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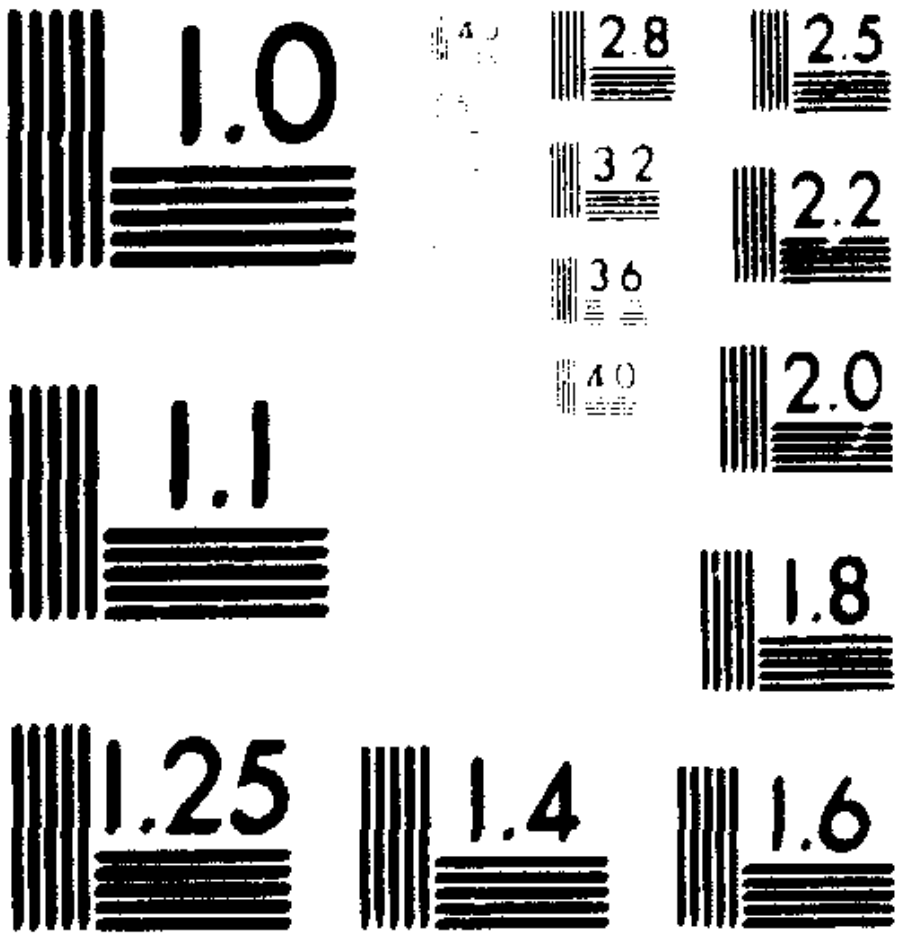

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DEVELOPMENT OF THE HOSIERY KNITWEAR INDUSTRY, LUDHIANA (PUNJAB)

DP/IND/73/021

INDIA

Terminal report

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Donald Terrington, technical adviser

United Nations Industrial Development Organization
Vienna

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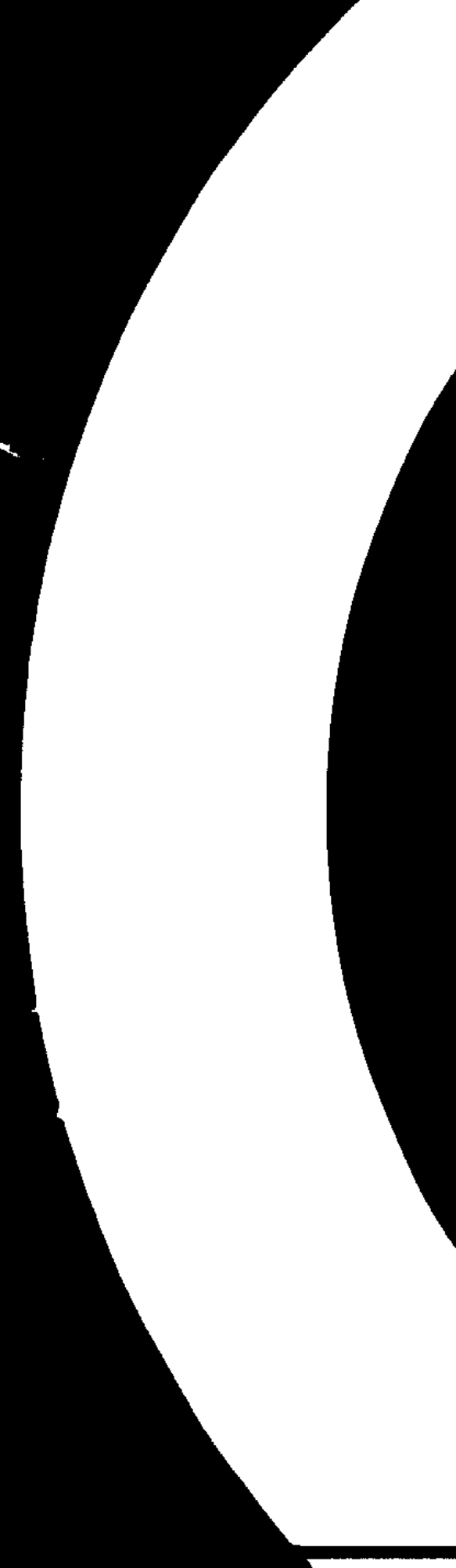
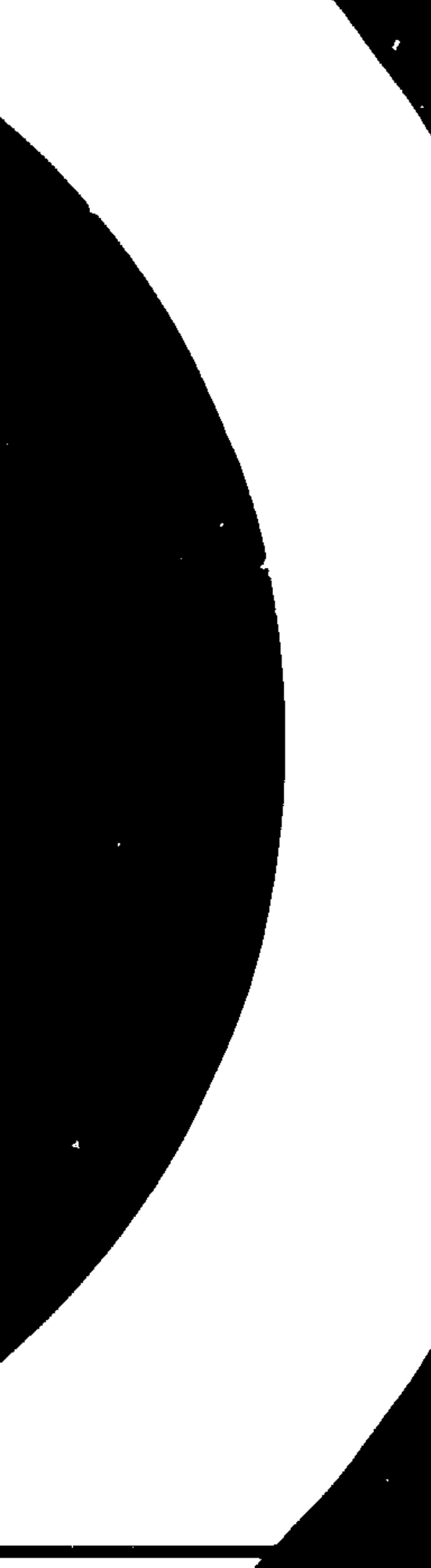




ABSTRACT

The Project "Development of the hosiery knitwear industry, Ludhiana (Punjab)" (DP/IND/73/021) was conceived in the early 1970s after a survey of the knitwear industry in Ludhiana had been undertaken by the Punjab State Government in collaboration with the International Wool Secretariat (IWS). The intended starting date of the project was September 1975, for a duration of 4 years 10 months, however, this was delayed till September 1976 and the project was completed therefore in June 1981.

The objectives of the project were to reduce the lag in technology in the knitwear industry and improve quality and export potential. The project gave assistance to the Knitwear Facility operating under the Punjab State Hosiery and Knitwear Development Corporation.

This report attempts to give a full account of the progress of the project during the expert's assignment. The project had a slow start, but during the course of 1980 became operational. During the first year of his assignment, the expert devoted much time to assisting the local staff to get the installations and machinery to place. Meanwhile he surveyed the industry and gave practical advice to the mill managers on technical matters.

During the second and last year of his assignment the expert started up the equipment supplied by UNDP/UNIDO. A large number of trials were carried out, most of them being innovative techniques for the local industry.

The large scope of technology covered by the expert has now been taken over by the technical staff of the project trained by the expert. Because the present status of the project is only the first step to provide the Punjab knitwear industry with modern technology to increase the mills capability to offer exportable qualities of knitwear, phase II of the project is urged. One of the major constraints to exporting manufactures is the low quality of yarn available in Punjab State. Therefore, additional inputs, in line with the original project document, which was reduced because of financial constraints, are essential.

These requirements are detailed in the recommendations in the draft project document for Phase II "Development of the hosiery knitwear industry, Ludhiana, Punjab, Phase II" forwarded to UNDP and the Government of India in August 1980 by the Punjab State Government for implementation in January 1982. Based on the experience gained on the project up to March 1981, a review of the contents of the draft document is desirable. Outlines for such a review have been given in the report.

