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RESEARCH AND DEVELOPMENT PROGRAMME

ON APPROPRIATE INDUSTRIAL TECHNOLOGY.

COTTON TEXTILES:

THE COMMERCIALIZATION OF NEW PRODUCTS1/,

Technical Report No.1: Project Design,

Prepared by the
International Centre for Industrial Studies

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Introduction

In the Declaration and the Programme of Action on the Establishment of a New International Economic Order embodied in General Assembly Resolutions 3201 and 3202 (S-VI), industrialization is seen as one of the major instruments for "bringing about a new international economic structure which should increase the share of the developing countries in world industrial production". Among the measures recommended by the General Assembly, attention was drawn to the promotion of technology transfer and the creation of indigenous technologies suited to the economies of the developing countries. Emphasis was also placed on improving the competitiveness of natural materials facing competition from synthetic substitutes.

In response to the measures outlined in the General Assembly resolutions cited above, the International Centre for Industrial Studies at UNIDO has launched an action-oriented research and development programme on appropriate industrial technology. One of the components of this programme is the project outlined in this report: it represents an endeavour to promote co-operation not only among the developing countries, but also closer co-operation between research and development institutions in developing countries and local industries. Through this interchange of industrial experience and academic research, a methodology for the development of appropriate technology in the field of textiles will be established which should prove applicable to other consumer-oriented inudstries in developing countries.

In view of the importance of cotton to the developing countries in terms of both production and manufacturing, this project has been directly specifically towards the cotton textiles sector. Its prime objective is to support the competitive position of cotton be it through the production of cotton or cotton-rich textiles.

This report represents the outcome of a study commissioned by UNIDO into the feasibility of developing a research and development project on appropriate product-technology in the textile industry sector. The initial findings and proposed plan of work were reviewed at a meeting of high-level experts drawn from academic and industrial environments, whose comments and modifications have been incorporated in the project design.

The project has been conceived in three phases. The first phase comprises market and laboratory research on cotton textile products with specific end-use requirements. The findings of the first phase will be subjected to practical tests, including mill runs, in a second phase. The products will then be commercialized during the third phase, and a careful evaluation made of consumer reaction to the newly-developed products.

The programme will be closely followed up by UNIDO in its co-ordinative function. To this end, an independent advisory panel of experts will be constituted, its members being drawn from industry and institutions in both developed and developing countries. The panel members will periodically review project progress and assess the applicability of the methodology thus developed to other industrial endeavours.

1. Background

The importance of cotton production as it relates to the textile industry cannot be overestimated, particularly in terms of maintaining employment and providing export commodities for over sixty developing countries. An in-depth UNDP Report to the Administrator (INT/71/032) issued in May 1973 on the subject concluded that of all commodities, cotton and its by-products provided the greatest opportunity for employment and income for the developing countries. It documented several areas which required strenuous effort if the potential for cotton were to be realized. These included increased productivity; attention to price, variety grown and quality; and maintaining current awareness of world-wide technological advances so as to remain competitive and cost effective.

During the past twenty-five years, world production of cotton has approximately doubled; it has grown at a rate of 3.0 per cent per year from 6.65 million metric tons in 1950 to 13.7 million metric tons in 1975. However, total fibre growth over the same period increased at the rate of 4.3 per cent per year, from 9.41 million to 26.1 million metric tons. It is estimated that, at present, more than 500 million people in developing countries alone derive a livelihood from the production of cotton. Cotton is now facing intense competition on a global level from synthetic textile fibres. Cotton's share in total fibre consumption dropped from 71 per cent in 1950, to 68 per cent by 1960, 54 per cent by 1970, and 52 per cent by 1974. Synthetic fibre production now accounts for almost one-half of total world-wide fibre production, and an overwhelming proportion of these synthetics is produced and consumed in industrialized countries.

Despite the percentage drop in cotton consumption, total world-wide production has remained relatively constant. However, the following major geographical shifts have occurred in the share of world cotton production. Developing countries have increased their share from 29 per cent to 45 per cent since 1945. Production in the United States has remained fairly constant during the same period, fluctuating in the range of 10-15 million bales annually, but its percentage of world production has dropped from 45 per cent in 1939 to 18 per cent in 1975. U.S.S.R. and China have increased their shares in cotton production from 14.0 per cent to 21 per cent and from 10.8 per cent to 15.7 per cent, respectively, since 1950.

Cotton production is experiencing increased global competition from other crops, especially food products. For example, since the 1920's acreage devoted to cotton planting in the United States has declined steadily from over 40 million acres to approximately 10 million acres. However, through increases in average yeild from 150 pounds linters per acre to over 500 pounds per acre, output has remained more or less constant. It can be expected that, in the long term, similar increases in yield per acre can be achieved in developing countries, and such a trend can already be seen in many growing regions.

It is expected that the production and use of cotton in developed countries will continue in long-term decline. Virtually all U.S. cotton is now produced by mechanical tilling and harvesting, and thus no major price advantages are to be expected. Furthermore, the increased demand for the cultivation of more profitable food crops on available land is more likely to put upward pressure on the price of U.S. cotton. It is improbable that the United States will regain its former position as the world's greatest supplier of cotton.

Substantial relative price changes in the fibre market have occurred during the past several years. Polyester fibre in the United States, for example, became cheaper than cotton. Polyester $1\frac{1}{2}$ denier staple fibre gradually dropped in price from 82 cents per pound in 1965 to about 32 cents in 1972, whereas cotton prices have increased from one cent per pound in the early 1930's (through the 1960's) to fluctuate at a level which even approached $1 per pound in the 1970's. Similar relative price changes have occurred in other industrialized countries. Modest increases in the price of polyester fibre are expected in the future, reflecting escalated oil prices and inflation factors in industrialized countries. Direct price comparisons between polyester and cotton must also take into account the higher waste factor in spinning cotton as well as the higher utility factor for polyester which, by virtue of its higher tenacity, can provide an estimated 10 per cent advantage over cotton on a weight basis in many products.

In the light of recent developments in the petroleum sector considerable attention has been focused upon new conservation measures in terms of both energy and materials. Some attention has been given to methods of recycling certain industrial products, including textile fabrics. The high inherent strength and stability of synthetic fibres against natural causes of degradation make them more suitable for recycling than natural fibres, and in any event their non-biodegradability makes recycling necessary.

Market outlets for cotton fall into three textile categories: industrial applications (20 per cent), household fabrics (30 per cent), and apparel (50 per cent). While the position of cotton in industrial applications has remained fairly constant, it is an especially price sensitive area. It can be expected that polyester, which is currently cheaper than cotton in the industrialized countries, will make rapid inroads into markets for industrial fabrics in the future. Cotton's share in household fabrics has already dropped significantly, and price sensitivity will probably contribute to further erosion of the market. The most drastic displacement, however, has been in apparel fabrics, where the superior performance of synthetic fibres affected substantial conversion to polyester despite its higher price.

Synthetics have managed to penetrate cotton markets in three forms: through new products; through new properties in existing products; and through new processes. Other major contributory factors have been extensive promotion campaigns by the synthetic fibre producers, price stability and guaranteed availability.

In developing countries, synthetic fibre textiles can cost two to three times more than those made of cotton. Of still greater importance to the relative economies of the developing countries is the fact that serious labour disruption arises since a single employee in a synthetic fibre plant can displace up to 33 persons associated with cotton production.

