BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR UPGRADATION
OF
TEACHING FACILITIES
AT
THE NATIONAL COLLEGE OF TEXTILE ENGINEERING, FAISALABAD
IN
THE ISLAMIC REPUBLIC OF PAKISTAN

MAY 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study on the Project for Upgradation of Teaching Facilities at the National college of Textile Engineering, Faisalabad and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team headed by Prof. Dr. Akira Shinohara, Dean of Faculity of Textile Science and Technology of Shinshu University, from December 10 to 29, 1990.

The team held discussions with the officials concerned of the Government of Pakistan, and conducted a field survey at the study area. After the team returned to Japan, further studies were made. Then, a mission headed by Mr. Masashi Fujita, First Basic Design Study Division, Grant Aid Study and Design Department, JICA, was sent to Pakistan in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the teams.

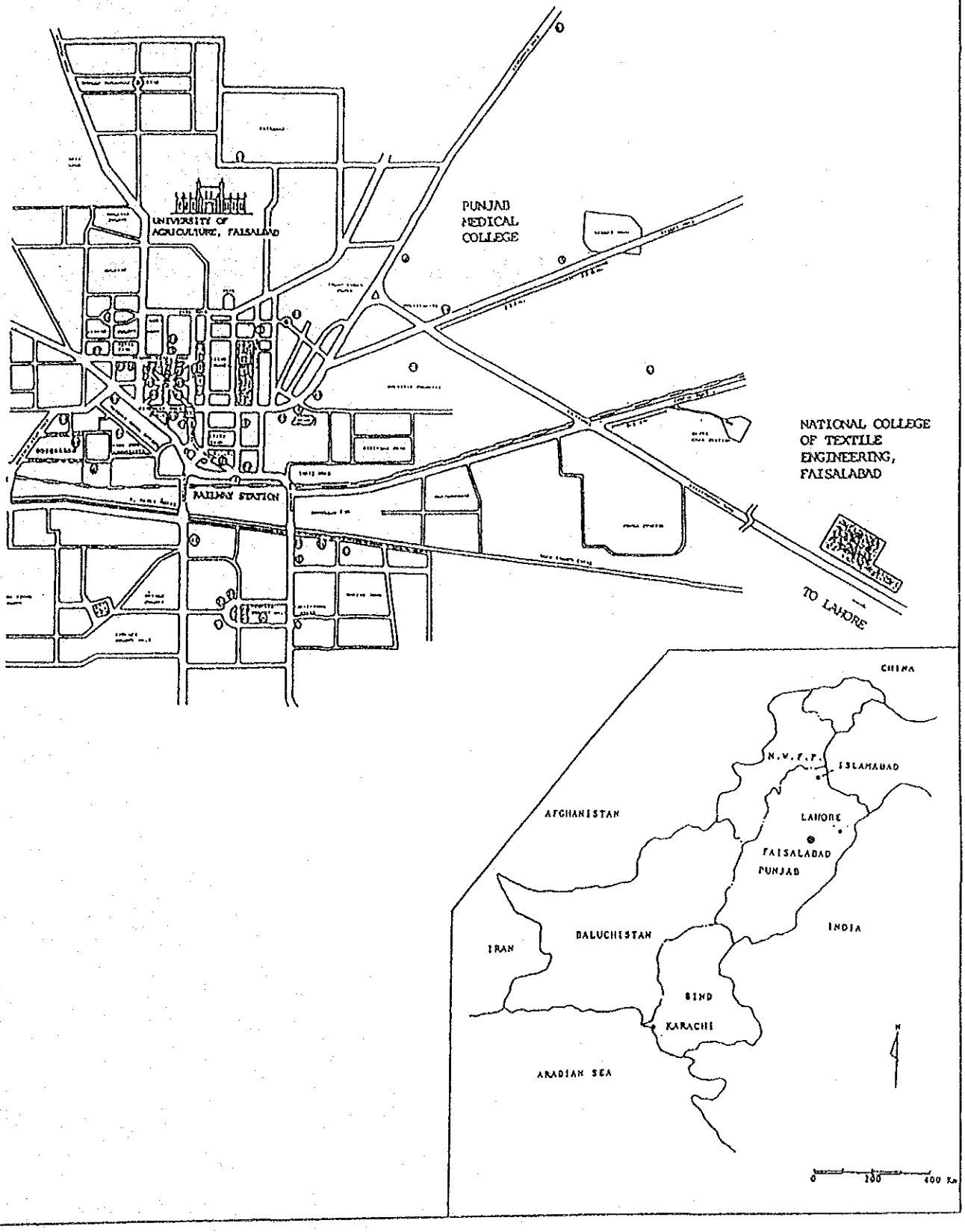
May, 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

LOCATION MAP

CITY OF FAISALABAD



SUMMARY

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The manufacturing sector of Pakistan is dominated by light industries such as textiles, food processing and farm produce processing. In the heavy industry segment, expanding industries include iron and steel, fertilizers, cement and automobiles. The manufacturing sector, which accounts for about 17 percent of national GDP and about 13 percent of national workforce, is next only to the agricultural sector in importance to the Pakistan economy, and has shown continuous expansion to date.

Cotton-related industries are central to the Pakistan manufacturing sector. The textile industry, one of the country's largest traditional industries, represents about 8 percent of national GDP and about 40 percent of the work force employed in the manufacturing sector. The Pakistan textile industry has developed on an export-centered basis to date. Exports of medium-quality cotton yarn and cloth account for 42 percent of the country's total exports. If exports of raw cotton are added to this, the cotton-related industries account for 62% of the country's total exports. This means that the raw cotton and textile industries are the country's largest sources of foreign currency. Pakistan ranked second worldwide in exports of cotton yarn (in 1987-88) and third worldwide in exports of raw cotton (in 1988-89).

In recent years, however, textile products from Indonesia, Thailand, India and the Soviet Union have been increasing their share of the international market. As a result, the Pakistan textile industry has been forced to step up its efforts to increase international competitiveness. Major causes behind the increase in the number of textile products manufactured in the above countries are said to be the uniform product quality and high productivity achieved. On the other hand, the major causes for the decline in the international competitive power of Pakistan-made textile products include the superannuation of equipment and machinery, the decline in operating rates of

machinery and the decline in productivity, all of which are problems concerned with production.

In response to these problems, the Government of Pakistan has examined ways to a) enhance product quality and efficiency through equipment replacement, b) promote investment not only in spinning but also in weaving, dyeing and finishing, and sewing to promote a shift to products with higher value-added content and c) introduce process/cost/quality control technologies while at the same time enhancing the level of production technology through improved maintenance of equipment and machinery. The government has adopted various policy measures, including incentives, for the promotion of this industry.

In an effort to promote further expansion of the country's textile industry programs to increase both production and exports of cotton yarn, cotton cloth and dyed and finished textile products were included by the Government of Pakistan in its Seventh Five-Year Plan. It is considered necessary to add 1.5 million spindles and 46,000 weaving machines to the textile industry's existing production base in order to achieve the goal of effective expansion.

The Pakistan textile industry is expected to continue expanding with the impetus received by the federal government's industrial policy package and industrial incentives mentioned above. It is therefore expected that demand for qualified engineers to take charge of production management and quality control in the mills will also continue to increase as a consequence.

National College of Textile Engineering, Faisalabad is responsible for educating and training textile engineers. It occupies an important place in the country's educational system since it is the only institution of higher education that is in a position to provide the Pakistan textile industry with qualified textile engineers. The college offers four-year bachelor's degree courses in textile engineering comprising a spinning course, weaving course and textile processing course in

respective departments. Sixty to seventy students are enrolled annually in the college. Its graduates receive a B.Sc. Textile Engineering from the University of Engineering and Technology, Lahore with which the college is affiliated.

It should be noted, however, that most of the college's existing equipment was installed around the time of its founding (1960) and nearly thirty years have passed since that time. Compared to the latest equipment actually being introduced in the country's textile mills, the college facilities are so outdated and/or superannuated that they are considered unsuitable for training students in modern textile engineering. Most of the existing items of equipment were donated by the Government of the United Kingdom under the Colombo Plan, and were therefore manufactured in Europe, largely in the United Kingdom. They differ therefore in design and operational system from the Japanese-made ones now being introduced in the Pakistan textile industry, and this makes it difficult to integrate the college's educational achievements into the actual conditions of the textile industry.

In keeping with the present policy of the Government of Pakistan, the textile industry tends to place greater emphasis on weaving, knitting and dyeing and finishing which generate higher value-added than on spinning sectors as in the past. In this connection, too, the college finds it difficult to cope with the ongoing technological innovations of the textile industry.

In view of this difficulty, the Government of Pakistan has formulated a project to modernize and improve the college's equipment. The project will revitalize the college's educational activities through the introduction of up-to-date equipment and state-of-the-art technologies and thereby improve the educational training of students who are expected to take the future leadership of the textile industry. A request to the Government of Japan to provide a grant aid for the project has been made by the Government of Pakistan.

In response to this request, the Government of Japan decided to conduct a basic design study concerning this project, and Japan International Cooperation Agency dispatched a basic design study team to Pakistan from December 10 to 29, 1990. The basic design study team verified the background and contents of the project and investigated the systems of the Pakistan party for implementing the project through consultations with representatives of the National College of Textile Engineering, Faisalabad. The team also investigated the country's industrial sector and other related matters.

The college's education and training in textile engineering is characterised by the fact that almost the same weight is given to theory and practice. At the college, the subjects offered are reviewed annually so that the students may have opportunities to study new theories in close relation to new technologies and equipment. The problem is, however, that the college's existing equipment is outdated functionally, compared with that which has been introduced in the textile industry, and that there is a shortage of instruments for use in lectures and practical training.

The present situation of the college's equipment as clarified by the basic design study is described below.

(1) Spinning Department

This department possesses almost all the equipment necessary for training students in spinning technology. It has 10 types of equipment, but most of these were manufactured in the United Kingdom around 1960 when the college was founded. Compared with the types of equipment actually used in the textile industry, which are designed to generate higher product quality and productivity, these are outdated functionally.

(2) Weaving Department

This department also has 10 types of equipment, most of which were manufactured in the 1960s when the college was established. They are sufficient for training the students in the processes of weaving, but are far from sufficient for training them in the enhancement of product quality and productivity. The department has no knitting machine though this is necessary for training the students in knitwear production, a sector of rapid expansion in recent years. The college therefore finds it very difficult to keep abreast of the latest developments in the textile industry.

(3) Textile Processing Department

Most of the department's existing items of equipment, which are basic cotton cloth processing devices, were installed around the time of the college's founding. They are used independently, and their processing capacity is to a laboratory level. The department has a total of 28 types of equipment. But most of them are functionally insufficient for practical training, and some of them are out of order, and not therefore in use at present.

(4) Testing Laboratory

Most of the equipment existing in the testing laboratory was installed around the time of the college's founding. Although some equipment is out of order, all the others are still functioning. However these testing equipment is considered functionally outdated in view of the fact that the Pakistan textile industry is required to conduct a strict and high level of quality control in order to remain competitive on the international market.

(5) Auxiliary Equipment

Despite the fact that in recent years audio-visual devices such as overhead projectors and video units have been increasingly installed in the universities and colleges of Pakistan, there is no provision of such devices in this college. Even in the college's engineering and basic science laboratories, basic laboratory equipment is provided quite insufficiently. There are no personal computers installed in the college although these are now considered indispensable to engineering education. Furthermore, the college is without copying machines for use in preparation of teaching materials. The college's instructors are forced to utilize outside copying services available nearby. This results in a waste of time and money. In conclusion the college is judged to be without the basic devices for common use indispensable to carrying out engineering education.

An outline of the project prepared taking the above-mentioned facts into consideration is given below:

(1) Executing Agency: National College of Textile Engineering, Faisalabad

(2) Activities covered by the project:

1) Technical education in the area of textile engineering,

2) Guidance for improvements in product performance and quality in the course of commissioned product testing and

3) Consulting services to enhance productivity, quality control and process control.

(3) Items of equipment selected:

1)	Spinning Department:	Blow Room Machinery, Carding Machine, Ring Spinning Frame, etc.	9
2)	Weaving Department :	Weaving Machine, Knitting Machines, etc.	10
3)	Textile Processing Department:	Colour Difference Measuring System, Auto-Screen Printing Machine, etc.	30
4)	Testing Laboratory :	Testing Equipment	9
5)	Auxiliary Equipment:	Overhead Projectors, Electric Laboratory Equipment, Personal Computers, etc.	9

In this project, procurement, transportation and installation of the planned items of equipment, test running and adjustment of the equipment together with consultant services for detailed design and project supervision are included in the scope of work under grant aid. On the other hand, all activities necessary for moving existing items of equipment, receiving the planned items of equipment and obtaining the Government of Pakistan's approval necessary to implementing this project are included in the scope of work of the Pakistan side.

For this project, 3 months will be required for the detailed design of the project, and 9 months for the procurement and installation of the equipment.

Expected effects of this project include:

(1) Improvement of the college's technical education in line with the present needs of the textile industry,

(2) Enhancement of the college's role in providing technical guidance to the textile industry,

(3) Revitalization of the college's educational activities, and

(4) Expansion of the college's technical services to the textile industry.

In view of the above-mentioned expected effects of this project, together with the prospect of experts educated at the college taking the leadership in the textile industry and thereby contributing to the growth of the Pakistan industrial sector, it is judged appropriate and reasonable to implement this project under the grant aid of the Government of Japan.

CONTENTS

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

While the textile industry, which is one of Pakistan's key industries, has continued to grow through the replacement of manufacturing equipment in recent years and the subsequent technological innovations, the country's efforts to nurture engineers equipped with advanced technical skills and expertise in textile engineering have not been able to meet the needs of the textile industry. For this reason, the Government of Pakistan has formulated a project to modernize and expand the equipment installed in the National College of Textile Engineering, Faisalabad, the only institution of higher education that offers bachelor's degree courses in textile engineering. Equipment modernisation will permit the college to contribute more actively to national manpower development in the area of textile engineering. The Government of Pakistan has requested the Government of Japan to provide a grant aid for the improvement of the college's equipment necessary to implementing the above project.

In response to this request, the Government of Japan decided to conduct a basic design study on the project, and Japan International Cooperation Agency (JICA) dispatched a basic design study team headed by Prof. Dr. Akira Shinohara, Dean of Faculty of Textile Science and Technology of Shinshu University, from December 10 to 29, 1990 to verify the background of the project, the details and contents of the request, and to conduct on-site investigations. The members of the basic design study team and its work schedule are as shown in Appendix-2 and Appendix-3 respectively.

On December 18, 1990, Prof. Dr. Akira Shinohara, the team leader exchanged the Minutes of Discussions with Mr. Jehangir Khan, Deputy Secretary of the Ministry of Industries of Pakistan, and Dr. Abdul Majeed, Principal of the National College of Textile Engineering, Faisalabad. The Minutes of Discussions is shown in Appendix-1. During the on-site investigations, the basic design

study team verified systems of the Pakistan party for implementing the project and the contents of the request. At the same time the study team visited related organizations and private mills for the purpose of investigating the actual situation of the Pakistan textile industry. After returning to Japan, the basic design study team carried out repeated consultations with the Japanese parties concerned, and subsequently selected the necessary items of equipment. A draft final report of the basic design was prepared on the basis of the results of the study team's full examination of the justification, propriety of the project, the optimum scale of the project, the proposed system for operating and managing the project and the expected effects of the project.

In order to explain and consult with relevant officials of the Islamic Republic of Pakistan on the components of the draft final report, JICA sent the report explanation team headed by Mr. Masashi Fujita, First Basic Design Study Division, Grant Aid Study and Design Department, JICA from March 26 to April 6, 1991. Based on the result of discussion, the Basic Design Study Report has been drawn up.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 General Situation of the Industrial Sector

2-1-1 Industrial Policies and Industrialisation

(1) General Situation

When Pakistan gained independence in August 1947, the number of industrial establishments existing in Pakistan accounted for less than 10 percent of total business establishments in the country. For this reason, the Government of Pakistan implemented a series of development plans to industrialize the country with the aim of establishing the country's economic base through an expansion in employment opportunities and exports. Between 1955 and 1960, the Government of Pakistan gave utmost importance to the establishment of economic infrastructures. During the 1960s, a full-scale industrialization program was implemented which aimed primarily at giving rise to an import-substitution-type industries and consumer goods manufacturing industries. During the 1970s, progress in the country's industrialization temporarily slowed down partly because of the federal government's policy of nationalizing big businesses. During the 1980s, however, the country's private sector showed rapid growth. During that period, an active introduction of foreign private capital was carried out, export-oriented industries were promoted and both the use of indigenous resources and key industries were expanded. As a result, the country's industrialization was accelerated.

