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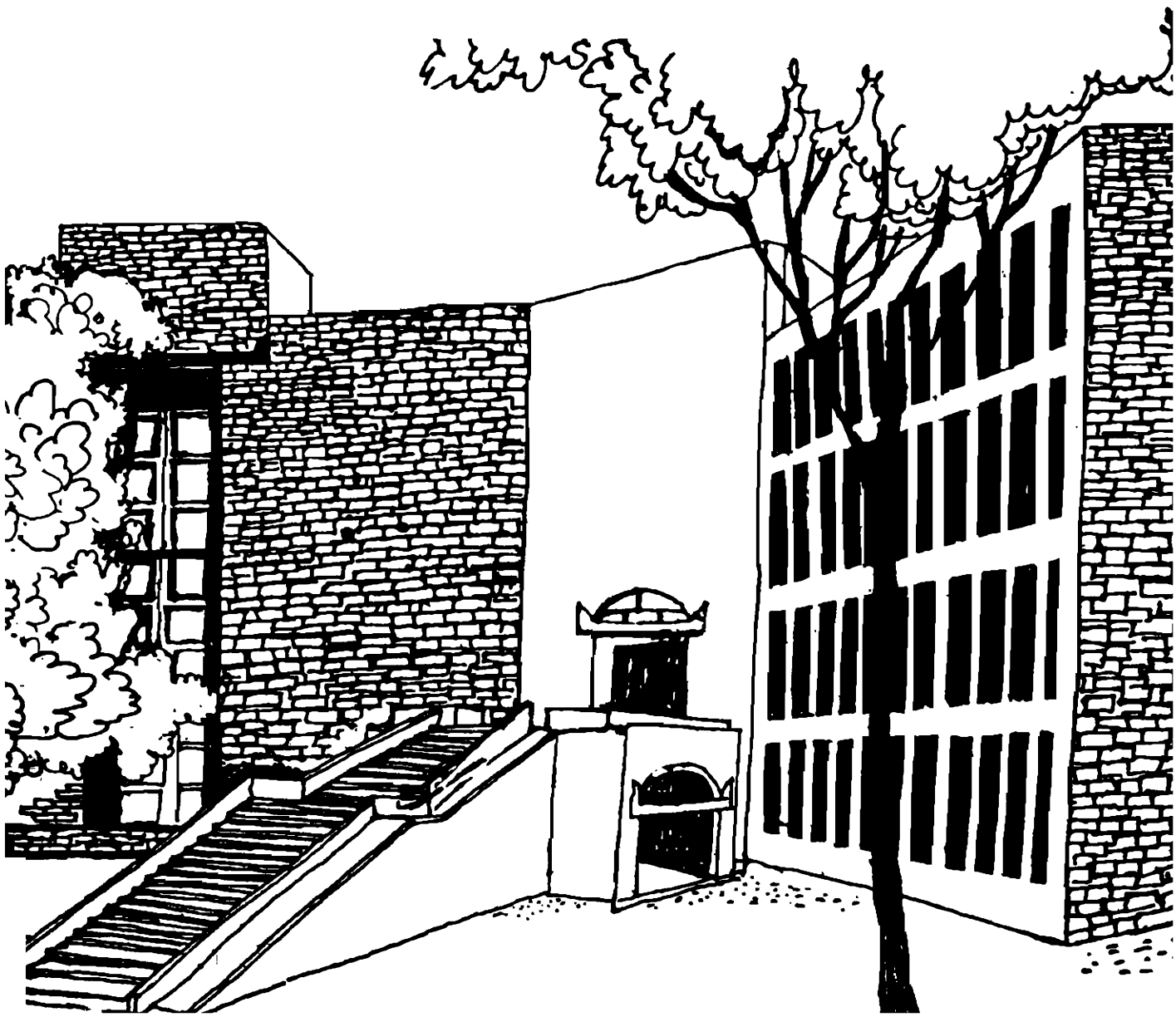

TECHNOLOGY DEVELOPMENT IN THE INDIAN TEXTILE INDUSTRY: INTERACTION BETWEEN GOVERNMENT POLICY, FIRMS AND COOPERATIVE RESEARCH ASSOCIATIONS

By

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Abstract

This study presents the findings of a study of technology development in the Indian textile industry undertaken by the author as part of a larger international study led by The World Bank. The study methodology included a field survey of 18 firms representing a cross-section of the industry in terms of firm size, technological dynamism and location; interviews with 4 relevant technology institutions catering to the technology related needs of the textile industry; a questionnaire survey mailed to randomly selected firms to facilitate generalisation of findings as well as a study of relevant published material.

The industry is characterized by a large number of firms, mostly small and technologically backward and some fairly large and technologically dynamic. Compared with countries competing in international markets, productivity levels and growth rates are lower in India. There is also considerable variation in productivity between mills in the country.

According to published research, ineffective management, inability to buy the right type of cotton at the right time and price, lower machine utilization, poor working conditions, lack of standardization, ineffective financial management are the main reasons for low productivity. These in turn are influenced by factors that are external as well as internal to the firm; lack of plant modernization, lack of timely availability of spare parts, capacity imbalance between stages of the manufacturing value chain, power shortage, lack of proper maintenance, and worker absenteeism.

The survey results indicated that firms in the industry spent very small amounts on R&D and technical training. However, the interviews indicated that firms did carry out some product and process changes. The majority of these technological changes were implemented by the firms themselves without the support of technology institutions (TIs). Though lacking in technological dynamism, textile firms showed evidence of accumulated technical expertise to undertake technical changes in product and process within the boundaries of the existing knowledge base. Wherever external support was required firms took the help of cooperative research associations (TIs) in the country rather than foreign collaborators. Standards/testing, information, problem solving/trouble shooting, and education/training were the most used services by the firms.

Technology Development in the Indian Textile Industry: Interaction Between Government Policy, Firms and Cooperative Research Associations

1. Introduction

The textile industry has existed in India for ages. Excavations at Mohenjo-Daro (around 3000 B.C) now in Pakistan have unearthed bits of textiles giving reason to believe that perhaps cotton was first grown and used in India before anywhere else in the world. From the time of the discovery of the sea route to India by Vasco Da Gama in 1498 eastward sea traffic from Europe continued to increase in search of textiles and other products. Fine textile products such as the Dacca muslin were the envy of European craftsmen. India's position in textiles has however changed dramatically since then. It has gone through ups and downs and is today an important industry domestically but not so in terms of its international competitiveness.

A brief historical picture of the development of the industry in pre-British India and during the British Rule is presented below. Subsequently an overview of the evolution of the industry is given. Government policy towards this industry is presented in an evolutionary framework with brief descriptions of the reasons for the changes in the following section. Some examples of technology institutions and their activities are then discussed in the following section.

Subsequently I discuss the statistical findings resulting from our interviews and mail survey of firms. In the following sections I present some selected case studies of technology management at the enterprise level. Finally I end with a discussion on what technical services firms demand and what implications we can draw in terms of policy and institutional priorities for the TIs. Some implications for enterprise managers are also discussed.

2. Brief History Prior to Independence [1]

Textiles and other luxury products constituted the bulk of Indian industry at the beginning of the nineteenth century. These were in great demand and formed an important item imported by the East India company from India. The industry was spread all over the country: Dacca, Murshidabad, Krishnagar, Chunderee in Bengal; Lucknow, Benaras in the then North-West Provinces; Ahmedabad in the West; Nagpur, Umrer and Paoni in the Central Provinces; Kashmir, Amritsar, and Ludhiana, in the north, etc.

Before the advent of modern methods of organizing production, textiles were made by weavers in the village. In the villages production quantities were small as they catered to local needs only rather than for larger markets. However, in the cities production was for exports like Dacca muslin, but even then the volume was small. Overall, production was done manually by skilled artisans and in small quantities rather than on a large scale.

The industrial revolution in Europe brought an end to the export of textiles from India. Machines raised production dramatically, which made European textiles cheaper than Indian products. Also, European nations imposed restrictions on imports from India to provide support to their indigenous textile industries. The year 1854 AD was an important land mark for the Indian textile industry. It was in that year that the first mill was set up by C.N. Davar in partnership with an Englishman. According to another source the first cotton mill was established at Fort Gloster near Calcutta in 1818

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1 This section is based on D.R. Gadgil, *The Industrial Evolution of India in Recent Times, 1860-1939* (Bombay: Oxford University Press), and Kasthuri Sreenivasan, *India's Textile Industry 1971*, pp. 3-46, (Coimbatore: SITRA)

(Kashyap, 1990, p.629). It was, however, Davar's mill which set the foundation for the growth of the textile industry in Bombay, and soon after in other parts of India. The entrepreneurial talent of the Parsis, a community, which came to India from Persia about a thousand years ago and their contact with the west was exhibited in the setting up of many textile mills in Bombay. Ahmedabad, also in the West, became another centre for the growth of the industry, with the first textile mill being set by Ranchodlal Chotalal in 1856. As early as 1875 the Bombay Mill Owners Association was formed, an indication of the growth of the industry in Bombay. Soon after the inception of the first textile mill in India the industry received a temporary boost due to the American civil war which cut off cotton supply to Lancashire, forcing England to temporarily import from India. Till independence the British government tried to control the growth of the Indian textile industry in order to protect their textile industry in Lancashire (Sreenivasan, 1984).

In the beginning, most mills were spinning mills supplying yarn to handloom weavers. This was natural since there had to be an established spinning industry before weaving could come into existence. Nor did the promoters have enough capital to set up composite mills. Mills began with spinning coarse yarn and gradually with experience moved into finer counts.

Data on the textile industry show that there have been periods of high and low growth at different points in time. The spinning industry continued to grow from 1854 onwards till the mid 30s after which there was a slow down. In 1854 there were 30,000 spindles which went upto 1.03 million in 1947. In fact there was very slow growth between 1933 and 1947. In 1858 there were only 300 looms which increased to 0.20 million in 1947. Again the growth rate slowed down between 1933 and 1947. The number of mills went up from 1 in 1854 to 423 in 1947. The real growth in the mill sector took place during the period 1880 to 1943. The war years was a period of turmoil. At the outbreak of the war there was acute depression in the industry which was suddenly flooded with orders from various government departments. Overnight, demand increased substantially not only for domestic consumption but also for exports to Ceylon (now Sri Lanka), Australia, The Middle East and Africa. These countries were earlier getting their supplies from Lancashire and Japan.

