

f. Establishment of infrastructural requirements, and formulation of policies on development of the power sector, including evolution of least cost generation plans.

g. Evaluation of requirements of resources like manpower, fuel and funds.

h. Formulation of realistic pricing and tariff policies .

i. Improvements in the financial situation of the sector and its economic performance.

j. Identifying reasons of system loss and formulation of action programmes and policies for its reduction .

k. Improvement in load management of the system .

l. Improvements in quality of service through enhancement of system reliability.

6.8 Disadvantages of the proposed Organization

The major disadvantages of the proposed organization would include the time required and financial inputs involved in creating the associated infrastructure and the recurring costs of resultant additional manpower and its operation. Another concern would be to protect the system against unauthorized access.

However, these disadvantages are expected to be out weighed by the direct and indirect benefits discussed earlier. In the long run the incremental costs would prove to be justifiable.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1 Conclusions

7.1.1 Proposed Electricity MIS Unit (EMISU)

Electricity sector of the country has been chosen as the field to apply the MIS considering that it has been the fastest growing sector of the economy. A sizable portion of the public sector investment in energy is being made in this sector. Therefore, the objectives of the meeting the demand for electrical power at the minimum cost and the maximum efficiency is sought to be given priority. As such the basic purpose of the current work has been to provide for a management structure of a system for the electricity sector of the country by proposing the establishment of an MIS organization. Since electricity sector is expected to be in the domain of the public sector and in particular of the Bangladesh Power Development Board, this organization has been envisaged to be established within its existing set-up. Provisions have been made to incorporate adequate scopes for exchange of information and data among the various entities involved in various stages of the sector. It is expected to facilitate better strategic planning and policy decision making for the sector and help to make it more efficient and compatible with the development needs of the country.

Establishment of such an organization is intended to provide the following benefits:

a. Increase in data processing, harnessing and storage capability by better usage of computer software and hardware and facilitating data usage by sharing them among the relevant users,

b. Improvement in quality of information for use by the managerial decision makers.

Planning and policy decision making involve the development and selection from alternatives, the course of action to achieve the desired objectives in the best possible manner, in time and at the least cost. The proposed MIS organization may be expected to meet such goals and requirements. A system approach has been considered so that decisions on the basis of snap shot ideas and intuitive guess is replaced by a methodical and analytical approach and so that the decision process is institutionalized involving entities at each stage of the related activities.

Certain constraints may act as limiting factors in the implementation of the proposed MIS. These may be, among others, financing, hardwares, softwares, personnel, compatibility in structures of other institutions and inter-entity relation. Following conditions are deemed important in implementation and subsequent operation of the organization :

a. Identifying tasks required for implementation of MIS such as, acquiring and installation of facilities, manpower development, acquisition of required softwares; identification, collection, validation and storage of data and information,

b. Establishing interfaces among various tasks of the MIS.

c. Upgradation of data, review of data and overall evaluation of the MIS.

d. Establishment of linkages with outside organization with respect to MIS requirements.

7.1.2 Factors to be considered for EMISU

Special considerations in the MIS are suggested to be attached to the following points:

Resource development

Characteristics of the resource such as, reserve and yearly supply, location, quality, etc., demand in fuels and their sectorial allocations, etc.

Investment decisions

Estimated investment profiles, internal resources required and its availability, external financing and terms and conditions pertaining thereto, implications of such financing on policy of the government.

Pricing policy

Tariff of electricity with particular reference to its impact on technical and economic performances of the system, equitable distribution of wealth, balanced growth of all areas of the country, especially gradual reduction of of the differences between the rural and urban location and among geographical areas, generation of internal revenue and enhancement of capabilities of self financing.

Conservation policy

Conservation of energy with a view to maximizing benefits from the national expenditure in this sector.

R & D strategy

A strategy on R & D in the sector may be considered essential with a view to gradually increasing local participation in implementation of various projects, in developing manpower for effecting such a strategy and in selecting technologies which are compatible with the local socio-economic conditions.

Strategy on Fuel-mix

A long term fuel-mix for the sector should be evolved so that the dependence on import can be reduced and for providing sufficient fuel security in event of any external event or in case of possible natural calamities and disasters.

7.1.3 General Conclusion on EMISU

Electricity is only a part of the overall energy sector of the country. The interdependences of energy and electricity on one side and the energy and other sectors on the other may be considered as a key element in formulating policies on national development. The proposed MIS structure for the electricity sector is expected to provide a sound basis for making related decisions and incorporates ways and means to link this sector with different categories of end-users and also sources of supply of primary fuels.

7.2 Recommendations for future work

a. A total MIS package be developed and implemented for the electricity sector. In this respect the limitations as identified in the context may be considered.

b. Based on the principle presented in the work a MIS could be developed for the entire energy sector, and in that event the proposed MIS could form a part of it or could play a supplementary and complimentary role. It may be noted that most of the requirements of such a MIS are akin to those considered in the present case and some of the analytical methods could also be similar. Endeavours may be made to develop such a MIS in future.

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