The largest sector of the Pakistan economy is agriculture, which includes production of cash crops such as cotton. Agriculture sector represents about 27 percent of the Gross Domestic Products (GDP), and about 51 percent of the total employed workforce. Further, this sector supplies raw materials to such manufacturing industries as textiles and food processing. In Pakistan, agricultural produce and processed agricultural products account for about 60 percent of the country's total exports. On the other hand, the country's agriculture is very vulnerable to climatic changes. It also suffers such problems as superannuated irrigation facilities and unstable agricultural production attributable to insufficient production management. The country's excessive dependence on agriculture has been a serious destabilizing factor to the growth of its economy. Given such circumstances, the Government of Pakistan is fully aware of the need to establish an industrial sector which complements the agricultural sector in order to attain a stable economic growth.

At present, the country's manufacturing sector centres around such light industries as textiles, food processing and farm produce processing. On the other hand, the country's heavy industries such as iron and steel, fertilizers, cement and automobiles have been growing gradually. The manufacturing sector, which accounts for about 17 percent of the national GDP, and about 13 percent of the total national working population, is the second largest sector of the country's economy. On the strength of tax incentives and government subsidies, the manufacturing sector has achieved a relatively stable growth (see Table 2-1).

The main objectives of the present Seventh Five-Year Plan include an average annual growth rate in GDP of 6.5 percent, full activation of the private sector export promotion, improvement in the balance of payments and

reduction in the fiscal deficit. Provision of employment opportunities and reduction of the regional economic imbalance were among the top priorities since Sixth Five-Year Plan. Thus, it is clear that high expectations are placed on the country's manufacturing sector.

Table 2-1 Main Indicators of Manufacturing Sector

	% Share of Manufacturing Sector in GDP +	Production Index (1980-81=100)	% Growth of Manufacturing Sector
1987-88 (Final)	17.55	179.1	9.98
1988-89 (Revised)	17.40	183.4	3.96
1989-90 (Provisional)	17.85	197.5	7.89

\+ In real term (Base: 1980-81 = 100)

Source: Economic Survey 1989 - 90

(2) Industrial Policy Package

Knowing the importance of developing an industrial sector to complement the agricultural sector in order to make the country's economy more self-sustaining, the Government of Pakistan announced, in July 1989, a new "Industrial Policy Package" aimed at expanding and improving the country's industrial base through the improvement of the country's investment environment and a positive introduction of modern technologies. The basic concept underlying this industrial policy is to liberalise investment opportunities available to the private sector, both at home and abroad, in certain industries, in order to provide more employment opportunities and to rectify the regional economic

imbalance. Particular emphasis is placed on development of export-oriented and of import-substitution, agro-based industries, electronic engineering and high-tech industries, as well as of small-scale industries. In this policy, mention is made of the need to simplify existing investment procedures. The main objectives of the 1989 "Industrial Policy Package" are as listed below.

1) Creation of employment opportunities by encouraging labour intensive projects;
2) Balanced regional growth through dispersal of industries to the less developed areas;

3) Giving a pivotal role to small-scale industries; and

4) Development of key industries:

   (Biotechnology, fibre optics, solar energy equipment, computers and software, electronic equipment, and fertilizers for adding higher value, acquiring sophisticated technology)

In order to attain the above objectives, the Government of Pakistan offers various financial incentives as part of its investment promotion policy measures. The financial incentives include:

Income tax holiday

Each key industry established within Pakistan during the Seventh Five-Year Plan will be exempted from income taxes for four years. In some less developed areas within the country, however, all industries, including key industries, will be exempted from income taxation for eight years.

Exemption from customs duty

When the key industries established during the Seventh Five-Year Plan import machinery, they will be exempted from customs duties provided that such machinery is not manufactured locally. In less developed areas, all the industries will be exempted from customs duties and import surcharge on the imported machinery provided that such machinery is not manufactured locally.

Sales tax exemption

All industries established within the country during the Seventh Five-Year Plan will be exempted from sales taxes on their output for eight years.

The other tax incentives include an income tax rebate in the case of exportation of products, reductions in import customs duties imposed on raw materials and duty draw backs. On the other hand, such industries as electronics, pharmaceuticals and mining industries are eligible for customs duty/sales tax reductions or exemptions.

In support of its objectives of developing an investment climate in the private sector conductive to a more dynamic, expanding and internationally oriented industrial structure in Pakistan, the government introduced policy reforms in the month of December, 1990. One of the most important objects of these reforms is to remove all bottlenecks faced by prospective investors both domestic and foreign. To a large extent, the requirement for government permission has been dispensed with for setting up industries except for the following sectors:

- Arms and ammunition
- Security printing and currency.

- High explosives.
- Radioactive substances.

(alcoholic beverages is on the negative list).

As a result of these policy reforms, the previous involvement of the Government in the regulation and sanctioning of industrial investments proposals has been drastically reduced.

Further in December 1990, the Government of Pakistan announced a new package for rural industrialization called "Rural Industrial Development Incentives" which is aimed at rectifying the regional economic imbalance and increasing employment opportunities in rural areas. Its outline is given in Appendix-8.

Recently, the government has also liberalized the foreign exchange control.

2-1-2 Outline of the Pakistan Textile Industry

(1) Historical Background

Pakistan is among the world's largest raw cotton producing countries. The Pakistan-made raw cotton, which is characterized by short fibre length, is suited for spinning coarse count yarn. At present, the country ranks fifth worldwide in the production of raw cotton, accounting for 7.5 percent of the world's total raw cotton production. It ranks third in terms of exports of raw cotton, representing 14.2 percent of the world's total exports of raw cotton. It should be noted, however, that Pakistan has traditionally concentrated mainly on raw cotton production, with cotton yarn production being carried out in such industrial cities of Bombay, Ahmadabad and Delhi in India. When Pakistan gained independence in 1947, there were only 79,000 spindles operating in the country. At that time, on the

other hand, there were as many as 400,000 weaving machines. However, only 3,000 of these were actually suited for mass production. As a result, the country was heavily dependent on foreign countries for the most part of supplies of cotton yarn.

In an effort to respond to this situation, the Government of Pakistan issued a statement outlining its first industrial policy in 1948, and started developing a processing industry to utilize mainly indigenous raw materials. In line with this measure, industrial investment of domestic commercial capital centering on the sector of cotton spinning was begun. In 1952, demand for raw cotton and cotton products increased dramatically with the outbreak of the Korean War. The profits from commercial capital were reinvested in the country's textile industry, which greatly contributed to the expansion of this industry. As a result, the textile industry became one of the country's key industries.

(2) Present Situation

At present, Pakistan's manufacturing sector is dominated by cotton-related industries. The share of the textile industry to the country's GDP stands at about 8 percent and that of the workforce employed in this sector at about 40 percent, with exports of cotton cloth representing 42 percent, or 62 percent if exports of raw cotton are added, of the country's total exports. Thus the raw cotton and the cotton-related industries are the country's largest sources of foreign currency. Pakistan ranks second worldwide in exports of coarse count (Nos. 1 to 20) cotton yarn and medium count (Nos. 21 to 34) cotton yarn. The country ranks third in the world in terms of exports of raw cotton. In recent years, the emphasis in production of cotton goods has been shifting toward higher added-value, from cotton yarn to cotton cloth and cotton clothing given the increased unit yield,

which is attributable to ongoing cotton breed improvements, and the federal government's export promotion. At the same time, equipment replacement investment has been attended to adequately, particularly in the textile industry, and so it is expected that the country's cotton-related production will continue to expand. A breakdown by region of the textile industry's production indicates that cotton yarn is produced mainly in the Punjab, and cotton cloth in Sind. In recent years, however, the Punjab has been the country's largest production centre for both cotton yarn and cotton cloth.

(3) Industrial Structure and Production Facilities

The Pakistan textile industry has a "dual structure." It consists of a "mill sector" represented by the spinning section, where mechanization is well under way, and a "non-mill sector (or unorganised power loom sector)" represented by the weaving section. There are reportedly 241 textile mills in the mill sector and approximately 1,000 in the non-mill sector. About half of the total number of textile mills in the mill sector are located in the Punjab, including Faisalabad, and about 40 percent in Sind. According to the statistical data made public in June 1990 by the Textile Commissioner's Organization under the control of the Ministry of Industries of Pakistan, there is a total of 241 textile mills operating in the mill sector, of which 34 are composite mills and 207 spinning mills. With regard to the number of installationed capacity, considered to be an important barometer of the production capacity for these mills, there are 5.27 million spindles, 72,000 rotors and 16,000 weaving machines, of which the numbers of spindles and machines in use are 4.49 million spindles, 64,000 rotors and 8,000 units respectively (see Table 2-2). Of these machines, 90 percent are said to be of foreign-made out of which 60 percent being Japanese-made.

Table 2-2 Province-wise Number of Mills and Capacity

	Punjab	Sind	N.W.F.P.	Balu-chistan	Azad Kashmir	Grand Total
Mills						
Composite Mill	19	13	2	-	-	34
Spinning Mill	105	83	6	8	5	207
Total	124	96	8	8	5	241
Capacity						
Installed Capacity						
Spindle	2,918,528	1,907,681	239,752	129,148	75,456	5,270,565
Rotor	23,992	38,604	-	9,432	-	72,028
Loom	7,252	5,596	436	2,300	-	15,584
Working Capacity						
Spindle	2,619,202	1,566,286	201,501	29,168	72,521	4,488,678
Rotor	20,874	35,649	-	7,564	-	64,087
Loom	4,365	3,403	242	-	-	8,010

Source: Textile Commissioner's Organization, June 1990

According to the 1990 statistical data on textile machines prepared by the Japan Machinery Export Association, Japan's total exports of textile machines to Pakistan were U.S.$144 million (based on FOB prices), of which about 53 percent were exports of spinning machines (see Table 2-3). Most of the textile machines manufactured in Japan are designed to enable users to improve product quality and productivity in line with the rise in technical level in the country's textile industry. For this reason, most Japanese-made textile machines are characterized by high speed and energy-saving mechanism. They can be used for the manufacture of a wide variety of textile products. In addition, they

are very easy to operate as they are equipped with state-of-the art electronic components. Textile machines exported from Japan are basically of the same design as those sold in Japan. In the Pakistani textile industry, on the other hand, there is a general shift away from dependence on second-rate products of low added-value which are manufactured with low-productivity, outdated equipment to promotion of the manufacture of products with a high value-added content. Against such a background, imports of Japanese-made textile machines are on the rise in Pakistan. Pakistan's statistical data on imports of textile machines are shown in Appendix-9.

Table 2-3 Export of Textile Machinery to Pakistan (1990)

(Unit: US$, FOB)

Textile Machinery Total	144,831,705
Spinning Machine	76,975,962
Weaving Machine (W>30 cm)	6,810,793
Prepatory Equipment	45,329,683
Equipment for Yarn	502,313
Processing Equipment	337,880
Knitting Machine	3,304,941
Attachment of Textile Machines	348,064
Parts for Machine	11,222,069

On the other hand, the non-mill sector is dominated by weavers. There are very few spinners active in this segment. Tax incentives, including excise tax exemption, forming part of the federal government's tax policy measures launched in 1968 are provided to small operators who own four or less weaving machines. There are no official statistics available therefore on the number of equipment units owned by these small operators, and this

makes it difficult to gain a clear grasp of their actual situation. We can only estimate the total number of weaving machines installed across the country at about 110,000. These machines are used mainly for the production of lower quality textures.

One of the important aspects of the small-scale industrial section is knitwear manufacturing. Since 1963 when the export of hosiery began, knitwear production in Pakistan has expanded steadily. There is a total of 12,000 knitting machines, which produce about 180 million pieces of knit products (see Table 2-4). Most of the knit products are exported. The main export destinations include the U.S.A., EC nations, Hungary, Saudi Arabia, etc. The main export products are T-shirts, sweat shirts, infant garments, pyjamas, skirts/blouses, track suits and gloves.

Table 2-4 Knitwears - Estimated Capacity Installed & Production (1989)

A.	No. of Manufacturing Units	600
B.	No. of Machines	
	(i) Garments	
	- Circular	3950
	- Flat	1470
	(ii) Socks & Gloves	
	- Automatic	980
	- Manual	5580
C.	Production: The Installed Capacity Estimated to be about 180 Million Pieces	

Source: Pakistan Knitwear & Sweaters Exporter Association

(4) Problems Facing the Textile Industry

In 1977, the Government of Pakistan commissioned Warner International, a world-renowned Belgium-based management consultant company, to conduct a comprehensive survey on Pakistan textile industry, and on the other hand commissioned experts of the United Nations Industrial Development Organization (UNIDO) and the Textile Industry Research and Development Centre (TIRDC) to carry out a long-range survey of the textile industry (from 1972 to 1979) in order to pinpoint the problems facing the country's textile industry and to work out measures to cope with them. As a result of these surveys, the following were pointed out as the major production problems in the country's textile industry.

- Superannuated equipment and machinery

- Decline in the operating rate of the equipment and machinery

- Decline in productivity (machine productivity/efficiency, labor productivity)

In response to the problem of superannuated equipment and machinery, the Government of Pakistan introduced the Balancing, Modernization & Replacement (BMR) Plan, which was aimed at promoting imports of replacement machines by exempting these from customs duty and sales tax, while implementing incentives such as financing imports of machines by introducing Pay As You Earn (PAYE) Scheme. Particularly replacement of equipment and machinery in the mill sector is well under way, but about 50 percent of total national equipment units in current use have exceeded their term of depreciation.

The main causes of the decline in operating rates and productivity of equipment include the unstable supply of raw cotton, shortages of electric power, skilled labour and water for industrial use, the low level of quality control, low technical levels and competition from other developing countries, as well as from substitutes for synthetic yarn and fibres. These problems remain to be resolved.

In Pakistan, about 25 percent of raw cotton production is exported, with the remaining 75 percent being consumed mainly for the manufacture of cotton yarn. In turn about 40 percent of this cotton yarn production is exported, with the remaining 60 percent being consumed at weaving mills. Of the total production of cotton cloth, 37 percent is exported in the form of grey cloth, and 18 percent in the form of clothing and made-ups such as knitwear, towels, tents and canvases, while the remaining 45% is consumed domestically. As the country's textile industry has developed as an export-oriented one, it is imperative to maintain, and even increase, its international competitiveness (see Table 2-5). In 1987/88, the average per capita monthly income in Pakistan was 3,026 rupees. This cheap labour force has been a major factor contributing to the increased strength of the Pakistan textile industry's international competitiveness, but the industry is becoming aware of the problem of quality competition from other developing countries. Textile goods from India, Thailand, Indonesia and the Soviet Union are improving in quality. If the Pakistan textile industry should fail to keep a reasonable balance between high productivity and quality, it would become difficult to maintain a steady growth in exports of textile goods.

In an attempt to deal more actively with these problems, both the Government of Pakistan and the country's private sector are considering a) further improving product

quality and production through equipment replacement, b) promoting investment not only in the spinning section but also in the weaving, dyeing and finishing, and sewing sections and c) introducing advanced process and quality control techniques, as well as advanced equipment/machinery maintenance techniques.

Table 2-5 Cotton Textile Statistics from 1985/86

Year	Cotton		Yarn		Cloth	
	Production	Exports	Production	Exports	Production	Exports
	(103 Bales)	(Mill.kg)	(Mill.kg)	(Mill.kg)	(Mill.m2)	(Mill.m2)
1985/86	7,000	638.51	482.18	157.90	1,985.40	727.35
1986/87	7,640	640.96	584.76	259.67	2,009.56	693.46
1987/88	8,630	501.98	685.03	210.95	2,230.52	846.61
1988/89	8,200	840.27	767.43	291.95	2,250.00	845.33
1989/90	8,600	294.52	925.38	377.38	-	-

Source: Textile Commissioner's Organization, June 1990

(5) Effects of Measures for the Promotion of the Textile Industry

Between 1985 and 1987, the Government of Pakistan initiated a drastic easing of its restrictions on the manufacturing sector including the textile industry, in an effort to revitalize the stagnant sector. As part of this policy, customs duties on spinning machines and automatic winders were eliminated, and location regulations on textile mills were lifted. In 1988, the federal government announced its decision to designate the textile and clothing industries as the country's key industry and to continue to exempt their products from customs duty and income tax. This resulted in a four-

year income tax holiday and a guarantee of a refund of 75 percent of the taxes paid for the incomes from exports of clothing for all the textile mills established during the Seventh Five-Year Plan. Due to these incentives and the rapid increase in external demand for cotton yarn, many industrialists rushed to invest in spinning mills. This triggered investment in new and additional equipment. An analysis of the trends in the number of machines in operation in the mill sector reveals that the number of operating spindles increased from about 3.1 million in 1985/86 to 4.35 million in 1989/90, and the number of operating rotors from about 24,600 to about 64,000 during the same period (see Table 2-6).