In brief the technology inputs recommended are shrink-proofing of tops, spinning, dye recipe formulation techniques, circular knitting and yard goods processing. Design inputs are also envisaged so that manufacturers can move to better standards of design, fashion and style thereby becoming more competitive and self-supporting in the export target markets of Europe and North America. The recommended inputs are necessary if the Knitting Facility is to play its assigned role effectively and the objectives mentioned above are to be fully met.

The Knitting Facility will also continue to play its role of demonstration and training in a more institutionalized manner. This will become more important when manufacturers realize that technology improvement is necessary to meet the high quality requirements of buyers, particularly in the expert target markets.

CONTENTS

INTRODUCTION

The project "Development of the hosiery knitwear industry, Ludhiana (Punjab)" (DP/IND/73/021) originated in the early 1970s after a survey of the knitwear industry in Ludhiana had been undertaken by the Punjab State Government, in collaboration with the International Wool Secretariat (IWS). The intended starting date of the project was September 1975 for a duration of 4 years 10 months, which meant a completion date of June 1980. However, the start was delayed till September 1976 and the project therefore was completed in June 1981.

Ludhiana, Punjab, was chosen for the survey because approximately 90 per cent of the wool and other fibre, hosiery and knitwear industry is concentrated in the city and surrounding areas, and provides direct and indirect employment for over 200,000 people.

The estimated knitwear production for 1981 is over $100 million, therefore the knitwear industry plays an important role in the economy of Punjab State and, to a lesser extent, the economy of the country as a whole.

Basically, the knitwear industry is divided into medium- and small-scale units that produce knitted garments of multi-fibre types for export, home market and government requirements.

The conditions that led to the request for UNDP assistance, were the technology lag of the knitwear industry in general, the industry's inability to provide an adequately sound foundation, from both technological and marketing aspects, and to increase and diversify exports, particularly into hard currency markets.

Financial resources to provide the required technology and marketing expertise were also limited, mainly because the knitwear industry consists of medium- and small-scale or cottage type units.

The conclusion was that although the money could be made available, assistance would be required for the foreign exchange expenditure.

To reduce the technology lag and improve quality and export potential, the expert recommended that the Knitting Facility should:

(a) Function as a demonstration, training and technical assistance unit in the areas of yarn preparation, dyeing and the introduction of new techniques in top, yarn and garment processes, including garment finishing and knitted garment manufacture;

(b) On behalf of the small-scale or cottage-type industries and to a lesser extent medium-scale units, function as a common service facility, undertaking operations in the field of its competency and thereby improving the standard, uniformity and quality of products. Nominal charges are recommended for this service on a no-profit-no-loss basis.

(c) Provide the knitwear industry with designs, and economic and export market intelligence through collection, analysis and dissemination of market information to supplement the technical inputs;

(d) Transfer technology through seminars, lecturers and an extensive reference library with the latest magazines, periodicals and knitting publications;

(e) Be used as a prototype for the establishment of at least one similar unit on a co-operative basis by the small producers themselves.

The main objectives of the project were to increase and diversify exports of Indian knitwear through quality improvement, and to maintain woolmark standards for wool and equivalent standards for other fibres.

The immediate objectives were as follows:

(a) To demonstrate and train in all prototype additional units, or sections thereof;

(b) To provide common services and technical assistance in the areas of the project's competency, particularly in the small-scale sector;

(c) To collect and disseminate technical information to the industry, through various media;

(d) Provide knitwear industry with information on market and fashion trends, i.e. product designs and styles, in addition to economic information;

(e) Advise knitwear industry on machinery and raw materials, also measures for improving marketing procedures.

When all the objectives have been fully achieved, not only will the number of employees in the industry be increased, which in itself is an asset to the economy, but exports will have been increased and diversified, thereby increasing the desired foreign exchange earnings in convertible hard currency.

I. FINDINGS

Utilization of project input

The Knitting Facility can be divided into five sections:

Yarn preparation - winding and twisting
Yarn and garment dyeing
Garment finishing
Knitting and making-up workshop
Quality control laboratory

Yarn preparation - winding and twisting

Singles staple fibre yarn received from the industry, mostly from small-scale units, is processed on the latest type of automatic equipment. Major faults are removed by clearing the yarn which, in the case of package dyeing, is cross-wound onto packages suitable for dyeing, irrespective of fibre type. After drying, the yarn is assembly wound direct from the package, under even tension and in equal lengths; it is then twisted 2 to 4 ends as desired onto tapered cones weighing up to 1 kg. These are ideal for use on any type of knitting machine. Apart from the improvement of yarn quality through clearing, the yarn on cones has a minimal number of two-fold knots. The twisting machines are selected to avoid colour contamination through fly waste and therefore different colours can be processed simultaneously. Different coloured singles yarn can be twisted together to produce what is technically known as granderelle yarns.

In hank processing, singles yarn is wound onto sun cheeses and twisted on a special 2 to 1 twisting machine. The yarn is then reeled on a modern high-speed reeling machine, with four different cross-winding effects, selection of which depends on yarn count and fibre type, to ensure level hank dyeing. As in the case of package dyeing, any fibre type can be processed. The hanks after drying are precision-wound onto cones weighing up to 1 kg and are suitable for use on all types of knitting machines.

If desired, to improve knitting conditions by reducing friction, yarn can be waxed in the final twisting or precision-winding process. To ensure all processes are carried out in winding and twisting in an ideal environment, the entire section is air-conditioned to operate under controlled atmospheric conditions. This installation was completed in the second quarter of 1981.

Yarn and garment dyeing

Dyehouse equipment was selected to attain high quality, fastness standards and reproducibility. Almost all machines have control panels, which ensures that every individual operation in the dyeing sequence is automatically controlled. In addition, any fibre type in yarn or garment form can be dyed. Machines are coupled enabling two machines to work in unison and there are two pairs of hank-dyeing machines. One pair of machines, with a liquor flow through the spindles carrying the hanks, incorporates a telescopic carrier. This permits any hank diameter to be processed, avoids yarn contact with the hot metal of the spindle (essential for some fibre types in yarn hanks) and, at the same time, allows the liquor-to-yarn ratio to be maintained. These two hank-dyeing machines can be coupled together thereby ensuring the same dyeing conditions for the same shade in both machines. Aqueous bulking of acrylic hank yarn can be carried out, also muff dyeing.

The second pair are jet hank-dyeing machines which, in addition to carrying out all dyeing operations previously listed, are capable of giving a shrink-proof process on all wool yarn that meets IWS specifications for hand-wash category of knitwear.

Both pairs of machines can be used for scouring, moth-proofing and other chemical processes, apart from yarn dyeing. All the processes are followed by hydro-extraction and drying in a controlled temperature dryer, with fan circulators and moist air-extractors.

Four high-temperature package-dyeing machines, capable of dyeing singles yarn packages of any fibre type, are available with the flexibility to dye at any temperatures up to 140°C. The direction of the liquor flow and, more important, the amount of dye liquor passing through the packages, can be controlled by adjusting the pressure controls. This enables very fine yarn counts to be dyed without impairing yarn quality. Top dyeing can also be carried out.

Package dyeing is followed by a drying in a rapid dryer, automatically controlled to ensure even drying throughout the package at predetermined temperatures that depend on the fibre type being processed.

Facilities are available to process any fibre-type garments on a highly sophisticated low-liquor-ratio vertical drum type of dyeing machine with preprogrammed fully automatic controls. The rate of rotation of the vertical drum can be regulated, with self-watering possibilities. A further feature that enables special processes to be carried out is the five compartment automatic dosing device, enabling additions to be made over a period of time and in various concentrations. Alternatively, garments can be processed and dyed on a traditional side-paddle machine with special modifications, recommended by IWS, to carry out modern process technology e.g. superwash treatment. In addition to dyeing, both machines are capable of carrying out the following processes:

Scouring
Anti-cockle treatment
Milling
Chlorination
Moth-proofing
Bleaching
Resin application to superwash standards

After dyeing or other treatments, the garments are hydro-extracted and dried in a tumble dryer, which can be preprogrammed to carry out the functions of drying, steaming, milling and cooling.

The up-to-date dyehouse laboratory is equipped to match shades and recipe formulations on any substrate, and in particular to meet woolmark specifications for wool.

Garment finishing

The finishing section can solvent-process garments by using new techniques on a fully automated machine. The solvent used is perchlorethylene that is cleaned, purified and recycled through a distillation system. This enables each cycle of solvent processing to be carried out with clean solvent.

A further advantage with the installed modern solvent-processing machine is the ability to dry and deodorize garments immediately following the cleaning process. Therefore, on completion of the process cycle the garments are perfectly clean, dry, odourless and ready for immediate pressing. In addition to the solvent cleaning operation other modern techniques of processing in solvent media can be carried out such as:

Milling
Bulking
Optical bleaching
Softening
Anti-static finishing
Shrink-proof treatment

The latter process can be carried out up to superwash standards to meet the required specifications of IWS. Not only garments can be treated in the machine but yarn also, particularly the type of yarn that is susceptible to and requires bulking. Under certain conditions woven shawls can also be processed.

Stains are often a problem in textile processing and four special spotting tables are available at which almost any type of stain can be removed. This is done through the use of a variety of organic solvents, steam, water, compressed air and vacuum.

Facilities are available for the final pressing of garments on three different types of steam-presses. All have automatic controls for each operation; therefore, once a process cycle has been established, it can be repeated at any time. Two of the presses have steaming and vacuum for buck and header, with adjustable pressure, one has a flapper system for light pressing, while the second is capable of heat-setting garments when required.