At present, an ever-increasing segment of the population in developing countries enjoys a standard of living comparable to that of the industrialized countries. In this sector of the population the demand for high performance textile products is similar to that already manifest in developed countries. The resultant tendency in the developing countries to replace cotton products with synthetics and blend fabrics can only be averted if cotton fabrics can be modified to possess the same high performance and durability exhibited by synthetics.

Cotton fabrics have several redeeming features which can be used to advantage: two such properties are the inherent comfort and superior aesthetics of cotton fabrics which have not been truly duplicated by any synthetic. Consequently, if cotton could be modified to have the easy-care properties and ready serviceability of modern synthetic fabrics, its relative position would be strengthened. Furthermore, markets could be expanded in

industrialized nations, and the export opportunities of the developing countries could be increased provided that international trade barriers did not interfere.

Industrial companies in developing countries often lack the ability to recognize and exploit domestic marketing opportunities. To a large extent, it is this deficiency more than any other which has retarded growth in the private sector in many developing countries. The international climate is now ideally suited for a demonstration which will define selected industrial opportunities for cotton and cotton-rich fabrics. The results of a project encompassing such a demonstration could be used to advantage by all developing countries which have growing interests in cotton and could lead to relief from foreign exchange deficiencies. Furthermore, the exercise could serve as a model for future projects in other consumer-oriented industrial sectors.

2. Objectives of the Project

2.1 Long-term objectives

The proposed programme of work will provide central direction for research and development centres so that they might conduct relevant research on cotton, avoid duplication of effort, ensure that the work is carried out in the most appropriate places, and provide for the proper dissemination of results.

Furthermore, in the course of the programme a methodology will be developed for the introduction of appropriate product and process technologies. This methodology should be potentially applicable to a variety of consumer-oriented industries other than textiles.

This methodology will demonstrate step-by-step techniques leading to the commercialization and field testing of new products which are first identified by market surveys. As the programme develops, the results will be communicated to personnel in other developing countries and a multiplier effect is anticipated within the cotton-producing countries and, even more broadly, within other industrial sectors.

In this case, the methodology developed will focus upon four areas:

- the establishment of a mechanism whereby a significant technological development can be implemented without the constraints imposed by economic pressures and/or proprietary interests;

- the conduct of market analysis and laboratory research as a means of identifying and selecting product targets as well as establishing substrates, chemical systems and processing conditions suitable for scale-up and commercial utilization;
- after appropriate analysis of potential cost and technological feasibility, the production of treated fabrics on a pilot-plant scale in sufficient quantity to permit full evaluation of performance and cost;
- development on a full commercial scale in the mills.

Specific technical objectives will be discussed in detail in the proposed work plan which is given in Section 5.

2.2 Immediate objectives

The immediate objectives of the programme are designed to demonstrate a methodology whereby:

- the results of a market survey will at the outset define the most likely commercial technical opportunities (consumer acceptance) in easy-care and soil resistant properties for cotton and cotton rich fabrics related to specific end-use criteria;
- the results of a simultaneous experimental research and development programme will lead to:
  (a) optimization of fabric finishing technology based on the most advanced state-of-the-art of chemical systems and properties;
  (b) analysis of costs prior to scale-up;
  (c) conduct of commercial trials in selected textile mills with appropriate attention to quality control;
  (d) evaluation of the results of test marketing programmes for specific products selected;
- ultimate assessment which will include evaluation of cost-benefit ratios and potential commercial exploitation of the products chosen and developed.

3. Opportunities for Cotton Development

During the past two decades, considerable progress has been achieved in world-wide research which might enable cotton fabrics to compete effectively against the new synthetic fabrics. However, because markets in developed countries have shifted largely to synthetics or to their

blends with natural fibres, only few instances can be cited where research results in all-cotton fabrics have been commercially applied. Cotton research activity in developed countries has almost disappeared as commercial opportunities to exploit the results would appear to have vanished. The textile industry in developing countries, however, can benefit from a large backlog of earlier technical progress in cotton research. They can introduce superior cotton products in their own countries and improve their cotton export position in relation to both developed and other developing countries.

Synthetic-containing fabrics have been rapidly accepted in developed countries on account of their inherent easy-care performance. Blend fabrics containing at least 50 per cent synthetic fibre are treated with chemical finishes and heat-set to impart three desirable properties:

- the maintenance of a permanent, sharp crease as desired in apparel;
- smooth-drying properties after laundering which obviate the the need for ironing; and
- muss-resistance during wear and use.

The high inherent strength of some synthetic fibres, notably polyester, provides long, useful life to blend fabrics made from polyester and cotton. Despite the outstanding properties of polyester fibre, however, industry practice in the case of spun yarns is to blend up to 50 per cent natural fibre, e.g. cotton, with polyester so as to maintain the garment or fabric aesthetics required, comfort and freedom from pilling.

Advantages to the consumer inherent in these new blend fabrics are considerable, and polyester usage in blends has increased dramatically during the past decade, even at a time when polyester prices far exceeded those of cotton. Countries and organizations which have a vested interest in the production and sale of cotton have a responsibility to undertake research and development in order to enhance the cost-effectiveness of cotton and cotton-rich fabrics so that they might compete with the synthetics.

It can be expected that the most broadly acceptable technical advantage of cotton and cotton-rich fabrics would be realized in the areas of easy-care performance and, possibly, anti-soiling properties, designed specifically to meet identified end-uses.

Technological approaches for imparting both easy-care and soil resistant properties to cotton and cotton-rich fabrics are well-known in developed countries. However, because these finishes have not been reduced extensively to commercial practice, consumer response has not been tested adequately. It is essential, therefore, to measure the potential advantages of cotton products as they compete with synthetics or blends, and to evaluate the consequences of any price premium that might be required.

3.1 Easy-care properties

Research scientists have directed more attention to the object of imparting easy-care properties to cotton fabrics than to any other area. The extensive technology confirms that, although smooth-drying properties can be achieved in a number of ways, associated fabric strength loss is generally observed. Innumerable attempts to reduce this strength loss have resulted in partial successes in some instances.

The introduction of chemical corsslinks within the fine structure of the cotton fibre provides resiliency and easy-care properties. The condition of the fibre swelling at the time of crosslinking governs the type of recovery obtained (wet or dry) and, to some extent, the strength loss which occurs.

In developed countries, the common practice of tumble drying fabrics after laundering makes high levels of dry crease recovery essential. This also produces the greatest strength losses. When fabrics are line dried, as in most developing countries, smooth drying properties imparted as a result of crosslinking in the wet or swollen state are preferred.

In the late 1960's several technical approaches were described for imparting wet recovery with minimal losses in strength and serviceability.[1/] These have been referred to as wet fixation, mild cure and damp cure processes. An additional technique, the "polyset" process, can be varied almost at will to provide any desired combination of wet and dry recovery. One problem associated with this technology, however, has been the difficulty in avoiding fabric susceptibility to chlorine bleach, a problem which must be resolved or circumvented.

1/ "A Status Report on All-cotton Durable Press Research", B.M. Kopacz and R.M. Perkins, Textile Chem. and Col. 1, 80 (1969).

Each textile product presents a unique combination of specific property requirements. The finishing technique which best meets the overall requirements must be selected in each instance whereafter the process technology must be optimized to meet the specific needs of the item in question.

In many household textiles and certain items of apparel permanent creases are unnecessary. Fabrics for these items can be fully finished by completing the crosslinking process (precure) in the textile and utilizing technology suitable for crosslinking in the swollen state. In selecting items in this category, serious consideration will be given to those which can benefit most from wet crosslinking; the fabric and process selection will then be optimized on the basis of this approach.