Table 2-6 Capacity Installed and Worked from 1985/86

Year	Capacity Installed		Capacity Worked	
	Million Spindle	Rotor	Million Spindle	Rotor
1985/86	4,428	37,456	3,104	24,619
1986/87	4,292	48,176	3,223	32,340
1987/88	4,330	55,360	3,572	45,417
1988/89	4,790	66,408	3,879	52,412
1989/90	5,270	72,028	4,352	64,000

Source: Textile Commissioner's Organization, June 1990

In 1989/90, production of yarn, including cotton yarn and blended yarn, increased to about 980,000 tons. Exports of yarn increased from about 160,000 tons in 1985/86 to about 380,000 tons in 1989/90, or from about 4.6 billion rupees to about 18.2 billion rupees in value.

In recent years, production of cotton cloth in the mill sector has remained at the same level, while production in the non-mill sector is on the increase. As a result, the country's total production of cotton cloth increased from 1,985 million square metres in 1985/86 to 2,250 million square metres in 1988/89. On the other hand, knitwear production has been increasing in response to a strong export demand, and exports increased drastically from US$54.63 million in 1985/86 to US$ 166.93 million in 1988/89.

As is clear from the above description, the Pakistan textile industry is proceeding toward replacement and modernization of equipment, introduction of new production techniques (mainly for use in quality control and cost control), higher product quality and productivity, and higher value added. It is expected that this trend of the Pakistan textile industry which reflects the government's support through, for instance, the above-mentioned industrial policy package, will continue to gain momentum. At present, demand is increasing rapidly for qualified textile engineers to take charge of production management, cost control and quality control particularly in the administrative departments of private mills. The All-Pakistan Textile Mills Association (APTMA), which is a national trade organization of mill sector operators of the country's textile industry, estimates that Pakistan private textile companies' annual demand for qualified engineers will exceed the 100-person mark due to the fast growth of the sector. Thus in the area of textile engineering in Pakistan, there is a strong demand for experienced, well-informed engineers.

2-2 Outline of the Related Plans

2-2-1 Outline of the Long-Term Development Plan

The Government of Pakistan formulated a Perspective Plan (1988 - 2003), which was designed to help the federal government implement the five-year plan, its medium-term development plan, and the annual development plan, its short-term plan, from a long-range socio-economic perspective. The two main objectives of the Perspective Plan are a) to realise a self-sustained economy and b) to alleviate poverty. The development goals to be attained by the year 2003 under the two main objectives are as listed below.

- to reduce the rate of population growth from 3.1 per cent in 1987-88 to 2.6 per cent by the year 2003;
- to eradicate illiteracy among youth by the end of the Eighth Plan, through full enrollment of the primary age population;
- to provide the entire population with access to clean water;
- to provide all the urban areas and 60 per cent of the rural areas with access to sewerage facilities;
- to provide telephones to about 50 per cent of the population;
- to increase tertiary roads from about 80,000 km at present to about 140,000 km by the year 2003, against an estimated total requirement of 200,000 km;
- to provide a Rural Health Centre (RHC) for each Union Council;

- to gradually expand the level of health care facilities such as ambulances with a radio or radio links;

- to increase the installed capacity for power generation to fully meet growing demand; and

- to provide town development schemes, to accommodate the rapidly growing urban population.

In the above mentioned Perspective Plan, importance is accorded to the improvement and expansion of the industrial sector (manufacturing, mining, electricity/ gas, construction, etc.), particularly on expansion of the country's exports through an enhancement of the value-added content and international competitiveness of manufactured goods, in order to stabilize the Pakistan economy. The plan also calls for structural changes in the manufacturing industry. It is expected, therefore, that more emphasis will be placed on the engineering and electronics sectors and that the automobile, machinery, electronics, petrochemical and building material sectors will grow faster than the agriculture-related and the semi-processing sectors. In Pakistan, it is expected that the manufacturing industry's share of the country's total value-added production will increase from 17.5 percent in 1988 to 22.3 percent in 2003.

These development efforts are expected to create employment opportunities for 13.50 million persons nationwide, of which 30.8 percent will be created in the agricultural sector and 28.5 percent in the manufacturing and mining sectors. As a result, it is expected that the agricultural sector's share of the country's total employed workforce will decrease from 48.8 percent in 1987/88 to 43.2 percent in 2003, while the industrial sector's share will increase from 21.5 percent to 26.5 percent during the same period. Possible changes in the

industrial structure may lead to an increase in demand for more engineers, professionals and skilled labour. This implies a need to place more emphasis on technical education and job expertise development education.

2-2-2 Outline of the Seventh Five-Year Plan

The present Seventh Five-Year Plan (1988-1993) was formulated within the framework of the above-mentioned long-term plan, and therefore gives top priority to the attainment of an efficient economic growth and the improvement of the quality of life. The basic aims of the plan are as listed below.

- movement towards full employment, specially of the educated;
- provision of adequate nutrition, shelter, health care, education, transport and other public services;
- development of human resources, with emphasis on education and training of man-power;
- progressive achievement of self-reliance in all spheres of life, including the gradual reduction of dependence on foreign loans, technology and know-how;
- promotion of private sector activity through further deregulation of the economy in order to transfer the bulk of the financial burden of investment and growth from the government's budgetary resources to the private sector's own resources;
- restoration of equilibrium in public finances by a concrete programme of balancing the revenue budget, and eliminating the imbalance between the government's expenditure requirements and its revenue raising capacity;

- strengthening of the balance of payments by the aggressive promotion of exports, through industrial, commercial and exchange rate policies and achievement of a better balance between imports and export; and

- pursuit of a restrained monetary policy to ensure continued price stability.

The Seventh Five-Year Plan's economic growth targets include a 6.5 percent annual growth rate for GDP, a 4.7 percent growth rate for the agricultural sector and an 8.1 percent growth rate for the manufacturing sector (see Table 2-7). In the process of setting these economic growth targets, particular emphasis was placed on a) achieving self-sufficiency in a large number of agricultural and industrial products, b) export promotion and diversification of exports, c) generation of maximum employment opportunities, and d) price stability.

Table 2-7 Gross Domestic Product at 1987-88 Prices

(Rs Billion)

	1987-88	1992-93	Annual growth rate (%)
Agriculture	143.9	181.4	4.7
Industry	176.0	259.9	8.1
Manufacturing	108.1	159.6	8.1
Others	298.1	405.5	6.4
GDP (Billion Rs)	618.0	846.8	6.5
No. of Families (mln)	17.0	19.8	3.1
Family Income (Rs/month)	3,026	3,562	3.3

Source: Seventh Five-Year Plan 1988-93

The scale of investment required for attaining these goals is estimated at 660.2 billion rupees, a 42.9 percent increase over the Sixth Five-Year Plan, of which 367.8 billion rupees (a 35.3 percent increase) are to be expended by the public sector and 292.4 billion rupees (a 53.7 percent increase) by the private sector.

The growth strategy of the Seventh Five-Year Plan for the industrial sector is to place emphasis on the establishment of efficient, state-of-the-art technologies and export-oriented industries through investment by the private sector together with promotion of industry in less developed areas. To this end, it is necessary to implement proper foreign exchange policy measures, to streamline the country's tariff system and to implement fiscal incentives. In order to improve corporate management efficiency, it is necessary to improve the quality of export products through the introduction of a viable quality control system, while balancing and modernising the existing production equipment. In the present Seventh Five-Year Plan, the total amount of investment in the industrial sector is estimated at 96.5 billion rupees, of which 90.7 percent is to be expended by the private sector and 9.3 percent by the public sector. Of the amount of money to be expended by the private sector, 29 percent is to come from the textile industry, 25 percent from the capital goods industry, 23 percent from the agro-based small-scale industry, 16 percent from the chemical industry and 7 percent from other industries.

If these policy measures are taken, it is expected that the industrial sector's share of the national GDP will increase from 17.5 percent in 1987/88 to 19.0 percent in the final year of the plan and that the exports of domestic products will achieve an 11.5 percent annual growth rate.

In order to further promote the development of the Pakistan economy, it is necessary to continuously develop high-quality human resources. To this end, this plan should be implemented with emphasis on the implementation of investment incentives for the industrial sector, the promotion of small-scale industries, the implementation of job expertise development programmes and the promotion of labour-intensive industries.

2-2-3 The Textile Industry and Development Plan

To help the textile industry, which is one of the country's key industries, grow further, the federal government intends to ensure the followings during the Seventh Five-Year Plan.

- sufficient availability of cotton to textile mills at a price comparable with international market rates and improvement in quality of cotton;

- re-organisation and modernisation of weaving and finishing to produce superior cloth for export and for garment industry;

- provision of infrastructure and financial assistance to small and medium sized units for production of made-ups;

- freedom to exporting units to secure technical assistance from abroad or collaborate with foreign agencies for maximising export earnings;

- improvement in management and labour productivity;

- rationalization of fiscal incentives to encourage production and export of more value-added goods; and

- provision of institutional assistance by developing a data bank, market information system and design improvement services.

If these measures are implemented, it is expected that the following goals (Table 2-8) will be attained during the Seventh Five-Year Plan.

Table 2-8 Projection of Production and Export of Textile Manufactures during Seventh Five-Year Plan

	Items and Unit	Production		Export	
		1987-88	1992-93	1987-88	1992-93
1.	Cotton Yarn (M.Kg.)	560	887	197	317
2.	Cotton Cloth (M.m2)	2,230	3,447	750	1,005
3.	Textile Finishing (M.m2)	1,650	2,820	-	-
4.	Synthetics*				
	Fibre (M.Kg.) (Polyester)	65	75	-	-
	Filament (M.Kg.)	40	56	-	-
	Fabrics (M.m2)	592	830	54	80
5.	Made-Ups				
	(a) Yarn Based (M.kg)				
	Towels	24.6	49.2	21.3	39.2
	Hosiery&Knitwear	15.3	24.8	7.3	11.8
	Canvas&Tents	23.0	25.9	19.5	20.5
	Sub-Total (a)	62.9	99.9	48.1	71.5
	(b) Cloth Based (M.Kg.)				
	RM Garments & Fashion Apparels	76.0	188.5	57.0	141.4
	Other Made-Ups	24.0	49.5	16.0	33.0
	Sub-Total (b)	100.0	238.0	73.0	174.4
	Total Made-Ups (5)	162.0	337.9	121.1	245.9

* Includes imports of fibre 24 M.Kg., filament 10 M.Kg. for 1987-88.

Source: Pakistan Textile Statistics

However, in order to attain these goals, it is necessary for the textile industry to add 1.5 million spindles and 46,000 weaving machines to its existing production base. For this reason, the amount of investment in the textile industry, which is dominated by private businesses, is estimated at 25 billion rupees.

Through these development plans and the above-mentioned industrial policy measures, the Government of Pakistan is in the process of fully liberalising the installation of new equipment and the expansion of existing equipment to help the textile industry grow further. One sign of this is the increase in the number of textile mills. In 1989/90, 30 new textile units started operations, and in 1990/91 a similar number of new textile units are expected to go into operation.

2-3 The National College of Textile Engineering, Faisalabad

2-3-1 Outline of the College

(1) Background of the College Foundation

For the purposes of providing the textile industry with engineers holding a degree in textile engineering and so stimulate growth of the textile industry, the Government of the Punjab decided to establish an institute of textile technology in City of Faisalabad (then City of Lyallpur) with the cooperation of private textile mills. As a result, a board of trustees to promote the establishment of such an institute chaired by the Minister of Industries was established in 1954. The initial construction and administration costs were covered by donations from private businesses. The Government of the Punjab provided 63 acres (about 26 ha) of crown land for the institution. The equipment for use in education and training at the projected institute was donated by the U.K. Government in 1960 together with services of experts as part of a technical assistance program under the Colombo Plan.

(2) Outline of the College

The National College of Textile Engineering, Faisalabad offers four-year bachelor's degree courses in textile engineering. The major departments comprises the Spinning Department, Weaving Department and Textile Processing Department. There are also supplementary courses such as the Textile Testing, Basic Science and Engineering. Sixty to seventy students are annually enrolled at the college. Graduates of the college receive a degree (B.Sc.) in textile engineering from University of Engineering and Technology, Lahore, with which the college is affiliated. The college is the country's only institution which offers degree courses in

textile engineering. During their first academic year, the students study basic compulsory subjects, and from their second academic year on they study their respective specialist subjects as specified by the college. As of December 1990, there were 255 students enrolled at the college, of which 174 majored in spinning, 56 in weaving and 25 in textile processing. Table 2-9 shows a breakdown by year and class of the total number of students enrolled at the college.

Table 2-9 National College of Textile Engineering, Faisalabad
Total Numbers of Students on Roll

(As of December, 1990)

Sl. No.	Year Wise	Class	Spinning	Weaving	Textile Processing	Total
1.	1988-89	First Year	48	18	13	79
2.	1987-88	Second Year	39	16	7	62
3.	1986-87	Third Year	45	10	3	58
4.	1985-86	Final Year	42	12	2	56
	Total		174 (68%)	56 (22%)	25 (10%)	255 (100%)

More than 700 students have graduated from the college since its foundation. In March 1990, a total of 50 students graduated from the college, of which 37 were spinning majors, 9 weaving majors and 4 textile processing majors. Except for those who go abroad to study and those who are self-employed, the graduates of the college are mostly working at private textile mills (see Table 2-10). Most of them are employed as first-class engineers with a bachelor's degree in textile engineering. They become assistant manager (assistant spinning master, assistant weaving master or assistant processing master) on employment. Consequently many have already reached senior positions, including mills

managers and directors.

Of the graduates of the college who entered the private textile industry after finishing the spinning, weaving or textile processing course, about 90 percent were employed by major companies of the organized sector and the remaining 10 percent by weaving and textile processing mills of the non-organized sector. Some of them are teaching at the country's education/training institutions, including the Government College of Technology in Multan and the Textile Industry Research and Development Center in Karachi.

Table 2-10 Employment Record of Graduates

Year/Class	Textile Mills	Study Abroad	Own Business	Others	Total
1986	30	2	4	8	44
1987	26	2	-	2	30
1988	34	2	3	1	40
1989	37	1	2	3	43
1990	36	1	-	13	50

The college has a faculty of 23, comprising professors, associate professors, assistant professors and lecturers. It also has a staff of 42 technical officers and 15 clerks. Table 2-11 shows a breakdown by position of the members of college's teaching and technical staff.

Table 2-11 Teaching & Technical Staff

		Spinning Dept.	Weaving Dept.	Process-ing Dept.	Textile Testing Lab.	Engineer-ing Dept.	Basic Science Dept.	Grand Total
Teaching Staff	Professor	1	-	1	-	-	-	2
	Associate Professor	-	1	-	1	-	1	3
	Assistant Professor	2	-	1	-	1	3	7
	Lecturer/Instructor	2	1	-	1	4	3	11
	Total	5	2	2	2	5	7	23
Technical Staff	Ph. D. Holders	2	-	-	-	-	-	2
	M. Sc. Holders	-	-	1	1	2	4	8
	B. Sc. Holders	3	2	1	1	3	3	13
	Foreman	1	1	1	1	1	-	5
	Supervisior	2	2	2	1	1	1	9
	Machineman	5	5	3	1	2	1	17
	Electrician	2	2	2	1	1	1	9
	Lab. Assistant	-	-	1	-	-	1	2
	Total	10	10	9	4	5	4	42
Administrative Staff								15

The faculty of 23 is composed of 2 doctors (Ph.D.), 8 masters and 13 bachelors. The technical officers include foremen, supervisors, machinemen, electricians and others. Most of them are junior college/high school graduates. The technical staff are responsible for operating, maintaining and managing the equipment for use in practicals.

The college building consists of two main blocks -- a teaching block and a training block. The teaching block, which is a two-story structure, has an administration office, class rooms, physical/chemical training rooms, an auditorium, a library, a conference room and a dispensary. The training block has a spinning lab., a

weaving lab., a textile processing lab., a testing lab. and a workshop. The college's other facilities include a substation, a boiler house and a tube-well water supply facility (see Fig. 2-1).