The industry faced the problem of increasing production rapidly though machinery and spare parts which came entirely from Britain were not available. Till 1941 the industry responded admirably even under adverse conditions, after which cloth availability declined due to disruption caused by the civil disobedience movement. The British government therefore restricted exports in 1942 and started the standard cloth scheme in March 1943 and promulgated a comprehensive textile control order bringing all aspects of the industry under its control. The very active governmental intervention in the textile industry that started at the tail end of the British rule has remained an abiding characteristic of the industry till today.

3. Overview of the Industry

3.1 Industry Structure and Growth

The textile industry has witnessed phenomenal growth since independence. In 1947 cotton yarn production was 590.70 million kgs. and piece goods production was 3500.90 million metres. In 1991-92, the total production of yarn was 1780 million kgs. and total cloth production was 20020 million metres.

Starting basically as a cotton yarn spinning industry more than a century ago the Indian textile industry has over the years developed into a major industry. It accounts for 20 per cent of the country's total industrial production and provides employment to about 1.15 million workers accounting for about 18 per cent of all factory labour. The industry is complex and diverse with the hand spinning and hand weaving sector at one end of the spectrum and the technically advanced, capital intensive and high speed operations of the mill sector at the other. In between lies the decentralized small scale

powerloom sector. Thus, there are three sectors within the textile industry; handloom, powerloom and the organized mill sectors.

Table 3.1 gives an overview of the growth of spindle and loom capacity of the industry. As seen from the table, the total spindleage has gone up from 11 million in 1951 to 26.59 million in 1990 while the weaving capacity has declined from 195000 looms in 1951 to 181000 looms in 1990. There has also been a change in the composition of the spindles and looms in the organized sector. The spindleage of the composite mills increased marginally with fluctuations over the period 1951 to 1990 while the spindleage of the spinning mills increased dramatically from 1.84 million in 1951 to 15.05 million in 1990. The reason for this is the stagnation in the number of composite mills and a sharp rise in the number of spinning mills during the same period (see table 3.2). The number of ordinary looms installed decreased while that of automatic ones increased during the period 1951 to 1990, thus showing modernisation at a slow pace.

Table 3.1
Growth of Installed Spindleage and Loomage

Spindleage/Loomage Installed	Year				
	1951	1956	1973	1984	1990
Spindleage installed (no. million)	11.00	12.05	18.45	24.29	26.59
(a) Composite Mill	9.16	10.19	12.23	12.43	11.53
(b) Spinning mill	1.84	1.86	6.22	11.86	15.05
Loomage installed ('000)	195	203	206	210	181
(a) Ordinary		191	170	160	125
(b) Automatic		12	36	50	56

Source: Handbook of Statistics on Cotton Textile Industry, 1991.

Table 3.2
Growth of Number of Mills

Type	No. of Mills				
	1951	1956	1973	1984	1990
Spinning	103	121	325	620	760
Composite	275	291	290	280	280
Spinning	378	412	615	900	1040

Source: Handbook of Statistics on Cotton Textile Industry, 1991.

The daily average rate of spindle utilization was approximately 81 per cent in 1990. It was at its lowest in 1982 at around 65 per cent. The daily average utilization of looms was much lower at approximately 56 per cent in 1990.

The production of the textile industry may be divided into two categories - spun yarn and cloth. The break up of total production into cotton yarn, blended yarn and 100 per cent non-cotton yarn is shown in table 3.3.

It may be seen from table 3.3 that the greater part of the spun yarn produced is cotton yarn (about 80%). The average production of spun yarn, countwise, has gone up over the years, from 25.64 average count in 1961 to 30.90 average count in 1983. The production of spun yarn countwise is shown in table 3.4.

Table 3.3
Production of Spun Yarn (1985 to 1991)

Types	Production Million Kgs.						
	1985	1986	1987	1988	1989	1990	1991
Blended and 100% non-cotton yarn	103	231	231	255	265	315	330
Cotton Yarn	1261	1257	1348	1297	1337	1447	1450
Total Spun Yarn	1364	1488	1579	1552	1602	1762	1780

Source: Handbook of Statistics on Cotton Textile Industry, 1991 & Annual Report 1991-92 of Ministry of Textiles

Table 3.4
Spun Yarn Production Countwise

Count Range	Percentage					
	1985	1986	1987	1988	1989	1990
1s to 10s	10.5	10.5	10.5	9.0	9.0	9.0
11s to 20s	26.3	26.3	26.3	24.3	24.3	24.3
21s to 30s	23.4	23.4	23.4	16.7	16.7	16.7
31s to 40s	26.0	26.0	26.0	30.2	30.2	30.2
41s to 60s	7.8	7.8	7.7	11.8	11.8	11.8
61s to 80s	4.1	4.1	4.2	5.0	5.0	5.0
above 80s	1.9	1.9	1.9	3.0	3.0	3.0

Source: Handbook of Statistics on Cotton Textile Industry, 1991.

Table 3.5 gives a break-up of cloth production sector wise. It may be seen that while yarn production takes place entirely in the organized mill sector, about 85 per cent of total cloth production takes place in the decentralized handloom, powerloom and hosiery sectors. The organized mill sector contributes only 15 per cent of total cloth production (Ministry of Textiles, Annual Report, 1991-92).

Table 3.5
Total Cloth Production: Sectorwise

Sector	Production (million sq. meters)					
	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Mill	3544	3483	3178	2948	2781	2720
Power Loom	8083	8632	8885	9372	9788	10988
Hand Loom	4135	4305	4370	4323	4537	4888
Hosiery	1451	1517	1544	1541	1616	1758
Total	17213	17937	17977	18184	18722	20354

Source: Handbook of Statistics on Cotton Textile Industry, 1991 & Annual Report 1991-92 of Ministry of Textiles

It may be observed that over the years, while there has been a decrease in production in the mill sector there has been an increase in the other sectors.

The total production of cloth in terms of different categories - cotton, blended and 100 per cent non-cotton is shown in Table 3.6.

Table 3.6
Production of Cloth: Categorywise

Category	Production (million sq. meters)				
	1985-86	1986-87	1987-88	1988-89	1989-90
Cotton	12467	12727	12626	12255	12738
Blended	1660	1817	1815	1921	1838
Hundred percent non-cotton	3086	3393	3536	4008	4146
Total	17231	17937	17977	15184	15722

Source: Handbook of Statistics on Cotton Textile Industry, 1991.

The production of cotton cloth is approximately 70 per cent while the remaining 30% is blended and non-cotton. About 97 per cent of 100 per cent non-cotton production takes place in the powerloom sector. The mill sector contributes 50 per cent of the total blended cloth production and 16 per cent of total cotton cloth production.

The per capita consumption of textiles has been steadily going up in the recent past from 13.84 meters in 1984 to 16.35 metres in 1987. The pattern of consumption has also undergone a significant change. While cotton cloth accounted for around 72 per cent of total consumption in 1984, its share fell to 60 per cent in 1987. The share of non-cotton cloth went up marginally from 13 per cent to 15 per cent in the same period. Blends on the other hand showed a larger increase from around 15 per cent in 1984 to nearly 20 per cent in 1987 (Ministry of Textiles, Annual Report 1991-92). Table 3.7 gives per capita consumption for the period 1985 to 1988.

The textile industry provides employment to 15 million people. Employment by different sectors is shown in table 3.8.

Table 3.7
Per Capita Consumption (in meters)

Category	1985	1986	1987	1988
Cotton cloth	10.9	10.91	10.91	10.95
Non-cotton cloth	2.25	2.35	2.35	2.35
Blended cloth	2.49	2.52	3.25	3.30
Total	15.50	15.90	16.35	16.35

Source: Ministry of Textiles, Annual Report 1991-92.

Table 3.8
Sectorwise Employment (in million)

Sector	1988-89	1989-90	1990-91
Mill	1.10	1.16	1.10
Power Loom	5.11	5.52	5.70
Hand Loom	8.43	8.86	9.69
Total	14.64	15.54	16.49

Source; Ministry of Textiles, Annual Report 1991-92.

Textiles constitute about 25 per cent of total Indian exports. Textile exports in one of the highest net foreign exchange earners since the import content in this sector is relatively low. The annual growth in textile exports has been high, going up from Rs.18880 million in 1984-85 to Rs.84930 million in 1990-91, registering an annual growth rate of about 30 per cent. Readymade garments constitute 50

per cent of overall textile exports (Ministry of Textiles, Annual Report 1991-92). Textile exports include export of silk, readymade garments, handicrafts and cotton textiles. Table 3.9 gives data on exports of different categories of textiles for the period 1985-86 to 1990-91.

Table 3.9
Exports of Textiles

Category	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Silk	160	202	255	331	401	440
Cotton Textiles	631	726	1273	1341	1825	2461
Readymades	1096	1504	2000	2278	3416	4641
Handicrafts	503	670	541	770	1009	1220
Total	2390	3102	4096	4720	6696	8762

Source: Ministry of Textiles, Annual Report 1991-92.

Indian textile exports are regulated under Multi Fibre Argument (MFA), an instrument under GATT. MFA is proposed to be phased out by 2003 AD in accordance with Uruguay Round of GATT.

3.2 Regional Development

Though the textile industry developed faster in the western region being concentrated in Bombay and Ahmedabad, it did not remain confined to this region only. The existence of a base for manufacturing textiles already existed. Most of the regions in India had handloom production taking place in the villages. Only what was required was to organize them. This had been done successfully in some of the states leading to the growth of textile centres in various parts of the country. Some of the other important textile centres are Tirupur and Calcutta for hosiery, Ludhiana for woollens and Kanpur.

3.3 Evolution of Government Policy

The textile industry - like other industries - comes under the purview of the industrial policy framework of the country. In the Industrial Policy Resolution of 1948 and the modified resolution of 1956, described in the Integrated Country Report the textile industry was allowed to be developed in the private sector. However this policy underwent change later on and many silk textile companies were nationalised. The government's concern has been to ensure adequate availability of cloth at reasonable prices - particularly to the weaker sections of society. The government, in order to achieve this has provided protection to the handloom sector. Soon after attaining independence the Government of India decided to skip the installation of additional looms by the mill sector. This policy has influenced the development of the industry significantly. For example, Coimbatore, which had developed into a spinning centre by the time of independence wanted to forward integrate by adding weaving factories which they were not allowed, so most of the textile units in Coimbatore even today are spinning factories.

