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DIVERSIFICATION AND DEVELOPMENT OF NEW FABRICS,
SOUTH INDIA TEXTILE RESEARCH ASSOCIATION, COIMBATORE,

DP/IND/73/004

INDIA . 1977

Project findings and recommendations

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

Based on the work of M.S. Burnip, research consultant (knitting industry)

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Explanatory notes

References to dollars (\$) are to United States dollars.

The monetary unit in India is the rupee (Rs). During the period covered by the report, the value of the rupee in relation to the United States dollar was \$US 1 - Rs 9.

The following abbreviations of organizations are used in this publication:

SITRA	South India Textile Research Association
ATIRA	Ahmedabad Textile Industries Research Association
BTRA	Bombay Textile Research Association
SASMIRA	Silk and Art Silk Manufacturing Industries Research Association
WIRA	Wool Industries Research Association
IWS	International Wool Secretariat
IIT	Indian Institute of Technology
CSIR	Council of Scientific and Industrial Research
NITRA	North India Textile Research Association

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ABSTRACT

This report seeks to do three things:

- (a) Assess the achievements under Phase I ending February 1977 of the project "Diversification and Development of New Fabrics" at the South India Textile Research Association (SITRA), Coimbatore, India;
- (b) Make provision for a detailed research and development programme for implementation by SITRA staff;
- (c) Produce a modified proposal under Phase II of the project, acceptable to the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO) and capable of implementation by SITRA staff.

The report concludes that under Phase I the following outputs were achieved:

- (a) Training of one United Nations fellow in knitting technology (completion date August 1976) and another in receipt of training (completion date August 1977);
- (b) Training of some personnel within SITRA for the operation and maintenance of circular and flat-knitting machinery;
- (c) Production of a wide range of new products, utilizing different types of yarn, including dyed and blended yarns, producible on existing machinery;
- (d) Introduction of hand-vec bed machinery and their operation with suggestions for deployment in South India;
- (e) Development of some instrumentation including yarn specometer, course length tester and machine tachometer, with the object of their production in quantity for use by industry.

More detailed comment and explanation of Phase I will be found under Findings Phase I; in this report, and in the final report of the knitting expert, K.P. Moltu.

The detailed research and development programme, prepared after consideration of previous work by SITRA in knitting and other fields, but taking into account the capability of staff and industrial needs as perceived in South India, provides for work under the following headings: fundamental studies; applied studies; instrumentation or engineering; operations research; human relations; training; and library and information services.

Full details are given in annex III of this report, and in Findings Phase II.

The final section of the report details an assessment of the original Phase II proposal to UNDP. It is concluded that Phase II as proposed is based upon the aims of Phase I as stated in the proposal and not upon the

achievements as assessed. The implications of the aims of Phase II as proposed are discussed in Findings Phase II of this report. It is concluded that these are not attainable or necessarily applicable to the state of development of SITRA and of the industrial requirements.

In consequence a revised Phase II proposal, given in detail in Findings Phase II, annex VI was prepared and agreed to in principle by SITRA and the UNDP in Delhi. This revised proposal provides for a two-year programme with 12 man/months (m/m) of UNIDO expert help, UNIDO fellowships of 18 m/m and equipment estimated at \$68,000 for knitting, and associated equipment including a simple table tufting machine in which might be utilized the coarse count cotton yarns produced by some mills in South India. The main machinery input is in the second part of the Phase II, but some specific items required for the research programme should be purchased at the beginning of the project. The proposal calls for a consultant report on progress made and upon the necessity of additional inputs of personnel or equipment under a possible Phase III, to be carried out towards the end of the Phase II project.

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INTRODUCTION

The Government of India requested assistance from the United Nations Development Programme (UNDP) for the project Diversification and Development of New Fabrics, South India Textile Research Association, Coimbatore (DP/IND/73/004). The request was approved and the project commenced on 1 July 1975 for a duration of eighteen months. The United Nations Industrial Development Organization (UNIDO) was the executing agency with the Council of Scientific and Industrial Research (CSIR) acting through the South India Textile Research Association (SITRA) as the co-operating agency. The UNDP contribution totalled \$64,350; the contribution of the Government of India totalled \$99,710.

A. Phase I

The purpose of Phase I of this project (a draft project proposal for Phase II is under consideration) was to aid the cotton spinning industry of South India which, with six million installed spindles, will be vulnerable in any future expansion by its dependence upon the fabric production sector whose capacity to grow is limited by its lack of technical know-how and advanced technology. The industry is also vulnerable in times of recession. The intention was to create a modern knitting capacity, based on both large and small production units.

The proposal for Phase I stated that a knitting industry seems to be one of the most labour-intensive industries. Therefore a judicious and rapid expansion of the knitting industry would lead to the creation of employment potential at a comparatively low investment. To develop this industry the following activities should be taken into account:

- (a) Improvement of yarn quality;
- (b) Production of yarns suitable for knitting;
- (c) Formulation of part-time training courses;
- (d) Improvement in machine utilization;
- (e) Production of quality standards;
- (f) Standardization of garment sizes.

It is obvious, and must have been even at the time of writing the proposal, that such requirements could not be met fully within the duration of the project. It is clear however that as long-term guidelines the above are both sensible and appropriate.

The original proposal also stated that further development of the industry would depend to a large degree upon the introduction of advanced knitting technology including warp knitting and weft insertion processes that would require the introduction of a comprehensive and long-term programme of research and development to assist the entire knitting industry.

A knitting expert (K.P. Moltu) was therefore sent to Coimbatore for eighteen months; his terminal report on the activities of the project will be issued by UNDP.

A knitting consultant (M.S. Burnip) also went to Coimbatore on 17 January 1977 for four weeks to review the achievements of Phase I and to assess the Phase II draft project proposal. The consultant's duties included reviewing the work in progress, working out a comprehensive research and development programme including circular, weft and warp knitting and elaborating a second phase of technical assistance to implement such a research and development programme. The results of his mission are reported in this document.

Objectives

Since the objectives of Phase I are crucial to any assessment of this phase, they are given in full below.

Long-range objectives

1. To further the expansion of the national economy by developing the textile sector in South India, by creating a large-scale, high-quality knitting capacity thereby increasing employment opportunities, by ensuring greater stability in the industry and by improving the industry's performance.
2. To diversify the production of South Indian spinning mills by developing spun yarns especially for knitting, including warp knitting, thus enabling the mills to utilize their capacity more fully.
3. To establish a centre within SITRA to carry out research and to provide services for the knitting industry.

Immediate objectives

1. To investigate the present operational efficiency of the knitting mills and ascertain what steps are necessary to improve it.
2. To establish norms for yarn waste, bleaching loss, machine efficiencies, worker performance, cutting waste etc.

3. To study fabric defects and to devise methods of minimizing them.
4. To study the relation of yarn quality to processing efficiency and fabric quality.
5. To demonstrate the operation of modern knitting machinery and to train mill personnel in knitting technology with particular reference to maintenance, efficiency and product quality.
6. To develop new products suitable for production on existing machines.
7. To carry out experimental work to improve machine efficiency by modification of existing machines.

Training

Formalized training by means of United Nations fellowships was made available to two members of the staff from SITRA. One fellowship has been completed and the staff member concerned recommenced his duties in August 1976; the other fellowship candidate is currently completing his studies in Europe. Details of the fellowship education and training programmes are contained in annexes IV, V and VI of the terminal report of the knitting expert, K.P. Moltu, who helped to arrange the programmes to be followed and who visited both candidates during their sojourns in Europe.

Informal training was given by the knitting expert to the staff of SITRA: in particular there are now two trained and experienced knitting mechanics/knitting operatives on the SITRA staff. One of the two technical officers listed in the Phase I proposal had already received some formal education of a rudimentary type at a college in Northern India. The other technical officer who also acted as the project leader received advice and assistance in the organization of development activities in knitting and in the production of training programmes connected with the staff at SITRA. Procedures for the initiation, progress and recording of development samples, especially in connexion with diversification of fabrics was set up by the knitting expert to provide a lasting system whereby all concerned could be informed of work in progress and completed. Some research and development activity was commenced and certain publications arising from this work have been produced: details are given in a later section of this report (annex I).

The knitting expert also took part in discussions with companies in South India and elsewhere provided with SITRA staff technical assistance, where possible of an immediate or short-term variety. Other informal training situations took place with SITRA staff and outside personnel during lectures given and through an exhibition of garments produced as part of the diversification programme by the SITRA staff under the direction of the knitting expert.

B. Phase II

In Phase II of the project it is planned to continue the activities started under Phase I. The proposal is to provide technological assistance to SITRA so that it is adequately equipped to help the small weavers who are technologically backward to diversify and use the spun yarns in the knitting industry both circular and warp. Recent developments in the textile industry in India have resulted in a steep increase in production potential of fine count yarns from indigenous sources and also from sophisticated man-made fibres. However the knitting industry in India is by and large composed of small-scale units that use only a limited range of machinery, that is elementary in nature being confined primarily to circular knitting. There is an urgent need for providing adequate training and demonstration to these small units on the use of modern knitting machinery so that they are able to handle the substantial increase in yarn production and produce a sufficient quantity of knitted fabrics, used not only for undergarments, sport wear and stockings, but also for outerwear for which there is substantial demand in India and elsewhere. Moreover the knitting industry, being labour intensive, will lead to creation of employment through judicious mechanization. That the above contains several ambiguities and misconceptions, can for the moment be ignored.

Phase II of the project is to be executed by UNIDO with CSIR acting through SITRA as the co-operating agency.

Objectives

The objectives of Phase II are given below. They are set out in full because of their importance.

Long-term objective

The project will continue to help further development of the spinning sector of the textile industry in India by creating a large-scale, high-quality knitting capacity to provide more employment opportunities, ensure greater stability in the industry and improve the industry's performance.

Immediate objectives:

The project represents continuation of the activities started under Phase I of the project that are mainly concerned with the development of services and training facilities for the existing knitting industry in the country. The specific objectives of Phase II are:

(a) To introduce various advanced types of knitting such as warp knitting and sophisticated weft knitting with a view to making available an adequate quantity of knitted fabrics for internal markets as well as for export;

(b) To diversify the production of spinning mills by developing the spun yarns specially required for the various types of knitting thus providing greater stability for the mills;

(c) To build up expertise at SITRA to advise the spinning mills and the knitting industry on problems related to the special requirements of the knitting industry and to the finishing of fabrics;

(d) To improve machinery, fabricate suitable accessories and make know-how available to indigenous machinery manufacturers thus helping to modernize the knitting industry;

(e) To promote the export of knitted fabrics in general and finished outer garments in particular (Phase II proposal, pages 2 and 3).