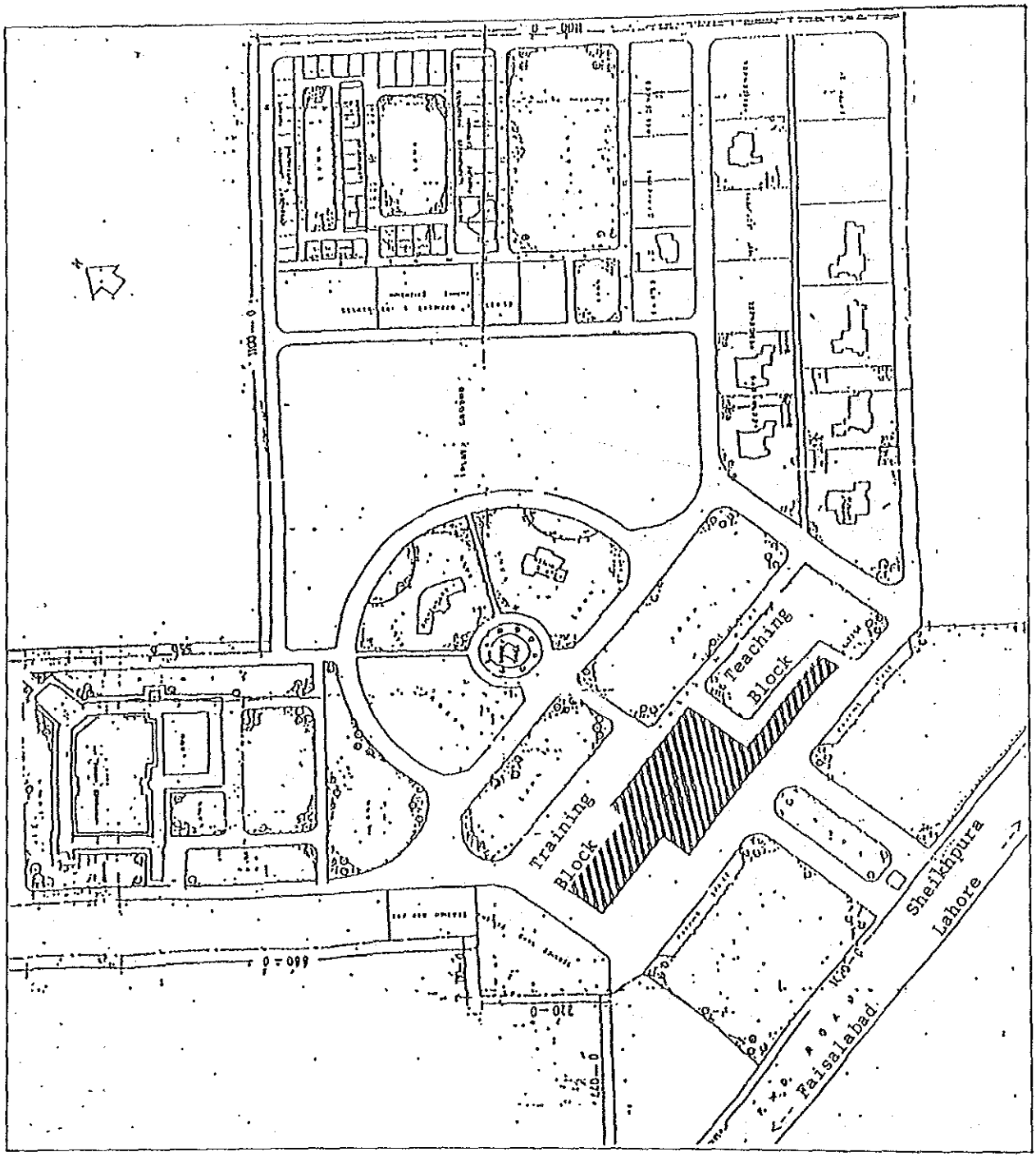
The college's main items of equipment in use for education and training include 10 items (1 line and 16 units) for the Spinning Department, 10 items (32 units) for the Weaving Department, 28 items (43 units) for the Textile Processing Department and 21 items (21 units) for the Testing Laboratory. Most of them were manufactured in Europe, notably in the United Kingdom, in the 1960s. They are generally well maintained and managed. A listing of these items of equipment is shown in Appendix-5.

The items of equipment currently used in each of the department feature as follows.

1) Spinning Department

The department has almost all items of equipment necessary for the spinning process. It has a total of ten items of equipment, most of which were manufactured in the United Kingdom around 1960 when this college was established. They are functionally outdated, compared with the high- quality, high-efficiency machines actually being introduced in the Pakistan textile industry.

Figure 2-1 National College of Textile Engineering, Faisalabad



2) Weaving Department

This department also has almost all the necessary items of equipment. Most of them were manufactured in the United Kingdom around 1960 when this college was founded. This department has a total of 10 items of equipment. While it is possible to train the students in the mechanism of weaving machines using them they are not sufficient for training the students in the high-quality, high-speed spinning operations actually carried out in the Pakistan textile industry. It should also be noted that there is no equipment for use in production of knitwear, an area which has been expanding rapidly in Pakistan in recent years. In view of the present situation of the Pakistan textile industry, this department's equipment is not considered sufficient.

3) Textile Processing Department

Existing items of equipment for this department are all used for finishing purposes. Most of them were manufactured around the time of the college foundation. They are all used separately, and their treating capacity is at a laboratory level. The department has a total of 28 items of equipment. This is insufficient for the scope of the practical training conducted in this course. Some items are out of order and need replacement.

4) Testing Laboratory

Most items of equipment installed in this laboratory were manufactured around the time of the college foundation. Although some of them are out of order, all the others are still usable. Textile products to be sold in international markets must pass strict quality control. However, these testing machines are

considered outdated for such testing. It is difficult to train students in testing at the same level as that actually conducted in the country's textile industry.

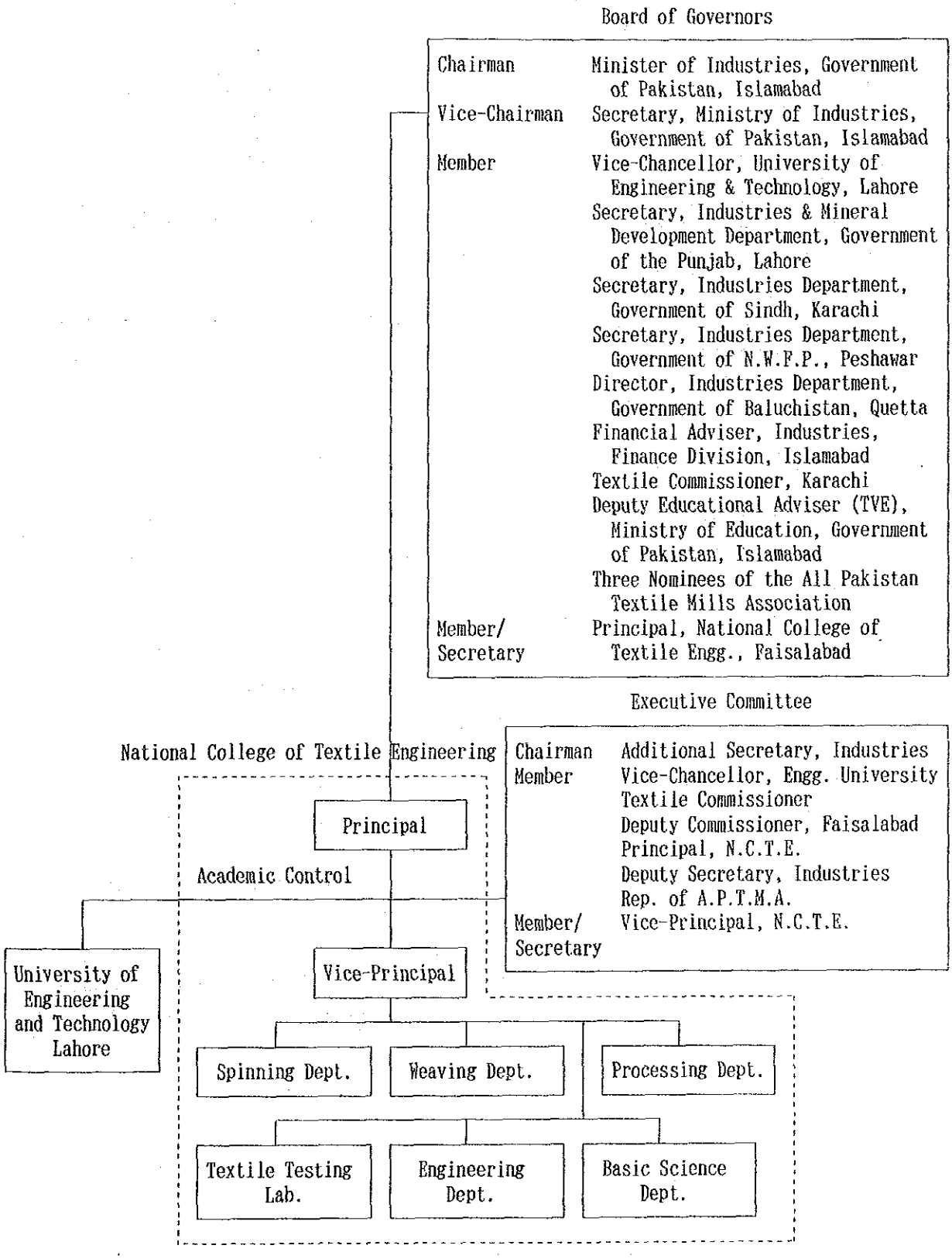
5) Auxiliary Equipment

Audio-visual devices such as overhead projectors and video devices, which are installed in many other universities and colleges in Pakistan, are lacking in this college. Even the basic science and engineering laboratories are under equipped with basic training equipment. This college is without personal computers though these are now considered general-purpose machines indispensable to engineering education. There are no copying machines for preparing teaching materials, and so use outside copying services. This results in a waste of time and money. This college lacks basic auxiliary equipment for common use.

(3) Managerial Organization and Budget

The National College of Textile Engineering, Faisalabad was established as a college operating under the direct control of the federal government of Pakistan in accordance with the National College of Textile Engineering (Governing Body and Cess) Order, 1983. The college's governing body is the Board of Governors, chaired by the Minister of Industries. The college has an Executive Committee, which is authorized by the Board of Governors to take charge of managerial and budgetary matters (see Fig. 2-2).

Figure 2-2 Organizational Chart



The Board of Governors is empowered to manage a "Board Fund" employed as part of the college's funds. Included in the Board Fund are:

- grants-in-aid made by the federal government;
- loans obtained from the federal government;
- loans raised by the Board with the special or general sanction of the federal government;
- foreign aid and loans obtained by the Board with the sanction of, and on terms and conditions approved by, the federal government; and
- fees and other sums received by the Board.

The Ministry of Industries has a system for collecting Cess from private textile mills for the purpose of supplementing the college's budget (see Fig. 2-3). The system is called the Textile Cess Fund. Cess proceeds are collected annually by the Textile Commissioner from textile mills across the country at the rate of one rupee per spindle in use and 20 rupees per loom in use. The annual total amount of cess collected is estimated at more than 5 million rupees. The annual total amount of cess less the amount of necessary expenses is put into the Textile Cess Fund. All the Fund's money is used for the construction, maintenance and management of the college's facilities and equipment.

Table 2-12 shows the college's expenditures and revenues for the past five years and its budget plans for 1991-92 and 1993-94.

Figure 2-3 Flow Chart of Cess Proceeds

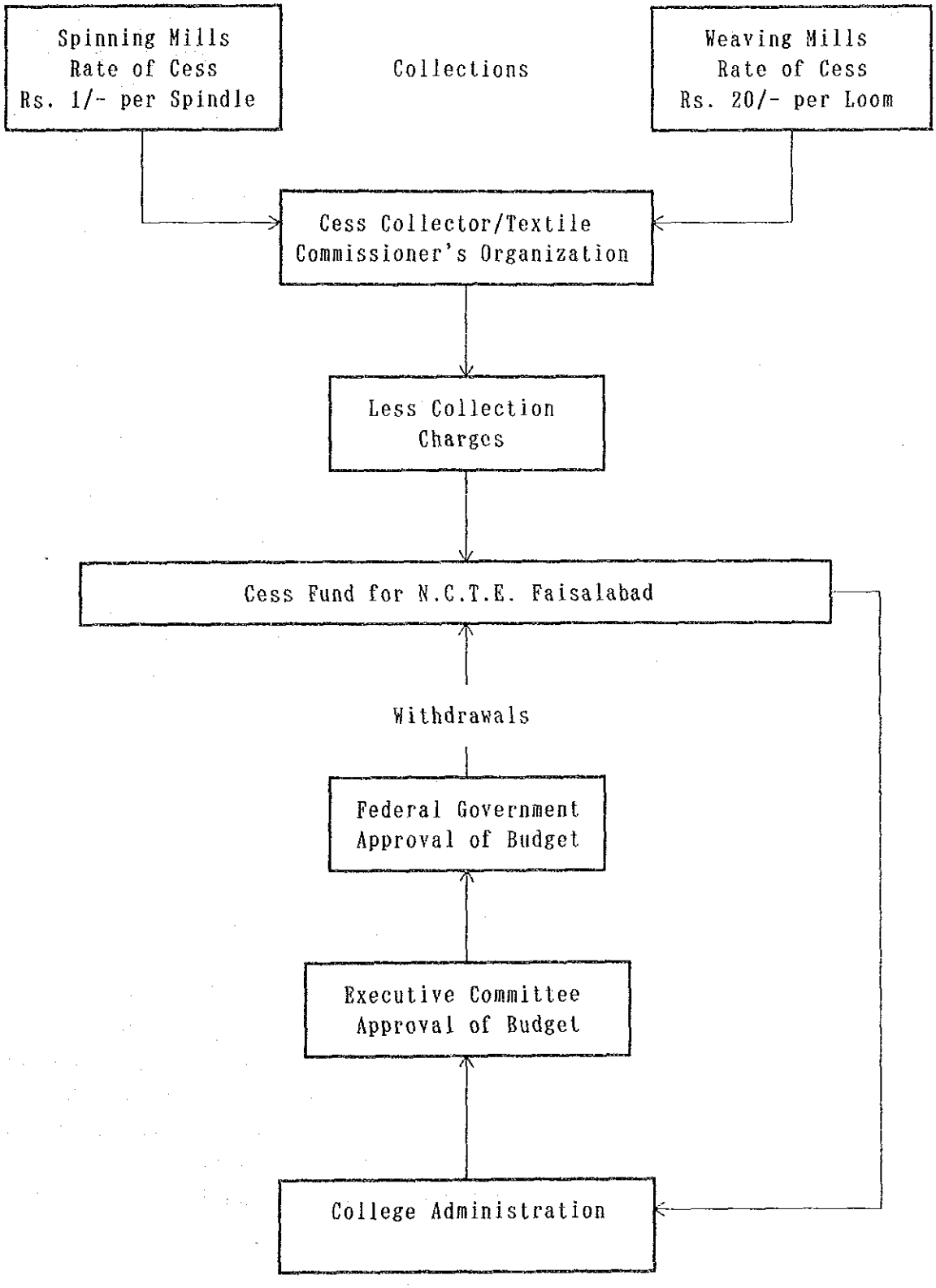


Table 2-12 Breakdown of the Annual Recurring Budget and Expenditure

(Unit: Rs.)