A specialized press is the style finisher, which enables light-weight garments to be pressed while retaining a full handle. The garment is placed on a former, which holds it in position. The cycle of steaming, steam-schock, drying and cooling is done from inside to outside which, apart from allowing a fuller handle, avoids glaze marks.

The knitting and making-up workshop

The facilities of the knitting and making-up workshop are diversified as the potential of the two different types of automatic machines can produce a wide range of knit structures, including jacquards, on weft knitting machines of from 8 to 14 gauge. Medium-to-fine yarn counts can be used to produce complete garment ranges, particularly light-weight garments, suitable for the development of new export markets. The finer gauge machine is a 4 head intarsia with selection possibilities. Therefore, apart from being able to produce traditional fully fashioned garments, mixed colour design effects can also be produced by the use of the intarsia attachment with argyle, which is controlled by a punch-card system. The second machine, an automatic flat-bed jacquard machine, is controlled by a punch-card and steel-tape system to produce different knit stitches and colour selections. An additional feature is a presser foot attachment that can be used to produce garment pieces in addition to continuous fabric lengths. Further flexibility is given by the interchangeable 8 and 12 gauge beds that allow a wider range of yarn counts to be used. Medium- to light-weight quality garments are ensured by the use of package storage positive feeds. Both machines are suitable and capable of design development.

Two hand-flat machines are available to modify patterns and designs developed on the automatic machines to enable them to be made by the small-scale industry on hand-flats. Trims are also produced on one of these machines, which complements the full fashion intarsia. The second hand-operated machine is a 6-gauge jacquard capable of producing heavier or chunky designed garments.

All the knitting machines are backed up by a complete sewing and making up section, where fashions and styles can be developed and assembled using correct stitch structures for a particular operation. The entire knitting workshop is air-conditioned to ensure correct machine operation under standard atmospheric conditions.

Quality control laboratory

The laboratory is equipped to carry out all required tests to ensure high quality standards from fibre to finished garments irrespective of fibre type. It also has the facilities to operate as an in-plant quality control check for the processes carried out in the project. In addition, it carries out routine quality control, assesses performance in relation to specifications and develops new processes and products.

The investigation service is specially designed to assist the textile industry, particularly spinners, dyers and knitters, to objectively evaluate quality. All equipment in the laboratory is up to date and of the type used internationally. Physical testing is carried out under standard atmospheric conditions; therefore, the laboratory is approved by IWS as a woolmark testing laboratory and its tests are recognized internationally.

Facilities available in the Knitting Facility are shown in figures I and II.

Figure I. Flow chart of facilities for yarn

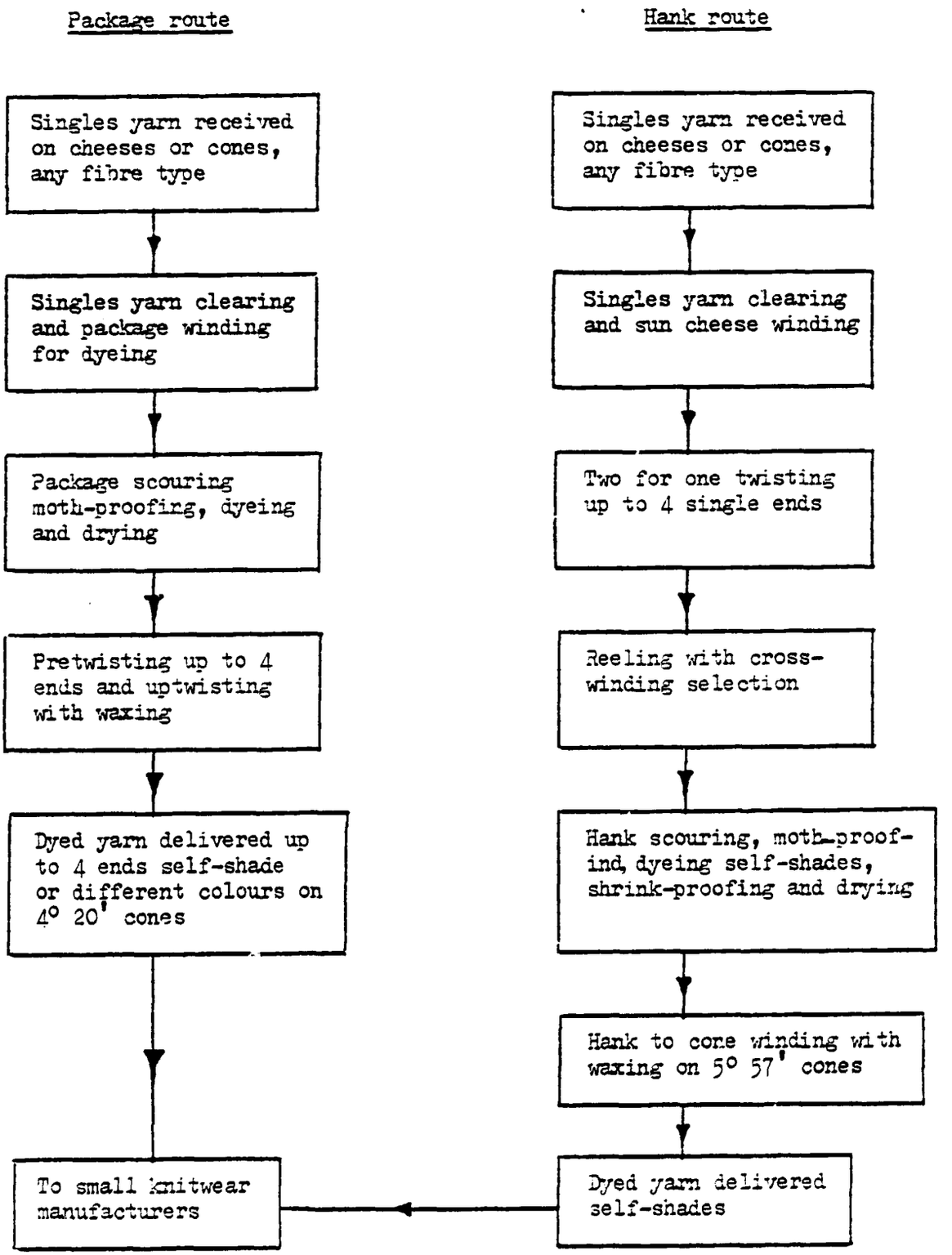
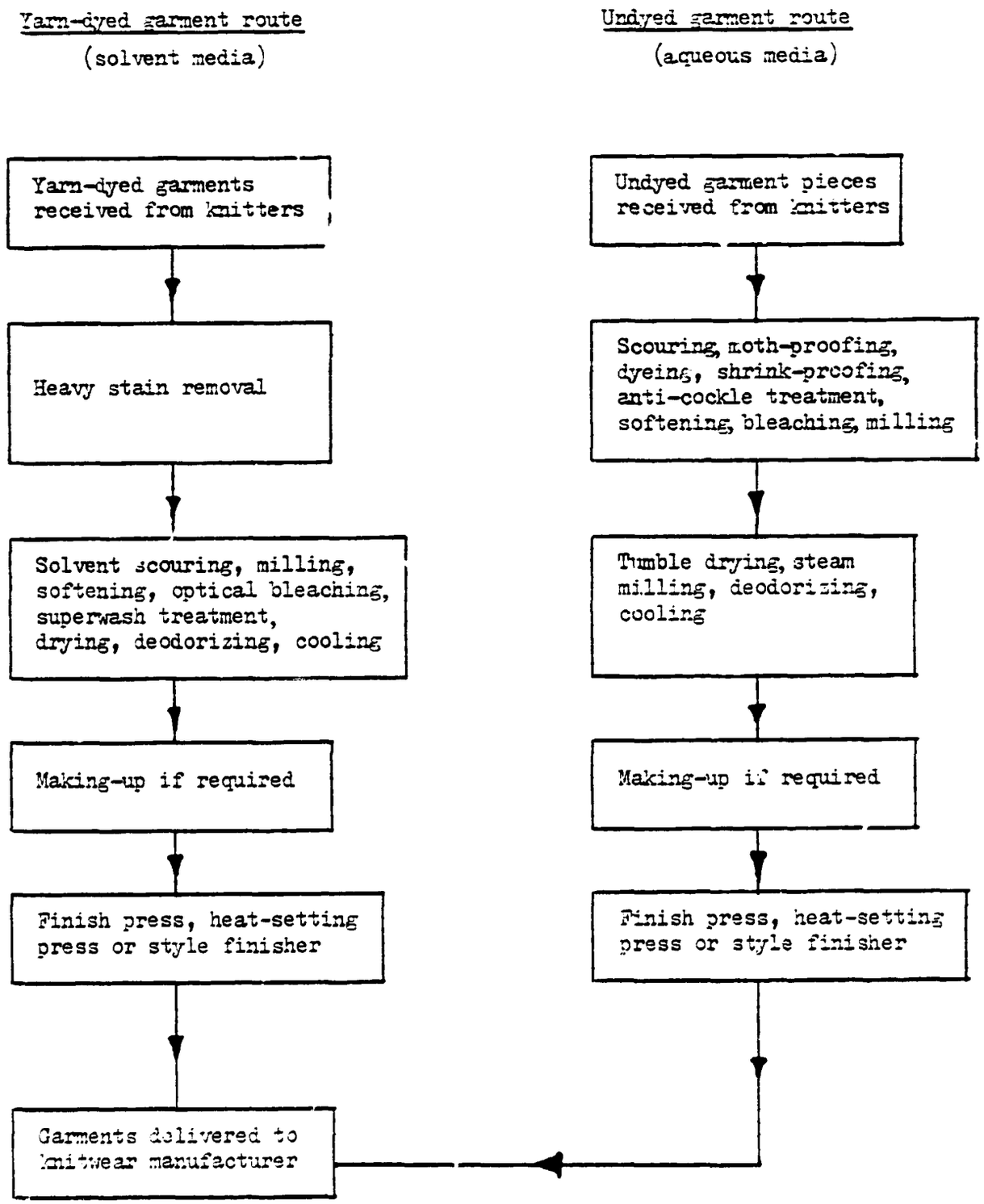


Figure II. Flow chart of facilities for garments



Progress of the project

Buildings

Although the civil construction work was completed late in 1979, equipment installation was started while the interior of the building was being completed. It will be advisable, if phase II is implemented, to ensure that all the necessary buildings are completed, including all service installations (in particular air-conditioning ducting that should be an integral part of the building), before the erection of the machines starts.