Training

The proposal allows for three UNIDO experts in warp knitting, chemical technology and marketing spending 30 man months at SITRA. The proposal states (page 5) that three SITRA technical officers including one who will be expected to train abroad under a United Nations fellowship scheme will "also undergo training under the respective international experts on various aspects of warp and weft knitting as also in finishing". The duties of the two technical officers due to remain at SITRA are given (page 5) but they do not altogether agree with the training requirements given above. Provision is also made for the project leader to embark upon a study tour of the Federal Republic of Germany, the United Kingdom and the United States, for 2 months shortly after the commencement of the project.

The Work Plan of the proposal provides (page 7) for the "intensive training at post-diploma for supervising staff". It is unclear whether this implies training for the SITRA supervising staff, or training imparted by them to the local industry.

I. FINDINGS

A. Phase I

It is important, in view of the Phase II proposal to be considered later, to assess the Phase I proposal in as objective a manner as possible, since any possible starting point for Phase II could only be based on the actual achievements of Phase I.

Visits and discussions

Attendance at this symposium on 22 and 23 January 1977, included in which was an exhibition of fabrics and garments developed as part of the Phase I project, enabled a sort of ratio-delay or snap-reading technique to be applied to the project and to the progress made.

On 24 January a thorough tour was made of the laboratory facilities of SITRA and informal discussions held with the heads, or senior members, of the various sections. This tour included the SITRA library facilities and arrangements were made for all the published work of SITRA, not only on knitting technology but from the inception of the institution, to be made available for reference. In addition copies of published work on knitting technology were received for evaluation (annexes I and II).

Visits in the Tiripur area of Tamil Nadu on 25 January 1977 to spinning, knitting, making-up, bleaching, dyeing and finishing works of assorted sizes, helped to formulate an impression of the industrial prospect there. Discussions with industrialists, SITRA staff and the UNIDO expert helped also in providing useful background information.

The physics and physical testing, engineering, mechanical processing, human relations and statistics sections of SITRA appeared well organized and with a very clear understanding and feel for their work. However it was clear that this work was based almost entirely upon spun yarn made on the cotton system.

The knitting laboratory consists of a room 30 metres by 15.5 metres in which are housed three circular knitting machines of indigenous manufacture comprising a fine gauge sinker top model of a diameter appropriate for body lengths, an interlock machine of similar dimensions and a rib machine with pattern wheel jacquard mechanism; three hand-vee bed machines also of indigenous manufacture in gauges corresponding to fine, medium and coarse;

and a three-bar 84 in. compound needle tricot machine of 24 gauge, together with a creel and direct warper for the production of beams, both installed at SITRA by the Government of the United Kingdom under the auspices of the Colombo plan.

Further background information was gained by a brief visit to a cotton plantation, followed by a detailed visit to a knitting-machine builder in Coimbatore with whom, among other things the knitting expert had co-operated on the design and production of a fine gauge machine of 1 in. diameter which, with a single feed, allowed tubular synthetic knitted fabric suitable for subsequent preparation as artificial arteries to be made. This company, although ill-housed and ill-informed by European standards of technology, had demonstrated considerable initiative since its inception some three years ago. It had, for example, sought out, purchased and installed a very sophisticated programmable machine tool for the cutting of tricks in cylinders and dials either separately or simultaneously. Considerable insight into the problems faced by machine builders, even progressive ones, was gained from this visit.

To gauge the supply of graduates and others into the textile industry, a visit was made to the local PSG College where a textile department is situated carrying out graduate and post-graduate courses for degrees from the University of Madras. The laboratories were inspected and discussions held with the principal of the College and with the head of the department, his staff and students. A subsequent visit was made to give a lecture to staff, some SITRA staff and students on Studies on Increasing the Productivity of Circular Knitting Machinery.

Current experimental work in knitting technology being carried out at the Huddersfield Polytechnic and elsewhere in the United Kingdom was discussed with staff at SITRA to whom was shown a film on computer-aided design processes and high-speed experimental films on warp knitting and sliver knitting. More detailed discussions with technical officers including those assigned to the knitting section were held at intervals throughout the assignment.

To gain insight into the problems of the knitting industry and machine builders in other parts of India, a visit was arranged to spinning and manufacturing companies in Bangalore processing yarns other than cotton-spun, including wool and wool/man-made fibre blends. A visit was also arranged to knitting, making-up, finishing, machine building and textile education establishments in the Punjab area of India centred upon Ludhiana. Brief

discussions were also held with educationalists and industrialists at meetings in both Delhi and Bombay, including representatives from the Indian Institute of Technology (IIT) Delhi, the International Wool Secretariat and Centary. Spinning and Manufacturing.

At the Institute of Textile Chemistry and Knitting Technology in Ludhiana, discussions were held with the principal and staff of both the knitting technology and dyeing technology departments. Copies of course curricula were received and a tour of the equipment and facilities was made. A short lecture on The Use of Knitted Fabric Geometry Studies to Industrial Fabric Manufacturers was given to staff and students.

Visits were made to (a) the Bharat machinery works to see the production of circular single jersey and interlock machines; (b) to a vertical wool combing, worsted and woollen spinning, waving and knitting company operating very modern equipment including Cotton's patent machinery; and (c) to small-scale hand flat, hand circular and garment producers. The relationship between the College courses and industrial requirements was readily apparent.

Appraisal of achievements

A meeting was held on 21 January 1977 with the director of SITRA to review the work completed in Phase I. He provided a valuable review of the background against which the achievements might be viewed and emphasized the importance to the economy of South India, in particular, and of India as a whole, of creating jobs as a result of the diversification studies.

The objectives of Phase I were discussed and reviewed, with the conclusions set out below. The numbers refer to the numbers of the objectives as given in the Phase I document.

Long-range objectives

1. This is a broad-based statement of intent which is an on-going objective and indeed likely to be so for some considerable time, beyond Phase I and the proposed Phase II.
2. Diversification of South Indian spinning mills towards the needs of the knitting industry has been achieved in part, certainly for the manufacturers of circular knitted fabric in South India. The objective of diversification for the production of spun yarns for warp knitting is a spurious one however,

according to a survey carried out by CSIR^{1/}, since there are no warp knitting machines installed in Tamil Nadu and there is currently a government ban on their import. Indeed the importance attached industrially to warp knitted fabric development was rated as 4 per cent by respondents to the same survey^{2/}. There are indications that while knitters may purchase yarns from South India, many spinners have hitherto made little concession to the requirements of hosiery yarns^{3/}. Many knitters complain about the use of twist multipliers of a level more suited to weaving yarns. Certainly SITRA has been able to help in facilitating understanding between the two sides of the industry and by the yarn studies (annex I) that they have carried out. However compared with the amount of work done hitherto purely on spinning research, the input related to the needs of the knitting industry is but a beginning.

Hosiery yarn appeared to have accounted for some 10 per cent of cotton yarn production in India between 1967 and 1971, with, surprisingly perhaps, an increase during that period in consumption of finer count yarns.

3. The objective of establishing a centre within SITRA to carry out research and service the knitting industry is certainly proceeding. Examination of the research published to date (annex I), as might be expected, a strong bias towards work related to yarn technology or organizational studies, no doubt because of the strong basis of research achievement which exists in those areas of study (annex II). Not unnaturally, in view of the shortage of trained research staff in knitting technology and the apparent lack of a detailed research programme, the research efforts appear diffuse.

Service to the knitting industry of a more tangible and immediate kind has been provided through the fabric development and diversification efforts of the UNIDO knitting expert assisted by SITRA staff. The member of SITRA who apparently will be responsible for the technical service to knitters only

^{1/} CSIR, Management Attitudes Towards Research, 1975, Appendix XIX, p. 94.

^{2/} CSIR, Areas Considered Important for Further Product Development, 1975.

^{3/} K. Sreenivasan and I. Doraisway, Survey of Knitting Industry. August 1973, p. 23, Appendices I and II.

returned from his United Nations fellowship tour in August 1976 and is thus just beginning to render this type of service. The establishment by this man of a technical service centre in Tiripur, a large-scale hosiery manufacturing complex some 50 kilometres from Coimbatore, on a two-day per week basis, will obviously increase the amount of immediate problem-solving activity that SITRA can provide. Other centres, it is understood, are planned for Calcutta and Bombay, subject to the availability of trained staff.

Immediate objectives

1. Investigation of the operational efficiency of knitting mills is covered in part by the SITRA report survey of the knitting industry (annex I). A questionnaire sent to 2,000 knitting mills in India elicited a 12 per cent response following which 85 mills were selected for detailed study. Mills were selected to give an emphasis on spun yarn usage. Their distribution was:

Tiripur	Tamil Nadu	45
Calcutta	West Bengal	21
Bombay	Naharashtra	8
Salem	Tamil Nadu	6
Kerala State		5

From the sample it was established that single-shift working is universal in Salem and Kerala and practised by three quarters of the mills in Tiripur and Ludhiana. Only in Bombay and Calcutta was there any noticeable multi-shift working by 43 per cent of the mills in Bombay and 36 per cent in Calcutta. A quarter of the knitting mills in Calcutta and a fifth of the mills in Bombay were estimated to be working on three shifts. The majority of mills (about 95 per cent of sample) work six days per week with the rest working five or seven days per week. Machine utilization was estimated variously as being around 70 per cent for single jersey, somewhat higher for interlock and a good deal lower for half hose machines; centres operating warp knitting machines appeared to do so to capacity in most instances. The report on the survey makes a number of recommendations, some of which are purely speculative but suggest the need for authoritative information with regard to this important and growing industry, a sentiment heartily endorsed by the expert and which could profitably be extended to include the consumption and use of hosiery goods as well (annex II, Ministry of Commerce, Purchases of Textiles). The report goes on to point out many facts that are self-evident to practising knitting technologists, and some assumptions that may be incorrect, but which in the

context of the growing interest of SITRA in knitting could be pursued further with advantage. It is however important not to confuse publication with implementation, since many of the factors to which the report correctly draws attention can only be effected considerably in the future, while others have the effect of provoking thoughts both of alternatives and unanswered questions. Nevertheless in the context of the objective being considered, the report survey of the knitting industry represents a useful basis for further action.

2. The objective relating to the establishment of norms for knitting, making-up, finishing, machine and worker efficiency represents a lifetime task. Indeed SITRA has instituted a biannual survey of norms for the spinning sector and continually find it necessary to update and change these as trade, end-use and market requirements alter.

The studies carried out to date (publications 4, 5, 6, 7, 8 and 9 in annex I) again provide a useful beginning, but in many instances the important details are based upon recommendations from similar studies carried out in developed countries where operating characteristics are greatly different (fig. I, annex II).