A major advantage of durable press technology lies in its ability to introduce permanent creases and pleats in garments setting them to the desired configuration. Following garment fabrication, resin-sensitized fabric can be creased on a hot-head press and the finished, pressed garment is then cured in an over (post-cure). Whereas the garment industry in industrialized countries is highly proficient in this technology, the approach has not made any significant inroads in developing countries, owing to such problems as distribution and low volume production.2/ The proposed project presents an opportunity to test further the potential benefits to be derived from post-cure technology under circumstances removed from economic pressures and proprietary interests. At least one product line using the post-cure technology and the co-operation of an apparel manufacturer should be included in the project in order to test the advanced technology and marketing concepts.

In many items of apparel muss resistance during wear is particularly important. This requires a measure of dry crease recovery as well as wet recovery and might, for example, utilize the "polyset" process. On the other hand, in many household fabrics such as sheets and pillow cases, tablecloths, napkins and aprons, muss resistance is not as important a performance criterion and other processes, such as wet crosslinking alone, would be more suitable.

2/ "Relating Management and Technology Inputs to Socio-economic Conditions", P C. Mehta. Presented at the Annual Conference of the Textile Institute (Manchester), Sydney, Australia, February 1975.

3.2 Soil resistance and soil release

Soiling problems associated with the servicing of easy-care cotton textile items will be dealt with on several levels.

It is well known that the treatment of cotton fabric with cross-linking agents may cause the fabric, upon being laundered, to retain oily soils, such as common food stains and sebum oil from perspiration. Therefore, the best available soil release finish will be studied for possible use on selected items in combination with easy-care finishes.

Comparative data on soil release performance of experimental finishes on untreated cotton and on easy-care finished cotton and blend fabrics reveal that the performance even of untreated cotton fabrics can be improved. Therefore, the merits of test marketing appropriate soil release finishes, both alone and in conjunction with easy-care finishes, will be considered.

A large number of natural and synthetic hydrophilic polymers have been evaluated as durable soil release finishes. While considerable progress has been made in durable finishes for 100 per cent synthetic fabrics and several finishes are used extensively on a commercial basis, results with cotton blend fabrics have been less satisfactory and do not enjoy broad commercial application.

The preliminary market survey will attempt to identify textile products with maximum soil-release finishes. Known soil release technology will then be adapted to meet best the needs of those particular items. These textile items may or may not be included among the items, the easy-care property of which is also evaluated.

Finishes evaluated will include those based on synthetic polymers, including acrylics, as well as on natural polymers with demonstrated effectiveness as soil release agents, such as carboxymethylcellulose and hydroxylethylcellulose.

The natural environment of arid countries also gives rise to dry-soiling problems in textile items used in home furnishings (upholstery, rugs, curtains, etc.). Convenient means of cleaning these items, such as vacuum cleaners, are not commonly available or used. Therefore, a textile finish which provides dry-soil (dust) resistance would also be highly desirable. Items with a dry soil resistant finish will be selected for field and development testing should the results of a market survey and laboratory research indicate such a need.

4. Opportunities and Requirements in a Developing Country: The Case for India

4.1 Introducing new textile products in the Indian market

India is a large producer of cotton textiles (including cotton/viscose and cotton/polyester blends); annual production is approximately 9,350 million metres. India also enjoys an appreciable export trade in textiles amounting to approximately 525 million metres, valued at 2,000 million rupees.

Undoubtedly, the demand in India for the functional properties discussed earlier differs from that of the developed countries. This is primarily due to a difference in socio-economic conditions and to a lack of vigorous promotion by industry of the new technology. This notwithstanding, the urban population in India (approximately 120 million people) is rapidly achieving socio-economic conditions similar to those in developed countries. Living space is scarce and domestic help in short supply. Since most urban dwellers work in offices, a fairly high standard of "smartness" in dress is required.

Though cotton accounts for nearly 85 per cent of the total fibre consumption in India, pressure from synthetics is mounting, particularly in the metropolitan and urban areas. With the changing socio-economic conditions in urban areas, the need for easy-care textiles (and other consumer goods) has been steadily increasing. This need is particularly marked in the middle and upper income groups. It is also probable that a potential demand for easy-care commodities exists in the upper income groups in the developed rural areas.

Since synthetics and easy-care cotton which soil more readily cannot be cleaned easily or thoroughly when laundered at home, it would be desirable to add the functional property of soil release to that of easy-care.

Various textile mills in India have been marketing resin-finished cloth under a variety of brand names, which generally carry an assurance of "wash-and-wear". Unfortunately, the standards of dry and wet crease recovery vary considerably among the wash and wear fabrics marketed by different mills. Little attempt has been made to link production of wash-and-wear fabrics with the easy-care garment industry. Furthermore, consumers have not been adequately educated about the rigorous tailoring

necessary if maximum advantage is to be derived from the easy-care properties in the textiles. These factors have contributed to a certain amount of disillusionment among the consumers.

In the market-economy countries durable press (DP) or easy-care textiles are usually marketed in the form of garments. This has the advantage of ensuring that necessary precautions have been taken in the making up process to achieve maximum benefit from the DP finishing of the textile material. In the Indian market, the sale of ready-made garments constitutes but a very small fraction (less than 5 per cent) of the total textile sales primarily because ready-made garments are expensive and their sale is limited almost exclusively to urban centres.

Ten years ago, a DP finishing process for cotton/polyester fabrics was developed by the Ahmedabad Textile Industry's Research Association (ATIRA) and licensed to two leading Indian textile mills. DP shirts and slacks were marketed by the mills through reputed garment manufacturers. A fairly intensive promotion campaign by both the mills and garment manufacturers was launched to back the products, which proved quite successful. The initial demand for shirts, however, gradually declined after some three years owing to the significant price difference between the conventional and the DP polyester/cotton product. The DP cotton slacks are still being marketed; business, however, is generally of a very small volume in India, owing to the limited range of sizes in which slacks are manufactured.

From this experience and from an analysis of such factors as consumer needs and socio-economic conditions a fairly good potential demand for textile products with easy-care properties exists, provided that:

- a product of the highest standard is offered;
- marketing of the product does not ignore the rigorous tailoring requirements for satisfactory easy-care performance;
- reasonable pricing policies are adopted; and
- the product is adequately promoted.

In view of the above market characteristics, a finishing technology will have to be developed which will permit the sale of easy-care textiles by the meter and their conversion to the required garment following appropriate tailoring instructions.

Marketing of ready-mades will also be studied in the project. It is expected that the predominant demand will be for shirts (both formal and

casual), children's clothing, school uniforms, and slacks, the latter albeit on a relatively small scale.

Easy removal of soil (soil resistance and soil release) is almost a new concept in India and as such unknown to the large majority of consumers, even in highly educated circles. Demand for this property may be very low at present, particularly in view of domestic laundering habits which are based on manual washing rather than washing machines. However, in designing the project and test marketing, the export market requirements should also be taken into consideration, and soil release properties may be important in this context.

4.2 R and D requirements and ATIRA capabilities

The cotton processing industry has evolved gradually during the past two centuries, with the result that there is a large degree of world-wide uniformity of practice. History attests that cotton processing equipment enjoys a very long useful life, with relatively low maintenance and replacement costs.