The government stipulate that mills produce adequate yarn suitable for handlooms. An excise duty was levied on mill cloth and the money was used to subsidise handloom fabrics.

According to Sreenivasan (1984, p.29) the effect of excise duties on the industry has not been beneficial. For example when excise duty on fine fabrics was increased mills produced coarse cloth to avoid paying excise duty. But this behaviour on the part of many mills led to excess production and unsold stocks, and price increases in other varieties. Also technological developments have been inhibited particularly in the decentralised sector. Handlooms could not for many years use yarn in

bobbins to eliminate the process of reeling because of excise duty on yarn in any form other than hank.

Because of rising prices in 1964 the government introduced the controlled cloth scheme to ensure production and supply of cheap, durable cloth for the weaker sections of society. Under this scheme all composite mills had to produce coarse and medium varieties of dhotis, saris, shirting etc standard specifications and sell them at fixed rices. The implementation of this scheme left much to be desired. Different interest groups were able to wangle exemptions under a variety of conditions stipulated by the government from time to time. However, it was also realized that even the poor wanted better fabrics at affordable prices.

During the recession of the mid seventies the textile industry was hit hard and any mills has to close down. As a result the government took over the managements of many sick textile mills. In April 1968 the National Textile Corporation (NTC) was incorporated to manage the affairs of the nationalised textile mills. In 1990 NTC mills accounted for 59,000 installed looms or 28% of the mill sector's weaving capacity.

The government's objective was to make the nationalised mills economically viable by modernising and expanding them wherever required, since taking over the mills at different times the NTC mills have been on the whole a drain on the exchequer making huge losses year after year. However, there are regional variations in financial performance. Particularly, some mills in South India have recovered and are making profits.

The government policy of fixing the procurement price of cotton affected the input price of the textile industry. For non-cotton inputs needed to be imported as they were not available locally or that the supply was not adequate.The import, excise and custom policies affected the price and availability of these inputs.

Till 1976 there had been no comprehensive textile policy maybe due to the fact that there did not exist a department or ministry for textiles and textiles was under the ministry of commerce. In 1976 the department of textiles was set up under the ministry of commerce. The first textile policy was formulated in 1978 followed by subsequent policies in 1981 and 1985.

In 1978, seeing the unsatisfactory performance of the industry, declining productivity in a large number of units, growing incidence of sickness, tardy progress of modernisation, steadily rising cost of textiles, and falling per capita consumption of cloth, the government announced its policy for the industry aimed at making available larger quantities of quality cloth at reasonable prices and encouraging industrial growth through decentralised sectors. The public sector was expected to play a major role in meeting the clothing needs of the weaker sections of society. The government also sought to protect the interest of cotton growers by regulating use of synthetic fibres.

The textile policy of 1978 had a number of drawbacks and also did not take a long term point of view as pointed out by industry analysts. Hence the government evolved an integrated textile policy framework in 1981.

The salient features of the textile policy of 1981 are:

1. Increasing production of cloth of reasonable quality at reasonable prices.
2. Promoting balanced growth of all sectors of the textile industry inconsonance with national priorities and the 5 year plan.
3. Maximum growth of handlooms in the decentralised sector and faster growth of Khadi, hosiery and natural silk to generate more employment and raise the standard of living of the small weavers and those employed in this sector.

4. Strengthening and streamlining the infrastructure for the distribution of cloth to the weaker section.
5. Encouraging the use of man-made fibres and yarn by different sectors of the industry keeping in view the national and international consumption trends and for this purpose increasing the availability of natural and man-made fibres and yarn.
6. Generate surplus to produce fabrics of acceptable standards for world markets at competitive rates.

In 1985 a review of the earlier policy pointed out a number of weaknessess. Per capita availability and consumption were low. There was increasing evidence of sickness in the organised sector. Also there was a great unfulfilled demand for durable synthetic and blended fabrics and the export potential remained unrealised.

A new policy was formulated by the government for restructuring the industry with a longer term perspective in 1985.

The salient features of the new textile policy of 1985 were:

1. Restructuring of the industry.
2. Organised sector and powerlooms to be treated on par.
3. Optimum utilisation of spinning capacity.
4. Preservation of unique role of the handloom sector.
5. Fuller fibre flexibility and reduction of levies.
6. Pre-eminent role of cotton and remunerative prices for its growers.
7. Capacity expansion by existing units to be permitted.
8. Compulsory registration of all powerlooms.
9. Production of entire controlled cloth by handlooms.
10. Encouragement to khadi programmes.
11. Closing of economically unviable units and change of management.
12. Creation of rehabilitation fund for workers.
13. Modernisation and technology upgradation.
14. Liberal imports of textile machinery.
15. Elimination of controls and regulation.

In order to combat sickness in the textile industry the government through the Industrial Development Bank of India created a textile modernisation fund of Rs.7500 million to meet the modernisation requirements of the industry. The scheme came into force on August 1st 1986. It was provided for units that were weak but viable. However, the problem was the inability of the promoters to contribute their share. Hence a sum of Rs.1000 million was provided for providing special loans to selected viable units to meet part of the promoters' contribution.

3.4. Some Comments on the Industry's Problems

From the time of independence till the early sixties the textile industry was a sellers' market. However, with the onset of a major depression in the mid sixties, the market acquired the characteristics of a competitive one. Steep increases in food prices, and rise in the cost of production of textiles, resulting from increases in raw material prices, credits squeeze, etc. were major factors that contributed to the declining fortunes of the industry. However, mills having good finishing equipment were able to produce good quality blended fabrics and respond to changes in demand pattern from traditional to cosmopolitan products, from grey to finished cloth, and from natural to synthetics. These mills were not affected by the recession very much. During this period many mills went under and were taken over by the National Textile Corporation. A second recession hit the industry in 1974 but not as many mills closed down as during the first one.

Modernization has been on the top of the list of strategic issues in the textile industry. The industry was saddled with obsolete and worn out machinery at the time of independence. A number of government committees identified this as a critical issue for the improvement of the fortunes of the industry, but a host of problems have inhibited large scale and comprehensive modernisation - low profitability, high cost of machinery, non-availability of equipment in certain years, etc. Technological developments like open end spinning, automatic looms, wide bodied shuttleless looms, etc. have made the industry highly capital intensive. The funding needs of the industry being gigantic, the soft loan scheme of the Industrial Bank of India for modernization of the textile industry was only a drop in the ocean.

Productivity has been very low in India, when compared to other countries. Studies conducted by textile research associations have shown that productivity growth rates in India have lagged behind that of others. Not only that, there is also considerable variation in productivity between mills in the country. While the best mills in India may compare favourably with the better firms in the advanced countries the Indian textile industry is saddled with a large number of technologically weak and inefficient organizations.

The reasons for low productivity are multifarious : ineffective management, poor ability to buy the right type of cotton at the right time and price[2], low machine utilisation, poor working conditions[3], lack of standardisation, and inefficient financial management. Low machine utilisation may itself, result from external as well as internal factors: non-availability of spare parts on time, imbalance between different manufacturing stages, shortage of electric power, repairs and renovation not attended on time, and operator absenteeism. A study by one of the textile research associations showed that in a large number of low productivity mills nearly 50% of the productivity drop was due to factors noted above and the remaining 50% was due to lack of modernization.

The issue of modernisation is, to a certain extent, a legacy of the past. During the second World War, most mills were over utilised, creating a need for modernisation. After independence there was also a need for expansion. So, often there was a conflict between modernisation and expansion. War time high profits also bred in the managements a sense of complacency. Non-availability of indigenous machinery also hampered modernisation as the delivery lead times for European manufacturers were very long. High machinery prices fuelled by the post war boom also complicated the problem. As a result many mills modernised in an incremental fashion which often tended to be haphazard. The textile industry which for long had been fairly stable in terms of technological change also started showing signs of dynamism on this front. The sixties and seventies saw some major technological innovations - high production cards, high speed draw frames and ring frames, shuttleless looms of various types, electronic control and automation. As a result of these factors too machinery prices went up thus compounding the problem of modernisation further.

Studies show that the profitability of the industry is lower than the average for all industries in the country. Coupled with this is the year to year variation which is the highest for the textile industry. There are a number of factors responsible for this: price control in the industry for a considerably long period of time, excise duties levied on particular varieties of yarn and cloth to mop up excess profits at good times, distress sales during depressions and regulated cotton imports at higher prices. These factors among others reduced the average profitability of the industry. Raw materials, being

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2 Cotton constitutes 40 - 45% of total cost for a composite mill and 65 - 70% for a spinning mill. It is highly variable in cost as well as quality. Using better quality cotton for a given product may raise the price of the product without a concomitant increase in profits. Poor quality cotton, on the other hand will result in decline in productivity.

3 Resulting from poor house-keeping, poor maintenance of plant and machinery, lack of atmosphere control, inefficient work methods, etc. Poor working conditions will in turn result in increased yarn breakage in spinning and weaving, and frequent machine stoppage and poor quality.

an important element of cost, fluctuations in their prices as well as availability also played a part in lowering industry profits.

Intensification of competition in recent years is another factor resulting in lowering of average profitability of the industry. Powerlooms have in recent years become very strong competitors to the composite mills. Major reasons for improvement in their performance was: availability of finishing facilities, use of filament and blended yarns, improved quality, use of automatic looms, excise duty advantage, and lower wage structure.

The ascendance of the powerloom sector in recent years is a result of government policy. In a sense the uneven playing field for the composite mills has been a major factor for their declining importance though they cannot take shelter behind this reasoning as there are many mills which have consistently performed far better than the average. One of the major reason for the good performance of the high performing mills - if one had to think of only one major one - was probably better overall management of which management of technological change was a critical component.