Services

The power supply to the project over the two-year period under review has been spasmodic with long periods of power cuts. However, it is only fair to state that this situation applied to all industries in the Punjab State owing to a general and acute shortage of power against the required demand. On one occasion the Punjab State Electricity Board crossed the polarity after a reconnection, which caused all motors to run in the reverse direction; fortunately it was immediately discovered and rectified, otherwise the motors and sophisticated electronic equipment could have been spoiled. The main power supply was connected in June 1980; prior to this date 60 kV on a temporary connected line was supplied. Therefore, individual machines could be run for installation trial purposes only, so the main activities started in June 1980. For emergency purposes two generators of 110 kV each are installed; however, they are insufficient to run the entire plant simultaneously.

Equipment and expendables

All the UNDP/UNIDO equipment is installed and in operation (see annex I), the only remaining item is a vacuum yarn-steaming oven, which the Government has ordered, and it is expected to be on site by mid 1981.

Due to the non-receipt of some UNDP/UNIDO expendable items, trials for superwash treatment were delayed until the end of March 1981. However, sample trials have been carried out successfully. Some chemical items have been ordered in excess of amounts originally requested and, owing to various reasons, the expiry date has now passed.

Staff

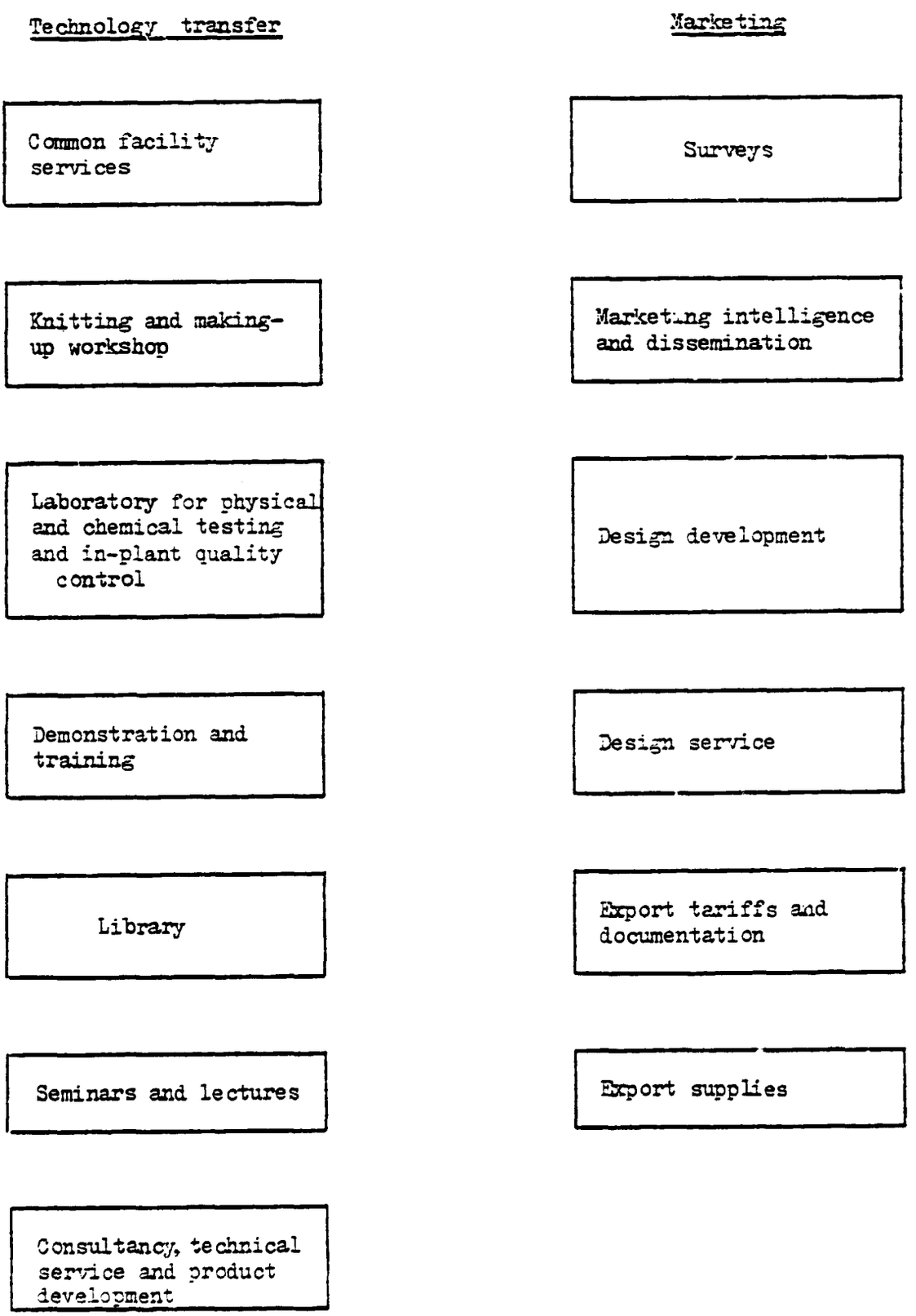
Senio staff appointments except for the knitting and making-up master and the training officer have been filled. The two persons concerned are expected to join before mid 1981.

Four fellowships were awarded to senior staff (see annex II).

Activities

The main activities of the project are summarized in figure III. Activities are divided into two basic sections i.e. technology transfer and marketing. These two headings cover the project development objective to increase and diversify the export of Indian knitwear through quality improvement. In addition, the immediate objectives outlined in the project document are fulfilled.

Figure III. Activities



Common facility services

Prior to starting the services to the small-scale units and after the installation runs were complete, trials to transfer technology and to introduce the Knitting Facility's services were undertaken. Problems and difficulties did arise, but were overcome through modifications to processes and techniques. One difficulty, however, still exists in that the temperature of water for hank shrink-proof treatment, which should be 20°C, is much higher during the summer. This problem will be overcome once the air-conditioning units are in operation and the cold water produced is utilized for shrink-proofing. Considering the power supply situation, the project's services to the small-scale sector was acceptable. Up to the end of February 1981, 33.5 metric tons of yarn were processed in the winding, twisting and dyeing sections, while approximately 16.0 tons were processed in the finishing section. This throughput was mostly all wool: however, 100 per cent cotton, acrylic and acrylic/viscose blends have also been processed. It must be realized that full-fledged operations only started in June 1980, and to be completely established the project must be in operation for at least one and a half years and have had the experience of at least two full seasons, of which there are two per year, winter and summer.

Knitting and making-up workshop

Unfortunately, the Knitting Facility had the services of an assistant knitting master for only a short period; therefore, the activities were limited. None the less approximately 70 garments were produced to develop styles, designs and fashions. Once the knitting master joins the project, the knitting and making-up workshop will start its full and continuing activities of design and development work.

Laboratory for physical and chemical testing and in-plant quality control

The laboratory has four basic functions:

In-plant quality control
Testing
Technical service
Development work

All testing equipment has been fully utilized and valuable information obtained on the present status of quality in the textile knitwear industry. Although tops are more or less up to International Standards, the quality of yarn over the past decade has deteriorated. Yarn plays an important role in the quality of the final garment and improvements must be made as quickly as possible if the Indian knitwear industry is to reach International Standards and fulfil the project objectives of export increase and diversification through quality improvement. Because of the low quality of yarn from the spinners, yarn clearing has only marginally improved the yarn by eliminating major faults and two-fold knots.

Demonstration and training

Five training programmes have been undertaken. In addition to the programme, on-the-job training has been provided to the project work force as well as guidance for the senior staff. Demonstration and training is a continuous process and is carried out to some extent during factory visits and alternatively when personnel from the industry visit the Knitting Facility. Training has been limited and needs strengthening, but once a training officer joins, he can devote his full time to the subject and make a more scientific and detailed approach. At present all the training is provided by the senior technical staff, who prepares lectures, slides and overhead transparencies in addition to the practical demonstration and dummy runs.

Library

A full-time librarian joined the project only in March 1981, but has already started developing the basic requirements for a textile information cell. A comprehensive range of necessary text books, periodicals and magazines has already been formulated. In addition the librarian will catalogue all trials, lecturers and development work and introduce a complete cross-reference under different subject headings. Close liaison is recommended with textile institutes within the country itself. Utilization of the library by senior technicians will keep them updated on new technologies and trends within the world-wide textile industry, apart from providing a source of information for technical service, development work, lectures and other similar functions. The government Agency (Punjab State Hosiery and Knitwear Development Corporation) carrying out the project also publishes its own news-letter to report its activities and provide information on international technical developments of importance, marketing and so on.