3. Studies of fabric defects have been commenced (annex I, ref. 5) with a view to making recommendations for improvements - sometimes with explosive results. While substantial improvement can be achieved by changes in yarn condition, many fabric faults are the result of incorrect machine setting and maintenance. As diversification of fabric manufacture continues, the range and number of fabric defects encountered will increase. There is an undoubted short-term need for further research and development to be carried out in this area - indeed the compilation of visual as well as quantitative information on fabric and garment defects and the means for their rectification is an urgent requirement and is included in the suggested research and development programme prepared in conjunction with this report (annex III).

4. Studies of yarn quality in relation to machine performance is something that SITRA is well equipped to carry out. Work in this area is proceeding as evidenced by some of the publications listed in (annex I, ref. 4, 8 and 9). What will no doubt eventually emerge is the more comprehensive and more widely applicable studies comparable to some made in the spinning sector for different purposes (annex II, ref. 2, 6, 7, 8 and 11).

5. Demonstration of the operation of modern knitting machinery has proceeded only in so far as the equipment installed at SITRA represents modern machinery. Given the financial inputs for equipment to this Phase I project, there was little hope of this objective being attained in any event. A more laudable and obtainable aim would have been to demonstrate the operation of knitting machinery using modern knitting technology. This was done by the knitting expert and the SITRA staff trained by him in machine operation, setting and maintenance. The range of instruments, including a course length tester, yarn speed meter and tachometer developed and used for this purpose, also demonstrate this capability.

The training of mill personnel with reference to maintenance, efficiency and product quality has not been achieved. Some of the problems in this matter are the requirements to conduct such courses in the local dialect of Tamil, to carry them out perhaps in the knitting centres of the industry's location rather than at SITRA, to make them available possibly on an evening basis and, above all, to produce courses of a practical variety which takes considerable practical experience of knitting technology. Recommendations in the research and development programme (annex III) suggest the need for the adoption of objective learning methods in the devising of training courses (M.S. Burnip some examples of TEC courses. Collected papers SITRA library).

The time taken to write appropriate training courses, even those of a practical nature, should not be under-estimated.

6. This objective, the development of new products for manufacture on existing machines, occupied the knitting expert and knitting technicians for a considerable amount of the last period of the Phase I project. A full account of this is contained in a paper given by the knitting expert and alluded to in connexion with arrival at the duty station. The comments of visitors, both from the industry and elsewhere are recorded in annex VI of his report. The exhibition highlighted the achievements of those concerned, but the lasting benefit to the SITRA staff should be the methodology taught for the production of fabric trials, with full documentation of machine, yarn, structure and finishing conditions to be followed and disseminated to all concerned for both successful and unsuccessful trials. There is no reason why such developments should not continue at SITRA and within the industry.

7. The final objective may be seen as highly ambitious, long-term or a matter for collaborative effort between SITRA and machinery builders. In fact instrumentation developed including a course length tester, a yarn speed meter - of which a digital version is under development and a tachometer (annex II) should prove of great value not only to SITRA, but to the industry as well. Development of a positive yarn feeding system is also proceeding in collaboration with a machinery builder. Further instrumentation and simple machinery aids are required. SITRA has also produced a hank-to-cone winder that is to be put into series manufacture and this should assist in the diversification of manufacture plans of the industry since the availability of dyed hosiery yarn, especially from South Indian spinning mills, is not good.

Outputs

The tangible outputs from Phase I are as follows:

Personnel. One fellowship candidate has returned from his studies and is being given responsibility for the organization and establishment of technical service facilities but these are not yet operational.

One fellowship candidate will return in July/August 1977 and is apparently to be given responsibility for mounting the training courses referred to in Immediate Objective No. 5.

One technical officer, Indian trained in knitting technology, is to assume responsibility for fabric development and diversification (immediate objective No. 6). It is unclear whether he will be responsible for machine and accessory development (objective No. 7). Knitting machine mechanics and operators will continue development as occasioned under objective No. 6 or by other aspects of experimental work.

The project leader in conjunction with other SITRA staff, as permitted by their existing equipment, will continue the fulfilment of all long-term objectives unless modified and those short-term objectives not completed or commenced, namely 1, 2, 3 and 4.

Buildings. More than adequate floor area exists for machine knitting, but the building requires air conditioning since changes in ambient conditions, not only throughout the year but throughout the day, are substantial. Partitioning and conditioning of parts of the building may provide an adequate solution. Other SITRA facilities including library and administrative services are available.

Machinery. The machinery and equipment available have been mentioned earlier; they include three indigenously manufactured circular machines of single jersey, interlock and jacquard types, and three hand vee bed machines of coarse, medium and fine gauge and a three bar warp knitting machine of European manufacture.

Conclusions

The biggest shortfalls of the current Phase I are:

- (a) There is a lack of trained personnel of experience and knowledge to direct both the research and training functions;
- (b) Until August 1977 the most knowledgeable knitting technologist will be away from the Institute for a substantial portion of his time;
- (c) The other United Nations fellow does not recommence his duties until August 1977 and will need to spend a substantial amount of time devising training courses and procedures;
- (d) Any additional UNDP support under a Phase II project would not only be required to commence from the base evaluated in this report, but would, by its various inputs, generate more demands upon staff who already have full-time commitment in progressing the incomplete aims referred to above.

B. Phase II

A meeting on 27 January 1977 attended by heads of sections and senior members of the SITRA staff together with the knitting consultant enabled an appraisal to be made of the relevant sections of the Phase II project. Those not familiar with its contents were given copies of the appropriate sections in advance for study.

Those present were: K.P.R. Pillary, Head of Textile Physics and Assistant Director; P.V. Veeraraghavan, Head of Human Relations; K.S. Shankaranarayana, Head of Mechanical Processing, including knitting technology; T.V. Ratman, Head of Operational Studies; T.M. Krishna Varma, Textile Physics and former United Nations fellow in knitting technology; S. Govindrarajan, Mechanical Processing - Engineering section; A.R. Kalyanaraman, Textile Physics - X-ray and Electronics section; M.S. Burnip, UNIDO Consultant.

Outputs

As listed in the Phase II proposal, these are:

- (a) The formation of a National Research and Development Centre at SITRA for implementing a comprehensive research and development programme relating to knitting technology and for providing training facilities in this field;

- (b) The establishment of service centres in areas where the knitting industry is concentrated;
- (c) The development of sophisticated knitting machinery and accessories adapted to local conditions;
- (d) The diversification of products from the existing knitting industry to suit the requirements of indigenous and export markets;
- (e) The increased technological sophistication in the existing knitting industry;
- (f) The expansion of the knitting as well as the garment-making industry and consequent increase in consumption of yarn and fabrics;
- (g) The diversification of the yarn produced by spinning mills for meeting the growing demands from the knitting industry;
- (h) The increased employment in the knitting and the garment-making industry;
- (i) The availability of a greater variety of indigenous products to consumers;
- (j) The commercial production of sophisticated knitting machinery and accessories by indigenous machinery manufacturers.

Results from the first meeting

The meeting gave an opportunity to examine each of the activities and the anticipated outputs from the Phase II proposal with the following results (Phase II proposal pages 3 and 4).

The formation of a research, development and training centre for knitting technology is clearly feasible only provided an adequate programme for the implementation of those three objectives is prepared and followed. The question of the national status of such a centre is a matter for the CSIR and its policies with respect to other institutions. On the matter of the training aspect of this output there seems to be considerable confusion (Phase II proposal, pp. 1, 2) between the requirements of education and of training. This matter is dealt with later in this report.

Training at technician level is imperative, especially since this has not been covered in Phase I. This training should be of two types: (a) short-term for existing mechanics/operators; and (b) longer term for new mechanics/operators. In both cases practical courses are essential.

The establishment of service centres in areas of concentration of the industry was discussed. Whatever the intention, the development of this is bound to be slow. The Tiripur centre still requires a building and will require at least one machine for the conduct of courses. Instruction and

training courses have not yet started, but discussions have been held with the staff member responsible and guidance given. The establishment of service centres in other areas is bound to proceed slowly because of, among other things, shortage of qualified staff. It should be noted that while knitting in South India in general and Tamil Nadu in particular is confined to the use of cotton yarns, this may not necessarily be the case in the setting up of other centres. While SITRA has expertise in yarn technology for cotton and cotton/man-made fibre blends, it is lacking in yarn expertise in filament, textured, worsted or woollen-spun systems.

The development of sophisticated knitting machinery is necessarily a matter for the machine builders themselves. SITRA could best assist by carrying out fundamental studies of machinery (annex III) this would require only simple machinery but perhaps more elaborate instrumentation. The views of the Textile Machinery Manufacturers Association in Bombay might be sought, and a more profitable line might be for them to pursue the possibilities of building machinery under licence from makers in developed countries.

The work of SITRA in the development of accessories and instruments should however be continued.

The diversification policy instituted under Phase I should and will continue. The development of products suited to export markets will depend upon the development of expertise to assess product requirements and product performance. This in turn will lead to a new role for the testing section of SITRA. The ability to think instinctively about fabric requirements in the way that yarn requirements are currently considered is important. Further diversification of fabrics and products might require eventually the services of a textile designer. Diversification can however be aided by appropriate development of library resources to include a fabric library of samples, journals and design magazines (annex III).

Increased technological sophistication within the industry in South India is a long-term objective, but can be aided by improvement in quality control standards and the transfer of modern management techniques. SITRA can help to achieve this through the development of an appropriate short course programme by the Human Relations, Operations Research and Testing divisions, allied to appropriate on-going research activities.

The expansion of the knitting and the garment-making industry should follow from diversification policy. This was the premise behind the diversification objective of Phase I and it is but repeated here. Again the ultimate need for design staff must be stressed. Equally SITRA must realize that such expansion will

create new problems relative to making-up - in which they have no expertise - and in dyeing and finishing, in which very limited expertise exists at SITRA.

Diversification of yarn production in South India is a matter also for the industry, but SITRA could help in this respect with development of spinning conditions using the existing cotton-spun system. Any other form of yarn diversification would require not only that SITRA increase their range of machinery, but that the mills invest in new production equipment.

As a natural consequence, employment will increase in the knitting and garment-making industry making available to consumers a greater variety of indigenous products. Therefore these two aims are not a function of SITRA to achieve.

Commercial manufacture of sophisticated equipment is a function of the machinery builders and of policies with respect to machinery imports. Through its research studies and prototype developments SITRA can assist in this matter and complement other actions such as those suggested above in the paragraph on the development of knitting machinery.