4. Technology Development Infrastructure

The cooperative textile research associations (TRAs) set up by the textile industry with the financial support of the government form an important component of the technology development infrastructure related to the textile industry. Table 4.1 provides a listing of the TRAs with their dates of establishment along with their focus areas. It is evident that though described as TRAs, Wool Research Association (WRA) and Indian Jute Industries Research Association (IJIRA) are not relevant to the segments of the industry covered in this study.

Table 4.1
Cooperative Textile Research Association in India

No.	Research Association	Year of establishment	Primary Area of Work
1.	Ahmedabad Textile Industry's Research Association, Ahmedabad (ATIRA)	1947	Cotton Textile Industry
2.	South India Textile Research Association, Coimbatore (SITRA)	1951	- do -
3.	Bombay Textile Research Association, Bombay (BTRA)	1954	- do -
4.	Northern India Textile Research Association, Ghaziabad (NITRA)	1974	- do -
5.	Wool Research Association, Thane, Maharashtra (WRA)	1963	Wool Textile Industry
6.	Silk and Art Silk Industry Research Association, Bombay (SASMIRA)	1950	Man-made Textile Industry
7.	Man-Made Textile Research Association, Surat (MANTRA)	1980	- do -
8.	Indian Jute Industries Research Association, Calcutta (IJIRA)	1966	Jute Industry

Source: Betrabet & Garde, 1991

Most of the textile research associations were formed during the first two decades after independence. The cooperative institutions were considered appropriate and necessary because of the common range of products and lack of R&D infrastructure at the firm level.

There is some degree of specialization amongst the TRAs. ATIRA and BTRA were created to meet the needs of the composite mills while SITRA and NITRA have been more concerned with catering to spinning mills. The names of the research associations suggest their regional scope and activity specialization. The research associations are concerned not only with their members but for the industry as a whole. Their activities cover basic and applied research, product and process development in textiles and to a limited textile machinery, training of personnel, consultancy services etc. In recent times the scope of work has broadened to include hi-tech and micro processor based instrumentation and appropriate technology for the decentralised sector and also policy research.

4.1. Technology Institutions: Some Selected Examples

The government of India has supported the establishment of five cooperative textile research associations specifically catering to the needs of different segments of the textile industry. This section presents short case study of one of the more well known TRAs, the Ahmedabad Textile Research Association (ATIRA) and details of the activities of South India Textile Research Association (SITRA). The case study of ATIRA focuses on the management processes of the organization while the example of SITRA describes the various activities which are similar to those of ATIRA.

ATIRA: Ahmedabad Textile Research Association

The Ahmedabad Textile Industry's Research Association (ATIRA) is one of the more successful and dynamic cooperative research associations in the Indian textile industry. From its inception in 1947 soon after India attained independence from British rule ATIRA has traversed a long distance. The institution began as a research association to cater to the technological needs of textile mills of Ahmedabad, at one time the capital of Gujarat and known as the Manchester of India. Today it is a nationally known research institution catering to not only the textile industry but also related industries.

It has enjoyed an almost consistent growth in membership which in 1993 reached a figure of 366 members including around 10 foreign firms. The original founding members account for only 35 per cent of the current membership.

During the year 1991-92 in consonance with the New Economic Policy of the Government of India ATIRA's Council of Administration redefined its mission. Its previous objectives were to (a) help the textile manufacturing industry to improve its technical and financial performance at the unit and sectoral levels; (b) promote the development of a professional culture; and (c) interact with the policy formulation processes of the Government to help in framing a rational set of national textile objectives.

During 1991-92 ATIRA, however, decided to open up its membership to firms in industries related to textiles viz. process houses, manufacturers of dyes and chemicals, manufacturers of instruments, textile machinery, fibre and filaments - indeed a very major change from its limited original scope. It also decided to do away with zonal distinction, which had been practised in the past to provide partial territorial monopoly to each of the textile research associations. And finally but very significantly ATIRA decided to adopt a new objective, that of, helping forward looking managements of textile companies in becoming globally competitive.

At the time of its inception the textile industry was technologically very backward. The concept of industrial research was very new to the industry as well as to the country at large. ATIRA, from the very beginning focused on activities that had relevance to its members in the short and medium term.

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Winning the industry's confidence was a long and arduous journey. ATIRA has, however, been quite successful in creating a credible image for itself. One measure of its increasing client orientation is the proportion of income coming from its clients. During the period 1955-60 total income was a meagre Rs.6.54 million. Contribution from membership fees accounted for 34 per cent, government grants 50 per cent, consultation 5 per cent and sponsored research 2 per cent. By 1992-93 total income had grown to Rs.24.7 million. Membership fees accounted for 17.8 per cent, government grants 25.3 per cent, consultation and licence fees 23.8 per cent and sponsored research 31.9 per cent. In effect dependence on government grants had declined from 50 per cent to around 25 per cent.

According to a recent report prepared by the organization, ATIRA had won 18 national awards for research and development and 54 researchers had been honoured for their achievements. ATIRA had completed more than 425 R&D projects, their average duration being 2-3 years; it held 85 patents of which 45 had been utilized; and had 50 licencees.

ATIRA was founded by the city's two well known and influential industrialists, Mr. Kasturbhai Lalbhai and Dr. Vikram Sarabhai, the latter, well known for his involvement with the Bhabha Atomic Research Centre, Indian Space Organization and Indian Institute of Management, Ahmedabad. They successfully mobilized financial support from the city's textile mill owners and the government. Dr. Sarabhai also served as the part time director of ATIRA till 1956 when the first full time director was selected after a protracted search process.

Continued focus on client orientation has been facilitated by the autonomous nature of the institution and inputs from representatives of the textile industry in its key decision-making bodies.

In the initial years services did not account for any significant income. Over a period of time ATIRA has responded to the emerging needs of member organizations. In the beginning textile services provided by ATIRA included routine physical and chemical testing, assessment of work load and training and quality control, etc. Problems tackled by ATIRA as part of its consultancy services have varied from transient shop floor problems to surveys of mill operations; planning of renovation, modernization, expansion and planning of new mills; comprehensive performance analysis; optimization of performance of various departments; and energy conservation, etc. Other services include inter-firm comparison of financial performance, costs, productivity staffing patterns, yarn and fibre quality, etc.

A variety of training programmes for different levels in order to update knowledge and competence and promote a professional culture. Workers, jobbers and supervisors are given attitudinal training and administration of proper work methods. Organizational restructuring and top management role clarification also forms a part of ATIRA's capability portfolio.

ATIRA has also developed a comprehensive range of testing services for fibres, raw materials, intermediate products and finished goods, machinery accessories and spares.

ATIRA's evolution has, however, not been a consistently smooth sailing. Most basic research at ATIRA has been possible through extra-mural funds provided by the CSIR and other national institutes, US Department of Agriculture, USAID under PL-480 funds and other international organizations. As a result it has tended to decline in times of resource scarcity in the funding organizations or change in their funding priorities.

Financial difficulties also had a dampening effect on capital expenditure for modernization. ATIRA also experienced a staff turnover of 8 to 10 per cent during 1960's and 1970's. Most people who left ATIRA belonged to middle and senior levels in the organization. These people joined member mills or other industrial firms at substantially higher salaries - often double the income they received from ATIRA.

On the whole ATIRA has given a good account of itself despite some weaknesses. ATIRA has exhibited a capability for self renewal through periodic strategic planning exercises beginning with the first in 1974.

Very recently inspite of significant cuts in government grants, the financial condition of ATIRA has improved as a result of a number of actions including dramatic increases in membership fees, aggressive search for new sponsored projects in traditional areas, diversification into new areas, adoption of efficiency measures, introduction of new consultancy services, increases in know-how fees and royalty rates. Two major issues would, however, have to be dealt with for continued success in the long term, one, the issue of how to balance the need for long term capability building through research and the immediate need of clients for current problem solving and two, the issue of how to attract and retain high quality technical personnel.

SITRA: South India Textile Research Association

South India Textile Research Association (SITRA) was set up in 1956 at Coimbatore to carry out research for the spinning mills in and around Coimbatore in particular. At present SITRA has 371 members comprising in all 454 units. In terms of capacity this represents about 12 million spindles and 32000 rotors accounting for about 40% of the installed capacity of the country. Almost doubling every 12 years the membership has multiplied 8.5 times over the past 36 years. SITRA carries out research on various aspects of textile technology with a view to improve quality, reduce cost and ensure optimum utilisation of men, machines and materials. Income from consultancy services represents 33% of the total income, grant from Ministry of Textiles constitutes 27%, contribution of member mills 19%, sponsored projects 16% and funds for Powerloom Service Centres 5% (Annual Report of SITRA 1992-93).

SITRA is a link in the chain of national laboratories in the country, sponsored by the textile industry and supported by the Ministry of Textiles, Government of India. It is governed by a Council of Administration consisting of twenty five members including representatives of the industry, government and scientists.

SITRA employees 175 persons and possesses a full range of sophisticated textile testing instruments and modern machines in the pilot mill. It probably is one of the best equipped textile research organizations in the country.

In accordance with the objectives set forth in the preamble, SITRA has devoted itself to the application of science in the solution of industrial problems in the textile industry. This has been based on the philosophy that a research institution serving the needs of a particular industry should not only fulfil the long-term needs of development of that industry but also meet its short-term requirements. A brief outline of the work in different areas is given in the following paragraphs.

Basic Research

Basic research relating to materials, machines and processes used by the textile industry has been undertaken in order to get a thorough understanding of their nature. The knowledge gained has been utilised for the solution of technological problems. Some of the work carried out in this field are:

i) X-ray dating of archaeological fibrous artifacts
ii) Fibre structure by X-ray diffraction studies
iii) Disorder in cellulosic fibres
iv) Taper on cotton fibres
v) Frictional forces in cotton and regenerated cellulosic fibres.
vi) Effect of swelling agents and dimensional characteristics of fibres and yarns, etc.

These studies have helped to understand the various parameters of fibres and many of the results obtained have been published in international journals.