In order to meet consumer expectations or demands, cotton fabrics off-the-loom are subjected to a protracted series of chemical treatments. Loom-state (greige) fabric is first singed, desized, scoured, bleached and usually mercerized before being finally dyed and finished. Of these operations, the "finishing" step was the last to be adopted. It requires a gas-fired heating oven, or stenter, through which the fabric is passed under controlled tension and at a specific speed. Many textile companies in developing countries, including India, already have all this equipment.

Research by industrialized countries in the areas of easy-care and soil-release cotton fabrics has been conducted to an extent where the type and magnitude of R and D in-put required for this project is demonstrable. With appropriate attention to published literature and the advice of experts as required, ATIRA can be expected to carry out the necessary research and development effort and to complete the remaining related objectives of this project. The results of this research must be implemented on the basis of close co-ordination between local industrial groups and the research organization.

ATIRA is very well equipped to undertake this research programme. For the last fifteen years it has had a research group active in chemical finishing which has contributed significantly both to the understanding

and industrial practice of resin finishing. Personnel competent in both the theory and practice of resin finishing are available in adequate numbers in the ATIRA Chemistry and Chemical Technology Divisions. Support in basic research competence in such fields as fabric behavior, etc., is available in the Physics and Chemistry Divisions of ATIRA.

ATIRA is also fully equipped for this project. It has a complete pilot mill in which yarns and fabrics of desired constructions can be produced in experimental quantities and finished either on a laboratory scale or on standard machines. Fully equipped physical and chemical testing laboratories are available for any analytical work that may be required. For more sophisticated measurements, recording UV, visual, and IR spectrophotometers, a scanning electron microscope, GLC, and NMR spectometer are also available. Staff specifically trained in the operation of these instruments and the interpretation of results are available.

ATIRA also disposes of the instruments needed to screen easy-care and soil-release fabrics and to test fabrics to specifications. In addition to these specific facilities, ATIRA disposes of other support facilities such as a well-stocked library, a central workshop, a precision workshop, and an instrumentation group as well as specialists in various technologies related to textile manufacture.

Being a co-operative research association and having a membership of nearly 150 textile mills, ATIRA's relations with the textile industry are very close indeed. The association is held in high esteem by the industry which has put several of ATIRA's research results and recommendations into practice. On two occasions in the last twelve years, DP finishing projects were sponsored by some of the leading member mills. This sponsorship involved substantial financial contributions, the supply of fabrics of given specifications, and the provision of semi-bulk and bulk processing facilities. Some of the member mills in and around Ahmedabad have their own, or subsidiary, shirt-making factories while others work in close co-operation with garment manufacturers. No difficulty is therefore visualized in getting support from industry in the supply/manufacture of fabrics to required specifications, nor in effecting the necessary finishing under stipulated conditions, and converting the finished fabrics into ready-made garments. Many of the mills are well equipped for resin finishing with suitable preparatory machinery, padders, stenters and polymerizers.

Initial market research and final test marketing are visualized in this project. India has some very competent advertising and market research agencies, with two of which ATIRA enjoys excellent professional relations.

5. Plan of Work

5.1 Research

The project can be divided into four major phases, each of which includes a number of tasks and goals discussed in detail below. The block diagram (Table 5.1) summarizes the phases of the project, tasks and targets which must be implemented and co-ordinated in the course of the project.

Phase I: Research

This phase includes both the market research needed to identify product targets and the laboratory research aimed at selecting optimum materials and conditions for processing. The research results will constitute the basis for the preliminary cost estimates and development plans.

Phase II: Development

This phase includes scale-up experimentation in the pilot plant and the complete evaluation of the processes and products selected. Results of development work will be used to identify mills where evaluation can be carried out on a commercial scale and as a basis for a realistic analysis of cost/benefit ratios.

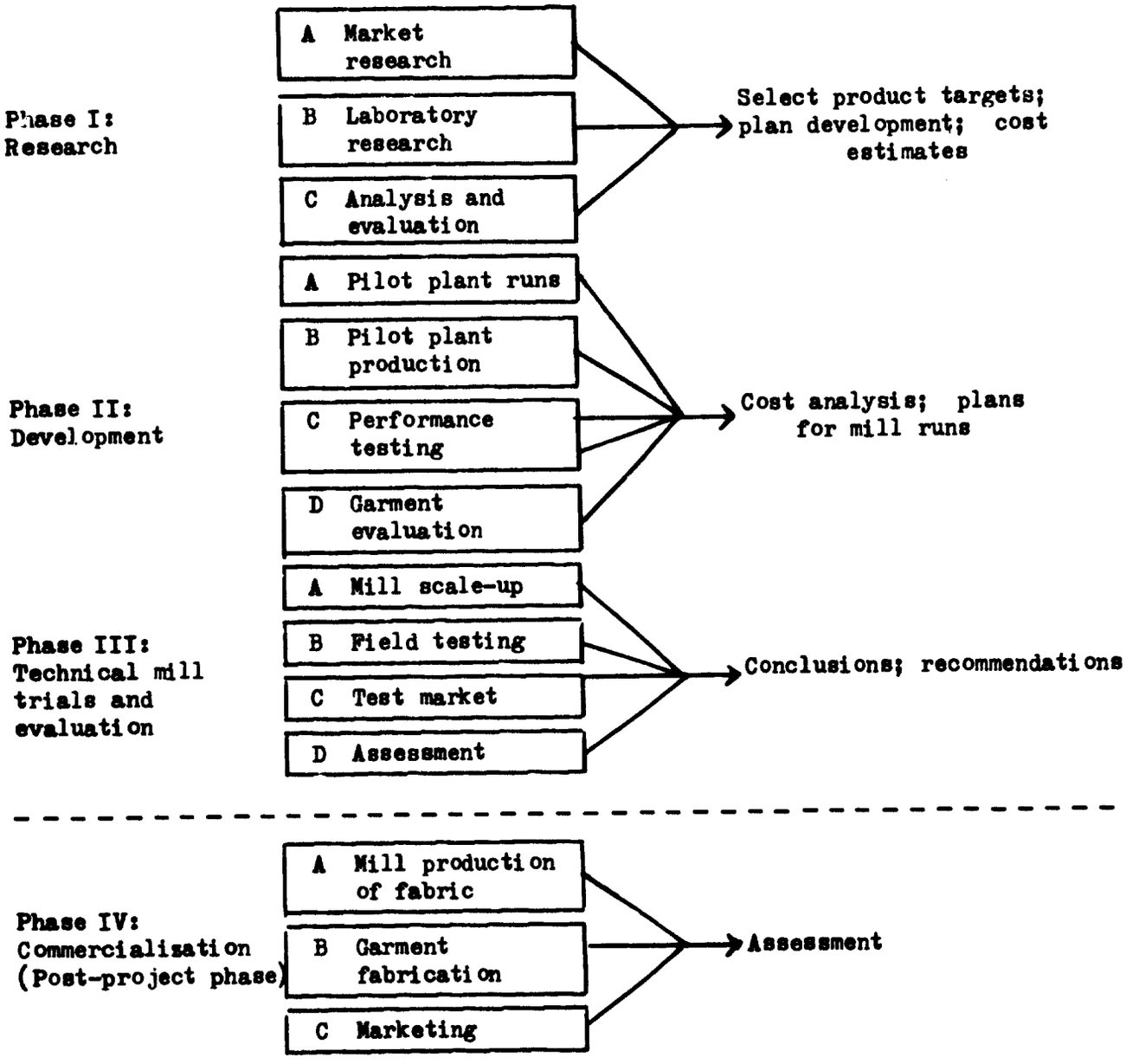
Phase III: Technical mill trials and evaluation

This phase includes production and limited testing under realistic conditions of commercial practice and consumer use. The results obtained will be used to define the conditions for fabric processing and garment fabrication, performance specifications, marketing recommendations and economic analysis.