	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94
Budget								
Grant-in-Aid	2,626,000	2,364,000	2,425,000	2,626,000	2,626,000	2,626,000	2,626,000	2,626,000
Cess Proceeds	1,162,000	2,502,500	2,896,700	2,960,900	3,420,600	3,609,000	4,145,450	4,512,450
Total	3,788,000	4,996,700	5,321,700	5,586,900	6,046,600	6,235,000	6,771,450	7,138,450
Expenditure								
Basic Salary of Officers	1,254,200	1,472,649	1,527,000	1,579,090	1,514,685			
Basic Salary of Other Staff	833,800	1,019,049	1,064,200	1,081,110	1,115,460			
Regular Allowances	570,000	902,402	919,900	971,700	1,235,347			
Other Allowances	200,000	271,600	286,600	315,000	363,108			
Purchase of Durable Goods	20,000	30,000	35,000	60,000	70,000			
Repair/Maintenance of Durable Goods/Works	50,000	70,000	107,000	161,000	191,000			
Commodities, Services, Communications and Utilities	490,000	600,000	737,000	766,500	877,000			
Transfer Payments	200,000	425,000	435,000	432,500	475,000			
Miscellaneous Expenses	170,000	206,000	210,000	220,000	205,000			
Total	3,788,000	4,996,700	5,321,700	5,586,900	6,046,600			

2-3-2 Outline of the College's Educational Activities

The main educational activities of the National College of Textile Engineering, Faisalabad include theoretical education, practicals and in-service training. Classes are given six days every week, from Saturday to Thursday. One academic year comprises 32 weeks. In the morning, mainly classes in theory are given (there are four periods in the morning, with one period being net 45

minutes). In the afternoon, mainly practicals are conducted for three periods. Table 2-13 shows the subjects offered in the Spinning, Weaving and Textile Processing Departments and the number of teaching hours (number of credits) per week. At the time of its founding, the college selected the subjects to be taught based on the advice of Professor Morton, who had been invited from Manchester University, as well as the curricula of Leeds University, Manchester University and Bradford University. It can be said, therefore, that the college's method of education follows the traditions of British textile engineering education. The industrial education curricula which were developed at redbrick universities in the United Kingdom from the 19th to the 20th century were also adopted at technical colleges in Japan several decades ago.

The college sends its juniors and seniors to private textile mills in neighbouring areas for in-service training and theme study called projects. During the summer vacation, the college also utilises the facilities of these private textile mills to teach students to operate the state-of-the-art machinery installed in these facilities. The textile mills which give in-service training to the college's students pay their food and travel expenses. Some textile mills also pay salaries.

Table 2-13 B.Sc. Textile Engineering-Outlines of Courses of Reading for the Annual System (1/2)

Subjects	Spinning		Weaving		Textile Chemistry, Dyeing, Bleaching & Finishing	
	Theory	Practice	Theory	Practice	Theory	Practice
First Year						
TE-101 Applied Mathematics-I	3	-	3	-	3	-
TE-102 Applied Physics	3	3	3	3	3	3
TE-103 Applied Chemistry-I	3	3	3	3	3	3
TE-104 Engineering Materials	2	-	2	-	2	-
TE-105 Theory of Machines	3	-	3	-	3	-
TE-106 Textile Raw Materials	2	-	2	-	2	-
TE-107 Applied Thermodynamics	3	2	3	2	3	2
TE-108 Engineering Drawing & Graphics	2	3	2	3	2	3
TE-109 Workshop Practice	-	3	-	3	-	3
TE-110 Islamiyat & Pakistan Studies-I Compulsory (For Muslims)/Eth. Behaviour & Pakistan Studies-I Compulsory (For non Muslims and Foreigners)	1	-	1	-	1	-
Second Year						
TE-201 Spinning	3	1	3	1	3	1
TE-202 Weaving	3	1	3	1	3	1
TE-203 Textile Chemistry	3	1	3	1	3	1
TE-204 Applied Mathematics-II	3	-	3	-	3	-
TE-205 Textile Mechanics	2	1	2	1	2	1
TE-206 Textile Testing	2	1	2	1	2	1
TE-207 Textile Raw Materials	2	-	2	-	2	-
TE-208 Engineering Design	2	-	2	-	2	-
TE-209 Electrical Engineering-I (Spinning & Weaving)	2	3	2	3	-	-
TE-210 Applied Chemistry-II (Chemistry Group)	-	-	-	-	2	3
TE-211 Islamiyat & Pakistan St.-II Compulsory (For Muslims)/ Ethical Behaviour & Pakistan Studies-II Compulsory (For Non Muslims and Foreigners)	1	-	1	-	1	-
Third Year						
TE-301 Statistics & Quality Control	3	-	3	-	3	-
TE-302 Electrical Engineering-II	3	1	3	1	3	1
TE-303 Textile Testing	2	1	2	1	2	1
TE-304 Hydraulic Machinery	2	2	2	2	2	2
TE-305 Textile Physics	2	-	2	-	2	-
TE-306 Spinning Preparatory Processes	3	-	3	-	-	-
TE-307 Yarn Production	2	3	2	3	-	-
TE-308 Fabric Structure & Designing	2	-	2	-	-	-
TE-309 Weaving Mechanism	2	3	2	3	-	-
TE-310 Textile Finishing	-	-	-	-	2	-

(cont'd)

Table 2-13 B.Sc. Textile Engineering-Outlines of Courses of Reading for the Annual System (2/2)

Subjects		Spinning		Weaving		Textile Chemistry, Dyeing, Bleaching & Finishing	
		Theory	Practice	Theory	Practice	Theory	Practice
(Continued Third Year)							
TE-311	Bleaching & Dyeing	-	-	-	-	3	3
TE-312	Polymer Chemistry	-	-	-	-	2	-
TE-313	Colour Physics	-	-	-	-	2	-
TE-314	Applied Chemistry-III	-	-	-	-	2	3
TE-315	Islamiyat & Pakistan Studies-III Compulsory (For Muslims)/Ethical Behaviour & Pakistan Studies-III Compulsory (For Non-Muslims and Foreigners)	1	-	1	-	1	-
Fourth Year							
TE-401	Textile Engineering	3	1	3	1	3	1
TE-402	Economic Management	3	-	3	-	3	-
TE-403	Fibre Physics	2	-	2	-	2	-
TE-404	Textile Testing	2	1	2	1	-	-
TE-405	Spinning Preparatory Processes	2	3	-	-	-	-
TE-406	Yarn Planning & Production	3	3	-	-	-	-
TE-407	Spinning Calculations	2	3	-	-	-	-
TE-408	Advance Spinning Studies	1	-	-	-	-	-
TE-409	Project	-	3	-	-	-	-
TE-410	Weaving Theory & Practice	-	-	2	4	-	-
TE-411	Fabric Structure & Textile Design	-	-	2	3	-	-
TE-412	Weaving Calculations and Fabric Analysis	-	-	3	-	-	-
TE-413	Advance Weaving Studies	-	-	1	-	-	-
TE-414	Project	-	-	-	3	-	-
TE-415	Dyestuff Chemistry	-	-	-	-	3	3
TE-416	Bleaching & Dyeing	-	-	-	-	2	3
TE-417	Textile Printing	-	-	-	-	2	3
TE-418	Planning & Production in Textile Finishing	-	-	-	-	2	-
TE-419	Textile Chemical Analysis	-	-	-	-	1	3
TE-420	Project	-	-	-	-	-	2
TE-421	Islamiyat & Pakistan Studies-IV Compulsory (For Muslims)/Ethical Behaviour & Pakistan Studies-IV Compulsory (For Non-Muslims & Foreigners)	1	-	1	-	1	-

2-3-3 Outline of Other Activities

(1) Contract Research

The Faisalabad National College of Textile Engineering's textile testing laboratory is equipped with a total of 21 testers and analyzers. Using these testers and analyzers, the college is carrying out product testing commissioned by textile mills operating in the neighboring areas and is also providing technical guidance on quality control and product improvement to them. Research work comes mainly from companies at which graduates of the college are working.

(2) Consulting Service

The college's consulting service includes advice on introduction of new manufacturing equipment at private businesses, factory improvement and factory modernization. It also provides technical guidance on productivity improvement, quality control, cost control and process control.

2-3-4 Plan to Expand the College's Facilities

In 1989, the Executive Committee of the college decided on a plan to expand the college's facilities, separately from this project, in an attempt to cope with the rapid progress made in recent years by the Pakistan textile industry and the subsequent sharp increase in demand for textile engineers, and submitted a project proforma (PC-1) to the federal government. The main aim of the plan was to increase the college's prescribed number of new students from 60 - 70 to 140 and to expand its facilities accordingly. More specifically, the plan included a) construction of a hostel accommodation to accommodate 70 students (one-storied building to which a story will be added in the future), b) addition of five classrooms

(seating capacity: 70), c) construction of supplementary facilities (library, dispensary, cafeteria and rest house) and d) incidental works for wiring, piping, etc. In this plan, all the construction works were to be executed within the limits of a local currency budget. Of the total estimated cost of 9.5 million rupees, 1 million rupees were approved as part of the 1990-91 annual development plan. This plan did not refer to any need to increase the number of instructors, but it is considered possible for the college to newly recruit qualified instructors at any time. Also, it is understood that recruitment of new instructors is within the limits of its ordinary budget.

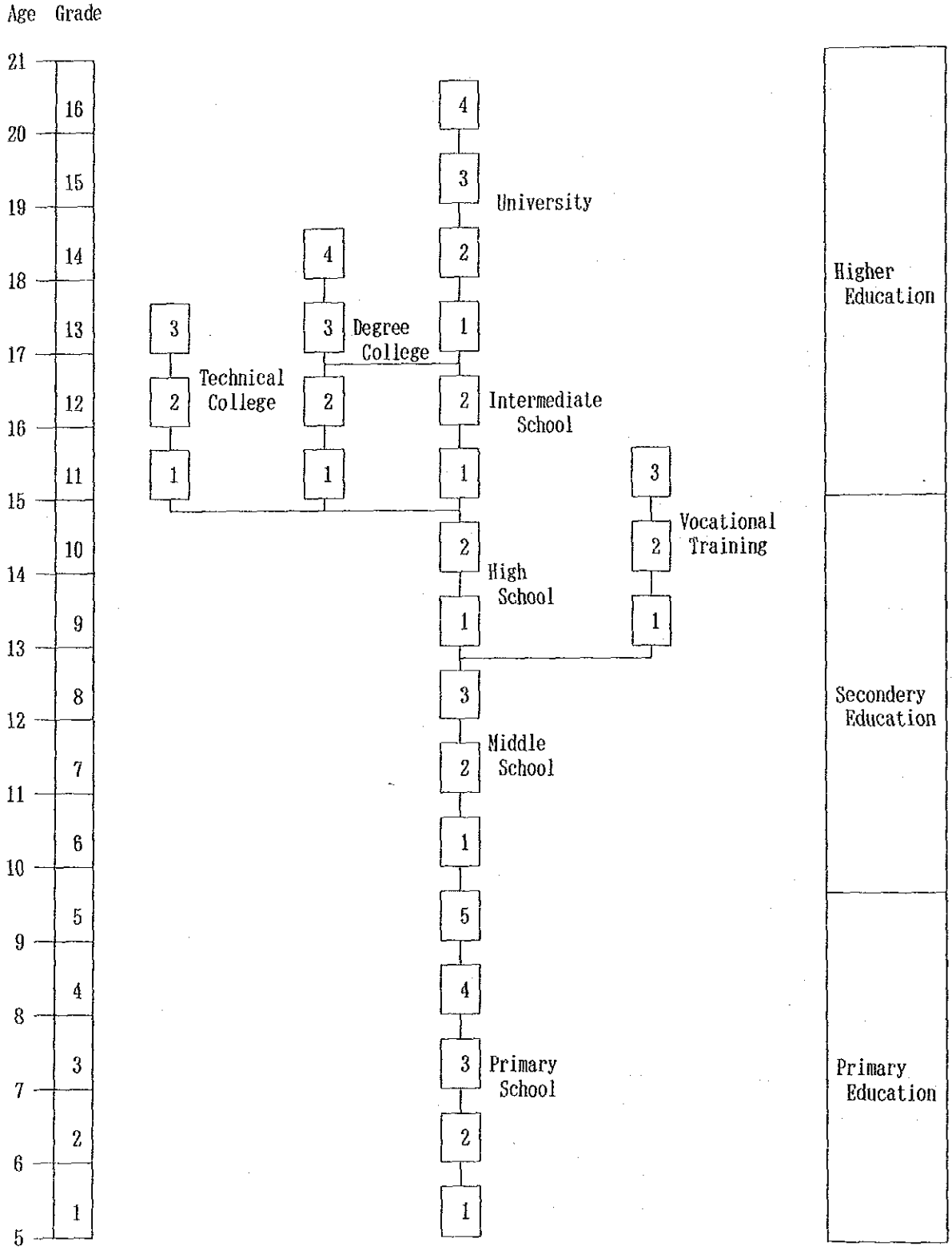
Therefore, this expansion program is aimed at increasing the full number of students and expanding the facilities accordingly. The promotion of this program, coupled with the equipment improvement project for which the Government of Japan's grant aid is requested, will make a greater contribution to the improvement in the quality of education and training at the college.

2-3-5 Outline of Other Educational Institutions

(1) Institutions of Higher Education in Pakistan

There are 22 universities which operate under the control of the Ministry of Education--14 general, 4 engineering, 3 agricultural and 1 medical. There is also an agricultural university which was established in 1909 in Faisalabad. Under the country's present educational system, the number of school years is 5 for primary schools, 3 for middle schools, 2 for high schools, 2 for intermediate schools and 4 for universities and colleges (see Fig 2-4).

Figure 2-4 Structure of Education System of Pakistan



The National College of Textile Engineering, Faisalabad is the only college that operates under the control of the Ministry of Industries, not the Ministry of Education. But the college's educational activities are carried out in line with the Ministry of Education's basic policies for education. The Ministry of Education is represented on the Board of Governors of the college. To qualify for entry to the college a student is required to have finished ten years of primary and secondary education plus two years of intermediate education.

(2) University of Engineering and Technology, Lahore

University of Engineering and Technology, Lahore is a big engineering institution with a total of 15 departments. The Vice-Chancellor of the university serves on the Board of Governors as well as the Executive Committee of the National College of Textile Engineering, Faisalabad. The National College of Textile Engineering, Faisalabad is affiliated with University of Engineering and Technology, Lahore. University of Engineering and Technology, Lahore supervises the graduation examination of the college's seniors and awards successful candidates a B. Sc. in Textile Engineering. During any review of subjects offered in departments of the National College of Textile Engineering, the representatives of University of Engineering and Technology, Lahore exercise the decisive influence.

The National College of Textile Engineering plans to introduce its first computer course, and it will be possible for the University of Engineering and Technology, Lahore to send its instructors specialising in computer science to the college. It will also be possible for the instructors of the college to receive reorientation in computer science at the University of Engineering and Technology, Lahore.

(3) University of Agriculture, Faisalabad

This is a big agricultural institution established in 1909. The college has seven faculties with a total enrollment of about five thousand. It has a total of 16 computer laboratories and about 150 personal computers. Most of these personal computers were procured with financial aid from the United States Agency for International Development (USAID). As many as 27 personal computers are installed in the Computing Laboratory 1 of the Department of Mathematics and Statistics. The department's eight-week computer seminar is open to the public (see Table 2-14). Instructors and technical officers of the National College of Textile Engineering, Faisalabad can utilize this seminar to study or restudy computer science.

(4) Other Educational, Training and Research Institutes

1) Textile Industry Research and Development Centre (Karachi)

This institute was established in 1973 as a research and training centre to contribute to the improvement in the quality and productivity of the Pakistan textile industry with the cooperation of the United Nations Industrial Development Organization (UNIDO) and the United Nations Development Program (UNDP). At present, the institute has a technical staff of about thirty and a clerical staff of about thirty and provides such services as consulting to private businesses, in-service training, textile machine development, engineering, corporate feasibility study and research. It also provides advisory services to such organizations as Pakistan Standards Institute (PSI), Investment Promotion Bureau (IPB) and Textile Machinery Corporation (TMC), and publishes "Pakistan Textile Statistics" periodically.

Table 2-14 8 Week Certificate Course on Computer Appreciation and Applications

CONTENTS

Computer Appreciation & Introduction to DOS	1 week
System Commands	1 week
Programming with BASIC	5 week
Professional Write	1 week

OBJECTIVES: During this course the participants would learn.

- Computer input/output units, control, storage/memory, arithmetic unit.
- The use of keys/function keys on the keyboard.
- Use of various commands e.g. format, list, delete, auto, copy, disk-copy, disk-comp etc.
- To make programs using BASIC language.
- Using software package professional write.

LOCATION: Computing LAB.I, Department of Math & Stat. UAF

TEACHING METHOD: Lectures cum practicals

FACILITIES AVAILABLE:

The department has an excellent laboratory equipped with about 30-IBM AT compatible microcomputers with 40-150 MB hard disks. The systems are 286 and 386 series. In addition there is one IBM PS/2 system with printers and a data display unit. A wide spectrum of microcomputer software such as WPS, PW, MINITAB, MSTATC, MS-EXCEL, DBASE IV, BMDP, Lotus 123 are also available.

CLASS TIMINGS: 2 to 5 P.M. (Saturday through Thursday) with 30 minutes break for prayer.