Applied Research

A major portion of technological research carried out by SITRA relates to areas which are of immediate benefit to the members and can be broadly classified into two categories: Process Development and Product Development.

a) **Process Development**: Work on process development which forms the bulk of applied research has led to improvements in the operational efficiency of the processes ensuring that maximum utilisation is made of machines, materials and man-power. SITRA has taken up over 200 studies in this area and some of the important studies are; (i) Optimisation of draw frame roller settings using span length concept, (ii) Blend uniformity, analysis and evolving of new concepts, methodology and guideline, (iii) Measures to achieve low count CV of yarn for exports, (iv) Nature, causes and control of defects in yarns, (v) Studies on open-end spinning: quality, processing, comparison of different methods and economics, etc.

b) **Product Development: Some Examples**:

i) **Siliconised Silk Sutures**: SITRA has developed a process technique and suitable machine by which braided silk suture threads can be encapsulated with polymeric silicon by pad-dry-cure method. This process has been licensed and is in commercial production. SITRA has received the National Research Development Corporation Award for the development.

ii) **Increasing the Wear-Life of Cellulosics**: A technological break-through has been achieved by SITRA in increasing the wear-life of cellulosic materials by chemical treatment and this has been patented as SITRALISED process. The process has been licensed and is in commercial production since 1980 and the coated tapes are used by a large number of mills.

iii) **Energy Saving Cotton Spindle Tape**: A light weight energy saving cotton spindle tape has been developed. These tapes save about 7% energy in ring spinning and are found to be more economical. The development has been licensed and the tapes are in use in a large number of mills.

iv) **Antibacterial Finishing of Fabrics**: Another important development which can find numerous applications in hospitals hotels and homes besides holding good export potential is the novel two-in-one hygiene finish for textiles developed by SITRA. The new product has excellent bacterial and fungicidal activity, reduces perspiration odour also. The fabric has better feel and handle. The development has been patented and licensed for commercial production.

v) **Fabric from Unconventional Fibres**: A break-through has been achieved by producing 100% pineapple leaf fibre and blends in the cotton system that was suitably modified to handle long coarse Pina fibre. A wide range of products numbering about forty have been produced, including carpets, furnishing material, wall covering, terry towel, mop cloth, door mat, bathroom mat, paper board and reinforced fibre plastic sheet.

Machinery Development: Some Examples

i) **Two-for one Twister**: SITRA developed a Two-for-One Twister in 1970 and the licensee has marketed over 300 machines. SITRA was the first textile research organisation in the country to develop a commercial model of a full-fledged machine.

ii) **High Speed Cams**: A polynomial cam with uniform profile has been designed which could be machine made. The high speed cams have been licensed for commercial manufacture.

iii) **Fabric Inspection Machine**: To facilitate inspection on both sides simultaneously, a fabric inspection machine has been fabricated. The development has been licensed for commercialisation.

iv) **High Speed Reel**: The semi-automatic high speed reel designed and fabricated by SITRA and M/s. Lakshmi Machine Works Limited under sponsorship from TMMA gives an increase in production of 10 to 30% besides improved hank quality. The reel has been released for commercial production.

v) **Automatic Lubrication Device**: An automatic mist cum-spot lubricating device for circular knitting machine has been designed and fabricated. With this device, the frequency and duration of lubrication can be programmed with an electric circuit. The development has been patented and is ready for commercialisation.

vi) **Kapas Purifier**: SITRA has developed a Kapas Purifier to clean the seed cotton before it is subjected to the process of ginning. This machine can be used for cleaning the ginned lint also before baling. This recent development has been licensed to a local manufacturer for commercial production.

Instrumentation

SITRA has fabricated over 25 testing instruments which are important from the point of view of quality control and import substitution. Most of these instruments have been licensed and are in commercial production. There is a good demand for SITRA developments and a few of them have been exported.

SITRA's work in machinery design and instrumentation has won awards from the Invention Promotion Board, National Research Development Corporation of India, ASSOCHAM, Indian Merchant's Chamber and Director of Handlooms and Textiles, Government of Tamil Nadu.

Operational Studies

Inter-firm comparison studies on productivity which have a large participation of 285 mills from all over India have contributed to a substantial rise in productivity of labour as well as machine in spinning. Productivity norms published by SITRA seems to enjoy overwhelming popularity all over the country with five editions totalling 18,000 copies having been brought out. Detailed analysis has been made of the financial and non-financial factors which contribute to profits and norms have been set up for various cost components.

Energy Conservation

Management and conservation of energy have assumed tremendous significance in the last decade particularly with the advent of high speed machines which consume more power per unit production. SITRA undertook a number of studies in this area and has brought out a comprehensive manual which discusses several aspects of energy conservation measures in a spinning mill.

An Energy Cell studies the pattern of energy consumption from the powerhouse down to the production machines of a spinning mill and so far it has undertaken energy studies in over 65 mills. SITRA has also formulated procedures and systems for the introduction of energy conservation programme (ECP) in mills as a routine control and has also suggested methods to audit electrical energy consumption in mills.

Consultation and Services

Consultation and technical services constitute an important aspect of SITRA's work. SITRA offers consultation services on a wide variety of problems in the following areas:

Modernisation	Techno-economic Viability
Productivity	Computer Application
Cost Reduction	Energy Conservation
Quality Improvement	Staff Recruitment
Arbitration	Machinery Valuation

The concepts of modernisation developed by SITRA have been used by member mills to optimise investment. The Arbitration and Workload Studies conducted by SITRA has resulted in amicable settlement of disputes between management and labour. SITRA has undertaken a number of valuation and techno-economic surveys as well as feasibility studies on behalf of various financial corporations, banks and mills.

The testing services offered by SITRA are extensively used by the mills to evaluate the quality of cotton, man-made fibre, yarn and fabrics. Every year more than 60% of member mills avail of this service. Besides SITRA offers accessory testing services which enable the mills to judge the quality of various machinery components such as rings, spindles, bobbins, travellers etc. Also servicing and recalibrating of instruments are done for mills.

Training

The following programmes are available: (a) Management Development Programme for different levels, (b) Unit Level Supervisory Development Programme, (c) Quality Control, (d) Productivity, (e) Energy Conservation, (f) Maintenance Management, (g) Textile Testing (h) Cost Control, (i) Computer Applications, and (j) Programme for Trade Union Leaders etc. Need based training programmes are also offered for knitwear manufacturers and powerloom entrepreneurs. Over the past 5 years training was offered for more than 3750 management personnel, supervisors and trade union leaders.

The labour research training centre of SITRA, the first of its kind in India, has so far trained more than 12,000 workers in five regional languages - Tamil, Hindi, Malayalam, Telugu and Kannada. The demand from member mills for retraining programme for existing workers and pre-employment training for new entrants is on the increase year after year. Management of mills and workers have expressed their high sense of appreciation about the usefulness of these programmes.

SITRA has been recognised as an International Institute for Training relating to various aspects of textile mill management. So far, under various Government of India aids about 525 foreign nationals from 36 developing countries have been trained for a period of 3 months. The participating countries and Government of India have highly commended SITRA for the excellent training offered under this programme.

Communication

SITRA also maintains a library of fabrics in order to acquaint the industry with the range of fabrics manufactured in the country. Xerox copying facilities are also available in the library.

Besides the Annual Technological Conference, a number of meetings are held through out the year so that information on modern developments is made available to the members as soon as they are known. Quite often regional seminars are held in southern states so that the mills in the region will be abreast of latest technology. In addition to this, during the liaison visits that are undertaken by the staff of SITRA, the various findings are discussed in relation to the individual mills.

Assistance to Decentralized Sector

In view of the special needs of the decentralised sector in the country, considerable emphasis has been laid in SITRA's activities on transfer of technology to all the three wings viz. handloom, powerloom and knitting.

The assistance provided for the handloom sector covers market surveys as well as exhaustive studies on improving the performance and efficiency of the handlooms. Of the various studies undertaken in handlooms particular mention may be made of the studies 'Sizing Practices in Handlooms', 'Cost Differential between Handlooms and Powerlooms', 'Organisational and Technical Methods Necessary for Improving and Maintaining Exports of Ready-made Handloom Garments' and 'Cone Yarn for Handlooms'.

SITRA is the pioneer in setting up of service centres for the powerloom sector with a special funding from SIMA. SITRA has at present three Powerloom Service Centres at Somanur, Komarapalayam and Salem and the three sub-centres at Palladam, Erode and Dalavaipuram. In addition, SITRA has established three Powerloom Service Centres entirely funded by the Ministry of Textiles, Government of India. They are located at, Sankarankovil, Tamil Nadu, the other at Nagari, Andhra Pradesh and the third at Dodballapur, Karnataka. Assistance is given at these centres for increasing productivity, improving quality of fabrics, diversification of production and producing fabrics for exports. SITRA has been asked by the Ministry to start three more PLSCs two in Tamil Nadu and one in Karnataka.

With UNIDO assistance SITRA has set up a separate division in knitting. Production of quality outer-garments by introducing modification in the existing machinery has also been identified which has enabled the industry to cater both to the requirements of common man as well as the requirements of export markets. SITRA also provides consultancy service and training to improve the quality of hosiery goods and to reduce costs. A knitwear service centre funded by Apparel Export Promotion Council and administered by SITRA has been set up at Tirupur and the knitters in large number make use of its services.

Services to Government

Because of the vast expertise and knowledge that have been built up, SITRA is called upon to advise the various departments of Central and State Governments on a wide range of issues.

Conclusions

In all four TRAs have been promoted by the industry with the support of the government. The five institutions have tried to carve out niches for themselves in terms of their scope of work as well as geographical coverage. For example, SITRA has emphasized more on spinning as there are a large number of spinning mills in the south of the country. Their success in catering to the decentralized sector is also enviable - there are a number of power loom units waiting to get membership of SITRA. SITRA, however, is not in a position to accommodate them because of its limitation to service a very large membership. ATIRA has traditionally focused more on weaving though its profile has been changing in recent times.

In the apparent success of the TRAs there also lies a potential weakness: These TRAs having uptil now catered more to short term needs of the members have not given emphasis on acquiring sophisticated technological capabilities required for process and product innovation which are likely to be required in the emerging business environment. In the competitive environment of the future export oriented firms would need technological support of a higher level. The TRAs need to take note of these developments.

The success of the TRAs uptil now may be attributed to a number of factors; a prime one being strong influence of industry in the strategic actions taken by the organizations. The TRAs have at the helm of affairs a top manager from industry as the Chairman of the Council of Administration. Various important committees have industry representatives as members. This practice seems to have helped in providing client orientation to the organizations.