Phase IV: Commercialization

This phase involves the full-scale implementation of the recommendations resulting from preceding work prior to an overall assessment of the programme results. Due to the prolonged time span between full-scale marketing of the products and evaluation of the commercial success of the project, this phase is not an integral part of the proposal and, therefore,

Table 5.1 Co-ordination of Phases of the Project



no budget provision has been made. Nevertheless, the subcontractor will provide UNIDO with a full-scale report of the results of commercialization as soon as they become available.

5.1.1 Market research

The market research will be undertaken in the middle and upper income groups in the larger cities of India. It is planned to obtain the following information:

- existing/potential demand for the selected properties;
- effect of price level on demand;
- fabric preference: for example, would consumers accept twill instead of poplin for shirting, provided this gave them better performance at equal or lower costs;
- fibre preference for the same price and performance: would consumers prefer 100 per cent cotton or cotton/polyester blend;
- consumer expectation of durability from the various end-use garments included in the study.

The details of the market research plan are attached as Appendix A.

5.1.2 Laboratory research

(a) Selection of fabrics

The ultimate selection of fabrics will depend on the results of market research carried out to identify desirable end-products (see 5.1.1 above). Within each end-use category, optimum constructions and preparation procedures will have to be defined. While awaiting results of the market research study, laboratory work will be initiated on readily identifiable prototype fabrics to be used in the investigation of chemical systems and processing conditions.

The following variables will be investigated on appropriate fabric substrates in initial laboratory work, using a limited number of chemical finishing systems:

- weight (e.g., 4 ounces per square yard, 8 ounces per square yard)
- weave (e.g., 4 ounces per square yard, oxford weave vs. plain weave vs. twill weave)
- preparation (e.g., mercerized vs. unmercerized sheeting)
- dyeing (e.g., white or light shade vs. dark shade - vat dyed).

After this initial investigation, two to four prototype fabrics to be used in laboratory research will be identified and procured in sufficient amount to provide material throughout the research and development phases

of the project. For example, one of the prototype fabrics used for laboratory research will be included as a reference material in pilot-plant experiments carried out on fabrics selected for commercialization in later phases of the project.

(b) Selection of crosslinking agents and processing conditions

The variables investigated will include corsslinking agents, catalysts, additives and processing sequences as summarized briefly in Tables 5.2, 5.3 and 5.4. Properties of critical importance will be evaluated on laboratory treated samples (see list in Table 5.5). Part of this research will include a scrutinous survey of recent technical literature to obviate the risk of duplication. Generally speaking, the investigation of cross-linking agents and processing conditions will be designed to identify optimum chemical finishing systems and processes for the fabrics and end-uses selected. Considerations of chemical availability, ease of processing, performance and economics will determine the preferred systems and conditions. The objective of this research task is to optimize existing technology rather than to develop new approaches. This investigation is considered to be a critically important and technically demanding task. Its success will depend primarily on the skillful and effective design of the experiments, and on the critical analysis of experimental results.

(c) Evaluation of finishes that impart resistance to dry soiling

The possibility of imparting resistance to dry soiling will be investigated if it is proven that it could add a functional property of particular interest to countries with arid climate.

Finishes that impart resistance to dry soiling such as aluminum, zirconium and other metal oxides are known, but have generally been recommended for synthetics. Furthermore, they require application from strongly acidic media and are inherently unsuitable for use on cellulosics 3/4/5/

3/ "Antisoiling Alumina Coatings for Porous Surfaces", U.S. Defensive Publication T 904,025, November 1972.

4/ "Antisoiling Synthetic Textile Fibers", British Patent No. 1,237,628, June 1971.

5/ "The Treatment of Textile Fabrics", British Patent No. 1,231,009, May 1971.

Table 5.2 Durable Press Finishing

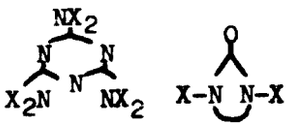
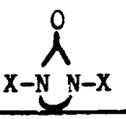
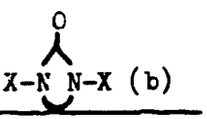
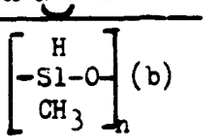
Finishing process	State of cellulosic fibre: Reaction	Constitution of basic crosslinking agent
Dry crosslinking (elevated temp.) Conventional finish Flash curing Permanent press Combined finishing and dyeing	De-swollen; Acid catalysis	X-HN-CO-NH-X X-HNCO-$(CH_2)_n$-CONH-X X-HNC(O)O$(CH_2)_n$O(O)CNH-X X-O$(CH_2)_n$O-X $ROCONX_2$ $ROCNX_2$ (X=CH_2OR R=H, Alkyl) 
Moist corsslinking (various temps.) Moist-batch Will Speed-dry	Partially swollen; Special acid catalysts	Special types of 
Wet crosslinking (low temps.) Alkaline (a) Acid (b)	Swollen; Alkaline or acid catalysis	$S^{\ominus}(CH_2-CH_2-OSO_3^{\ominus})_3 2Na^{\oplus}$ (a) $CH_2-CH-CH_2Cl$ (a) O 
Multi-stage crosslinking (various temps.) Bel-O-Fast Tab-X-Cal Ambivalent crosslinking	De-swollen and swollen; Acid and alkaline catalysis	$CH_2-CH-CH_2Cl$ First stage → $S^{\ominus}(CH_2-CH_2-OSO_3^{\ominus})_3 2Na^{\oplus}$ → $CH_2=CH-C(=O)-NH-X$ → Second stage 
Special finishes Oil-repellent (a) Water-repellent (b)	De-swollen; Acid catalysis	$C_7F_{15}-CONR_1R_2$ (a) $C_7F_{15}-SO_2NR_1R_2$ (a) 

Table 1 Resin-finishing processes and the basic corslinking agents used.

Table 5.3 Catalysts and Additives
(Dry Crosslinking)

Catalysts:	Ammonium salts (e.g., NH_4Cl)
	Amine salts (e.g., hydrochloride)
	Organic acids (e.g., citric acid)
	Metal salts - (Zn, Mg, Al)
	Metal salts + organic acids (low temperature cure)
Additives:	Polyethylene emulsions
	Polyacrylate dispersions
	Silicones

Table 5.4 Processing Sequences
(Durable Press)