Activities to be considered

The Phase II proposal lists the activities that are necessary to attain the outputs referred to above. They are as follows:

(a) To build up the necessary expertise at SITRA in the different types of knitting under the guidance of the UNDP expert;

(b) To depute national staff for study tours to advanced countries for appraisal of the present state of research in knitting and to determine areas which require special thrust in the local industry;

(c) To depute national staff for advance training in finishing technology in advanced countries and eventually to build up expertise in finishing at SITRA with the assistance of the expert in finishing;

(d) To undertake research on yarn and fabric qualities for improved knitting performance and appeal characteristics;

(e) To undertake research in machinery development as well as development of accessories;

(f) To provide operational research support for knitting units through the service centres and to help this industry to adopt modern techniques and to solve their day-to-day problems;

(g) To undertake feasibility studies for the establishment of small-scale knitting, finishing and garment-making units;

(h) To provide counselling and advice on the establishment of various types of advanced knitting units, in particular warp, sophisticated weft as well as flat knitting;

(i) To provide consultation services to the spinning and knitting industries for problems likely to arise when sophisticated yarn is used to diversify their products;

(j) To undertake evaluation of the performance of the industry as a whole and suggest measures for improvements;

(k) To undertake market surveys with the assistance of an expert in marketing and provide advice to the knitting and garment-making industries regarding domestic as well as foreign market requirements;

(l) To provide intensive training at post-diploma level for supervisory staff in advanced knitting technology and short-term training at lower levels;

(m) To acquire intimate knowledge of the latest types of knitting machinery and adopt this sophisticated machinery and accessories to suit Indian conditions;

(n) To transfer know-how on machinery and accessories that have been developed to indigenous machinery manufacturers.

Results from the second meeting

The above matters were discussed with SITRA section heads and the following points emerged relative to the activities listed.

The input of a further UNIDO knitting expert, this time in warp knitting, would permit the development of expertise in that area by the second United Nations fellow (under Phase I) when he returns in August 1977.

If the project leader undertakes a study tour it will delay implementation in certain areas: the problem is one of lack of qualified personnel.

The fellowship proposed will not be sufficient to provide the in-depth expertise required, since other areas of importance - for example making-up have been completely neglected.

The programme of research is of necessity long term (annex III).

Work on machinery and accessory development is necessary, but should be done in conjunction with the machinery builders and, if necessary, other institutions with specialized expertise, e.g. metallurgy for studies of cam hardening. Such machinery work will also necessitate further staff with engineering training and experience.

Such work can be done by the operations research division who already have expertise in running short management training courses.

The feasibility studies envisaged are to be offered as demand requires.

Provision for advice on machinery purchases on a demand basis is envisaged; this will be dependent upon the acquisition of data on equipment specifications.

Advice to hosiery yarn spinners on a demand basis will be offered; currently 10 or so hosiery yarn spinners are operational and SITRA is providing service for them.

Performance evaluation is carried out for spinning mills on a biannual basis and the intention would be to extend this type of service to the knitting sector. The problem is that the spinning mills are large and highly organized with well-qualified staff able to appreciate the purpose of such surveys, while skew distributions were likely to result from such studies in the knitting sector because of their lack of organization, size and paucity of trained personnel.

Market surveys, for example of the hand-weaving sector have been carried out in the past (annex II) and this would be extended to the knitting sector in due course. The function of the proposed UNIDO marketing expert seems rather unclear, both in this respect and in others.

The provision of training courses envisaged is extremely ambitious. It is also doubtful if it is what is required at this stage of industrial development. However this proposal has been recommended by a committee to the Government of Tamil Nadu (annex I) though it was understood that finance would not be made available in 1977.

The use of conferences and symposia for the dissemination of information is envisaged. The matter of adaptation of sophisticated machinery might well be best dealt with through licensing arrangements.

This is essentially the same point made in the above paragraph. It will require a considerable increase in SITRA staffing to accomplish.

Conclusions

It was clear from this meeting that the majority of the staff has not much conception of what is required in the realization of this proposal. In particular, the lack of knowledge about knitting technology means that the full implications of what are required are not apparent.

No progress has been made in the planning of a research and development programme for implementation in a systematic manner. Some research activity has proceeded (annex I, Phase II proposal annex II), however some of the findings are somewhat tentative and experimental techniques are sometimes used and conclusions drawn erroneously.

The most serious deficiency however concerns the concept of educational programmes in knitting technology. While a committee has established a need and indeed has produced also syllabuses culled from various sources, the enormity of the proposal has not been comprehended. No staff qualified to teach, with academic experience in programme production or assessment are available, nor does the Phase II proposal include plans for them. The requirement of industry in terms of basic courses of practical training of a short, part-time variety has been ignored completely. Despite the fact that such courses will be required to be given in Tamil rather than English, the person designated to implement such courses, does not speak Tamil. Given the current availability of staff knowledgeable in knitting technology, it is extremely doubtful if such persons could be expected to know enough to teach such subjects.

Discussion of the equipment inputs for the Phase II proposal were also undertaken: it was concluded that such equipment requirements are for the purposes of demonstrating equipment rather than for serious research or training programmes.

Appraisal

As with the Phase I proposal, a meeting was held with the director of SITRA to assess the Phase II proposal in the light of the deliberations held with SITRA staff.

Having established the necessity to implement the Phase II project upon the achievements and not upon the stated objectives of Phase I, the errors of assumption became apparent. The ambitious nature of the Phase II proposal, given the limited personnel resources of SITRA were explained. The omissions with respect to the international staff inputs in making-up and to the provision of such expertise amongst SITRA staff was discussed. The need for a considerable staff increase to implement the training and service centre functions was pointed out and the equipment lists were discussed in detail. It was

agreed that the proposal should be revised in the light of the consultant's findings. The need for a structured research and development programme was also discussed and it was agreed that this would be prepared if possible by the consultant and SITRA staff for discussion after the Bombay conference.

Research and development programme

A research and development programme was drawn up in consultation with SITRA staff and with the knitting expert to reflect the short- and long-term industrial needs and to provide a base for the involvement of all sectors of SITRA staff, so that an element of internal re-education and training would take place. The programme involves instrumentation and accessory development of a type to assist the knitting, garment and finishing sectors, as well as establishing areas for which training courses are required.

Discussions with staff on the development of training courses and the use of learning objective methods of programme writing were held. The finalized research programme (annex IV) was discussed with SITRA staff and ultimately with the director of SITRA with whom a copy was lodged (annex III).

Proposed revisions to the Phase II project proposal

A final meeting between the director of SITRA and the knitting consultant on 8 February 1977 began by a presentation to the director of bound copies of work on knitting technology and other aspects of textiles and education for use by the SITRA library. On the matter of the research and development programme, it should not necessarily be implemented in the order set down, but in the main the most important studies, especially in the fundamental areas, are the first ones listed. The importance too was stressed of collaboration with other Institutes, for example the Ahmedabad Textile Industries Research Association (ATIRA), the Scanning Electron Microscope (SEM) studies (UNDP mid-term tripartite review IND/72/035, February 1976, para. 15), and the university of metallurgical research establishments for work on cam hardening techniques.

A redrafted version of those parts of the Phase II proposal that require a technological input, as prepared by the consultant in the light of his assessment of Phase I, the conditions obtaining in the industry, the capabilities of the personnel involved and following discussions with the director of SITRA, the staff and the UNIDO knitting expert, was examined in detail.

The revised proposal calls for:

- (a) The appointment of a suitably qualified and experienced person with either a sound knowledge of knitting technology or other qualities fitting him for the position as project leader;
- (b) The appointment of at least five technical officers to undertake specific duties with respect to technical service; research and development in knitting, making-up, dyeing and finishing; and training;
- (c) The provision for UNIDO experts in training, dyeing and finishing and making-up totalling 12 man-months and a consultant for 1 man-month;
- (d) The provision of United Nations fellowships in dyeing and finishing and making-up totalling 18 man-months, with a possible increase by three months for the project leader, dependent upon his background;
- (e) An increased government input of indigenous equipment to allow for additional making-up and dyeing activity (cost as yet unknown);
- (f) A redetermined UNDP machinery input totalling an estimated \$62,000 with a 10 per cent allowance for spares and packing;
- (g) The provision of an operating timetable to ensure experts and fellows are present at SITRA at the same time;
- (h) The provision for the machinery input to arrive in the second part of the project, so that it can be utilized readily on receipt (this should not prevent the ordering of agreed items at an earlier date);
- (i) The implementation of the detailed research and development programme (annex III);
- (j) The detailing of more complex dyeing and finishing equipment, as originally specified in annex III (d) by the dyeing and finishing expert during his period of duty;
- (k) The purchase, notwithstanding (h) and (j) above, of certain limited items of equipment costing an estimated \$5,000 at the commencement of the programme, to enable certain of the research studies to be carried out.

It was agreed that the revised proposal (annex VII), offered an attainable objective which after completion should leave SITRA with considerable expertise in knitting technology and related topics, and the textile industry, especially in South India, better served with training facilities, instrumentation, processing assistance and techno-economic data of knitting processes, knitted products and end-use requirements.

It was agreed that this revised proposal be recommended to the UNDP.

II. RECOMMENDATIONS

The main recommendations are contained in the revised proposal in annex VI and in the summary given at the end of the Findings on the Phase II proposal. The further recommendation needed to be made in this section is that the project on Diversification and Development of New Fabrics at SITRA is allowed to continue, with a further review of progress in two years.

A secondary recommendation concerns the wider educational issue raised by the proposal of SITRA with the assistance of the State Government of Tamil Nadu to begin post-diploma educational courses in knitting technology. From the visit made to Ludhiana where the only educational centre running courses in knitting technology is situated, and from discussions and projects undertaken for the Ministry of Overseas Development of the United Kingdom with respect to other textile educational institutions in India, it seems that further consideration should be given by the Indian Ministry of Education to its policy with respect to textile education in general and knitting technology in particular.

The UNDP should, it is recommended, satisfy itself as to whether this current project at SITRA and the machinery inputs requested originally under Phase II are for the purpose of developing research expertise and experience or to provide demonstration equipment for use as part of an educational system.

A final recommendation concerns the objective stated in the original Phase II proposal that SITRA should become the national centre for research etc. in knitting technology. While accepting that the Government of India can confer this status or preserve the prerogatives of its institutions as it wishes, the UNDP should consider whether the interests of the development of the knitting sector of the Indian textile industry might not be better served by encouraging the co-operation of all interested textile research associations in this matter where geographically and by industrial concentration it is sensible so to do.

Thus closer co-operation between SITRA in the south and possibly in the west, between Silk and Art Silk Manufacturing Industries Research Association (SASMIRA) and possibly Wool Industries Research Association (WIRA) in the east and between the recently formed North India Textile Research Association (NITRA) in the north might ensure a more rapid and effective development of knitting industries in India.

Annex I

SITRA PUBLICATIONS RECEIVED, RELATING TO KNITTING TECHNOLOGY

Pillay, K.P.R. and K. Ranganathan. Techno-economic feasibility of using spun yarns for warp knitting. Proceedings of the 16th Joint Conference, January 1975.