Seminars and lectures

Seminars and lectures were held in the Knitting Facility's lecture theatre, which can seat up to 100 persons. A permanent loudspeaker system, hand and stand microphones, 35-mm slide and overhead projectors and a 16-mm movie projector with speakers are available.

Consultancy, technical service and product development

The Knitting Facility is accepted by the knitters and local textile industry as an institution capable of providing assistance and advice on technical matters within the area of its own activities. These activities have of necessity to be expanded beyond the present project inputs, especially into the yarn spinning area, which is the main cause of most of the current problems.

A tentative survey on the conditions of machines in the local textile industry has been undertaken (annex III). This confirmed the run-down condition of most of the spinning equipment, and the requirement for modification and overhauling of the equipment presently installed where possible, or in some cases complete machine replacement.

Co-operation has been established by the Knitting Facility for product development with the Central Sheep and Wool Research Institute (annex IV). A study will be carried out to assess suitability of Indian wool to produce satisfactory knitwear. Once this objective is achieved, CSWRI will ensure that correct wool types or blends are available to the industry.

Marketing

The board of directors of the Knitting Facility is fully aware of the need to strengthen the marketing inputs if the objective of exports to general currency markets is to be met. However, it is difficult to penetrate these new markets and an overall long-term plan must be evolved. This is particularly so when previous imports of Indian knitwear have been poor, which needs to be overcome in the face of strong competition from present-day reliable sources of supply from the Far East.

A start in the right direction was made when during a study tour by the Executive Director and Marketing Manager, a sample collection prepared by the Knitting Facility and associated small-scale knitters, who are keen to export, was presented in the target export markets. During the tour agents were appointed in Canada, the United Kingdom of Great Britain and Northern Ireland and the United States of America, which countries have already forwarded samples to the Knitting Facility for reproduction. This is in line with the strategy already adopted by the Knitting Facility of producing counter samples for exports in the initial stage, until the Knitting Facility in particular, and Indian knitters in general, have the facilities and ability to produce satisfactory fashions, designs and styles suitable for the target markets.

Consultants

The knitwear marketing consultant completes his two months assignment on 21 April 1981. The following four consultants are still to be recruited:

	Man-months
Maintenance engineer	2
Textile dyeing, finishing and processing expert	2
Quality control and worsted spinning expert	2
Knitting expert	2
Designer	3

It is advisable for the knitting expert's consultancy period to commence after the knitting master joins the project.

Local staff and work-force

The management is aware of the need for a senior person to take over day-to-day administration and technical control at the project. Every effort has been made to recruit such a person, but with no positive results. A firm decision has now been taken to advertise the position on a wider basis and increase the salary to attract applications from suitable persons.

The work force for the Knitting Facility has been specifically recruited from non-textile workers, the requirement being that the minimum educational standard must be matriculation. This decision was deliberately taken to enable training of the Knitting Facility's own work-force to be given in a modern environment and to the required standard for the installed modern sophisticated equipment without the difficulties that would have been associated with operatives who had previous incorrect knowledge of textile operations.

Problems observed in processes

In the initial stages problems were many and of a diversified nature, which is the normal tendency when a new project such as the one under review is put into operation. Ad hoc power cuts for long periods on two separate occasions caused uneven dyeings. It was possible to correct some, but not all, of these through different applications. This type of fault is no longer a problem as two generators have been installed, unless of course, as has sometimes happened, there is a diesel fuel shortage.

Most of the problems have now been eliminated or solved, but a major one remains: the shrink-proofing of wool hanks under ambient temperatures. To carry out correct shrink-proofing of wool hanks, water at 20°C is required; this will be available only when the air-conditioning installation is complete. The shrink-proofing of wool hanks will then be done with the correct application techniques of temperature and pH.

Recommendations

At the time a survey of the knitting industry was undertaken in the early 1970s, the fibre usage was almost exclusively imported Australian wool. Therefore, immediate steps were suggested to improve the quality of knitwear to standards acceptable in sophisticated hard-currency markets by upgrading quality to meet the specifications of the IWS quality recognition sign 'Woolmark'. The intention was to increase the main export markets, Eastern European countries and the Union of Soviet Socialist Republics, and at the same time diversify into the target markets.

Yarn preparation

The original project document envisaged all the present inputs with the addition of a staple-fibre yarn production section, which because of the financial difficulties of the United Nations Development Programme at that time, had to be withdrawn. Therefore the project material starting point was adjusted from top processing to singles yarn clearing, twisting, precision reeling and hank-to-cone winding. Although the indigenous manufactured tops are in most cases up to international specifications, the overall yarn quality from spinners continues to be of a very low standard. This can be attributed to various causes i.e. technique, lack of training, condition and type of equipment in use, which result in a high number of faults that singles yarn clearing can only marginally improve. However, large packages are produced for subsequent twisting with minimum two-fold knots. A further restraint is the availability of singles yarn from the spinners, which is difficult to overcome as most of the yarn is spun by commission spinners from whom the small-scale knitters have to purchase their yarn requirements. Only a few of the larger knitting units have their own spinning sections; thus, most of the small knitters have no control over the quality of the yarn that they have to use. In different terminology, it is a seller's market for yarn, and because of this and the limitations of the locally installed spinning equipment it is difficult to improve yarn quality.

Under the prevailing circumstances it is the number one priority that spinning inputs, including fancy twisting to meet the exacting demands of the export markets, be provided to fulfil the project objectives of exports through quality improvement, technology transfer via demonstration and training, and providing a common service and technical assistance, particularly to the small-scale sector, in high quality yarn production.

Modernization of spinning, knitting and allied industries

Selective modernization of local spinning units is essential if the knitting industry in general and the small-scale knitters in particular are to have a continuous supply of the required quality yarns. To this end, the spinning equipment recommended will be a guide, and also provide facilities for demonstration and training in modern spinning techniques to produce high quality yarn.

As a first step to modernization, a fully qualified textile mechanical engineer should undertake an in-depth survey of all sections of the textile industry allied to the local knitting industry in Ludhiana. Thereafter, he should recommend what action could be taken within the country to modernize existing equipment and advise, where required, on imports of selective machinery replacements.

In addition, he should identify the special requirements of the textile knitting industry in detail and of the allied industries in general, and advise indigenous machinery builders how to meet these requirements. A modest start on these lines has been made by the project engineering staff (see annex III).

Top superwash treatment

At present, shrink-proofing to superwash standards in the project is restricted entirely to batch treatment on garments or garment pieces in aqueous or solvent media. These processes have their limitations and are mainly intended for use on lambswool and shetland wool garments. The procedure for botany wool knitted garments is normally by the use of yarn made from continuous superwash treated tops. This technique in addition, enables superwash fibre-mixture yarn shades to be produced after top dyeing. For self-shades, the option is open for either top or yarn dyeing to produce multi-colour designed knitted garments.

International demand for superwash knitwear is increasing particularly in the target export markets. Continuous shrink-proofing equipment, which was not feasible in the established project because of the cost, is therefore the second priority. This will enable the knitwear industry to meet the anticipated export requirements from a technical point of view. It will, in addition, give more flexibility in knitwear production.

Yarn and garment dyeing

Although the equipment in the project for package, hand and garment dyeing is adequate for demonstration, training, technology transfer, and common service, shade-matching and formulation of recipes is still done by the dyers' subjective knowledge to judge when a dyeing is on shade. This procedure has many difficulties, particularly in training, and complications arise in shade matching. It is difficult to assess metamerism (alteration of shade in different light sources). The major input to overcome these difficulties will be a match prediction system, which will be multi-functional in that it will immediately provide a number of alternative recipes of dyes with fastness properties on various substrates, with costs. Recipe formulations will be possible by automatically considering the complete range available for the particular dye/fibre system. This will avoid the present rule-of-thumb method. It will be ideal for a colourist's training as suggestions can be fed into the system and the effects studied without actually adding the dyestuff. This also applies to original recipe formulations and is therefore an excellent training aid.

Knitting, making-up and designing

At present, the knitting workshop is limited to standard flat-bed and full fashion machines with punch-card controls. The modern trend is extensive use of electronically controlled machines for patterning that have the advantage of a quick setting-up and, if necessary alteration of designs. Therefore, a double-sided flat-bed knitting machine is recommended, one side with an electronic pattern device. Apart from introducing electronic pattern technology, it will be ideal for training which can be given first on the non-electronic pattern side and thereafter on electronic patterning.

Although the bulk of export production in wool and wool-type garments is produced mostly on hand flat-knitting machines, and to some extent on automated ones, there are some circular machines in use.

From the points of view of technology transfer and production type diversification to meet the exacting demands of the sophisticated export markets, circular, medium- and fine-gauge knitting machines are essential if the project is to fulfil its objectives. In addition, a suitable machine will be required to supplement circular knitting and to stitch knitted fabric into garments with a flat joint.

If the local knitting industry is eventually intending to be self-supporting, which it should, a design input for the project is recommended. In more advanced industrial countries there are specialized fashion design service agencies for the knitting industry and many free-lance artists who supply new designs and ideas. In India, there is very little free-lance art activity with none in the knitting industry. Knitting technicians with a limited knowledge of the subject handle this work. Therefore, if any advancement is to be made in designing, expertise must be developed through intensive design training for two fellowships of at least one year each and designing, fashion and style development for the overseas target markets incorporated as a function within the project. This important back-up to the export drive will then be available to the entire knitting industry.