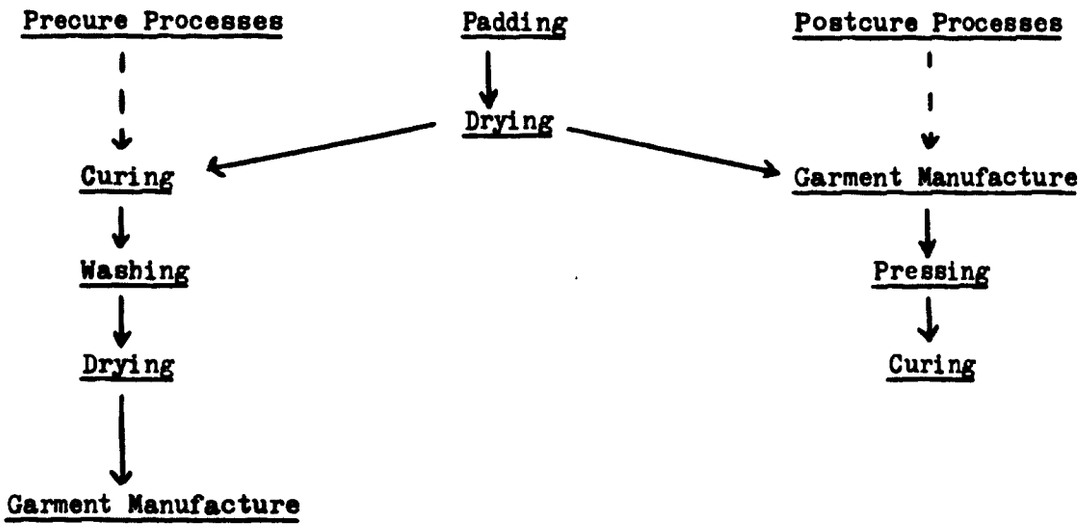


Table 5.5 Properties of Critical Importance
(Easy-care Cotton Fabrics)

1. Dry crease recovery; wet crease recovery
2. Dimensional stability
3. Tensile strength, tear strength; abrasion resistance (wear life)
4. Aesthetics (color, hand)
5. Durability of finish
6. Effect on dye fastness

It is proposed that modifications and improvements of approaches designed to improve resistance to dry soiling be investigated on easy-care cotton products in the present programme.

The study of this possibility will begin with the investigation of novel methods for obtaining metal oxides in situ, using a crosslinked (easy-care) cotton fabric as the substrate. Effect on resistance to dry soiling, durability, and side effects will be evaluated, and the possibility of combining "anti-soil" finishes with crosslinking treatments will be assessed.

(d) Evaluation of finishes to improve release of oily soils (soil release)

The selection of chemical systems which improve soil release in crosslinked cotton fabrics will be approached initially by evaluating candidate polymers applied to corsslinked fabrics as a second step or "topping" treatment. Candidate polymers will be obtained from commercial sources and/or "in-house" synthesis, including, for example:

- addition (vinyl) copolymers of unsaturated acids: acrylic, methacrylic, vinyl sulphonic, vinyl phosphonic, etc.;
- condensation polymers of ethoxylated polyols with polycarboxylic acids: citric, tartaric, etc.;
- copolymers of vinylpyrrolidone.

The effectiveness of these systems, their compatibility with crosslinking systems and/or finishes designed to improve resistance to dry soiling will be evaluated.

(e) Formulation of multi-functional finishes

Based on the results of studies outlined above in (b), (c), and (d), multifunctional finishes might prove feasible. At this stage of the project, results of market research studies 5.1.1 will have identified product targets and specific fabrics of interest. These fabrics will be immediately included in the laboratory research programme, and the emphasis will shift from the broad systematic laboratory investigation of variables to a narrow spectrum of systems and conditions for study in the pilot plant. Before embarking on the pilot plant phase, a decision will be taken as to whether finishes for resistance to dry soiling and/or for release of oily soils will be included in the pilot plant evaluation.

5.1.3 Analysis and evaluation of research results

Extensive laboratory evaluation of the systems selected will be carried out prior to experimentation in the pilot plant, and guidelines for the development phase of the project will be established, including the following:

- fabrics to be used in pilot-plant experiments;
- chemical systems;
- processing conditions;
- preliminary analysis of costs for candidate processes/products to cover chemical cost and processing costs;
- evaluation and testing.

5.2 Development

5.2.1 Pilot plant experiments

The first round of experiments in the pilot plant or initial scale-up will be designed to translate laboratory conditions to pilot plant equipment, and to detect pitfalls and problems that might arise in scale-up:

- estimated number of fabrics tested in pilot plant runs: four to six;
- estimated number of conditions tested for each fabric: four to six;
- number of samples to be tested: 16 to 36 (ca. 50 yards each);
- estimated number of pilot plant experiments: four to nine.

5.2.2 Pilot-plant production

From the results of pilot plant experiments, a maximum of three fabrics and three conditions will be selected for full evaluation (maximum nine samples).

Several hundred yards of each fabric will be finished under commercially acceptable mill conditions including all steps considered essential to the process (fabric preparation, impregnation, drying, curing, afterwashing, and mechanical aftertreatment, if any). The conditions and variables in each step will be carefully scrutinized in the context of known mill practice and adjustments will be studied wherever required by practical considerations. After testing and performance evaluation, treated fabrics will be selected for the purpose of investigating garment manufacture. Based on the results of scale-up work, fabric processing costs will be analyzed. While it is recognized that specific details of mill processing costs vary from mill to mill and are, in any event, not readily available, the analysis of finishing costs will be based on price ranges for the raw materials employed and on expert estimates of processing costs.

5.2.3 Pilot evaluation

Complete testing, manufacture of sample garments and wear testing will be carried out on fabrics produced in the pilot plant. Review and analysis of results and, if necessary, repeat runs, will lead to:

- identifying mills where commercial scale-up can be undertaken;
- preparing full instructions for mill processing of fabrics and quality control protocols;
- defining changes (if any) needed in end-product fabrication and testing;
- revising and complete cost analysis for selected fabrics/processes/products.

5.3 Technical mill trials and evaluation

This phase will include the following steps:

- mill trials (two to four) to confirm results of pilot plant evaluation, which will be carried out on sufficient yardage to constitute limited production runs, and to allow garment fabrication under realistic conditions;
- garment fabrication and evaluation.

Garment prototypes and styles selected will depend on the results of research work and on the fabric constructions which prove to be viable candidates. A few garments will be made and evaluated early in the project (see 5.2.3); garment manufacture and evaluation will be a key activity in this phase.

Garment pairs made from treated and untreated fabric will be styled, manufactured and tested according to the established techniques and programmes of the garment and retail industry, including field testing.

The number of garments required for a meaningful evaluation of performance will be determined by experts; however, several dozen garments will have to be included. All observations on the processing of the treated and untreated fabrics into garments will be recorded and reported; any insurmountable obstacles (if any) to the utilization of specific treated fabrics will be defined.

This evaluation will provide firm conclusions regarding the technological practicability of the processes studied, and will constitute a basis for the realistic analysis of cost/benefit ratios for consumers. Sales will be through selected market outlets.