Sreenivasan, K. and I. Doraiswamy. Survey of the knitting industry. August 1973.

Prasad, G.P. Bleaching of cotton knitted goods. January 1976.

Shankaranarayana, K.S. and S. Somasunder. Effect of yarn quality on the properties of the knitted fabrics and performance in knitting.

Blending of viscose staple fibre with cotton. SITRA report.

Blending of polymeric fibres with cotton. SITRA report.

Spun yarn quality requirements for knitting. By N. Ramani and others. January 1976.

Shankaranarayana, K.S. and K.T. Thomas. Effect of weaving and moisture on knitting performance. January 1976.

SITRA staff list.

Directorate of Technical Education Tamil Nadu. Report of the Committee on starting a course in knitting technology. November 1975.

^{1/}The Joint Conference publications result from an annual meeting between the the Ahmedabad Textile Industries Research Association (ATIRA), the Bombay Textile Research Association (BTRA) and SITRA.

Annex II

SITRA AND OTHER PUBLICATIONS READ, RELEVANT TO NEW FABRICS STUDY

- Sreenivasan, K. A report on Japan's cotton textile industry. SITRA 2:1, February 1957.
- South India Productivity Team. Productivity in the Ahmedabad Textile Industry. SITRA 2:6, September 1957.
- Scope, function and application of textile testing in a spinning mill. SITRA 2:7, September 1957.
- Work assignment in Coimbatore textile mills. By G. Itterah and others. SITRA 4:3, September 1959.
- Somasundar, S. and S. Seshadri. A special investigation for reducing cost of production. SITRA 12:1, February 1967.
- Srikantaiah, G. and T.V. Ratnam. Optimum utilization of cotton resources. SITRA 12:5, July 1967.
- Seshadri, S. and S. Somasundar. Processing parameters and technical details. SITRA 12:7, December 1967.
- Seshan, K.N. and K. Ranganatham. A survey of the quality of yarns. SITRA 18:4, December 1973.
- Ranganatham, K. Reporting to management. SITRA 19:1, January 1974.
- Srikanathan, G. and M. Ramachandran. Modernization in spinning. SITRA 19:3, August 1974.
- Balasubramanian, M. and G.K. Trivedi. A critical study of yarn quality and spinning performance in the mills. Proceedings of the 15th Joint Conference, 1974, p. 1.1.
- Spinning performance of some Indian cotton in polyester/cotton blends. By B. Srinathan and others. Proceedings of the 15th Joint Conference, 1974, p. 11.1.
- Sreenivasan, K. and I. Doraiswamy. A survey of the knitting industry. Proceedings of the 15th Joint Conference, 1974, p. 28.1.
- Early observations from prospective survey on byssinosis in Bombay. By S.R. Kamat and others. Proceedings of the 15th Joint Conference, 1974, p. 33.1.
- Pillay, K.P.R. and K. Ranganatham. Techno-economic feasibility of using spun yarns for warp knitting. Proceedings of the 16th Joint Conference, 1975, p. 127.
- Patel, A.N. The role of inspection and quality control in fabric defects control. Proceedings of the 16 Joint Conference, 1975, p. 149.
- Dolke, A.M., P. Malaviga and P. Patel. Measures for the selection of weavers in the textile industry. Proceedings of the 16th Joint Conference, 1975, p. 153.

Narasimham, T., G.H. Trivedi and C.G. Ventataramanan. Computerised plotting of shedding and picking. Proceedings of the 17th Joint Conference, 1976, p. 64.

Bhave, P.V. and A.R. Garde. A study of financial performance in textile mills. Proceedings of the 17th Joint Conference, 1976, p. 95.

Sridhar, U. and A.R. Kalyanaraman. SITRA electronic tachometer. Proceedings of the 17th Joint Conference, 1976, p. 133.

Pillay, K.P.R. and N. Ramani. Chemical treatment for cotton yarns to improve their knitting performance. Proceedings of the 17th Joint Conference, p. 146.

Bhatia, H.C., J.S. Rawat and R.C. Gupta. Dimensional stability of cotton knits through relaxing and stabilising methods. Proceedings of the 17th Joint Conference, 1976, p. 153.

SITRA market research studies: Market survey of handloom products in Coimbatore 1963; A study of traditional manufacturing centres 1964; Exporters of handloom goods in Madras State 1965; Consumption patterns on handloom fabrics: The Coimbatore; Study 1966; Patterns of sales and demand for non-wearing apparel, 1967.

CSIR. Management's attitude towards research vis-à-vis future research needs. Fibre sciences. Group report, 1975.

Textiles Committee Market Research Wing. Consumer purchases of textiles 1975 (also monthly and annually). Ministry of Commerce, 1976.

Annex III

PROPOSED RESEARCH AND DEVELOPMENT PROGRAMME IN KNITTING TECHNOLOGY

The programme of research and development with respect to knitting technology and training is not exhaustive or inviolate, nor is the order necessarily that in which the work is to be done. It represents the results of experience gained in conducting research, education and training in other places, the avoidance of shortcomings apparent in existing programmes and perceived industrial need. It was written as a series of parallel operations involving most of the divisions within SITRA and was compiled in consultation with members of the SITRA staff. It is considered extremely important that as many staff members as possible are involved in the programme, subject naturally to their existing commitments, since unless and until the whole institution becomes familiar with the scale, pace, method of commercial organization and practise and degree of technical competence of the knitting sector, particularly in South India, little progress will be made. Instinctive ability to "think yarns" is undoubtedly present at SITRA as might be expected from two decades of work with the cotton spinning industry of South India. It is important that a similar ability to "think fabrics" is developed as rapidly as possible. It will be for the SITRA staff to weigh the importance or necessity of the programme outlined and to implement, reject or modify it in the light of their developing experience and expertise. The programme is not written with an obvious time-scale save that most of the items represent problems, the solution of which would benefit the local industry.

A. Studies of knitted fabrics

1. Determination of dimensional changes of common weft-knit structures when made from locally-spun cotton yarns and subjected to recognized laboratory relaxation conditions such as dry, wet, washed and tumble-dried relaxation. Observation of loop shape ratio by measurement and by photo-micrograph and/or scanning electron micrographs (see SITRA project documents on SEM techniques).
2. The effect of changes in yarn type; yarn blend; and yarn construction, e.g. twist factor or twofold instead of singles, S or Z twist, upon geometry obtained for common structures.

3. The effect of chemical treatments designed to confer abrasion resistance, crease resistance, water repellency, softness of handle etc. upon the dimensional properties of knitted fabrics.
4. Determination of the effect of ambient conditions upon fabric loop length and dimensions for situations of knitting machine operation similar to those found industrially.
5. Determination of the effect of variations in knitting conditions such as input tension, takedown tension, coefficient of yarn/metal friction, rotational speed, machine temperature upon fabric geometry and dimensions.
6. Studies of fabric printing in relation to cotton, cotton/man-made fibre blends and the development of print paste recipes.
7. Study of loop-forming action of knitting machinery including robbing back, cam angle and means of increasing productivity of circular machinery.
8. Study of geometry of simple warp-knit fabrics made from continuous filament yarns and subjected to relaxation treatments (see A.1 above).
9. Study of geometry of warp-knit fabrics which are made from simple yarn mixtures of filament and spun yarns, using natural and man-made fibres.
10. Studies of the properties of knitted fabrics including tenacity, extensibility, recovery porosity, thermal insulation, permeability, crease resistivity, drape etc.
11. Studies of the construction, geometry and properties of seams.

B. Applied studies in knitting and finishing

1. Determination of dimensional changes of common weft-knit structures during and after typical commercial bleaching and finishing and/or dyeing conditions as practised in Tamil Nadu. Photo-microscopy of SEM studies of loop shape configurations: relationship of dimensions and results to those obtained in A.1.
2. Development of finishing routines to convert fabric dimensions and loop shape from that in B.1 to that in A.1.
3. In conjunction with instruments developed as described below in C.2 and 3, determination of dyeing and/or finishing routines to conform to B.2.

4. In relation to A.4 above, determination of measures to be taken by knitters to ensure continued maintenance of fabric dimensions.
5. Development of suitable adhesive for sticking fabric to screen printing tables.
6. Development of suitable grade and strength of cleaner for fabrics and garments to remove oil, stains, machine marks and other discolourations. The cleaner must have non-toxic characteristics, not give rise to dermatitis or other skin conditions, have a safe flash point and be capable of atomization.
7. Development of alternative dyestuff recipes for basic shades.
8. Study of yarn clearing standards in industry and in relation to knitting trials with a view to increasing quality of hosiery yarns.
9. Studies of knots, knotters, knitting and fabric faults with a view to making recommendations of procedures to be followed.
10. Development of adhesive for yarn joining in winding.
11. Comparison of yarn clearers for use on hosiery yarns including specific studies of comb mechanical and other indigenously available clearers.
12. Further studies of yarn lubrication including the redesign of waxers and/or tensioners to ensure adequate winding efficiency.
13. Development of methods for optimizing cutting waste in making-up by studies of lay marking.
14. Studies of transfer printing with respect to cotton cross-linked to polyamide, cotton/polyamide or cotton/polyester mixtures, including effect of differential modulus.
15. Development of hand-painted transfer paper for use on knitted garments.
16. Studies of fabric and garment properties in relation to end-use requirements.^{a/}
17. Studies of garment seams in relation to end-use requirements.

^{a/} M.S. Burnip. Methods of Assembling yarns and fibres to form fabrics, SITRA Library.

C. Engineering development

1. Development of a tubular fabric stenter of simple design to assist in procuring air-dried, mechanically stable fabrics.
2. Development of simple quality control instruments for industrial assessment of fabric dimensions, e.g. diffraction line gratings suitably calibrated to indicate correct Poisson ratio for loop shape of given structure.
3. Development of simple instruments to measure wet-and-dry-bulb temperature, pH, and hardness of water for use by dyers and finishers in Tamil Nadu.
4. In addition to digital yarn speed meters, yarn tensio-meters and course length testers being developed, the design and production of even simpler instruments for use by machine knitters, namely, marked yarn loop length control, simple tensioner to fit to existing machines, hand held mechanical tension meter for 2-10, 10-100 gram-force reading, yarn length counters for flat and rotating cam box machines, simple tachometers and/or counters for determination of machine rpm (a version of this might be fitted by machine builders to new machines).
5. Development of instruments for use by machine builders and knitting mechanics, namely dial/cylinder clearance, knock-over gauge, cam track clearance, evenness and levelness.
6. Development of fabric inspection stands for inspecting flat and tubular fabric on either one or both sides.
7. Development of garment development stands which permit both fabric and seam inspection.
8. Development of fabric unrolling and laying device, hand-driven, but with automatic reversal, suitable for both flat and tubular fabric.
9. Development from C.8 above of a fabric-laying carriage suitable for use on a flat screen printing table.
10. Development of a simple fabric baker or steamer for fixing screen prints.
11. Development of a hand-held spray gun for use with cleaning fluid developed in B.6 for fabric cleaning.
12. Development of simple colour-matching instruments.