5. Analysis of the Survey Results

Two surveys were carried out. One was through mail while the other was through interviews. Both the surveys used different questionnaires.

5.1 Ownership Pattern

Table 5.1
Ownership Pattern

Ownership Pattern	No. of Firms	
	Mail Survey	Interview
Privately owned through domestic capital	22 (88%)	16 (88.9%)
Government owned	2 (8%)	2 (11.1%)
Cooperative	1 (4%)	-
Total	25 (100%)	18 (100%)

Conclusion: Majority of the firms in the two surveys were owned by private capital either through family ownership or through dominant share holding by a few individuals. Most of the textile firms were started by entrepreneurial families (like Parsis initially and later by other Indian families, e.g. Lalbhais, Birlas, etc.). The involvement of the government as owners has been very little, as evident from the mail survey. The interview data also supports this inference though the sample was biased through a process of selection.

5.2 Sizewise Distribution

Table 5.2
Size of Firms Based on No. of Employees

No. of employees	No. of firms	
	Interview	Mail Survey
< 50	4 (23.5%)	1 (4.5%)
51 - 100	1 (5.9%)	-
101 - 300	2 (11.8%)	-
301 - 500	4 (23.5%)	-
501 - 1000	2 (11.8%)	7 (31.8%)
1001 - 3000	1 (5.9%)	10 (45.5%)
3001 - 5000	3 (17.60%)	2 (9.1%)
> 5000	-	2 (9.1%)
Total Response	17 (100%)	22 (100%)

Conclusion: According to the interview data firm size in terms of number of employees had a wide range, ranging from less than 50 employees to more than 3001 but less than 5000 employees. But according to the mail survey most of the forms were large having more than 500 employees. This discrepancy in the two sets of data may be explained by the fact, that in the interviews there was control on the selection of respondents while in the mail survey this was lacking. This could be the reason for the clustering of larger size firms in the mail survey as they were the only respondents. The interview data shows the existence of firms in almost all the size categories.

5.3 Sales Growth

Table 5.3
Sales Growth in the Period 1987-1992

Sales Growth	No. of Firms	
	Mail Survey	Interview
Declining	-	-
Negligible	2 (8%)	2 (13.33%)
Moderate	13 (52%)	5 (33.34%)
Rapid	9 (36%)	6 (40%)
Phenomenal	1 (4%)	2 (13.33%)
Total	25 (100%)	15 (100%)

Conclusion: The textile industry seems to have experienced moderate to rapid sales growth during the period 1987-92. Majority of the firms (73.33%) according to interview data and 88% according to mail data) enjoyed moderate to rapid growth in sales in the last 5 years. During the same period only 4 firms had negligible/no sales growth and only three had phenomenal sales growth.

5.4 Market Share

Table 5.4
Comparison of Market Share (Mail Survey)

Market Share	No. of Firms	
	Domestic Market	International Market
Minor	14 (56%)	18 (94.7%)
Average	6 (24%)	1 (5.3%)
Dominant	5 (20%)	-
Total	25 (100%)	19 (100%)

Table 5.4A
Domestic Market Share (Interview)

Market Share	No. of Firms
Insignificant	8 (44.44%)
Small	6 (33.33%)
Important	4 (22.22%)
Monopolist	-
Total	18 (100%)

Conclusion: According to the mail survey more than fifty percent of the respondents had a minor share in the domestic market, while according to the interview data, 14 (77.77%) firms had an insignificant share in the domestic market. Only about 20 % of the firms, in both the data sets, had a dominant market share indicating that the textile industry is highly fragmented.

A look at the market shares in the international market as perceived by the firms, shows the insignificant presence of Indian textile firms in the international market. This is due to the domestic orientation of the textile industry and also the existence of the quota system, under Multi Fibre Agreement (MFA) which restricts total exports from India. The insignificant presence of Indian textile firms in international markets is supported by the finding that 83% of the textile firms had less than 25% export sales (see Table 5.5).

5.5 Percentage of Sales Exported

Table 5.5
Percent of Sales Exported (Interview)

Percentage of Sales Exported	No. of Firms
0 - 5	6 (33.33%)
5 - 25	9 (50%)
25 - 50	2 (11.11%)
50 - 100	1 (5.56%)
Total	18 (100%)

As regards the destination of exports, a majority of the exporting firms exported to both the developing and industrialized countries.

5.6 Domestic Market Competition

Table 5.6
Degree of Competition Faced in Domestic Market

Degree of Competition	No. of Firms	
	Mail Survey	Interview*
Low	3 (12%)	4 (22.22%)
Average	11 (44%)	3 (16.67%)
High	11 (44%)	11 (61.11%)
Total	25 (100%)	18 (100%)
* The competition faced is from domestic firms		

Conclusion: According to both data sets, majority of the firms faced average or high degree of competition in the domestic market indicating market fragmentation.

5.7 International Competition

Conclusion: As regards the international market, most firms face high or average degree of competition which explains the minor market share of the majority of the firms in the international market. The interview data also supported the findings of the mail survey.

Table 5.7
Degree of Competition Faced in International Market

Degree of Competition	No. of Firms (Mail Survey)
Low	2 (9.5%)
Average	2 (9.5%)
High	17 (81%)
Total	21 (100%)

5.8 R&D and Technical Training Expenditure

Conclusion: For expenditure on R&D and technical training majority of the firms have reported missing data which may indicate that they probably do not have separate R&D and technical training expenditure accounts. This also indicates that firms do not attach much importance to R&D activities. They probably do not spend any amount on R&D and even if they do, the amount is very little, as seen from Table 5.8. Only one firm spends more than 10% of sales on technical training.

Table 5.8
R&D and Technical Training Expenditure as Percentage of Total Sales in 1992 (Mail Survey)

Percentage of Total Sales	No. of Firms	
	R&D Expenditure	Technical Training Expenditure
< 1.5	5 (62.50%)	6 (75.00%)
1.5 - 5	3 (37.50%)	1 (12.50%)
5 - 10	-	-
> 10	-	1 (12.50%)
Total	8 (100%)	8 (100%)

5.9 Technical Expenditure

Conclusion: The interview data shows 7 out of 11 firms (63.60%) spend less than 1.5% of sales on technical expenditure. And no firm spends more than 5% of sales on technical expenditure. Thus, it is evident that textile firms do not give much importance to technological development which may be because they have operated in a protected environment facing little or no competition from foreign firms. All the firms had less than 25 R&D staff which again indicates low priority given to R&D by the textile firms. This conclusion is borne out by both the mail survey and interview data.

Table 5.9
Technical Expenditure as Percentage of Sales (Interview)

Technical Exp. as % of sales	No. of firms
< 1.5	7 (66.60%)
1.5 - 5	4 (26.40%)
5 - 10	0
> 10	0
Total	11 (100%)

5.10 Domestic and World Technological Leadership

Table 5.10
Comparison of the Technological Capability (Mail Survey)

Degree of Technological Capability	No. of Firms	
	Compared to Domestic Leader	Compared to World Leader
Low	4 (16.67%)	11 (45.83%)
Average	7 (29.17%)	7 (29.17%)
High	13 (54.16%)	6 (25%)
Total	24 (100%)	24 (100%)

Conclusion: Just above 50% of the mail survey firms have rated their technological capability as "high" as compared to the domestic leader which indicates that some firms may be technologically

dynamic in the domestic market. Quite a large number of firms on the other hand have rated their technological capability low or average as compared to the domestic leader, which indicates lack of technological dynamism. This is because they are operating in a protected market. But in the international market majority of the firms (>70 %) have rated their technological capability as average or low as compared to the world leader. This may be the reason for majority of the Indian firms facing a high degree of competition and having a minor market share in the international market.

5.11 Product and Process Changes

Table 5.11
Technological Dynamism with reference to Product and Process changes(Interview)

Technological dynamism	Number of firms			
	Product changes		Process changes	
	Incremental	Significant	Incremental	Significant
Stagnant	6 (33.33%)	9(50.0%)	6 (33.3%)	5(27.8%)
Very slow	6 (33.33%)	1(5.56%)	4 (22.2)	1(5.56%)
Moderate	4 (22.22%)	7(38.9%)	7 (38.9%)	7(38.9%)
Rapid	2 (11.12%)	1(5.56%)	0	4(22.2%)
Exceedingly dynamic	0	0	1 (5.56%)	1(5.56%)
Total Response	18 (100%)	18(100%)	18 (100%)	18(100%)

a) **Conclusions**: As seen from the above table, the interviewed firms exhibit higher dynamism with respect to significant process change than incremental process change. In the case of significant and incremental product changes, there is not much difference in the dynamism exhibited by them.

b) The interviews revealed that the firms had implemented twelve significant product changes. For two firms had used support of technological institutions (TIs) while the rest had been done in-house without support of a TI or foreign collaborator. Of the 13 incremental product changes 9 had been done without any outside support while 4 had been done with the support of TIs. In significant process change, 15 out of 16 did not have any outside support. While in incremental process change out of 13 changes, 11 had been done without any outside support. Thus, it seems, textile firms have tended to depend more on their internal capabilities in making incremental and significant product and process changes than outside support. This also supports the mail survey finding of low usage of contract and collaborative R&D for technological services. Outside support has generally meant taking help of TIs rather than foreign collaborators.

c) Most of the respondents in the sample reported that there was no involvement of TIs in organizing inter-firm linkages for major or minor product or process changes. Only 3 firms had indicated involvement of TIs for minor process change but their contribution was rated as above average. Only one firm had links with other firms for major product change and the contribution of the links was rated below average. Thus it seems firms have tended to go alone in technology development. Also it seems firms have been successful with the linkage with other firms when TIs helped them than when they did it on their own. Lack of links between firms for minor or major product or process changes may be due to the high level of competition between them and hence their hesitation in sharing technical knowledge.

d) Most firms use research associations rather than other institutions. Industry specific associations and organizations are most frequently used for membership by the respondents,

given the fact that there are well established institutions in this industry. The next most used are general associations which is true for any industry. These memberships entitle them to benefits of access to information, attending seminar/workshops and advice. The firms use TIs most frequently for information and standards/testing services.