ELIGIBILITY: At least F.Sc. or F.A. with Math. or Stat. or Economics.

TUITION FEE AND OTHER CHARGES:

Registration fee - Rs 750
Expenses/other charges - Rs 750

STAFF: The teaching staff of Mathematics & Statistics Department. Some teachers may also be invited from other departments if required.

In the area of education and training, the institute offers short-term training courses, which include 8 spinning courses, 6 weaving courses, 4 textile chemistry courses and 2 industrial engineering courses. With a 20-member teaching staff, the institute accepts about 400 trainees -- from corporate managers to operatives -- every year.

2) Government College of Technology, Karachi

This college offers a three-year diploma courses in spinning and weaving. Every year 70 high school (matric with science) graduates are admitted to this college. The faculty staff consists of nine members. Most of the graduates of this college are working at private textile mills as supervisors.

3) Government Weaving and Finishing Institute, Shahdra

This institute offers a two-and-half-year diploma course in weaving and finishing. It accepts 40 high school (matric with science) graduates every year. It has a teaching staff of eight. Most of the graduates of this institute are working at private textile mills as supervisors or as jobbers.

4) Government College of Technology, Multan

This college offers a three-year diploma course in spinning and weaving. Every year 88 high school graduates are enrolled at this college. It has a teaching staff of fifteen. Most of the graduates of this college are working at private textile mills as supervisors or as jobbers.

2-4 Details and Contents of the Request

2-4-1 Details of the Request

The National College of Textile Engineering, Faisalabad carries out educational activities with emphasis on the education and training of qualified textile engineers. The college occupies an important position in the Pakistan educational system as the country's only institution of higher education dedicated to the educational training in textile engineering. However, most of its existing educational and training equipment was installed around the time of its founding.

As this was nearly thirty years ago most of the equipment is now superannuated. On the other hand, the country's textile industry has been actively replacing outdated equipment in recent years. As a result, it is clear that the college's existing equipment is far from suited for training the students in modern textile engineering. Most of the equipment was donated by the Government of the United Kingdom under the Colombo Plan. This means that most were manufactured in Europe, notably the United Kingdom. They differ in design and operational system from those equipment which the country's textile industry has been introducing in recent years and this makes it difficult to integrate the college's technical educational efforts into the practice of the textile industry. Furthermore, in line with the Government of Pakistan's policy, there is a shift of emphasis in the textile industry of Pakistan from a spinning-centered industrial structure to one with higher value-added content, that is to a weaving and processing-centered one. In this connection, too, the college's existing equipment is considered insufficient. In view of these facts, the Government of Pakistan formulated a project for the transfer of technology involving the replacement of the college existing equipment, guidance by Japanese

experts and in-service training in Japan of college's instructors, in an attempt to revitalize the college's educational activities through the introduction of up-to-date training equipment and state-of-the-art technologies. To this end the Government of Pakistan has requested the Government of Japan to provide a grant aid for the procurement of the equipment indispensable for realisation of above plan.

2-4-2 Contents of the Request

(1) Objectives of the Project

The objectives of the project for which the Government of Pakistan has requested Japanese grant aid are:

1) To replace or improve the college's superannuated equipment for use in education and training

2) To promote the study of modern textile engineering, as well as the transfer of technology, and

3) To provide the Pakistan textile industry with competent, well-trained textile engineers for the purpose of enhancing the country's technological standards, overcoming the problems of low productivity and low product quality and thereby increasing the international competitiveness of Pakistan-made textile products.

(2) Contents of the Request

The National College of Textile Engineering, Faisalabad has three major departments -- Spinning, Weaving and Textile Processing. The college has a spinning laboratory, a weaving laboratory, a textile processing laboratory, a testing laboratory and a workshop serving as facilities for practicals in the three departments.

The main items of equipment to be procured in this project are to be installed in these facilities, and include 17 items for Spinning Department, 5 items for Weaving Department, 27 items for Textile Processing Department, 12 items for Testing Laboratory, 9 items of auxiliary equipment and 1 set of spare parts.

As a result of the study team's discussions with representatives of the National College of Textile Engineering,Faisalabad as to the above-mentioned contents of the request, 12 items of equipment for the spinning course, 13 items of equipment for the weaving course, 30 items of equipment for the textile processing course, 9 items of equipment for the testing room and 9 items of equipment for common use were identified as the ones to be formally included in the request. These items of equipment are shown in the following list.

The order of priority indicated by A, B and C in the list of the equipment to be procured was decided by mutual agreement between the study team and representatives of the college. A, B and C are defined as follows.

A: Definitely needed
B: If possible, to be included
C: If budget allows

(3) Project Executing Agency

The National College of Textile Engineering, Faisalabad will be responsible for the implementation of the project.

List of Requested Machinery and Equipment (1/2)

Code-No.	Machine/Equipment	Quantity	Priority
1. Spinning Department			
SP-1	Blow Room Machines	1	A
SP-2	Carding Machine	1	A
SP-3	High Speed Drawing Frame	1	A
SP-4	Simplex Fly Frame	1	A
SP-5a	Ring Spinning Frame with Link Coner	1	A
SP-5b	Ring Spinning Frame without Link Coner	1	A
SP-6	Automatic Cone Winder	2	A
SP-7	Assembly Winder (Doubler)	1	C
SP-8	Two-for-one Twister	1	C
SP-9	Yarn Classimat with Winder	1	A
SP-10	Lea Strength Tester	1	A
SP-11	Open-end Spinning Machine	1	A
SP-12	Metallic Wire Mounting Machine for Card	1	C
2. Weaving Department			
WV-1	Weaving Machine	1	A
WV-2a	Warp Knitting Machine	1	A
WV-2b	Weft Knitting Machine	1	A
WV-2c	Flat Knitting Machine	1	A
WV-3	Braiding Machine	1	B
WV-4	Needle Loom	1	B
WV-5	Testing Equipment	1	A
WV-6	Interlock Knitting Machine	1	A
WV-7	Single Jersey Knitting Machine	1	A
WV-8	Single Testing Machine	1	B
WV-9	High Speed Rib Socks Knitting Machine	1	A
WV-10	Dial Linking Machine	1	C
WV-11	Fully Fashioned Flat Knitting Machine	1	A
WV-12	Hand Drive Flat Knitting Machine	1	C
WV-13	Tension Meter	1	C
3. Processing Department			
PR-1	Colour Difference Measuring System	1	A
PR-2	Auto-screen Printing Machine	1	A
PR-3	Heat Setting Machine	1	B
PR-4	Winch for Laboratory	1	A
PR-5	Calendering Machine for Laboratory	1	A
PR-6	High Temperature 12 Colour Pot Dyeing Machine	1	A
PR-7	Motor Driven Yarn Reel	1	A
PR-8	Continuous Pad Drying Machine	1	A
PR-9	High Pressure Steamer	1	B
PR-10	Over Feed Pin Tenter	1	A
PR-11	Open Width Continuous Dyeing Machine	1	A

List of Requested Machinery and Equipment (2/2)

Code-No.	Machine/Equipment	Quantity	Priority
PR-12	Blending and Mixture for Paste Preparation	1	B
PR-13	Electric Oven for Dyeing	1	A
PR-14	Ball Mill Grinder for Pigment	1	A
PR-15	Digital PH Meter	1	A
PR-16	Digital Thermometer	1	A
PR-17	Single Pan Electric Balance	1	A
PR-18	Viscocity Meter	1	B
PR-19	Sample Cutter for Fabrics	1	B
PR-20	Extruder for Spinning	1	A
PR-21	Refrigerator for Engraving Materilas	1	A
PR-22	High Temperature Dyeing Machine for Rope Form	1	A
PR-23	Automatic Pressure Jigger	1	A
PR-24	Laboratory Padder	1	A
PR-25	Laboratory Rotary Screen, Printing Machine	1	A
PR-26	Laboratory Rotary Screen, Engraved	1	A
PR-27	Hot Plate with Stirrer	1	A
PR-28	Launder-O-meter	1	B
PR-29	Fede-O-meter	1	A
PR-30	Rubbing Fastness Tester	1	A
4. Testing Laboratory			
T-1	Fineness and Maturity Tester	1	A
T-2	Yarn Count Analysis System	1	A
T-3	Hairyness Tester	1	A
T-4	Wrap Reel	1	B
T-5	Cloth Strength Tester	1	A
T-6	Elemendorf's Textile Tearing Tester	1	B
T-7	Portable Cloth Balance with Separate Cutter for Circular Fabric	1	B
T-8	Pilling Tester	1	A
T-9	Multi-purpose Abration Tester	1	A
5. Other Auxiliary Equipment			
OA-1	Overhead Projector	4	A
OA-2	Videodeck Display and Videocamera for Education	1	A
OA-3	Electric Laboratory Equipment	1	A
OA-4	Photo Copy Machine	2	A
OA-5	Generator	1	A
OA-6	Interphone	1	A
OA-7	Air-Con Unit for Testing Material	1	A
OA-8	Compressed Air System for AJL	1	A
OA-9	Personal Computer	1	A

CHAPTER 3 OUTLINE OF THE PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3-1 Objective

It is said that technical education provided at the National College of Textile Engineering, Faisalabad does not contribute as much as it could to the textile industry. The reasons for this are as follows:

1) The existing equipment of the college is obsolete and/or functionally inferior

2) Lack of experimental devices and equipment

3) Poor level of the college's technical education resulting from the above situation

In response to the above situation it is the objective of the present project to improve the quality and performance of college equipment for practical training by provision of up-to-date equipment which in turn will make it possible to upgrade levels of technical training through improved educational functions. The college will be better equipped to assure a supply of superior well trained textile engineers to the textile industry and the improved personnel resources will help the industry to eliminate problems of low productivity and poor product quality which it faces. This upgrading of the college's educational functions will contribute to overall national economic development and growth.

3-2 Evaluation of the Request

3-2-1 Appropriateness and Necessity of the Project

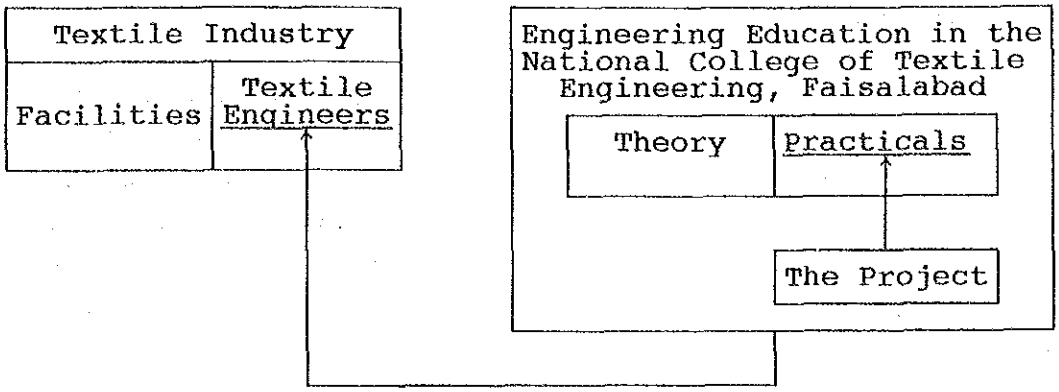
The Pakistan's textile industry ranks one of the world's largest in number of spinning and weaving machinery and

is exporting not only raw cotton but also high value-added cotton yarn and cloth. Under the federal government's positive measures to promote industrial development, the textile industry has been rapidly modernizing its equipment. On the other hand, however, the country's efforts to train textile engineers capable of making effective use of such equipment have lagged. There is thus a strong need to improve national education in the area of engineering, particularly of textile engineering.

At the college, which is the major source of engineers to the textile industry, theoretical study in the modern textile engineering is carried out. However, the college's training equipment for textile engineering practicals is functionally outdated, compared with that currently used in the textile industry, making it difficult for the college to train students in aspects of actual mill conditions.

This project is aimed at solving the shortage of human resources and technical services available for the textile industry, one of the country's most serious industrial bottlenecks, by improving the college's practical training facilities. The project is expected to contribute the country economy by nurturing high class well trained textile engineers with a sufficient knowledge of theory and practice in textile engineering. Therefore the request is judged to be appropriate and reasonable (see Fig. 3-1).

Figure 3-1



Furthermore, the following benefits can be expected to arise from this project, in addition to the overall upgrading of the college's educational activities.

1) Improvement of the college's technical education in line with the present needs of the textile industry

2) Enhancement of the college's role in providing technical guidance to the textile industry

3) Revitalization of the college's educational activities

4) Expansion of the college's technical services to the textile industry

3-2-2 Project Execution Plan

(1) Organization

As stated in the preceding chapter, this project is primarily concerned with modernizing and improving the equipment installed in the college. The college's organizational systems for implementing this project are

already in good order. There is therefore no need to form a special new organization for implementing this project.

At present, about 250 students are enrolled in Spinning, Weaving and Textile Processing Departments. The number of students per teaching staff is just over 10, which is considered sufficient. As to the number and quality of technical officers in charge of maintenance of the equipment, these are quite sufficient since they have been operating and maintaining existing equipment for about 30 years since their installation. Equipment is functioning and is generally well maintained and managed. After the completion of this project, however, technical officers will be required to learn to operate, maintain and manage the new equipment.

(2) College Educational Activities

After the completion of this project, new subjects mentioned below are to be added to the college's syallabus. The addition of computer science subjects aims to render the students more proficient in computer science and technology. The new knitting subjects reflect the present situation of the expanding knitting industry and are aimed to enhance training in the Weaving Department more comprehensive.

1) Computer Subjects

* Introduction to Computer Science/Use of the computer
* Basic Computer Programming
* Concepts and Applications of Data Processing
* Applications of Computer Technology to Textile Engineering

2) Knitting Subjects

* Concept of Knitting Technology
* General Patterns Used in Knitting
* Principles of Knitting and Knitting Machines
* Adjustment of Knitting Machines Design
* Management of Knit Products and Production Adjustment
* Practical training in the above theories

The new computer subjects are to be taught by instructors who have obtained a master's degree in computer science abroad, and the new knitting subjects are to be taught by the existing teaching staff of the Weaving Department.

3-2-3 Examination of Requested Equipment

The following table shows a summary of the reasons justifying the requested items of equipment.

Justification of Requested Equipment

Item	Justification
Equipment for Spinning Department	Replacing some of the existing equipment
Equipment for Weaving Department	Replacing some of the existing equipment and introducing new ones
Equipment for Textile Processing Department	Introducing new equipment
Equipment for Testing Laboratory	Replacement and introduction of new equipment
Auxiliary Equipment	Introduction of new equipment

In examining requested equipment, emphasis was placed on the following points:

a) Necessity and expected frequency of use (from the standpoint of upgrading the college's technical education)

b) Practical contribution to improving the college's guidance to, and interaction with, industries

c) Equipment which can be fully utilized within the limits of the present capacity of technical officers

d) Equipment which does not require sophisticated operating or maintenance skills

e) Equipment which is easy to repair and which is suported by after-sales services

f) Equipment suited to training students in both theory and practice

g) The raw material used with the equipment is cotton (except for some equipment for use in Textile Processing Department)

h) Equipment which can be procured within the framework of Japanese grant aid system (in terms of delivery period and specifications, etc.)

Based on the above framework, requested equipment are examined as follow.