Finishing

After the equipment for demonstration and training in circular knitting is introduced it will be necessary to have a two-part machine for finishing circular knitted fabrics as there is no equipment in the Knitting Facility for this operation. This method of fabric finishing is completely new technology for the indigenous knitting industry and is an essential input if the requirements of the export target markets and the objectives of demonstration and training in new technology in knitwear are to be fully met.

Laboratory

Testing equipment in the project's laboratory will need to be increased to meet the requirements of continued high quality and the additional quality control tests necessary for the modern technology now being recommended. Therefore extra laboratory equipment to carry out these functions is recommended.

III. PHASE II

The above recommendations have been forwarded to the Government of India and United Nations Development Programme in a phase II document. Phase II recommendations should have been an integral part of the original project document, but because of delay in implementation of the present project, it is strongly recommended that phase II, incorporating all the above recommendations should be taken up immediately to derive maximum benefit from the inputs already made. The additional inputs suggested are essential to attain fully the overall objectives of the project.

All the details of phase II of the project are given in "Development of the hosiery and knitwear industry, Ludhiana, Punjab, phase II". This document should be studied in conjunction with this terminal report along with the document prepared for the UNIDO review mission in March 1981. These documents will provide full information on the present and anticipated status of the project.

To appreciate how the recommendations dovetail with the present project inputs see figure IV.

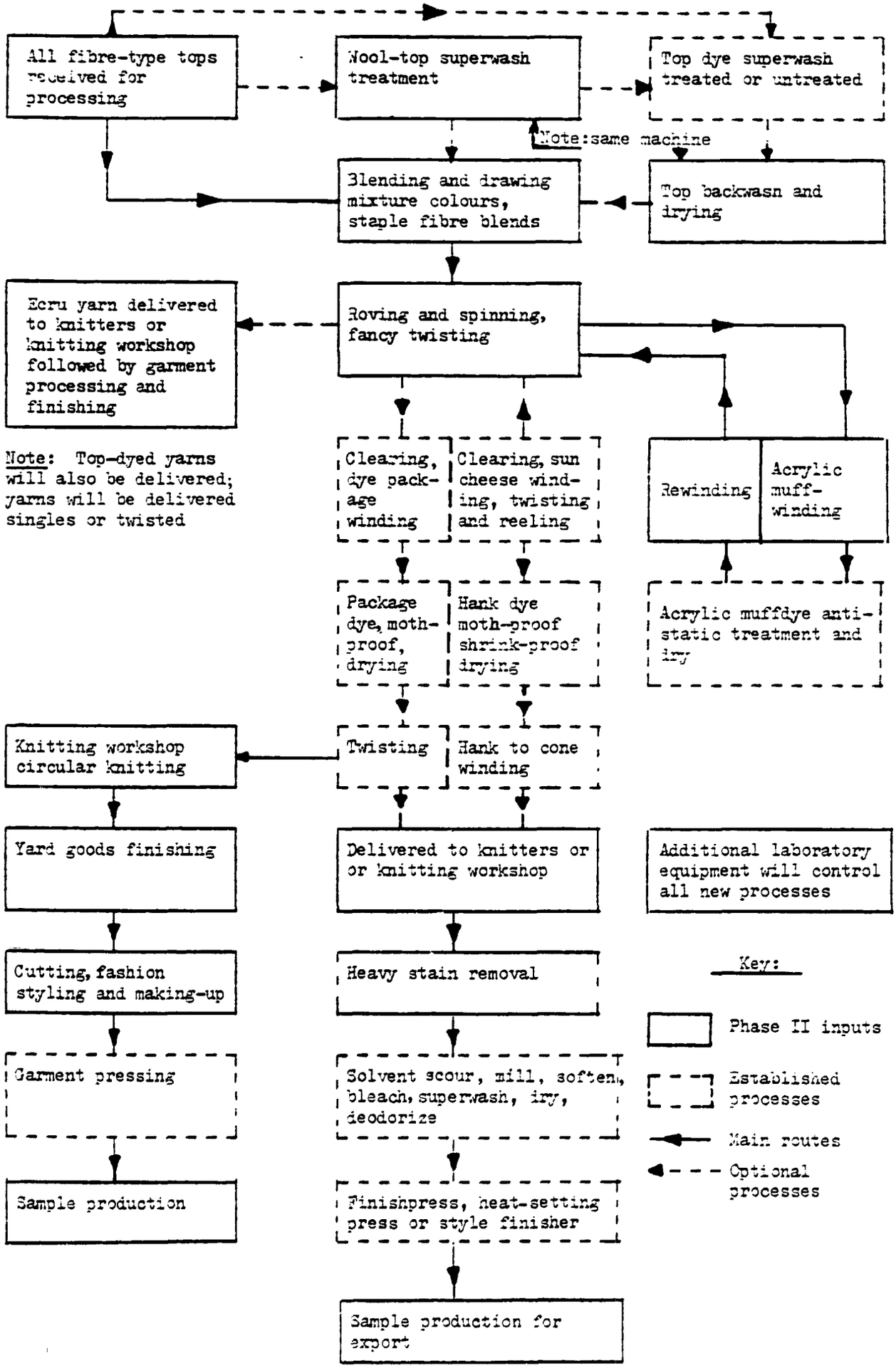
The Knitting Facility is equipped and technically staffed to assist the knitwear industry to improve quality from singles undyed yarn to finished garments, and to provide export market information and guidance. The Facility has a built-up area of 70,000 square feet in a total area of 7.25 acres; therefore, it is sufficiently large and suitably located for phase II.

At present the demand for acrylic and blends with other synthetic fibres are increasing, particularly for the domestic market during the summer. The knitting and processing of cotton knitted fabrics and garments over the past decade is also on the increase. Therefore the Punjab State Hosiery and Knitwear Development Corporation is considering the possibility of providing facilities within the Facility to meet these new requirements.

Although the Facility has top dyeing equipment, it is unable to carry out the necessary processes that follow backwash, drying and subsequent processing into yarns. The quality of yarn, when spun into finer counts, further decreases and singles yarn clearing has only marginally improved this.

Figure IV

PROJECTED INPUTS PHASE II IN RELATION TO ESTABLISHED PROCESSES



Therefore, knitted garments acceptable for the export markets of Western Europe and North America are difficult to produce. Under the conditions prevailing in the local spinning industry, it is essential to upgrade spinning through demonstration and training by introducing a modern minimum spinning unit in the Knitting Facility. It will then be possible to train by demonstration in the technology of making good quality fine worsted count yarns, to produce acceptable light-weight knitted garments for export.

Outline

The expansion of the Knitting Facility was formulated after a detailed assessment had been undertaken of the existing situation, attainments, capabilities and requirements within the knitwear industry and the facility itself. It was immediately obvious that spinning was the main priority to further upgrade knitwear quality to the desired level. Therefore, it was recommended that the Knitting Facility receive additional technology inputs, demonstration and training facilities and at the same time a common service facility in continuous top shrink-proofing with blending, drawing and spinning, including fancy twisting. To widen the scope of the technology, muff winding is recommended, which along with muff and top dyeing provides the facility with additional flexibility, extended areas for technology transfer and training in multi-fibre processing and versatility in the used coloured yarns and fibre blends. To keep up to date with modern dyeing technology, a computer match prediction system is incorporated for recipe formulation, shade matching and training.

Attachments have been recommended for the installed knitting machines along with new knitting workshop inputs of modern flat-bed electronic knitting and circular knitting machines (double-sided; one standard, the other with electronic patterned knitting). In addition, finishing equipment for yard goods should be provided to supplement the knitting inputs and to diversify techniques of manufacture and enable training and demonstration to be undertaken in the more exacting technical demands and varieties for target export markets.

More laboratory testing equipment is recommended for in-plant quality control of the new technology inputs and training in testing for the additional facilities. Fellowships and expertise have been recommended for the new techniqués. Fellowships are required to up-date the senior technical staff in the present technology inputs and the ones now recommended, and in particular for two designers who will be specially trained overseas in outerwear knitted garment designing, fashions and styles and all methods of weft knitwear manufacture including circular knitting. The facility will then have the competence and latest technology to fully meet its objectives.

Review

The phase II report was completed in August 1980. It is clear, after evaluating project experiences up to March 1981 that a review will be desirable, possibly in early 1982, and the following should be taken into consideration:

Establishment of an industrial and technological information bank and service unit

Specialized equipment for the preparation of audio-visual training aids

Photo-copying equipment capable of copying direct from drawings or books

Specialized equipment for a workshop for training prior to training on project machines under industrial conditions

Additional long-term expertise e.g. chief technical adviser, training expert, spinner, and knitter-cum-designer

Increase in training component and equipment

Utilization of services and anticipated results

Training Component

Probably the only way it will be possible to increase the training input will be by expanding the entire training section by adding technical training staff. Both national and international expertise and equipment could be installed specifically for training purposes. Separate training modules suitable for individual or small group training with programmes obtainable from suppliers of equipment already installed in the Knitting Facility could be an additional extra with the equipment recommended for phase II.

The training equipment should be similar to the machines already installed in the project and suitable for training in modern technologies in the knitting and allied industries.

Finally, an institution may be formed as a separate part of the facility, probably to have diploma or even degree courses in textile knitting technology and associated textile processes, and taking students not only from the country itself, but from the Asian region as a whole.