5.12 Firm Distribution by Training Expenditure

Table 5.12
Training Expenditure (Interview)

Training Expenditure (Rupees)	No. of firms		
	Total training expenditure	Contract	In-house
< 50000	8	0	3
50000 - 0.1 million	4	2	3
0.1 - 0.5 million	3	2	1
0.5 - 2.5 million	1	0	1
2.5 - 10 million	0	0	0
> 10 million	0	0	0
No expenditure	2	7	3

Conclusion: None of the firms had training expenditure of more than Rs.2.5 million, with the majority having less than Rs. 50000. Only two firms did not spend anything on training. The data indicates the low priority accorded to technical training. Most of the firms that spend on training, have focused on in-house activities rather than use contract service.

This corroborates the finding that most of the firms conducted some form of in-house training. Most imparted training to workers/operatives and technical staff though a few firms had conducted programmes for their managerial staff also. Most of the firms adopted on-the-job and seminars/ workshops as modes of training. A few had used interaction with other organizations as a training mode to impart in-house training.

5.13 Sources of Training

Table 5.13
Sources of Training

Sources of Training	Mail Survey*		Interview*	
	Used by No. of Firms	Mean Contribution (on a scale of 1 to 5)	Used by No. of Firms	Mean Contribution (on a scale of 1 to 5)
Vocational Institutions	5 (27.78%)	3.60	5 (27.78%)	3.60
Industry Association	12 (66.67%)	4.16	8 (44.44%)	3.50
Universities	-	-	5 (27.78%)	3.80
JV Partner	-	-	1 (5.56%)	-
Buyers	-	-	1 (5.56%)	-
Suppliers	8 (44.44%)	3.86	12 (66.67%)	3.60
* Both data percentages based on total response of 18				

Conclusion: From table 5.13 it is evident that mail respondents prefer industry associations more to suppliers and also rate it higher, while interview respondents prefer suppliers to industry associations. Overall, industry associations and suppliers are most used sources of training by both mail and interview respondents and their contributions are rated very highly. Industry associations are used highly perhaps because of the well organized institutional set up in the textile industry. Suppliers, especially of textile machinery, are used by a large number of firms as they help in the technological development of the firm. Fewer firms used vocational institutions as a source of training but rated their contribution highly. Only a few interview respondents used universities as a source of training and rated them very highly. Interestingly, no firms had used JV partners or buyers as sources of training. This is expected as most Indian textile firms do not have any links with foreign firms while buyers of textiles are individuals who are in no position to impart training.

5.14 Use of Technological Services

Table 5.14
Use of Technological Services (Mail Survey*)

Technological Service	Used by No. of Firms	Mean Importance (on a scale of 1 to 5)	Important Sources of Service
Information Service	19 (76%)	3.78	Long Term Supplier, Research Association.
Problem solving/ trouble shooting	17 (68%)	3.94	Long Term Supplier,In-house labs, Industry Association
Standards /Testing	20 (80%)	3.75	Research Association, In-house labs
Education/ Training	16 (64%)	3.64	In-house Labs
Contract R&D	6 (24%)	2.83	
Collaborative R&D	6 (24%)	3.67	In-house Labs
Commercial Advice	11 (44%)	3.60	Long term Supplier, Industry Association
Facilitating Formation of tech. networks	14 (56%)	3.50	Long Term Suppliers, Industry Association, Research Association

* Based on the total response of 25

Conclusion: As seen from Table 5.14, the technological services for which more than 50% of firms have used outside support are standards/ testing, information, problem solving/ trouble shooting, education/training and formation of technical networks. All these have been rated quite important. Contract and collaborative R&D were least used by firms. This could be due to the firms' perception of lack of confidentiality of R&D information that could affect their competitiveness. Another factor is that contract and collaborative R&D are for medium to long term technological development which does not meet most firms' needs as they are looking for short term solutions. All the services have been rated as above average (73.0) in importance except for contract R&D. This could be due to the fact that in contract R&D the involvement of the firm is minimal thereby making the process of technology transfer and subsequent technological development very difficult. Collaborative R&D is rated highly in importance of technological development as the involvement of the firm is more than in contract R&D.

As outside sources providing technological services, long term suppliers, research associations and industry associations are considered important. The importance of research associations is expected given the existence of well established research associations in the Industry. Long term suppliers, especially of textile machinery, are an important group having control over the technology embedded in textile machinery, and are therefore considered an important source.

5.15 Importance of Service Providers

Table 5.15
Usage and Importance of Providers of Technological Services (Mail Survey*)

Providers of Technological Services	Used by No. of Firms	Mean Importance (on a scale of 1 to 5)
Pvt. Contract Lab	6 (24%)	2.83
Long term Customers	10 (40%)	4.55
Long term Suppliers	14 (56%)	4.42
Labs within the Firm	16 (64%)	4.50
Foreign Investors	-	-
National Tech. Institutions	10 (40%)	3.00
Local/Regional Tech. Institutions	6 (24%)	3.25
Consulting Firms	11 (44%)	3.11
Universities	6 (24%)	2.25
Industry Association	13 (52%)	3.73
Academic Association	-	-
Research Association	20 (80%)	4.00
* Based on total response of 25		

Conclusion: As seen from Table 5.15, eighty percent of the firms use research associations as providers of technological services, which indicates that textile research associations play a significant role in their technological development. The other important providers are in-house labs, long term suppliers and industry associations. All these have been rated as highly useful. Technical institutions and universities have been less used and rated as less important providers possibly because they lack practicality in their approach. Also private contract labs are rated low in usefulness. No foreign investors are providers which is due to the lack of foreign ownership in the textile industry.

The most important benefits as perceived by the firms are (i) solutions to specific problems, (ii) quick and easy access to information and technology, (iii) new product development and (iv) improved quality and reliability.

The most important problems as perceived by the firms regarding service providers are: (i) not responsible in timely manner, (ii) fees are too high.

These reasons are common to most external sources.

5.16 Benefits from Government Policies

Table 5.16
Benefits from Government Policies

Policies	Mail Survey*		Interview*	
	Used by No. of Firms	Mean Beneficial Impact (on a scale of 1 to 5)	Used by No. of Firms	Mean Beneficial Impact (on a scale of 1 to 5)
Fiscal Incentives	19 (76%)	3.35	11 (61.1%)	3.82
Grants	4 (16%)	2.25	4 (22.2%)	3.50
Special technology Loans	6 (24%)	2.63	6 (33.3%)	3.50
Training	7 (28%)	2.29	2 (11.1%)	-
Government Procurement	4 (16%)	1.00	3 (16.7%)	2.40
Standards/ Testing	6 (24%)	3.00	4 (22.2%)	3.50
Market Protection	6 (24%)	2.33	3 (16.7%)	-
Export Incentives	15 (60%)	3.51	9 (50%)	3.78

* Mail data percentage based on total response of 25
* Interview data percentage based on total response of 18

Conclusion: Fiscal and export incentives are the most used policies. These policies are rated to have the highest impact on technology development. Fiscal incentives provide the much needed financial resources to the cash strapped firms for investing in technological development, while export incentives force firms to be technologically developed for facing competition in the export market. Grants and special technology loans, though used by fewer number of firms, have been rated quite high in terms of their beneficial impact by firms which have used them.

5.17 Policies and Programmes for Competitiveness

Conclusion: Most of the firms feel that changes in policies and programs of the government are necessary for future competitiveness. The firms also consider financial resources as a major stumbling block to their future competitiveness and technological development and would like to see policy and program changes in this area. Another important area is equipment/ machinery in which firms want policy and program changes to ensure their future competitiveness. Lack of modernisation in the textile industry explains the firms' view.

6. Selected Case Studies of Firm Level Technology Management

In this section we consider a few case studies of firm level technology management to get a qualitative picture of how firms in the industry look at technology, how they acquire technological capabilities and how they utilize the same for their business. Case studies of different types of firms are presented here: large and small, and technologically dynamic and stagnant.

1. Company A was established in 1930 by three brothers who traditionally were entrepreneurs. At this time the textile industry in India as well as in UK was in serious trouble. Around the same time Mahatma Gandhi gave a call to the people in India to boycott fine and superfine fabric imported from England. But the brothers believed that there was still a demand for these fabrics and the company that fulfilled this demand would prosper. They decided to set up a mill to produce this superfine fabric. Next, the company acquired the state-of-the art machinery available at that time and gradually built up a large business group primarily in the textiles industry.

In the mid-80s the Indian textile industry was in a crisis. The growth of the power loom sector had led to the closure of a number of composite mills. Faced with a competitive and hostile environment this company shifted its focus from domestic markets to international markets. It concentrated on a niche market-Denim. This required induction of sophisticated and expensive machinery. But since this product had a large and growing market, the company went ahead with its new strategy.

In 1991 the company set up a 100% export oriented unit for denim with a daily capacity of 23000 meters. In 1992 the company accounted for 2 per cent of the world denim market and was planning to become a major worldwide player. Over the period 1988-1992 the company invested Rs.800 million in technologies and facilities.The company has the most modern machinery purchased from Sulzer, Tsudakoma, Sucker Muller and Trutzschler to produce denim.

The company has initiated many process innovations. For example, till recently 14.5 to 16oz heavy denim was manufactured only on expensive conventional projectile looms. The company argued that if the same denim was produced on airjet looms costs could be reduced greatly. However, airjet looms could not weave high quality heavy denim. With the technicians from Tsudakoma, the company's technologists modified the machines to produce heavy denim and thus became the world's first company to produce denim in this unconventional way.

The company has also undertaken product changes. It has shifted from producing traditional items like sarees to high value products like denim and high value cotton garments.

It has set up an in-house research center with a number of purposes; to innovate, to obtain better quality at reduced cost, to discover new processes and improve existing ones. The company is unique in the industry as it is the only firm which has a research facility with a pilot mill.

The company's research centre has a number of achievements to its credit; (a) it pioneered the process of producing Denim indigenously; and (b) has developed the process for water repellant fabrics and permanent press cotton fabrics. Besides these, the centre has contributed to the company by mastering the multibeam dyeing technology to produce classical Oxford shirting, and through energy saving and cost reduction as well as process improvements.