(1) Equipment for Spinning Department

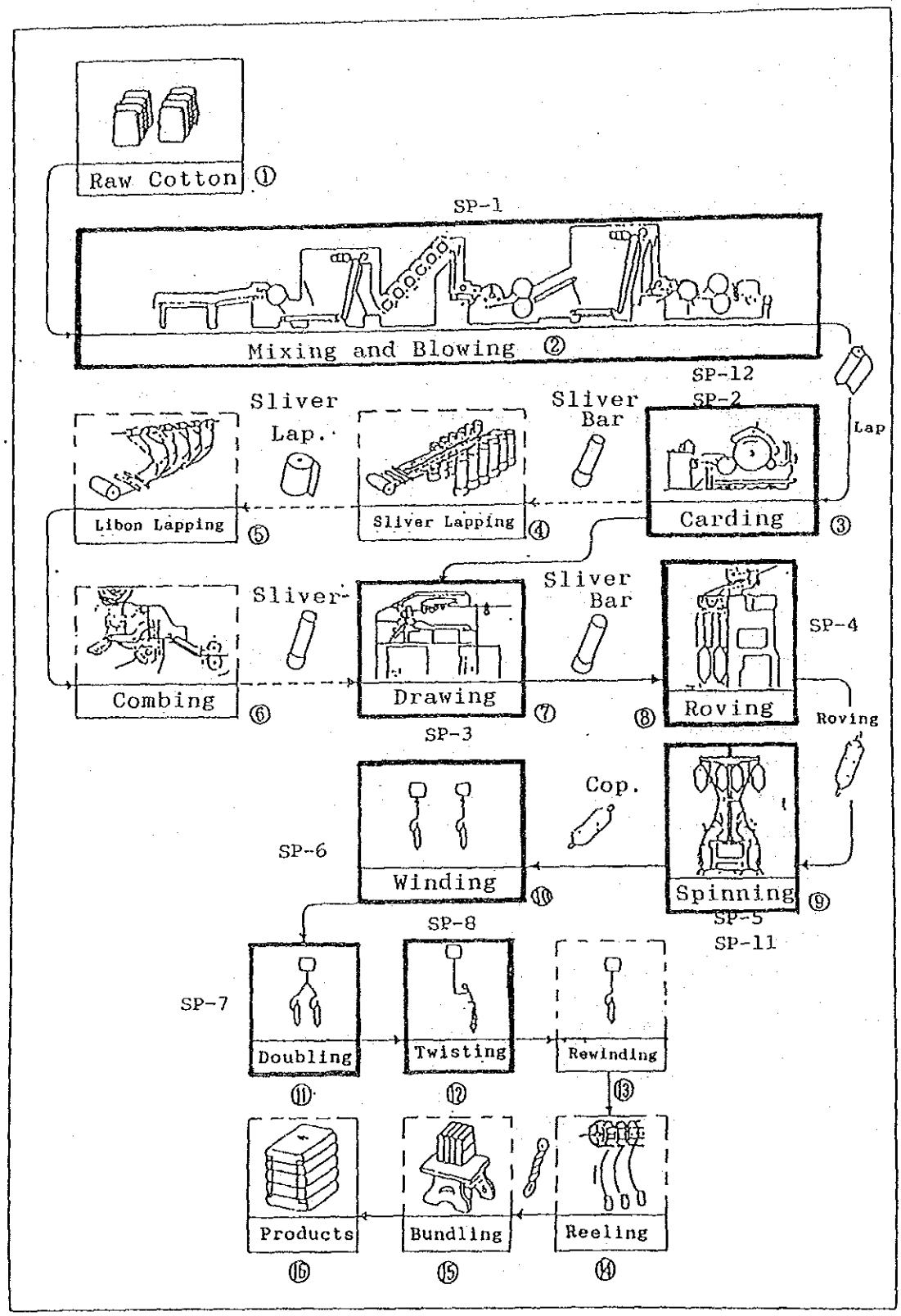
The spinning process--from spinning raw cotton into yarn to production of yarn products--is as shown in Fig. 3-2. The department has almost all machines necessary to manufacturing yarn products, except for the winding and assembly machine. There are 10 types of machines, but most of them were manufactured in the United Kingdom around 1960 when the college was established.

The equipment requested for this department is composed of ones mainly required for practical training in certain sections of the manufacturing process, and ones for product inspection (SP-10) and supplementary device (SP-12). The equipment to be used in the manufacturing process is shown in a bold-line boxes in Fig. 3-2.

Examination of Individual Items of Equipment Requested

The existing blowing machine is not suited to Pakistan-made raw cotton, which contains relatively large quantities of impurities. The requested machine (SP-1) is designed to ensure maximum cleaning and beating and is therefore suited for Pakistan-made raw cotton. It is also desirable to equip the machine with a control mechanism to ensure uniform lapping. The carding machine (SP-2), the high speed drawing frame (SP-3) and the simplex fly frame (SP-4) are all equipped with mechanical functions to ensure high product quality and productivity, and are therefore suited for training students in actual aspects of spinning in the Pakistan textile industry.

Figure 3-2 Yarn Manufacturing Process



The ring spinning frame is a machine for use in the manufacture of yarn as final product. Most of the ring spinning frames introduced in the country's textile industry in recent years have the following functions.

1) The draft system which excels in the ability to stretch the roving so that the yarn may be of prescribed thickness.

2) The driving system capable of increasing the speed of the twisting mechanism and consequently enhancing productivity by giving prescribed strength to the yarn.

3) The auto-doffer to realize labor saving through automation in the operation to provide a new cop when the yarn is reeled around a cop of prescribed size, which requires skill as well as much labor.

4) The link-coner system which makes it possible to link the spinning cop to the ring spinning frame in the yarn reeling process (in which the spinning cop is finished to a size in which it is shipped). This system is also conducive to labor saving in transportation.

Of the 4 ring spinning frames installed in the college, 2 were manufactured in the 1960s and are therefore outdated functionally. Another ring spinning frame, which was manufactured in 1987, has function 1) and is therefore suited for use in practical training. The ring spinning frame with link-coner (SP-5a), which is included in the items of equipment requested by the college, has all of functions 1) through 4). Practical training conducted by the use of this type of ring spinning frame is considered to be in line with the actual situation of the country's textile industry. The ring spinning frame without link-coner requested (SP-5b) is almost identical with SP-5a

except for its lack of function 4). As all training requirements can be met with SP-5a alone, SP-5b was excluded.

There is no cone-winding machine installed in the college. This is because the cone-winding machine's function was thought to be merely rewinding yarn from the small cop of the spinning machine to the large cheese. At present, however, all defects of the yarn are detected and removed electronically in order to ensure high yarn quality, and the joints are treated so as not to obstruct the process. The machine's winding speed itself has been remarkably increased. Practical training must be conducted using such a modern automatic cone-winding (SP-6) machine.

The assembly winder (SP-7) is used to make more than two threads even in length before commencing yarn twisting. This machine is simple in mechanism, and is not necessary to practical training. The college has no assembly winder because two threads are supplied to a single spindle on the thread-plying machine in practical training at the college.

The double-twister (SP-8) is a sort of thread-plying machine. Unlike an ordinary thread-plying machine it twists threads twice at one revolution. Being simple in mechanism, however, it is not considered indispensable to practical training in this department. Since, an ordinary thread-plying machine is existing in the college, the double-twister is not considered necessary to practical training in this department.

The open-end spinning machine existing in the college is a laboratory size machine manufactured by Bradford University. It is considered desirable, however, that practical training be conducted using the requested equipment (SP-11), which has a piecing and automatic-

doffing mechanism, and so reflects actual spinning conditions in the Pakistan textile industry.

The metallic wire mounting machine for card (SP-12) is simple in mechanism, and is not considered necessary to practical training in this department. As metallic wires are very expensive, it is impossible to conduct practical training in rewinding them frequently. Such training is involved in improving the skills of professional textile technicians and not a part of practicals in the college.

The yarn classimat (SP-9) and the Lea strength tester (SP-11) are necessary in practical training.

As a result of the above evaluation of the requested equipment, it is concluded that the following items lack necessity and appropriateness and should therefore not be included in this project.

SP-5 (b) Ring Spinning Frame (without link corner)
SP-7 Assembly Winder
SP-8 Double-twister
SP-12 Metallic Wire Mounting Machine for Card

(2) Equipment for Weaving Department

Existing equipment of this department was also manufactured in the United Kingdom around 1960. This department has 10 types of equipment in all. These are sufficient for studying the mechanisms of weaving, however, they are not considered sufficient in terms of speed and product quality. It should also be noted that the department has no knitting machine at present.

1) Weaving Machines

The requested items of equipment comprise weaving machines (WV-1), a brading machine (WV-3), a needle

loom (WV-4) and testing equipment, that are operated independently. The weaving machines (WV-1) are shown in the weaving process (6) in Fig. 3-3.

Examination of Individual Items of Equipment Requested

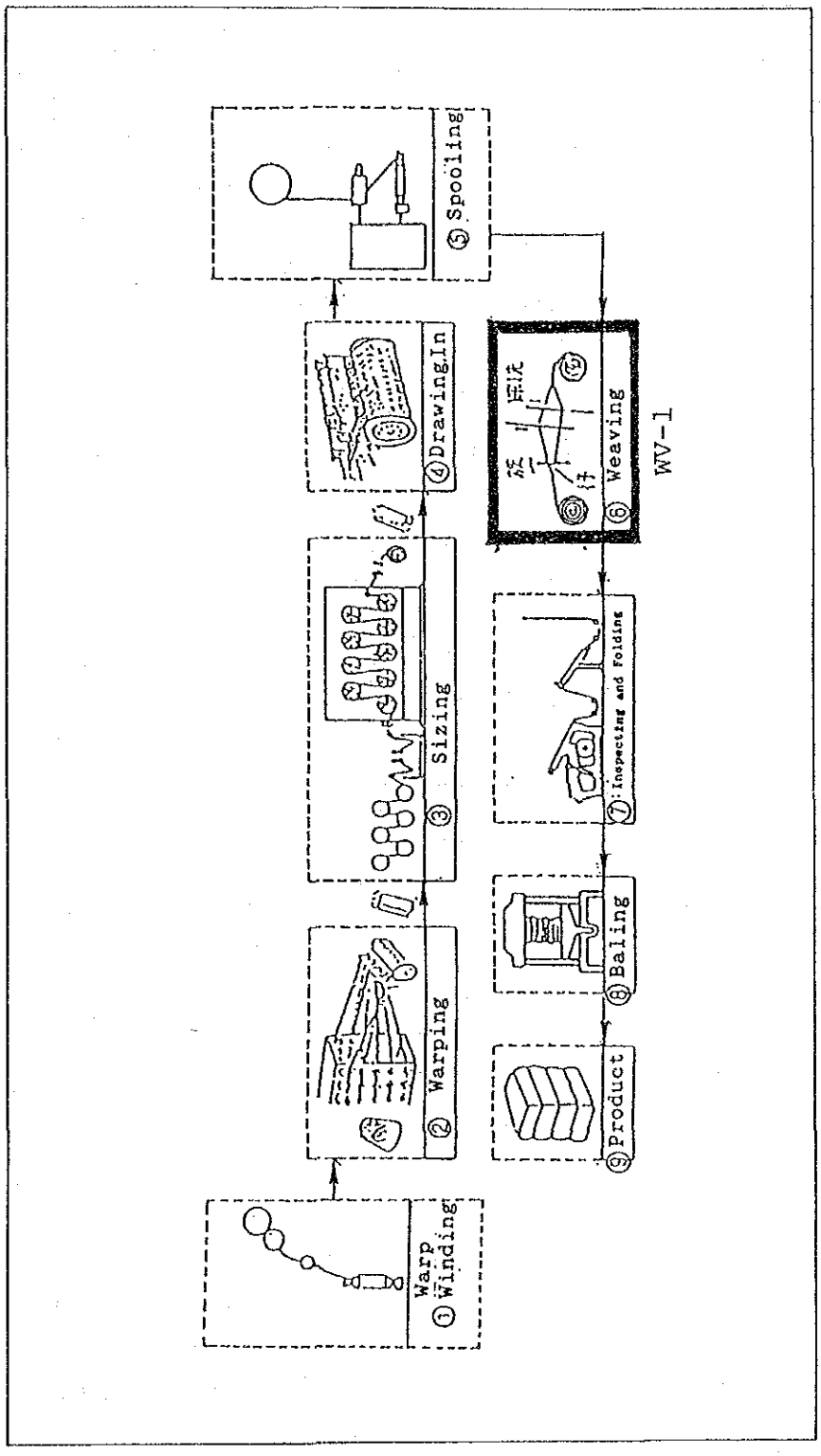
The requested weaving machines (WV-1) make the picking movement in accordance to a principle which is quite different from one applicable to the movement of conventional shuttle loom. These are commonly called "shuttle-less weaving machines" and are better suited for high-speed operation by their structure, weariness of component parts and consumption of the power. This type of weaving machine is widely accepted in the Pakistan textile industry. At present, the college has a total of 24 units of shuttle loom. In view of the fact that shuttle-less loom have now come into popular use in the Pakistan textile industry, it is considered imperative to install one for use in practical training at the college.

The brading machine (WV-3) and the needle loom (WV-4) are suited for manufacturing strings or ribbon-shaped cloth of single breadth, and are necessary in practical training for weaving. The testing is also indispensable to practical training in weaving.

2) Knitting Machines

The requested knitting machines are classified as follows.

Figure 3-3 Fabric Manufacturing Process



Classification by Shape	Classification by Products	Common Name	Products	Requested Equipment
Warp Knitting Machine	Tricot Knitting Machine		Langerie	
	Raschel Knitting Machine		Langerie	WV-2a
	Milanese Knitting Machine		Langerie	
Circular Knitting Machine	Circular Knitting Machine	Testing Machine		WV-8
		Single Jersy Knitting Machine	Underwear	WV-2b
		Single Jersy Knitting Machine	Underwear	WV-7
		Double Jersy Knitting Machine	Underwear	
		Double Jersy Knitting Machine	Underwear	WV-6
	Socks Knitting Machine		Socks	WV-9
Flat Knitting Machine	Flat Knitting Machine	Flat Knitting Machine	Sweater	WV-2c
		Hand Knitting Machine	Sweater	WV-12
	Cotton Knitting Machine	Full Fashion Knitting Machine	Sweater	WV-11
Others	Sewing Machine			WV-10
Instrument				WV-13

According to Pakistan export statistics, production of knit products has been increasing remarkably. Thanks to the federal government's incentives, production of knit products with high value-added content is expected to continue growing. A knitting machine is seldom used for multiple purposes. Specific knit products are manufactured with different special knitting machines. No single knit product manufacturer uses all types of knitting machine. Accordingly, a limited number of knitting machines are used in many medium-and small-scale manufacturing units. Under such circumstances, the National College of Textile Engineering,Faisalabad has plans to launch short-term (9 to 12 months), free knitting courses mainly for employees of small and medium knitting mills which have no employee training facilities, and is now considering concrete subjects, both theoretical and practical, to be included in these courses. The full number of trainees to take the new courses will be 30, of which 20 will be new students (the shorter-term course only) and the remaining 10 will be employees from knitting mills. Those who graduated from intermediate schools will be qualified as trainees in these courses. Those who finish the longer-term course will continue to work at their respective mills, while those who finish the shorter-term course will be employed by knit products manufacturing factories -- there are about 600 of them in the country -- as field overseers. Accordingly, requested knitting machines will be used for training employees of medium-and small-scale manufacturing units as well as students, in order to develop a downstream manufacturing industry with high added-value content. For this reason, the requested knitting machines are considered necessary to this project. However, the necessity of the following machines were re-evaluated taking into consideration of the present state of the Pakistan knitting

industry, the present technical level of the industry and the expected frequency in use.

WV-2 a) Warp Knitting Machine

The knitting machines currently used in the Pakistan knitting industry are mainly circular knitting machines. There are practically no warp knitting machines in use. The main reason for this is that products manufactured by warp knitting machines are mainly patterned curtains, table covers, high grade underwear, all of which are made of synthetic fibres (polyester and nylon). Pakistan-made coarse yarn cannot be used for the manufacture of these products. The yarn suited for the manufacture of these high grade products are not manufactured in Pakistan, and in addition, it is relatively difficult to import such yarn. Furthermore, these machines require advanced operating skills, and this explains why knitting machines of this type are not suited for practicals at an engineering college. As it is unlikely to achieve an immediate educational effect--let alone economic benefits--from the installation for educational purposes of a knitting machine which is not used in the Pakistan textile industry, this machine should be excluded from the project.

WV-10 Dial Linking Machine

This is a machine used for sewing up separate pieces of knit stuff. As students are only required to study the theory and practice of knitting technology there seems to be no need for them to learn sewing. This machine is therefore considered unnecessary to this project.

WV-12 Hand Driven Flat Knitting Machine

This type of knitting machine might be convenient in training the basic operation of the flat- type knitting machine. But it is considered unnecessary since other knitting machines are to be installed under this project.

WV-13 Tension Meter

This is an instrument for measuring tension of the yarn, however, it is relatively easy to measure how tense the yarn is visually. Moreover, there is no need to obtain exact measured values of yarn tension. For these reasons, this instrument is considered unnecessary to this project.

As a result of the above-mentioned examination, it is concluded that the machines and instruments below lack necessity and appropriateness and should not therefore form part of this project.