On a reduced scale, the possibility to amalgamate the training course with the established knitting technology diploma course already in Ludhiana should not be overlooked. However, there may be difficulties with this owing to the fact that modern technology has not been introduced and the equipment and staff facilities are old and mostly obsolete. Summing up, it may be ideal to develop up to whatever extent is desirable within the facility itself. However, the increase in cost of both equipment and expertise, both national and international, will be high.

Extension of training

Technical assistance, which embraces consultancy and trouble shooting, can be expanded. What must be taken into consideration is the acceptance by the knitting textile industry at large of this type of service. Unless individual firms are willing, it is not possible to force such assistance on them. There are also limits to the improvements expected on the type of equipment in use; they could be extensively modified or replaced. A textile engineer has been incorporated in the phase II document to examine this problem and also to provide correct schedules for machine preventive and maintenance methods. It is no use modifying or replacing essential equipment if it is not going to be maintained correctly (see annex III).

Quality control during manufacture

Quality control cannot be enforced on individual manufacturers unless they are willing to meet the cost. What is required in this area is more public relations work and active participation to demonstrate what results and quality improvement can be achieved through rationalized quality control. Quality control schedules can be made for a specific unit and only those tests that will give optimum results taken up.

Co-ordination, training and technical education

Co-ordination should be one of the functions of the training officer. The Knitting Facility image must be built up and no effort spared in promoting training, technical service and technology transfer. This function should be implemented basically through a modern library that has available magazines and periodicals on knitting and allied industries. The project's news-letter must also be used as a media for this type of information transfer. Seminars and lectures must be given by both national and international technologists when available, also by visiting representatives of machine manufacturers in knitting and related fields.

Utilization of services and anticipated results

The project staff are well aware of the seasonal aspect of knitwear wool production for the home market, which is June to December. In the initial stage, the period January to May could be utilized for wool knitwear garments for export. This ties in with the autumn/winter delivery period for northern countries. Therefore marketing and designing, particularly for exports, are an important part of the Knitting Facility activity.

Annex I

MAJOR ITEMS OF UNDP/UNIDO FINANCED EQUIPMENT [a/]

Description	Quantity	Cost ($)
Steaming table, type SEA/5UES	1	5 493
Hank-flat single system jacquard knitting machine typ dut	1	7 409
IBIS model BF. 59 powerflight MK 2 patent knitgoods pressing machine	1	9 558
Pegg barrow multi-purpose laboratory high temperature skein dyeing machine No. DF 16172	1	3 407
Pegg sample capacity pressure dyeing machine 7-¼" Kier No. DF. 16173	1	8 755
Pegg 100 lbs capacity hand dyeing machines type GSR mark 2, Nos DF. 16160-1	2	25 391
Coupling equipment to couple above machines	1	8 436
Drayton programme controllers model H4	2	6 975
Removable hank carriers	3	15 957
Removable stainless steel package carrier	1	7 829
Two speed drive with 10 hp motor	1	2 428
Controlled cooling	1	1 389
Pegg high temperature pressure dyeing machine type HTU/24 x D12, Nos DF 16162-3-4-5	4	80 617
Coupling equipments for above machines	2	12 572
Control panels with Taylor Fulflex temperature control	4	32 716
Taylor Hi-flow diaphragm operated steam valves	4	1 605
Pegg fully automatic flow control system	4	5 802
Removable stainless steel carriers	8	12 428
18" dia top cans, complete with loading mechanism and removable bottom plate	2	2 675
Pegg re-circulating 24" x D12 package drying machine no. DF 16166	1	43 210
Air reversing valve, with adjustable timer and provision for manual control	1	5 946
Bristol Tutor teaching machine	1	453
Canon AE-1 w/FD 50mm F1.4 SSC in case	1	372
FD28 mm F2.8 in case	1	153
Close-up lens 55mm 450	1	25
16mm sound projector, model Elmo 16AA	1	1 764

a/ Except for correction of recognizable spelling errors, the list is reproduced as received.

Description	Quantity	Cost ($)
35mm slide projector, model Elmo AS-3000A	1	696
Overhead projector, model Elmo HP 2450	1	510
Projectine micro/macro projector	1	3 607
Screen with mm-cross-hair and fresnel lens	1	300
Micrometer stage, reading 1/100mm	1	457
Polarization turret for 4 micro objectives	1	355
Polarizer, Ø 50mm	1	59
Achromat objective 7x/0.18	1	71
Achromat objective 10x0.25	1	83
Achromat objective 20x/0.45	1	102
Achromat objective 40x/0.65	1	119
Plan measure projective 500	1	97
Microcondenser n.A. 0.3/0.65	1	112
Periplan eyepiece 10x/19	1	49
Photo-plan eyepiece 10x/15.5	1	62
Stage micrometer 1 : 100	1	64
50 litre Cubex international shrinkage testing apparatus	1	1 965
Analytical balance	1	1 113
Single needle machine with artic. lever foot, double chainstitch, for straight seams, comp., cl.933-103 E 116	1	2 385
Automatic lockstitch buttonholer, with tape guide, with thread oiler 556 2842, compl., cl. 556-1101 E 28	1	5 947
Wira fibre diagram machine	1	6 163
Wira fibre fineness meter	1	1 521
Model CM-5 motorized crockmeter compl.	1	430
Overlook machine, T 327-CO-2CD-18	1	1 317
Vertical cup seaming machine	1	1 107
Lock stitch machine with zig-zag, Pfaff 437-6/61 BSx6.0	1	2 800
"Shirley" crimp tester, 4ft. model	1	1 008
"Hatha" couse length tester	1	432

Description	Quantity	Cost ($)
Assembly twister, type 2/05.3-10 288mm spindle gauge 60 spindles totally, 30 per side	1	89 403
Uptwister, type 4/2.1.3-10 144 mm spindle gauge 160 spindles totally, 80 per side	2	193 023
High speed hank to cone winder model SM-201 with 36 heads, single-sided execution	1	42 206
Dytex 27 machine, with high polish basket	1	62 249
Five hopper low level chemical and dye mixing tank	1	7 141
Additional inlet valve	1	114
Additional outlet valve	1	1 382
E612 Kamsin electrically driven hosiery/knitwear model drying tumbler	1	7 846
Electro polished stainless steel cylinder	1	1 360
Automatic cold air damper in place of standard manual arrangement	1	562
Fully automatic steam spray features compl. with fans cut off switch and protective painting of internals	1	1 707
Thermostatic temperature regulator	1	497
2-speed drive in place of single speed	1	323
Automatic double system jacquard stitch transfer flat knitting machine, type JDR2	1	51 935
Supplementary set of needle-beds in gauge E12	1	12 649
Presser-foot, automatic stitch presser device, incl. two lateral yarn tension supports	1	7 143
Complete equipment of yarn storage units, incl. two lateral supports and 8 yarn storage, Memminger SPF	1	2 577
Hand flat knitting machine, single system, type dubied NHF4	1	3 810
Instron table model universal testing instrument 5 kN max. capacity	1	17 949
Air control kit, automatic	1	643
Extension measurement and cycling unit	1	1 673
Tension cell, full scale ranges 0-100 to 0-2000g	1	1 000
Tension cell, full scale ranges 0-2 to 0-100kg	1	1 000

Description	Quantity	Cost ($)
Evenness tester with integrator, type UT1-ET-B, consisting of:		
1 monitor UT1-MO-B 1 control unit UT1-CO/..%	1	19 036
Spectrograph, UT1-SPG with spectrogram recorder	1	12 831
Imperfection indicator UT1-IPI	1	6 265
Support for large roving bobbins and sliver laps	1	892
Wrap reel for collecting tested yarn	1	404
Kannegiesser style finisher, model KF2	1	27 737
High speed cone winding machine, model NSK for winding from cop to cone or for re-winding with 24 spindles, one-sided, for producing sun cheeses	1	12 605
Reeling machine D 800 A serial no. 8789 Extra for free standing creels	1	24 400 3 921
BOEWE spotting tables		
b) still unit c) tanks d) automatic	4	5 557
BOEWE textile solvent processing machine model P360-ST(i)	1	44 734
Additional tank (tank IV)	1	2 303
BOEWE Activa, model A 125-1	1	8 506
Autoconer 138-II with 50 winding heads type GKN-X	1	168 533
Dyeing machine DAIWA's jet-spray type hank, model DJD-H-10	2	50 909
Bently cotton model intarsia 4 'tuck' stitch full fashioned outerwear machine	1	172 711
Recommended attachments (fitted to the machine marking (including independent fashioning frequency)	1	5 744
Four needle fashioning	1	1 244
Drop stitch	1	344
Sequential knitting	1	433
Typewriter card punch	1	1 978
Pattern strip guillotine	1	889
Large dial circular linkage machine class 760 G, no. 0020098	1	2 035
Precision microtome, model 779	1	548
Volkmann two-for-one twister model VTS-07, with 132 spindles Bauart 3.17 complete	1	91 673
Xenotest 150-light-and weather fastness tester complete	1	22 254
Stainless steel oval paddle machine	1	10 091

Annex II

FELLOWSHIPS AND STUDY TOURS

Four fellowships were awarded to local senior staff

1. The Dyeing Master had a fellowship from 2 Jan to 2 April 1979 to be trained in the scouring and dyeing of different substrates used in the knitwear industry in the form of garments and yarn in hank and package form. In addition, dyestuff classes suitable for dyeing to woolmark standards in conjunction with the different shrink-proof treatments, i.e. superwash, machine washable and dry-clean categories.