The groups' current chief executive was earlier the chief of R&D. The company's total R and D expenditure as a percentage of sales turnover was 0.12 in 1991-92, not significant in comparison to world standards but larger than the Indian textile industry average.

Great emphasis has been laid on development of human resources. The company sends its personnel to various training programmes at different places to improve productivity levels. It also has an in-house training center to train its workers.This center trains workers in new technology in weaving and spinning.

The company is a member of various textile associations including research associations. But it avers that the benefits received from these memberships are intangible and indirect.

Now the company is all set to achieve its global ambitions .It has set up offices in London,Hong Kong and New York.It has also recently appointed an reputed international consultancy organisation to enable the company to become a global textile company.

2. Company B is owned and managed by an entrepreneur who started off as a cotton merchant. Having found that manufacturing textiles was a good business, he started a weaving mill in the power loom sector. However, this was different from the other power loom units. Initially he started his unit with non-automatic looms. Then he graduated to automatic looms and finally to imported second hand shuttleless looms. In choosing the technology he consulted his friends in the industry. He did not feel the need to use consultants in the selection of the machines. The entrepreneur installed the most

sophisticated shuttleless looms which provided him an edge over other power loom units in terms of quality and cost.

The company produces suitings and shirting. It has made a few product and process changes; product changes in terms of change in composition of the products from Polyester Filament Yarn to Polyester Viscose which are high value products and process changes have taken place in the form of replacement of conventional looms with high speed shuttleless looms. The company has very active interaction with its dealers who provide feedback about the market, thus enabling the company to produce according to demand.

The company recruits workers from other textile mills through the indigenous badli or temporary worker system. The company has very little interaction with the TIs. The owner is of the opinion that the TIs cater to the needs of the composite mills or the large firms only.

However, the company has some interaction with its machinery suppliers to provide problem specific training to its personnel. The company also has used a private consultant to provide consultancy for maintenance of machinery. It does not have a full time engineer but manages with a part time technician and also shift supervisors on a part time basis. Interestingly the company has not taken any special benefits from government policies or instruments. Having been in the decentralized sector it has benefitted only from the fiscal policies that are available to units in the power loom sector.

The company is one of the most successful and technologically dynamic power loom units in the city.

3. Company C belongs to a well known industrialists' group, a group with interests in glass, sanitaryware, ceramic, tiles, cans, glass decoration, feldspar, and engineering in addition to textiles. The textile unit, previously a closed textile mill in Ahmedabad was purchased by the group in 1969 with an investment of Rs.3 million. Immediately the company began a process of modernization and rationalization with investments of over Rs.300 million. It is today among the most modern and profitable textile mills in India.

The company is a state-of-the-art mill, one of the first to use high speed airjet, microprocessor controlled looms. The high investments in and absorption of the latest technology has led to increase in productivity.

The company has aimed at carving out niche markets for itself through tapping the denim market at home and abroad. The company has made product and process changes mainly through in-house efforts. The machinery however has been imported from abroad. It has a long term perspective on technology, which is evident from the fact that the company does not have a single machinery which is older than 15 years. The company's unique selling proposition is " To make technology pay ".

The company has the distinction of going from chute feeding to card directly as against conventional lap feeding in its spinning preparatory section. It has gone for open end spinning for denim thereby eliminating two intermediate processes and two lines of machinery. The company has also acquired the hi-tech USTER-III instrument for quality control.

The company does not consider TIs as an important source for technology. TIs have only been used for counter-testing and for some process audit consultancy. The company recruits fresh students from Industrial Training Institutes (ITIs) as workers and provides them training in-house as well as through external agencies. Existing workers are also given training.

However, machinery suppliers seem to be a significant source of training with the company rating their contribution as high. This company has borrowed from the Industrial Development Bank of India (IDBI), a national financial institution which provided funds through its technology development programme.

4. Besides these technologically dynamic firms there are also units which are technologically stagnant. Such units were also surveyed for the study in the city of Surat in Gujarat.

These units in the power loom sector used conventional looms, and catered to the lower segment of the market. These units mainly produced grey cloth. The owners stated stiff competition and marginal profits as the reasons for not undertaking technological upgradation. Due to price fluctuations in this segment the units believed that it was too risky to go for better technology which required huge investments.

These units rarely used the services of the TIs. If used at all, it was because of customers' explicit product testing requirements.

The owners of the units surveyed believed that the TIs catered to the big mills only even though a cooperative research association existed hereby of which they were members. These units were extremely small with less than 10 employees. Hence no training was offered. The units employed persons having some experience in the industry.

7. Implications for Firms, TIs and Government

The industry is characterized by a large number of firms, mostly small and technologically backward and some fairly large and technologically dynamic. The problems that the industry is currently facing are the cumulative effects of the historical development process.

Compared with countries competing in international markets productivity levels and growth rates are lower in India. There is also considerable variation in productivity between mills in the country.

Ineffective management, inability to buy the right type of cotton at the right time and price, lower machine utilization, poor working conditions, lack of standardization, ineffective financial management are the main reasons for low productivity. These in turn are influenced by factors that are external as well as internal to the firm: lack of plant modernization, lack of timely availability of spare parts, capacity imbalance between stages of the manufacturing value, chain, power shortage, lack of proper maintenance, and worker absenteeism.

The organized industry's profitability is lower than the average for all industries. The industry's financial condition was further exacerbated by year to year variation in profitability. There are a number of factors which have affected the industry's financial condition; government's price control on particular varieties, high excise duties on certain varieties, distress sales during depressions, intense competition in recent years from the power loom sector, encouraged by government policy. and high price of cotton and important raw materials.

7.1 Implications for Firms

1. An ability to scan the environment for identifying the relevant technological developments, evaluating them in the context of the overall strategy of the firm and implementing them seems to have contributed to the success of the better performing firms.

The available data suggests that firms have found long term suppliers and research associations to be useful sources of technological information, and inputs on technical problem solving and trouble shooting. Long term suppliers and industry associations seem to be effective sources of commercial advice.

2. Effectively managed in-house R&D can be asset in becoming competitive. The survey results indicate that a majority of firms use in-house laboratories for technological problem solving, standard setting and testing and also for education and training. Product and process research conducted by in-

house R&D departments can help firms become competitive and in negotiating with technology and machinery suppliers as evidenced by experiences of some firms. However, survey results show that most firms spend small amounts on R&D and technical activities. Even technical training expenditure by most firms is quite small. These orientations explain the firms' assessment of their technological capability as low to moderate compared to the world leader.

Firms in the industry should note that to become competitive in world markets they would need to invest in in-house R&D facilities focused on product and process research with a fairly long term perspective on a sustained basis.

3. Most firms in the industry spend small amounts on training which is another important factor explaining the technological backwardness of the industry compared to firms in the technologically advanced countries. Overall, industry associations and long term suppliers have been found to be the most used sources of training inputs apart from firms' own in-house training facilities. In order to improve their technological levels firms need to consider a multi-pronged training strategy that emphasizes the development and exploitation of both internal resources as well as the existing network of various organizations including vocational institutions, institutions, universities, research associations, suppliers and joint venture partners. Firms suffering from paucity of funds may benefit from efforts towards exploiting training resources of public funded TIs.

7.2 Implications for TIs

Several implications for TIs may be drawn from the surveys:

The cooperative textile research associations (TRAs) have over the years developed considerable expertise in process optimization, productivity improvements, technical problem solving, developing standards, testing of various textile materials, plant management and to a limited extent product and process development. The TRAs have also been quite successful in developing relationships with the textile industry. Of late the TRAs have also begun providing their services to related industries. They should therefore strengthen their existing strengths as there are ample opportunities to exploit them. The surveys indicate that a significant number of firms in the industry undertake both incremental and significant product and process innovations but do not use much the services of TIs due to a variety of problems ranging from lack of customer orientation in terms of the timeliness of service, practical orientation, lack of specific expertise, etc. Many decentralized units do feel the need for technical support but are unable to access the services of TIs due to their distance from the relevant TIs or their perception that the latter would probably be disincluded to serve them. TIs may therefore have to develop strategies to develop better understanding of the needs of both the organized and decentralized units and cater to them. "Extension Centres" may be an effective mechanism to cater to the needs of decentralized units situated at large distances from the TIs. TIs need to consider implementing strategies to improve their ability to service clients "on time". Close association in applied research with firms may help TIs' technologists acquire a practical orientation.

In recent years exports of textile products have been looking up. Technical services for setting up new export oriented factories is likely to be in demand depending on the location of the TI. TIs would benefit from efforts to understand market trends and develop their capabilities to serve the technical service needs of their potential clients. Capability development requires a medium to long term approach that would entail considerable investments in human resource development.

Due to rapid changes in the marketing environment and technology, quick access to information is becoming increasingly important. This is likely to become accentuated because of the progressive integration of India's economy with the rest of the world. The surveys also revealed that one of the important services that firms look for from TIs is information. TIs may therefore benefit by organizing themselves to cater to this felt need. This may require creating structural mechanisms in

their libraries to cater to this need, library computerization, access to international patent search facilities, development of a costing and pricing system, etc.

TIs may not be able to play a critical role in the technological transformation of the larger and technologically dynamic firms unless they are able to build their technological capabilities considerably. Today the field situation is that the larger textile firms do not consider TIs' capabilities to be adequate to their needs. However, TIs may still be able to serve the larger firms by "technology gap filling".

When TIs acquire a large technology package from international technology suppliers there may be small technology "bundles" which may not be available with them for which the Indian firm may have to go to another supplier. This may increase the cost of the technology but also raise coordination requirements. In such situations Indian TIs may be able to get involved. Other areas which are becoming critical are: energy conservation, and pollution control. The large firms may also benefit if TIs can acquire capabilities specific to the textile industry. Customised information packages may also be marketed by TIs to the larger firms. Another potentially good area for the existing larger firms, and smaller firms trying to enter the big league is ISO 9000 certification. This has already become a booming field. But these are short to medium term options. Though the TIs have responded to the needs of the decentralized sector they need to strengthen their infrastructure to help firms improve their competitiveness. The pressure to seek projects from external sources has brought in a degree of dynamism and an awareness in the TIs regarding the need of strategic planning, which has helped the better performing TRAs in responding to the changing environmental opportunities and pressures.

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