13. Collaboration with machinery builders to produce external manually adjustable tuck/miss/knit cams.
14. Collaboration with flat machine builders in the design of automatic widening devices.
15. Design of appropriate fabric relaxation apparatus. Details of such a unit are given in Burnip and Elmasri, Journal of Textile Institute, 1970, 61 T. 197.
16. Collaboration with machinery builders in the further development of positive yarn feeding devices.

D. Operations research

1. Determination of physical and mental qualities required of: (a) knitting mechanics; (b) knitting machine winders; (c) sewing machine mechanics; (d) sewing or making-up operatives; (e) dyeing and/or finishing technicians; (f) colour matcher; (g) fabric and/or garment inspector; and (h) fabric mender, and the production of simple aptitude testing techniques for application by mills.
2. Determination of simple quality control routines and methods of recording and evaluating for use in knitting, dyeing and/or finishing and making-up units.
3. Study of colour requirements with respect to garments for specific ethnic groups, age ranges, countries, religions; then advise industry of the results.
4. Determination of size requirements for garments for home and where necessary, export markets.
5. Inter-firm comparison of hosiery yarns with respect to knitting performance and fabric appearance.
6. Compilation, if necessary in conjunction with the Textile Commissioner's office, of more reliable information on the number and operation of knitting firms in South India.
7. Compilation, if necessary in conjunction with the Textile Commissioner's office, of more reliable information on quantity, type and purchase of knitted goods. (See Consumer Purchases of Textiles, Ministry of Commerce, Government of India.)

8. Study of methods of improving waste control in knitting and making-up, with development of simple programme for factory implementation and evaluation.
9. Determination of quantities of fabric or garment rejection and means of their reduction.
10. Study of cost of fault rectification including fabric mending and seaming faults.
11. Development of systems for material labelling during processing to avoid batch contamination and to improve fault analysis and rectification.
12. Determination of simple sampling and testing routines for knitting firms who do not have access to full-scale testing facilities^{b/}. Methods of improving good housekeeping; by spinners and knitters could repay development very readily.
13. In conjunction with studies on sizes and with information on fabric yields from machines of different sizes, provide information on size cutting of garments in relation to fabric width.
14. Studies of work organization and materials handling in garment making.
15. Studies of garment design to facilitate simplification of cutting and seaming operations.

E. Human relations

1. Study of management structure of knitting firms in South India.
2. Development of training programmes designed to improve both management and employees knowledge of organization, structure and potential of knitting industry in South India.
3. Study of methods of working in knitting, making-up, dyeing, finishing, and printing works with a view to suggesting minimum standards of working conditions and methods of improvement.
4. Study and inter-firm comparison of job descriptions, work measurement and rates of remuneration in the South India knitting industry.

^{b/} See Fig. 1, p. 81 of Spun Yarn Quality Requirements for Knitting, N. Romani et al, SITRA Conference January 1977: this figure taken from a United Kingdom survey shows that one fifth of all consumer complaints are attributable to mixed yarn.

F. Training programmes

Note: It is recommended that both Tamil and English versions of courses are developed.

1. Development of training courses for existing knitting machine mechanics of a practical variety to be given in the industry to introduce and teach the correct usage of instruments for knitted fabric control such as: course length tester; yarn speed meter; yarn length counter; marked yarn method of machine setting; machine rpm measurement. It is recommended if possible that learning objective methods be adopted, for this purpose see Some Examples of TEC Courses, M.S. Burnip. Collected Papers SITRA Library.
2. Development of training courses for existing dye-house and/or finishing technicians to teach in a practical situation, procedures and use of instrumentation for determination of kier, jig and winch temperature, pH and hardness of water; dimensional control of fabrics, resulting from research and instrumentation developed in B and C above.
3. Development of training courses for fabric and garment inspectors and menders, including plain and rib fabric mending.
4. Development of training programmes to teach operatives how to install, set up, maintain and use hand flat knitting machines including the use of fashioning elements (see the Recommendations of the UNIDO Knitting Expert).
5. Development of simple methods of determining fashioning calculations to achieve desired garment shapes.

G. Library and information services

1. Maintain an up-to-date stock of basic text books on knitting technology, making-up and dyeing and finishing.
2. Maintain a comprehensive collection of leaflets, machinery makers' manuals and other technical information on all types of warp and weft knitting machinery, making up machinery, and dyeing and finishing equipment.
3. Operate a monthly news-sheet giving details of forthcoming training courses, new developments, exhibitions, lectures and other events, both inside and outside SITRA, that may be of assistance to knitting manufacturers.

4. Maintain a collection of fabric and yarn samples for confidential consultation.
5. Subscribe to textile design and fashion magazines of interest to knitters in South India and offer a consultative service on colour selection.
6. Development of a library of fabric defects, their cause and rectification.

Annex IV

PUBLICATIONS ON TRAINING IN KNITTING TECHNOLOGY

A knitter's guide to occupational safety and health
Single knit fabric primer
A primer on circular knitting machine lubrication
Double knit fabric primer
How to reduce Baré in knitting textured yarn double knits
Basic primer on warp knitting
Weft insertion: a primer
Dyeing and finishing of trioot fabric
Dyeing and finishing of polyester knit cloth
Language of knits for men's-wear cutters
How to cut warp knit fabrics
Facts about knits: a cutter's guide to basic fabric types
Overcoming needle cutting in sewing textured polyester double knits
Feeding principles for sewing knitted fabric
What a cutter should know about knitted cloth

Note: All the above are available from: National Knitted Outerwear Association, 51 Madison Avenue, New York, N.Y. 10010, United States of America.

Yarn purchasing and storage
The testing of yarn
Yarn issue and the control of yarn losses
Control of fabric quality
Making-up

All the above are in the series: Materials Control for Jersey Fabric and are obtainable, at £1.05 per copy, from: Hosiery and Knitwear EDC, National Economic Development Office, Millbank Tower, 21-41 Millbank, London S.W.1, United Kingdom.

Annex V

RECOMMENDED ADDITIONS TO THE SITRA LIBRARY

- Brown, T.D. Wool in double jersey. Watford, Merrow, 1973. 116 p.
- Burnip, M.S. Economics of fabric production. Salford, England, Textile Mercury Press, 1970. 60 p.
- Clulow, F.W. Colour: its principles and their application. London, Fountain Press, 1972. 236 p.
- Douglass, W.A. Braiding and braiding machinery. London, Cleaver - Hulme Press, 1964. 144 p.
- Ellis, P. Carpet substrates. Manchester, Textile Trade Press, 1973.
- Goodman, I. Synthetic fibre-forming polymers. Royal Institute of Chemistry, 1968. 83 p.
- Haigh, D. Dyeing and finishing knitted goods. Leicester, Knitting International. 147 p.
- Harrison, P.W. Asia and world textiles. Manchester, The Textile Institute, 1974. 213 p.
- Hearle, J.W.S., J.T. Sparrow and P.M. Cross. Use of the scanning electron microscope. Oxford, Pergamon Press, 1972. 265 p.
- Hirsh, B.W. and P. Ellis. Introduction to textile economics. Manchester, Textile Trade Press, 1974. 168 p.
- Jacob, B. The story of British carpets. London, Haymarket Publishing, 1972. 212 p.
- Keey, R.B. Drying - principles and practice. New York, Pergamon Press, 1972. 358 p.
- Kunick, P. Sizing, pattern construction and grading for women's and children's garments. P. Kunick, 1967.
- Jennox-Kerr, P. Flexible textile composites. Textile Trade Press, 1973. 161 p.
- Lord, P.R. and M.H. Mohamed. Weaving: conversion of yarn to fabric. Watford, Merrow, 1973. 368 p.
- Lyons, J.W. Chemistry and uses of fire retardants. New York, Wiley-Interscience, 1970. 462 p.
- Mark, H.F., N.G. Gaylord and N.M. Bikales. Encyclopedia of polymer science and technology: plastics, resins, rubbers, fibres. New York, Interscience, 1964-1972. Vols. I to XIV.

- Martindale, J.G. Selective bibliography of textile engineering. Textile Institute, 1973. 48 p.
- McIntyre, J.E. The chemistry of fibres. London, Edward Arnold, 1971. 68 p.
- Mills, R.W. Fully fashioned garment manufacture. London, Cassell, 1965. 276 p.
- Perdue, G.R. Technology of washing. Hindon, British Launderers Research Association, 1966. 255 p.
- Plastics and Rubber Institute. Carbon fibres: plastics and polymers. London, 1972. 374 p.
- Rhys, P. and H. Zollinger. Fundamental of the chemistry and application of dyes. New York, Wiley Interscience, 1972. 196 p.
- Robinson, G. Carpets and other floorcovering. Plainfield, New Jersey, Textile Book Service, 1972. 293 p.
- Ryder, M.L. and S.K. Stephenson. Wool growth. Academic Press, 1968. 805 p.
- Society of Dyers and Colourists. Colour index. Bradford, United Kingdom, 1971. Vols. I-V.
- Spibey, H. British wool manual. 2nd ed. Columbine Press, 1969. 630 p.
- Von Bergen, W. Wool handbook. New York, Interscience, 1963-1970. Vols. I and II.
- Weber, K.P. Introduction to the stitch formations in warp knitting. Obertshausen, Karl Mayer, 1966. 107 p.
- White, A.A. Designing and cutting ladies' garments. Tailor and Cutter, 1966. 132 p.
- Wildman, A.B. Microscopy of animal fibre blends, including complete methods of analysis. Leeds, Wira, 1954. 209 p.

Journals

Canadian Textile Society Seminar Papers (Montreal)

Clothing Institute Journal (Hendon, London)

Industrial Sewing Machine Times (London)

Jersey. Barcelona from knitting International (Leicester)

Kettenwirk - Praxis (English ed.) (Karl Mayer Obertshausen)

Laundry and Cleaning (London)

Manufacturing Clothier (London)

Annex VI

RECOMMENDED REVISIONS TO THE PHASE II PROPOSAL

Page 1. UNDP contribution \$136,300. This is an estimated figure based on pro-rata data from the Phase II document for international experts and machine prices are based only on approximations, not up-to-date quotations.