WV-2(a) Warp Knitting Machine
WV-10 Dial Linking Machine
WV-12 Hand Drive Flat Knitting Machine
WV-13 Tension Meter

(3) Equipment for Textile Processing Department

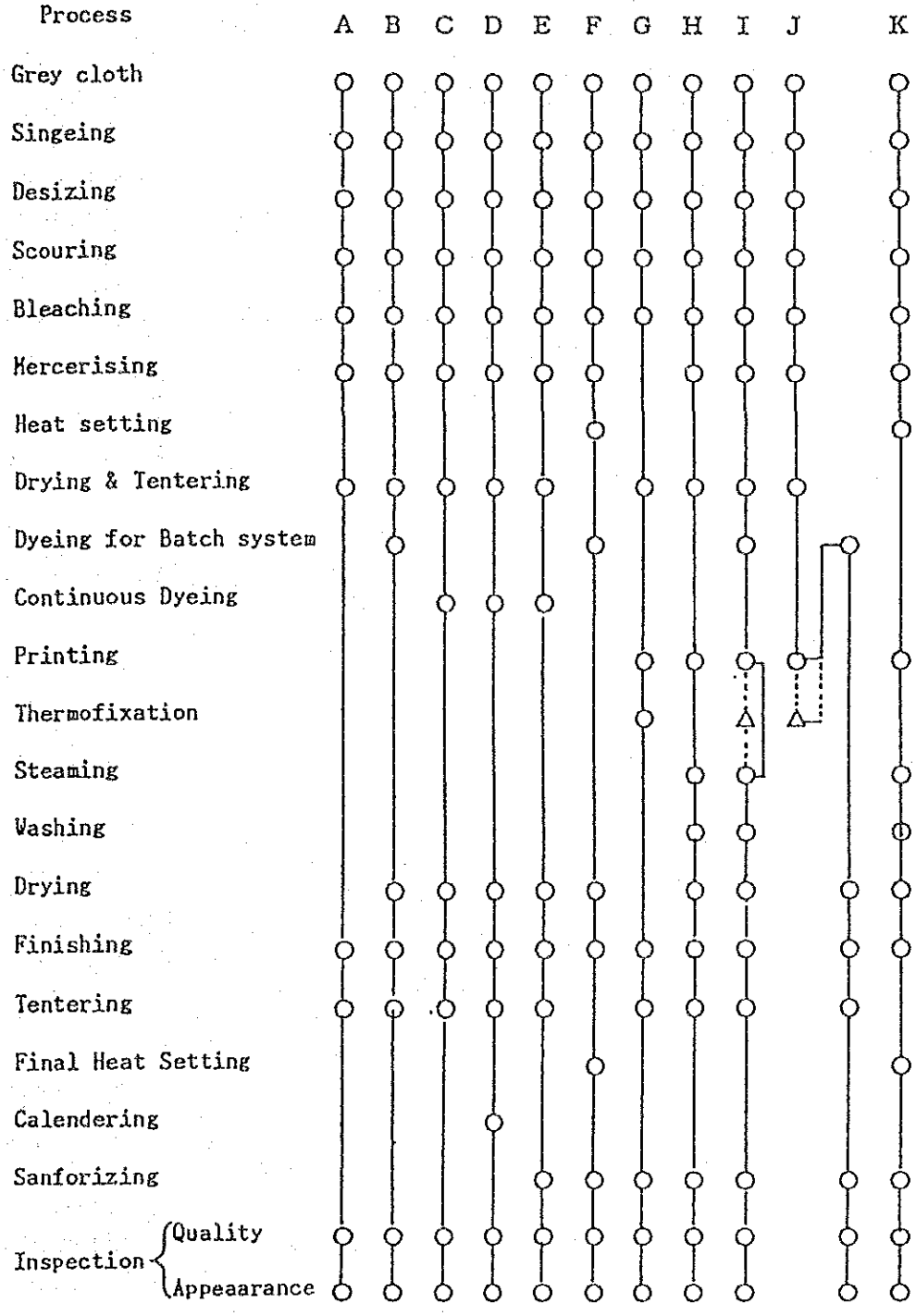
Existing equipment of this department are basic ones in textile processing and manufactured around the time of the college's founding. Present facility is consisting of singeing, desizing, scouring, bleaching, mercerising, beating, opening, drying, dyeing and tentering equipment. The processing capacity is to laboratory level. The department has a total of 29 items of equipment.

Most of the equipment requested for Textile Processing Department are supplemental to the existing equipment and are used in the country's textile processing mills. Also included are the testing equipment to test and evaluate the quality and standard according to Pakistan Standards Institute (PSI).

As shown in Fig. 3-4, there are a total of 11 typical dyeing/processing processes. The main items of equipment used in these processes are shown in Fig. 3-5. As can been seen from the figure, the requested items of equipment are to make up the deficiencies in the overall process of dyeing/processing. After implementation of this project, it will be possible for the college to conduct practical training in the following areas.

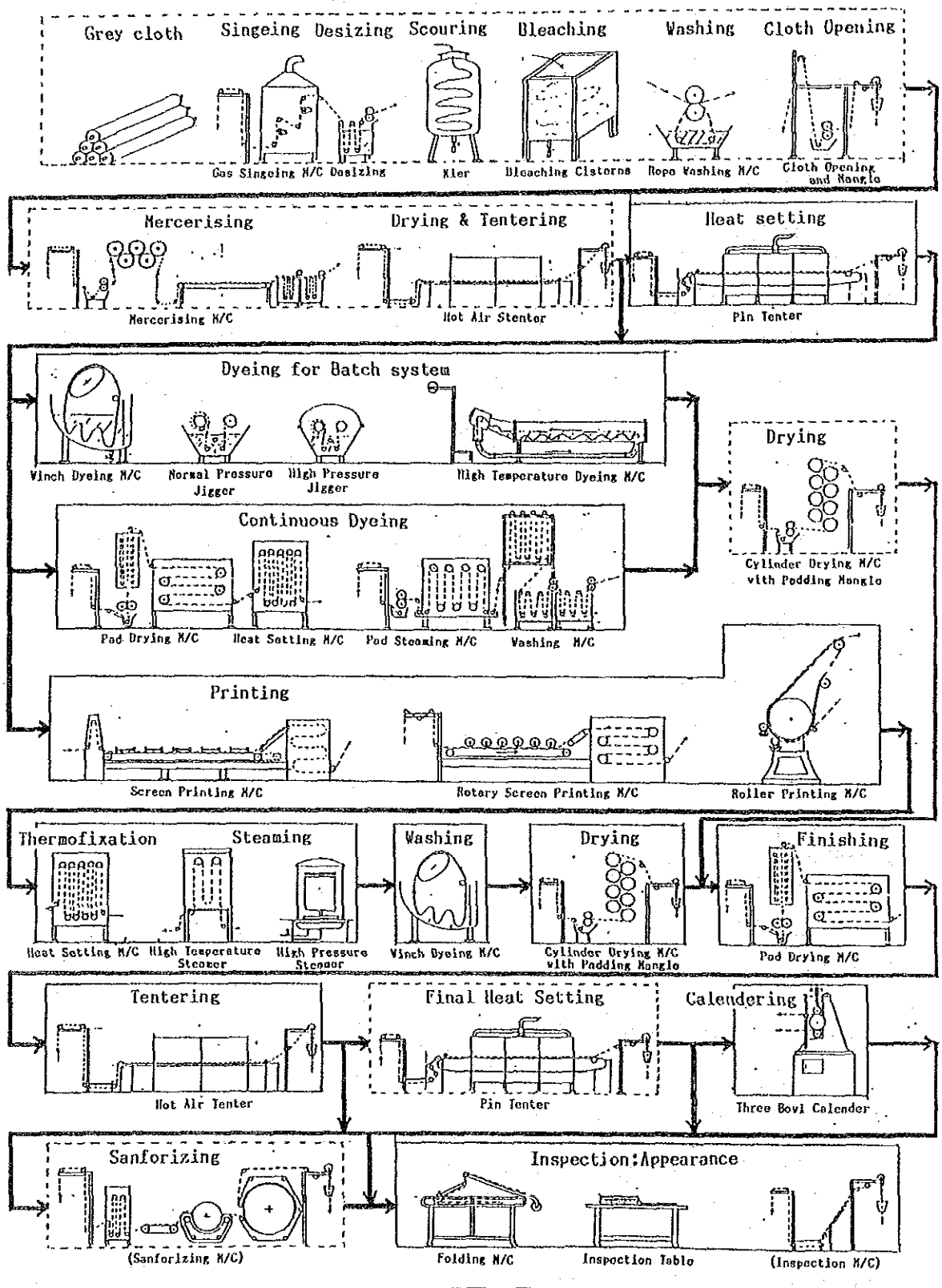
Practical	Requested equipment
Practice in theory of plain dyeing	Winch for laboratory, open width continuous dying machine and others
Practice in theory of printing	Auto screen printing machine, high-pressure steamer and others
Practice in theory of textile finishing	Heat setting machine, multi-purpose calendering machine for laboratory and others
Evaluation of quality of processed textile products	Launder-O-meter, Fado-O-meter, physical proterty tester
Practice in theory of spinning of synthetic fibers	Extruder for spinning
Training in test and measuring	Colour difference measuring system, viscosity meter and others

Figure 3-4 Typical Processing for Textile



1) Processes A to K above are typical. There are many processes by combining A to K
2) Processes A to F are for plain dyeing. And G to K are for printing.

Figure 3-5 Process and Required Equipment



After the completion of the project, it will be possible for the college to offer practical training in processing of natural and synthetic fibres, as well as blended fibres. In view of the fact that the Pakistan textile industry's production priority is shifting from raw cotton to cotton yarn to cotton products with higher added-value content, all the above-mentioned machines are necessary and appropriate in the project, with the exception of the following two devices.

1) The polymerization unit attached to PR-20 extruder is considered inappropriate in this project because i) the polymerization unit involve the technical know-how, ii) if the unit is to be manufactured, it has to be for mass-production. Moreover, frequency in use is low. For these reasons, the polymerization unit should not be included in this project.

2) The laboratory rotary screen engraving equipment (PR-26) is considered inappropriate because it will be of the same scale as mass-production and because frequency in use will be low with this device. For this reason, only rotary printing screens should be included as PR-26.

(4) Equipment for Testing Laboratory

All the equipment requested for Testing Laboratory are replacement of the existing ones, which are outdated or superannuated. These equipment is considered indispensable for Testing Laboratory in view of quality control of textile products not only for educational purposes but also as a testing institute accepting contract research on product quality inspection and giving guidance on improvements in product quality to industries. The requested equipment are also very important in use for the development of a database for controlling product quality statistically.

These items of equipment can be classified as follows according to their use.

Equipment necessary for spinning:	Fineness and Maturity Tester, Yarn Count Analysis System
Equipment necessary for weaving:	Portable Cloth Balance with Separate Cutter
Equipment necessary for textile processing:	Cloth Strength Tester, Pilling Tester

(5) Auxiliary Equipment

The requested 9 items of auxiliary equipment are to be used in all the department. Of them, overhead projectors and video units are commonly used in the classrooms and training rooms for education and training that require audio-visual presentation. In light of the college's existing items of equipment, these are considered indispensable. The personal computers are indispensable in technical education. They can be used by all the instructors and students of the college. In view of the fact that at University of Agriculture, Faisalabad and University of Engineering and Technology, Lahore, personal computers have proved very useful in enhancing the level of technical education. They can be categorized as follows according to their use.

Category	Equipment
Educational equipment:	overhead projectors, videoset, electrical laboratory equipment personal computers
Supplementary equipment:	air-conditioner, photo copy machines, power generator

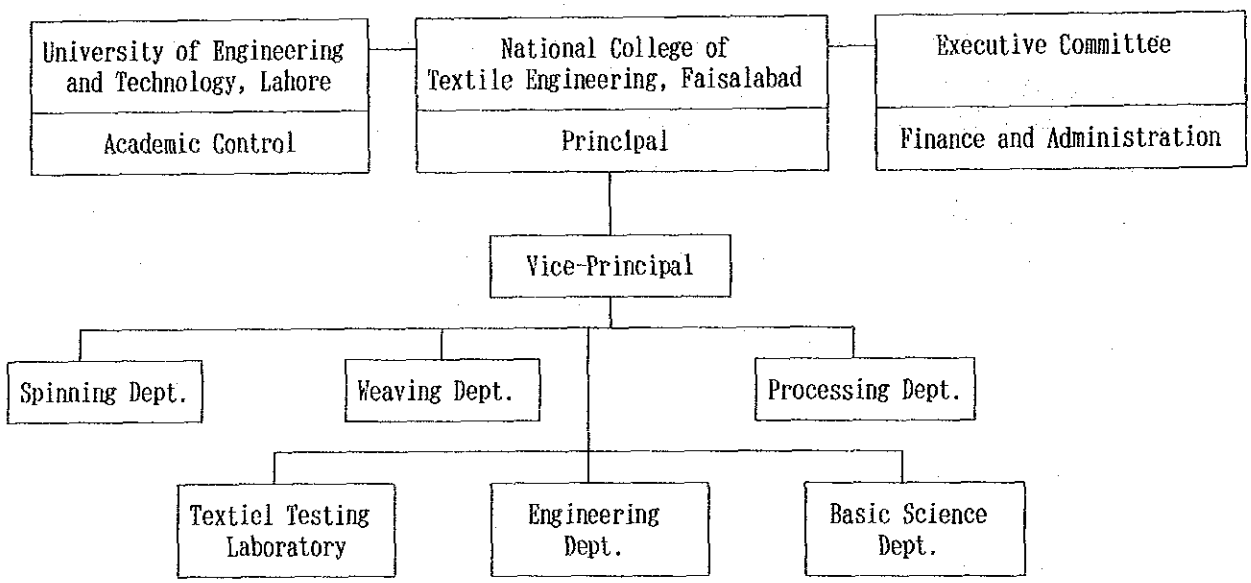
3-2-4 Basic Policy on Project Implementation

The above examination verifies the necessity and practicability of this project. It has also been confirmed that the Pakistan side is well prepared to implement this project. For these reasons, it is considered appropriate and reasonable to implement this project under grant aid from the Government of Japan. Therefore, the basic design is carried out on the assumption that this project is to be implemented under Japanese grant aid. It is considered appropriate however some of the request contents need to be modified as indicated in the preceding pages.

3-3 Project Description

3-3-1 Executing Agency and Operational Structure

After the completion of this project, National College of Textile Engineering, Faisalabad will be responsible for finance and administration. However, University of Engineering and Technology, Lahore, with which the college is affiliated, will be responsible for all academic control granting the college's students bachelor's degree, as well as for organizing and supervising examinations for the students. The burden and the organization for the operation and management of the college are as illustrated below.



3-3-2 Plan of Activities

The college's main activities are:

a) Technical education
b) Contract research
c) Consulting service

(1) Technical Education

The main aim of the college is to educate textile engineers with a bachelor's degree and it accepts 60 to 70 new students every year. As mentioned in the preceding chapter, the college's regular enrollment of new students will be increased to 140 when the college's expansion plan is materialized.

The college accepts a limited number of students from neighbouring countries. It also accepts employees of private textile mills as auditors for training in the theory and practice of areas of textile engineering of specific interest.

After completion of this project, the college will launch new short-term (9 to 12 months), free knitting courses, in addition to the existing bachelor's degree textile engineering courses. The full number of students to take these new students (the shorter-term course only) and 10 will be employees from knitting mills. Those who graduated from intermediate schools will be qualified as trainees in these courses.

(2) Contract Research

As the college has a testing laboratory, it accepts contract research work on product quality inspection from neighboring textile mills and also gives guidance on quality control, product improvement and other matters related to improving product quality. If the requested equipment is installed at the college, an expansion of the college's activities in this area is expected.

(3) Consulting Services

The college offers consulting services to textile mills, including advice on the introduction of new manufacturing equipment, improvements in mills facilities and modernization and technical guidance on such technologies as quality control, cost control and process control, etc. Reinforcement of the college's consulting service activities is expected to result from the installation of requested equipment.

3-3-3 Location and Present State of the Project Site

(1) Location of the Project Site

National College of Textile Engineering, Faisalabad is located in the eastern outskirts of the City of Faisalabad, at about 11 km away from the City along the Faisalabad - Sheriklpure Road. The college campus covers an area of about 26 ha. On the campus are the following main buildings, together with student hostels and rest houses for the instructors.

(2) Main Buildings

The college's main buildings include a teaching block and a training block. The teaching block is two-storied and houses an administration office, class rooms, physical/chemical laboratories, an auditorium, a library, a conference room and a dispensary. The training block is simgle-storied and houses separate training laboratories for spinning, weaving, textile processing, testing, etc. Other facilities include a substation, a boiler house, a workshop and a tube-well water supply facility.