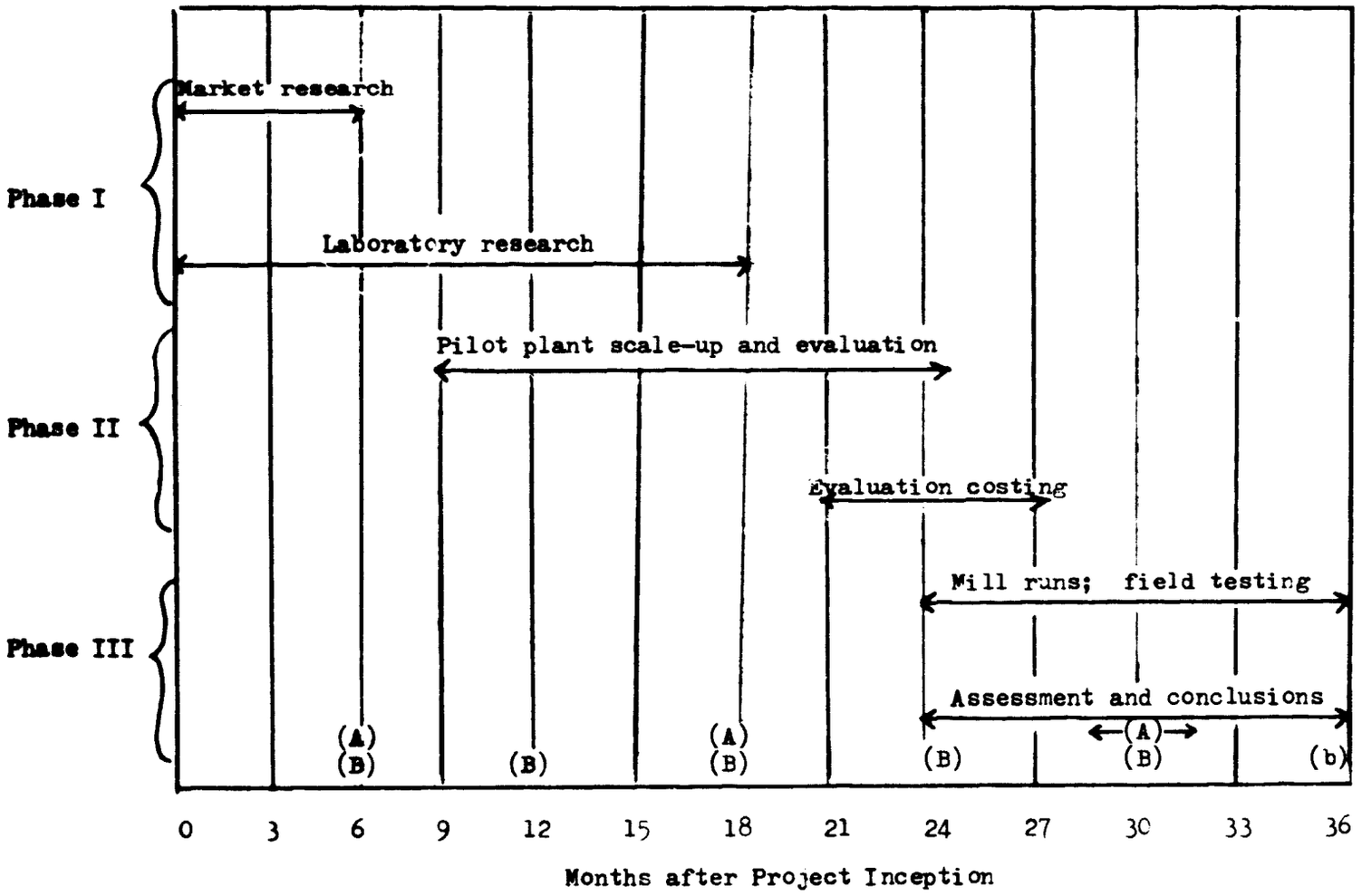
6. Reporting and Dissemination of Project Results

An essential component of the project is the dissemination of results and accomplishments during the various phases, not only in terms of meeting the research and development objectives of the project, but also in terms of developing a methodology on appropriate product technology. This dissemination constitutes an essential contribution to the third long-term objective of the project, the promotion of co-operation among developing countries.

The sub-contractor will establish an internal Advisory Committee drawn from academic and industrial environments for the purpose of advising on research and development efforts insofar as they relate directly to the Indian market, and of maintaining liaison with the industry. Furthermore, the sub-contractor will liaise with selected individuals in other developing countries in order to ensure wider application of the project's results. Towards the end of the third phase of the project, teams of experts from various geographical regions will participate in expert group meetings. These meetings will be held either at the ATIRA headquarters in Ahmedabad or, in the case of the more distant geographical regions, in those regions with ATIRA staff in attendance. At these expert group meetings, the various technical and other accomplishments of the project will be reviewed and recommendations for future action put forward.

UNIDO will also exercise a certain advisory role in respect of the project. Every six months, the sub-contractor will report to UNIDO on the implementation of the project. Furthermore, the sub-contractor will submit detailed technical reports to UNIDO at the end of each phase (see Table 6). For its part, UNIDO shall set up an advisory panel directly responsible to the Organization which, after studying these reports, will advise on any modifications to the research and development which it feels are necessary to the attainment of the project's objectives. The comments of the Advisory Panel will be communicated to ATIRA so that appropriate action can be taken.

Table 6. Project Time Table



(A): Advisory panel review; (B): Subcontracter review (progress report)

Appendix A. Market Research Proposal[1/]

The market research component of the New Product Commercialization Study - Cotton Textiles is aimed at providing guidelines to the technical group for development of new fabrics based on consumer preferences, acceptability and potential demand for the new fabrics. In addition, after the products (fabrics) are developed and tested both in the laboratory and in the fields, under controlled conditions, market research would assess consumer acceptance and satisfaction in a test market situation.

Two distinct phases of market research are being proposed:

- Phase I, which would precede extensive laboratory research, comprises three surveys:
  - (i) a consumer survey;
  - (ii) a survey among wholesalers and retailers of cloth and garments;
  - (iii) a survey among institutions such as hospitals and hotels, which are high volume consumers of bed linen (easy-care cotton sheets being one of the new products envisaged);
- Phase II, which would be synchronized with test marketing, comprises two surveys among panels of "purchasers" of the new products (fabrics or garments):
  - (i) Survey - Round 1 which would be conducted three months after purchase;
  - (ii) Survey - Round 2 which is planned nine months after purchase.

The specific research objectives of these phases, the survey plan and certain methodological aspects are discussed in the sections that follow.

Phase I: Market Survey among Consumers, Dealers and Institutions

Objectives

1. Consumer Survey

The research objectives of the consumer survey are to ascertain:

1/ Prepared by the CORE Division of Clarion-McCann Advertising Services, Ltd., Bombay, India.

1. Consumer attitudes, perceptions and socio-psychological associations with cotton fabrics, pure synthetics and blends;
2. Consumer purchase behaviour (fabric/ready-made garments; price expectations; fibre preferences) related to various end-uses;
3. Consumer perceptions and expectations regarding "easy-care" properties (wet creasing/dimensional stability/drycreasing);
4. End uses for which "easy-care" properties are required;
5. Consumer expectations regarding durability for various garments measured in terms of:
   - wardrobe size;
   - purchase frequency;
6. Consumer expectations regarding the "life" of various garments, i.e. how often and when garments are discarded and the reasons for discarding;
7. Relative importance attached by consumers to fabric properties: easy-care properties; wear resistance; comfort; cleanability; for various end-uses;
8. Consumer preference for fabrics which are which, coloured, checks, stripes, printed, related to various end-uses;
9. Consumer washing habits:
   - mode of washing;
   - expectations;
   - experience;
   - end-uses for which washing is most difficult;
10. Consumer reaction and buying interest/intentions for two product concepts at two alternative price levels:
    - easy-care cotton - price "low" (closer to cottons)
    - easy-care cotton - price "high" (closer to blends)
    - cotton-rich blends - price "low" (closer to cottons)
    - cotton-rich blends - price "high" (closer to blends);
11. Buying interest/intentions for the two fabric concepts related to:
    (a) end-uses as perceived by the consumer; open-end enquiry;
    (b) specific end-uses:
        - shirts (office wear, casual wear, dress shirts);
        - bedsheets;
        - children's garments (school uniforms, casual wear, occasional use);
12. Consumer preference as regards "weaves"; inclination to shift from poplins to twills if easy-care properties are available;
13. Consumer interest in a soil-resistant finish and price premium consumers would be willing to pay.