Page 2. Part II. Development objective

The project will enable the South India Textile Research Association to continue its help and support to the textile industry, particularly in South India, by providing expertise, instrumentation and information about the production, making-up, dyeing and finishing of knitted goods, thereby assisting the spinning sector to diversify into new market areas, the knitters to increase their product range and the makers-up, dyers and finishers to deal effectively with such new and existing products. The net effect will be, through the efforts of SITRA, to increase employment, create greater manufacturing stability and permit the development of a strong and viable knitting sector, capable eventually of developing export markets.

Pages 2 and 3. Immediate objectives.

Specific objectives:

(a) The implementation of a planned research and development programme designed to aid the knitting industry in both the short and long terms;

(b) The implementation of training programmes primarily of a practical variety designed to:

(i) Provide ad hoc courses in modern knitting methods of setting, operation and maintenance of existing equipment;

(ii) Provide ad hoc courses for current management and technical staff in management and quality control techniques;

(iii) Provide ad hoc courses for existing makers-up in more efficient methods of garment making using existing equipment;

(iv) Provide ad hoc courses for existing dyeing and finishing technicians in the improvement and control of fabric dimensions using existing equipment;

(c) The development of instruments and machine accessories designed to assist the knitting, making-up, dyeing and finishing industries in the production of articles with improved characteristics, low fault rates and increased performance by a more efficient and reproducible use of manufacturing equipment;

(d) The development of an integrated team of people at SITRA able to undertake co-ordinated development work in relation to yarn, fabric and garment manufacturing.

Page 5 (second paragraph)

In the second phase of this project it is proposed to introduce a comprehensive and long-term programme of research and development to assist the entire knitting industry.

Pages 5 and 6. Outputs.

The anticipated outputs from the project will be:

- (a) The development of SITRA as an establishment capable of undertaking research, development and training in fabric and garment manufacture;
- (b) The establishment of service centres in relation to the needs of the knitting industry, especially in South India;
- (c) The development of instrumentation and accessories in relation to knitted fabric and garment manufacture;
- (d) The continued development and diversification of products in support of the knitting industry;
- (e) The provision of recommendations relating to improved yarn, fabric, making-up and dyeing and finishing routines.

If SITRA is able to produce these outputs, it follows that the yarn and knitting industries of South India, and perhaps elsewhere, should prosper and develop accordingly. Such outputs cannot be directly tied however to this specific proposal.

Pages 6 and 7. Activities.

The following activities are precursors of the outputs mentioned:

- (a) The appointment of a project leader able to make a substantial contribution to the day-to-day implementation of the research and development programme laid down in conjunction with the UNIDO consultant;
- (b) The development or recruitment of several qualified staff to enable the research development and training programmes to be implemented;
- (c) The development and training of a minimum of five technical officers for the following functions:
 - (i) Liaison and technical service in the knitting, garment making, and dyeing and finishing industries;
 - (ii) Research and development in knitting technology;
 - (iii) Research and development in garment making;
 - (iv) Research and development in finishing technology;
 - (v) To develop training programmes of the type stated in objective (b) above;

(d) Development work in conjunction with machinery builders and/or other institutions on instruments and accessories for fabric, garment and finishing industries;

(e) Training programme within SITRA to provide an understanding of fabric and garment manufacture and their problem areas;

(f) Determination of considerably more and accurate statistical information about knitting in India and the consumption patterns of the industry's products.

Page 7. Description of government inputs.

(a) Project leader (see comments above). The recruitment of the correct person for this position should be a prerequisite of UNDP approval of the project.

(b) Five technical officers with responsibilities as given in Activities (c) above. Of these two will become available as a result of the fellowship inputs in Phase I, that is, a technical service or liaison officer and a knitting research and development officer. For the remainder, the garment technologist should undergo education and training in advanced countries for one academic year or 12 months. The technical officer for dyeing and finishing could be recruited from within the country probably from industry or from a university dealing with dyeing and finishing. After a period at SITRA to acquaint himself with the industry and its problems, he could be given further training abroad of an advanced and specific nature for a period of three to six months.

The training officer could be recruited from industry or other sources, not necessarily in textiles, and given an appropriate orientation course within SITRA. He would require some assistance in writing the technical aspects of training programmes, but his expertise in training would prove invaluable in providing a response to industry's pressing needs.

Description of UNDP inputs

Assignment of international staff:

(a) Expert in training development to ensure training programmes as specified in the Research Programme and in objective 2 are met - three months;

(b) Expert in dyeing and finishing of knitted fabrics and garments - six months;

(c) Expert in garment making - three months;

(d) Consultant to monitor and co-ordinate progress - one month.

The training adviser will be required first, but only after the technical officer has been recruited, is in post and has familiarized himself with the textile industry - if recruited from outside it.

The dyeing and finishing expert similarly will not be required until the technical officer is operational and has adjusted to the requirements of the knitting industry. The dyeing and finishing expert will plan the training abroad to be followed by the technical officer after the expert has concluded his duties. The making-up expert will be required after the return of the technical officer from training in advanced countries.

The timing of these inputs should be:

- 0-3 months recruitment and selection of project leader
- 0-6 months recruitment, selection, orientation of technical officers
- 3-15 months technical officer in making-up abroad on United Nations fellowship
- 6-9 months visit of UNIDO training expert
- 9-15 months visit of UNIDO dyeing and finishing expert
- 18-24 months technical officer in dyeing and finishing abroad on UNIDO fellowship
- 18-21 months visit of UNIDO making-up expert
- 3-24 months implementation of research and development programme
- 0-24 months development of service centres within the industry
- 0-6 months orientation and internal training of SITRA staff, including technicians and fitters as well as research staff on fabrics
- 0-24 months development of instruments and accessories for assistance to knitting, garment and finishing industries
- 0-24 months development of appropriate, reliable and accurate statistical record of hosiery industry
- 21 months visit of UNIDO programme consultant
- 9-24 months development of training courses as per objective 2

Project budget covering UNDP contribution

<u>Personnel</u>	<u>Man-months</u>	<u>Cost</u> <u>(\$)</u>
Training expert	3	11,400
Dyeing and finishing expert	6	22,800
Making-up expert	3	11,400
Consultant	<u>1</u>	<u>3,800</u>
Total	13	49,400
Internal travel		2,500
Other costs		<u>3,000</u>
Component total		54,900

<u>Training</u>	<u>Man-months</u>	<u>Cost</u> <u>(\$)</u>
Individual fellowships 18 ^{a/}	18	<u>13,200</u>
Component total		13,200
<u>Equipment</u>		62,000 ^{b/}
Spares and packaging		<u>6,200</u>
Component total		68,200
		<hr/>
Grand total	31	136,300

^{a/} Depending upon the background of the person selected, some orientation and re-education may become necessary. Provision may therefore be needed for a course of 3 months or more as training for this position.

^{b/} Estimates excluding dyeing and finishing equipment.

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Annexure III (a)

Government input

Items 1-10 as is.

Add 1 lockstitch sewing machine and adjust the cost if necessary.

Page 27

Annexure III (b)

delete warping equipment
delete interlock machine
add rib machine
delete rib jacquard machine
add three hand-operated half-hose machines
add 3 yarn speed meters
add 4 course length testers
add 4 tachometers
add range of various mechanical type yarn clearers
add yarn fanoy doubler
add half-hose machino
add laboratory dyeing equipment

Page 28

Annexure III (c)

delete 1 Raschel carpet machine
delete 2 double jersey jacquard machine
delete 4 fancy doubler
delete 5 automatic conewinder with Uster classimat
delete 9 small diameter (1 in) single jersey machine

Revised list

	<u>Estimated cost</u> (\$)
Table top tufting machine	3,000
Intermediate jacquard with 24 or 36 feeds	30,000
Linking machines for 5 and 10 gauge	4,000
Range of electronic yarn clearers and modern yarn lubrication services	8,000
Half-hose machine double cylinder or plush model	4,000
Mellor Bromley teaching machine	6,000
Fabric analysis knitter	4,000
Rotary hand-cutter	1,000
Reciprocating hand-cutter	1,000
Cubex washing machine for standardized fabric geometry studies	<u>1,000</u>
	62,000

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Annexure III (d)

This equipment list requires re-appraisal at the time of the visit of the UNIDO dyeing and finishing expert.

It is assumed that some laboratory equipment made indigenously will be purchased as part of the Government input.

Note: While the revised proposal requires no financial input for equipment until 1978, if maximum benefit is to be gained, it is recommended that it is ordered in time for use from the end of 1977. In particular two items of equipment, i.e., the Cubex washing machine and the Lawson-Hamphill fabric analysis knitter, should be purchased for delivery as early in the programme as possible.

Annex VII

LIST OF ORGANIZATIONS VISITED AND DISCUSSIONS HELD

Saturday and Sunday, 22 and 23 January 1977

SITRA 14th Conference, Spinners/Knitters Meeting and Knitted Fabric and Garment Exhibition.

Monday, 24 January 1977

Tour of SITRA Laboratories, discussion with K. Sreenivasan, Director of SITRA, re Phase I project.

Tuesday, 25 January 1977

Tour of the textile industry in Tiripur, Tamil Nadu, with visits to the Tiripur Textile Spinning Company; Tiripur Hosiery Company; Crystal Knitting and Making-up Company; Two bleaching dyeing and finishing companies; one knitted fabric and garment screen printing company; and one other knitting and making-up company.

Thursday, 27 January 1977

Visit to cotton-growing farm near Coimbatore; visit to Knit-mao textile machinery works in Coimbatore.

Friday, 28 January 1977

Discussions with SITRA senior staff re Phase I project; discussions with SITRA senior staff re Phase II project.

Saturday, 29 January 1977

Discussions with K. Sreenivasan re Phase II project.

Tuesday, 1 February 1977

Visit to PSG College, Coimbatore (affiliate for degree and post-graduate degrees of University of Madras). Discussions with the Principal of the College and the head of the textile department; tour of textile laboratories.

Friday, 4 February 1977

Discussions with senior staff of SITRA re proposed research and development programme.

Monday, 7 February 1977

Discussions with K. Sreenivasan, re research and development programme.

Tuesday, 8 February 1977

Discussions with K. Sreenivasan, re modified Phase II project proposal.

Wednesday, 9 February 1977

Visit to Binny Mills Ltd, Bangalore; tour of spinning, weaving, dyeing and finishing, silk spinning and weaving, making-up facilities; discussions with the director, B.K.P. Rao, and the development director, R. Ramakrishnan.

Thursday, 10 February 1977

Visit to the Government College of Textile Chemistry and Knitting Technology, Ludhiana; tour of laboratories; discussions with the principal and senior staff.

Thursday, 10 February 1977

Visit to Bharat Textile Machinery works, Ludhiana; visit to Oswald wool combing, worsted spinning, woollen spinning, weaving, knitting, dyeing and finishing and making-up companies, Ludhiana; visit to Government Co-operative circular, flat and half-hose knitting and making-up companies, Ludhiana.