2. The Finishing Master had a fellowship from 3 Jan to 7 April 1979 to be trained in the finishing of knitwear garments of all fibre types, particularly in solvent media, including dry-cleaning, milling, resin application on wool to superwash standards of IWS and pressing, and, bulking of acrylic yarn and yarn treatments in solvent.

3. The Quality Controller had a fellowship from 7 Jan to 20 March 1979 to obtain information on and be trained in all aspects of quality control in the knitting and allied industries, with particular reference to in-plant quality control, and in addition, identification, analysis and corrective methods for faults in knitting and associated industries.

4. The Marketing Manager had a study tour from 7 October to 9 November 1980 to evaluate the suitability of quality, design and style of knitwear manufactured in India. Sample garments produced by the industry and facility were shown to potential importers in the target markets to assess marketing possibilities of Indian knitted outerwear.

5. The Executive Director had two study tours, 6 October to 17 November 1979 and 4 October to 17 November 1980. The purpose of the first tour was to evaluate technological advances in woollen and worsted spinning, new techniques and practices in dyeing and finishing of knitted garments and fabrics, and production and new innovations in knitting technology and design development and dissemination procedures.

The second tour was to update knitting technology and marketing possibilities of Indian knitted outerwear in the target market areas of Western Europe and North America, also to introduce and expose the Marketing Manager to this environment. Further, it was to establish the availability of wool types suitable for the local knitwear industry and export market outlets.

Annex III

EQUIPMENT IN THE KNITWEAR INDUSTRY

Introduction

Machines and equipment used in the local textile industry are old, not well maintained and out-dated. The motive of the industry is to have maximum output with minimum expense. The machines are run continuously without preventive maintenance and only essential repairs are carried out when the machines break down. A further problem is that the system adopted, by some spinners in particular, of "short" processing, that is, using modern methods of processing sequences on the installed old equipment. Machine speeds are also increased to further enhance production, which in many cases is beyond the capability of the machine itself. Inadequate lighting and poor housekeeping, coupled with a poor worker environment contributes to the low quality output. As a result of these problems, quality is below international standards and productivity is low.

Maintenance and modernization

To introduce preventive maintenance methods and suggestions for modernization of machines and equipment in the local textile industry, it was decided to carry out a tentative survey of the knitting and allied industries. This was done to observe the working of the industry and to obtain first-hand information on the condition of machines and equipment.

The survey was divided into the different sections of the industry, as follows:

Top manufacture
Spinning
Dyeing
Knitting
Finishing

A cross-section of units in each section was taken and visits made. Except for a few isolated cases, all the units in each section operated on similar lines, under the same conditions and with similar types of equipment.

The conclusion was that in the context of maintenance and modernization of machines and equipment used in the local textile industry for different operations an in-depth study must be undertaken. Modernization was reviewed taking into consideration the capabilities of indigenous textile machine manufacturers.

Immediate activities

Schedules of maintenance including preventive maintenance will be drawn up for each section and grouped according to product, listing together wherever possible equipment/machines of the same make or type. A package plan for maintenance will then be developed as outlined below.

A check-list for various settings and component conditions will be prepared for preventive maintenance of the mechanical and electrical components. The mechanical condition of the machine will be examined in detail together with the recommendations of the machine manufacturers and permissible limits of settings, speeds and operations defined.

Because of the age of some of the machines and unavailability of manufacturers' recommendations, the objectives outlined in the previous paragraph can only be achieved by studying the machine. An example would be renovating a spindle by replacing and rectifying worn out components. Measurements of settings, speeds, operations and quality produced can be compared between the renovated and old spindle. The improved results can then be demonstrated together manufacturer using the same type of equipment with a view to motivate them to adopt similar methods. Schedules will be prepared to periodically check the performance, and necessary section for rectification or replacement carried out.

Lubrication

On moving mechanical parts, particularly at high speeds, lubrication is the heart of the maintenance system. Correct lubrication schedules with proper lubricants enhance the life and reliability of equipment. To this end, recommendations will be provided on when lubricants have to be applied, the types of lubricants, when to top in the case of reservoirs and when oil replacement is necessary.

A lubrication system coupled with a routine check-list on conditions of the machine will reduce unscheduled breakdown and ensure proper machine operation thereby reducing down-time and improving product quality.

Housekeeping

Improvements in housekeeping, lighting, worker environment and in some cases effluent disposal will provide further impetus to improve production and quality. A complete list of recommendations will be drawn up to include maintenance and cleanliness of the buildings and compound, proper lighting for a specific operation, introduction of international recommendations for service supply colours, machine area, demonstrations and introduction of humidified air conditioning where desirable.

Modernization

Improvements effected by the previous recommendations will be restricted to the basic parameters of machines and equipment and therefore the results achieved will be limited. It is, therefore, essential to introduce a scheme for modernization of machiens and equipment. This could be done on a selective basis, but nonetheless will be essential. Before the introduction of modernization, the industry in general will have to be made aware of the need for such action and the quality improvement expected coupled with productivity.

Difficulties are foreseen in the present production capacity and quality produced by the industry as it is geared up to exports to Eastern Europe. However for general currency markets, the overall quality of knitwear garments must be improved. The first step to implement quality improvement is machine renovation and replacement by modern machines. One way of overcoming these problems may be by introducing incentives such as financial assistance or long-term, low-interest loans.

Machine improvements through local resources and expertize

Short-term modification plans with the available expertise and resources can be undertaken immediately. This work can be carried out with one participating manufacturer and the effect of the renovation evaluated.

Once the improvement in results is established the idea can be extended to other similar firms.

For modernization on a long-term basis suitable equipment manufactured within the country must be surveyed and its performance evaluated. The possibility of development work to upgrade critical sub-assemblies should be undertaken and a comparison made with the performance of the original.

Assistance from other sources

The assistance of local engineering centres may be obtained to improve the performance of indigenous manufactured equipment. Such centres are the Marado Centre and Central Tool-Room as these two organizations have equipment and expertize for undertaking such work. Marado Centre is already carrying out some prototype development work for the engineering industry and is willing to take up textile machine modernization in selected areas. The possibility of locally available expertise to supplement known resources should not be overlooked.

In the final analysis it may be necessary to import certain items of equipment that are not available domestically. This equipment should act as a catalyst to induce local manufacturers to undertake the manufacture of such equipment and maintain the same quality for local machines and equipment.

Engineering assistance to the textile industry by the Facility

The engineering staff at the Facility has undertaken a survey of the local textile industry as outlined above. However, because of heavy commitments within the Facility they have been unable to proceed further with the practical applications outlined. It is the intention shortly to commence implementation of the recommended development work. Engineering assistance to the industry has been fully covered in the phase II document. Therefore, the work now undertaken may be considered as the fore-runner to the more concentrated activities outlined in phase II.

Annex IV

DEVELOPMENT RESEARCH PROGRAMME TO BE CARRIED OUT JOINTLY WITH OTHER RELATED UNDP PROJECTS

The knitwear facility intends to work together with the Central Sheep and Wool Research Institute (CSWRI), Avikanagar, on the use of Indian wools and blends in knitwear for making sophisticated non-traditional items. Briefly, the aims of the programme will be as follows:

(a) To estimate qualitatively and quantitatively various types of Indian wool available for processing into outer knitwear;

(b) To evaluate the work already done by CSWRI in cross-breeding in relation to the fibre's suitability, either as a singles component or in blends to produce suitable outer knitwear;

(c) To develop blends and carry out trials to manufacture knitwear. The yarn will be spun at CSWRI either by the woollen or worsted system. The singles yarn will then be processed at the Knitwear Facility into the final garment. Various methods of processing and treatment will be undertaken to ensure the best results;

(d) Once wool types suitable for the manufacture of speciality knitwear have been established, CSWRI will undertake to improve the quality where necessary and build up the required production through an extension with wool growers;

(e) To undertake trials similar to these outlined for wool with speciality fibres e.g. mohair, angora rabbit, goat hair, and their blends with natural or man-made fibres;

(f) To assess the suitability, quality and quantity of Indian merino wools for the manufacture of outer knitwear. To start with this work will be carried out in conjunction with J and K and Nilgiri farms;

(g) To continuously update the Ludhiana knitwear industry on results and findings through seminars, demonstrations and lectures at the Knitwear Facility;

(h) To assist knitters, with the help of CSWRI to identify the sources of availability of quality Indian wools. Technical assistance to produce speciality knitwear of the type referred to above will also be made available.

At this stage, it is evident that the quality of Indian wool has improved through the efforts of CSWRI and other experts. The next step is to evaluate various wool types and their suitability for knitwear production. This step and action to be taken has been outlined in detail in the above programme. Once correct wool qualities have been established, the final step will be to ensure increased regular production of correct wool types for knitwear manufacture. This will reduce dependency on import of foreign wools thereby curtailing some of the foreign exchange required for this purpose. It is anticipated that the impetus created by the efforts outlined in the programme will establish Indian wools on a more commercial basis.

It is essential that an immediate start be made. With the modern technology available at CSWRI and the Knitwear Facility and close co-operation with similar organizations both national and international, it will be possible to introduce Indian wools in larger quantities into the knitwear industry, and, in the long term, to export speciality knitwear made from Indian wools and other speciality fibres and blends. An advantage is that apart from foreign exchange saving from imported wool purchases, extra foreign exchange will be earned through the export of knitwear made out of Indian wools.