Friday, 11 February 1977

Discussions with professor and senior staff, Department of Textile Technology, Indian Institute of Technology, Delhi.

Saturday, 12 February 1977

Discussion with V.R. Shivakumar, CSIR Pool Officer; sent by the director of SITRA.

Saturday, 12 February 1977

Discussion with K.C. Kothwala, International Wool Secretariat, Bombay.

Saturday, 12 February 1977

Discussion with Director, K. Swani of IIT, Delhi, and President R. Poddar of Century Spinning and Manufacturing, Bombay.

Annex VIII

LECTURES

Monday, 31 January 1977

Lecture to SITRA staff, illustrated by high speed films on warp knitting of spun yarns and sliver knitting.

Monday, 31 January 1977

Lecture to SITRA staff, illustrated by a film on computer-aided design in weft knitting.

Monday, 7 February 1977

Lecture to SITRA staff, illustrated by slides on modern developments in warp knitting.

Friday, 4 February 1977

Lecture to staff and students of the textile department at PSG College, Coimbatore, on research studies designed to increase the productivity of circular knitting machinery.

Thursday, 10 February 1977

Lecture to staff and students of the College for Textile Chemistry and Knitting Technology, Ludhiana, on knitted fabric geometry and its industrial applications.

Tuesday, 8 February 1977

Collected published papers on knitting machinery developments, fabric geometry studies, fabric economics and educational systems, presented to SITRA library.

Annex IX

PHASE II REVISION - JOB DESCRIPTIONS OF UNIDO EXPERTS

Expert in training: three man-months

This expert need not necessarily be a textile person, but a knowledge of the textile industry would help. The expert should have extensive experience of preparing training schedules and short training courses for specific skills or related activities of a mainly manipulative type for textile operatives and mechanics and/or engineering duties. Should be able to utilize learning objective techniques, and if possible have experience of personnel aptitude and selection procedures and methods of assessing training effectiveness. A person able to demonstrate aspects of training skills to be imparted, would be desirable.

Should be capable of assisting the local expert to do the following:

- (a) Identify those areas and job functions both within SITRA and in the knitting, making-up, dyeing and finishing industries which require training programmes;
- (b) Prepare a detailed programme of priorities and minimum amounts of training necessary for each of the identified job functions, based upon (i) existing personnel in the industry; and (ii) new entrants;
- (c) Assist the local expert to develop model training programmes, if at all possible using a learning objective technique for one type of activity to ensure the local expert knows what is required of him;
- (d) Assist the local expert in carrying out one training programme and/or training course;
- (e) Assist the local expert in the assessment of candidates from such a course and in the modification of such programmes in the light of experience;
- (f) Suggest further activities or techniques of training which the local expert should study or develop in the future.

Expert in dyeing and finishing: six man-months

This expert should have considerable experience of the dyeing and finishing of knitted fabrics and made-up garments, especially from cotton and cotton/man-made fibre blends. He should be familiar not only with the advanced technology of these processes, but also with methods and techniques for ensuring consistent results with limited processing equipment and minimum supplies of dyes and auxiliaries whose standards and consistencies are variable. Some knowledge of printing/knitted goods in particular would be advantageous, as would a knowledge of yarn dyeing. The international expert would be required to work with a local expert knowledgeable in dyeing and finishing, but not necessarily of knitted goods, and perform the following functions:

- (a) Familiarize himself with the industry, especially in South India, for the bleaching, dyeing and finishing of knitted goods;
- (b) Review the detailed research and development programme prepared by the UNIDO consultant at the end of Phase I, in relation to activities in dyeing and finishing including the suggested instrumentation for those industries, and suggest modifications/additions for the staff of SITRA to pursue;
- (c) Provide short-term assistance, with the local expert to dyeing and finishing firms for the improvement of processing techniques and performance using existing equipment and to spinning firms wishing to produce dyed yarns;
- (d) Review the training programme activities in dyeing and finishing suggested by the consultant and by the training expert and suggest modifications and additions in the light of experience and practise in the field;
- (e) Assist the local expert in the planning and implementation of appropriate dyeing and finishing facilities, including laboratory scale dyeing and finishing equipment inputs and appropriate instrumentation, especially in relation to colour matching for possible installation at SITRA;
- (f) Make recommendations concerning the programme and detail of the local expert's UNIDO fellowship for six months following the visit of the expert;
- (g) Make suggestions as to additional staffing requirements, internal training and equipment requirements needed in the longer term by SITRA, in particular concerning the necessity for additional expertise in fabric and garment printing.

Expert in making-up: three man-months

This expert should have extensive experience of the various skills and practices of making-up, especially of garments from knitted fabrics and of knitted garments from partly formed garment lengths, using both yarn dyed and piece dyed materials. It is particularly important that the expert has experience of small-scale making-up units and of the requirements of multi-skilled labour. The international expert will assist the local expert (who will be a recently returned United Nations fellowship candidate, and therefore relatively inexperienced in industrial practice) in the following functions:

- (a) Familiarization with the problems of the making-up industry in the knitting sector, especially in South India;
- (b) Review of the research and development programme relating to making-up prepared by the UNIDO consultant and modification and addition in the light of existing requirements and developing expertise in SITRA;
- (c) Review of internal arrangements for training personnel in making-up in SITRA and the provision of additional programmes of work;
- (d) Provision of assistance, with the local expert, to the making-up industry of a short-term variety designed to improve operational practice and efficiency and to reduce garment faults, by the better organization and utilization of existing equipment;

(e) Review of development programme prepared by consultant with respect to instrumentation for the making-up sector and modifications and additions as required;

(f) Review with the local expert of training courses and projected courses provided by SITRA training staff as assisted by UNIDO expert, in making-up and modifications and additions in the light of experience and developing expertise in SITRA;

(g) Preparation and planning with the local expert of adequate laboratory facilities in making-up, including provision of detailed equipment and instrumentation requirements for possible installation at SITRA.

Consultant: one man-month

This consultant will be expected to review the progress made by SITRA in:

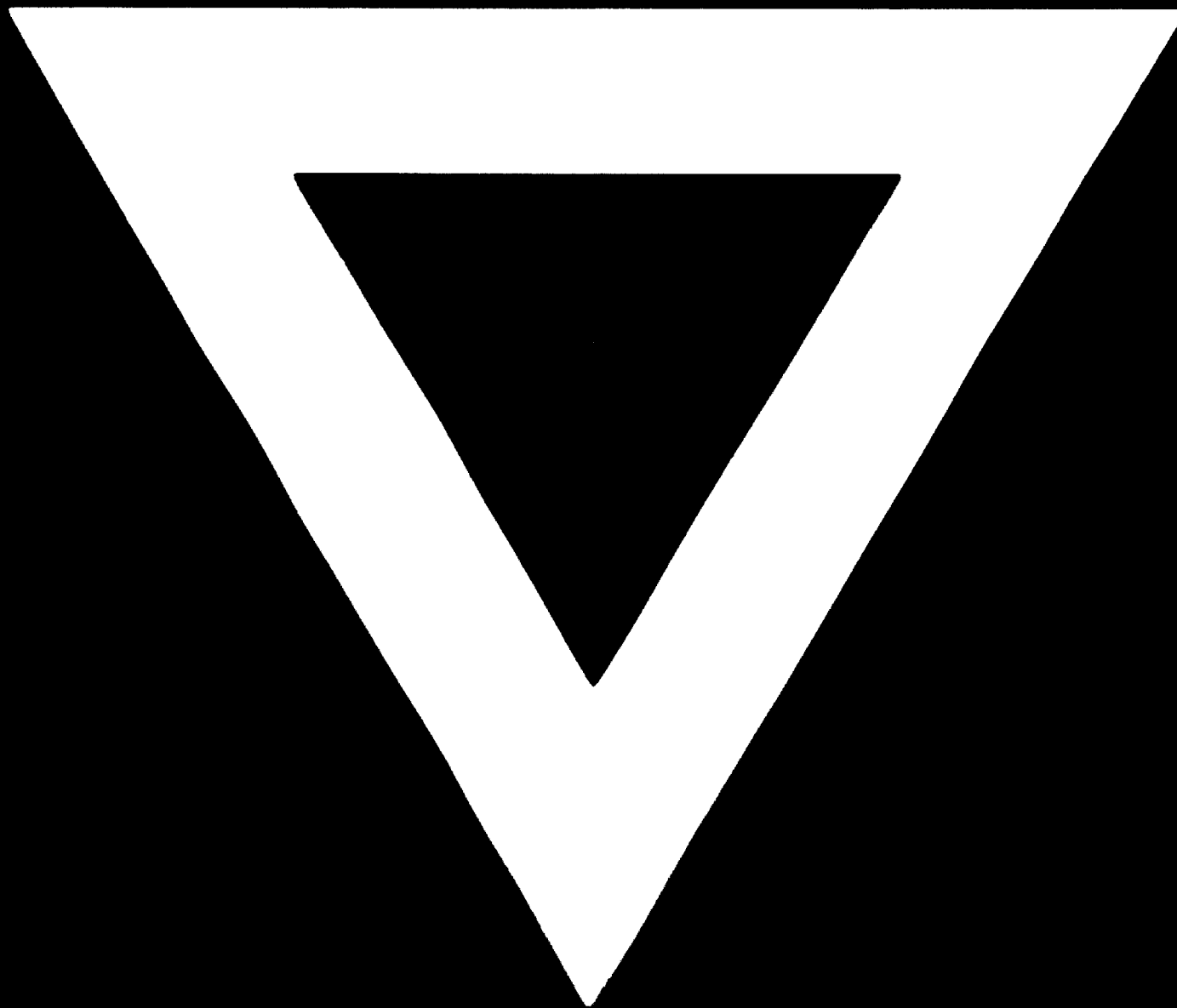
- (a) The implementation of the research, development and training programme prepared for them at the end of Phase I;
- (b) The development of additional skills and expertise in knitting technology, making-up, dyeing and finishing;
- (c) The provision or planning of training courses in the above areas;
- (d) The production of additional equipment and instrumentation requirements in knitting, making-up, dyeing and finishing, and as a result of this assessment, to recommend any additional application to UNDP and UNIDO for further assistance under a Phase III proposal.

In the event of a Phase III application being necessary the consultant in conjunction with CSIR and SITRA staff and local UNDP and UNIDO personnel would assist in the formulation of those aspects of the proposal concerning: aims and objectives; provision of UNIDO fellowships; and provision of equipment and resources whether by the Government of India or the UNDP.

The consultant should have a wide background and experience in textile manufacture, research and training. The particular area of expertise in textiles does not matter as much as an ability to formulate objective judgements and to provide workable solutions.



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