2. Trade Survey

The research objectives of the trade survey are to ascertain:

1. Dealer perceptions regarding consumer preferences and requirements:
   - cottons/blends;
   - white/coloured/checks/stripes/printed;
   - fabric properties (particularly easy-care and durability);
   - weaves (poplins/twills).

The above would be related to various end-uses.

2. Dealer opinions on consumer acceptability of the two fabric concepts:
   - easy-care cotton;
   - cotton - rich blends

at two alternative price levels.

3. End-uses for which each of the two fabric concepts is more likely to be acceptable.

4. Consumer inclination to shift from poplins to twills if easy-care properties are available.

3. Survey among Institutions (hotels, hospitals)

Since hotels and hospitals are high-volume consumers of bedsheets and table and bed linen, it is felt that a survey among a few major hospitals and hotels would provide feedback on their requirements and their perceived "need" for easy-care fabric properties.

The research objectives of this survey are to ascertain:

1. The institution's requirements for table and bed linen (table cloths; bedsheets; pillow cases; etc.):
   - inventories;
   - annual requirement.
2. Fabric preferences (plain cotton; khadhi; coloured; stripes, etc.).
3. Limitations, if any, for choice of fabric or source of supply.
4. Washing patterns:
   - mode of washing;
   - frequency of washing;
   - finishes/washing requirement;
   - washing costs.
5. Perceived need for easy-care properties.
6. Buying interest/intentions/price expectations for the fabric concepts:
   - easy-care cotton;
   - cotton-rich blends.

7. Inclination to change washing habits if easy-care properties are available.

Survey Plan

1. Selection of Centres

Most consumer products in the Indian market are initially launched in the major metros and mini metros. Since three of these cities (Bombay, Ahmedabad, Kanpur) are textile manufacturing centres, the survey among textile wholesalers will be restricted to these three centres. The survey among institutions (hotels and hospitals) will be conducted only in the major metros due to the prevalence of large hotels and hospitals in these centres.

The centre-wise survey plan for the various surveys is shown below:

Urban Centres (Population)	Consumer survey	Trade Survey: Whole-salers	Trade Survey: Retailers (cloth)	Trade Survey: Retailers (garments)	Survey among institutions
Major Metros					
Calcutta (7.6 million)	X		X	X	X
Bombay (6.6 million)	X	X	X	X	X
Delhi (3.7 million)	X		X	X	X
Madras (3.2 million)	X		X	X	X
Mini Metros					
Hyderabad (1.8 million)	X		X	X	
Ahmedabad (1.8 million)	X	X	X	X	
Bangalore (1.7 million)	X		X	X	
Kanpur or Lucknow (1.3 million / 0.6 million)	X	X	X	X	
Pune (1.1 million)	X		X	X	

The above centres are geographically dispersed and together are broadly representative of the geographical, cultural and climatic conditions prevailing in the Indian sub-continent.

In addition to selecting these urban centres we also propose to extend the consumer survey to cover the rural population in five developed districts which are geographically dispersed.

2. Consumer Survey

The share of cotton textiles has declined over the years among all income groups; however, it has declined considerably more in the Rs. 6,000 and above annual income groups Data on consumer purchases of textiles (1974)

gathered by the Textile Committee (Ministry of Commerce, Government of India) indicates that in income groups with an annual income of Rs. 6,000 and above, textile purchase of non-cotton and mixed fabrics as a proportion of total purchases is 30 to 50 per cent in terms of quantity (meters) and 50 to 65 per cent in terms of value.

Our focus for the consumer survey would be households with an annual income above Rs. 6,000. About 55 per cent of the population in the selected centres has an annual income over Rs. 6,000.

Since income is a major determinant of preferences for textiles, we propose to increase the sampling efficiency by drawing the sample from three separate income strata:

	Annual income
middle	Rs. 6,000 to Rs. 9,999
upper middle	Rs. 10,000 to Rs. 19,999
upper	Rs. 20,000 and above

The consumer survey in the rural areas would, however, be restricted to the Rs. 20,000 and above income group for reasons similar to those cited earlier.

Within each income strata we propose to have two sub-samples. Each sub-sample would be exposed to the new fabric concepts at different price levels.

Sub-sample I: Exposed to concept at low price level (closer to cottons)

Sub-sample II: Exposed to concept at high price level (closer to blends)

In order to permit valid statistical analysis by income strata for the selected major metros and mini metros we propose the following sample sizes:

For each Major Metro	Number of Households with Annual Income of:			
	Rs. 6,000 to Rs. 9,999	Rs. 10,000 to Rs. 19,999	Rs. 20,000 and above	Total
Sub-sample I	100	100	100	300
Sub-sample II	100	100	100	300
Total	200	200	200	600
For each Mini Metro				
Sub-sample I	75	75	75	225
Sub-sample II	75	75	75	225
Total	150	150	150	450

For the rural areas a total sample size of 600 households is being proposed, which will be equally distributed among two sub-samples.

Respondent: In each household there will be two respondents.

1. The housewife, who will be interviewed regarding the household's washing habits and end-uses such as bedsheets, children's garments;
2. An adult male (age 15 years and above) who will be interviewed on end-uses such as shirts, trousers/ slacks, kurtas, etc.

The centre-wise sample distribution for the consumer survey is shown below:

Urban Centres	No. of Households	No. of respondents
Major Metros		
Calcutta	600	1,200
Bombay	600	1,200
Delhi	600	1,200
Madras	600	1,200
Mini Metros		
Hyderabad	450	900
Ahmedabad	450	900
Bangalore	450	900
Kanpur or Lucknow	450	900
Pune	450	900
Rural Centres		
Five developed districts (geographically dispersed)	600	1,200
Total	5,250	10,500

3. Trade Survey

The trade survey will be conducted among wholesalers in the major textile centres (Bombay, Ahmedabad and Kanpur) and among retailers of cloth and ready-made garments in all the centres selected for the consumer survey.

The sample size proposed for this survey is 575, with a centre-wise distribution as follows:

Centres	Wholesalers	Retailers (cloth)	Retailers (garments)
Major Metros			
Calcutta	25	50	25
Bombay	-	50	25
Delhi	-	50	25
Madras	-	50	25
Mini Metros			
Hyderabad	-	25	15
Ahmedabad	25	25	15
Bangalore	-	25	15
Kanpur of Lucknow	25	25	15
Pune	-	25	15
	75	325	175

4. Survey among Institutions

As indicated earlier this survey would be restricted to larbe hotels and hospitals in the major metros.

The proposed sample distribution for this survey is as follows:

Centre	No. of Hotels and Hospitals
Calcutta	25
Bombay	25
Delhi	25
Madras	25
Total sample size	100

Methodological Aspects

1. Data Collection

Data in all the market surveys will be gathered via a questionnaire based interview. The development of the principal data collection instrument, i.e. the consumer survey questionnaire, will constitute the following stages:

1. Group discussions and consumer interviews

Group discussions and consumer interviews will be conducted among small groups of consumers in Bombay, Delhi, Calcutta and Madras. The objective of these is to:

- ascertain general consumer notions and perceptions regarding various fabric properties and the terms used by consumers for articulating these perceptions;
- ascertain the terminology used to identify various types of fabrics particularly synthetic and blended fabrics;
- ascertain the range of attitudes which consumers have regarding cottons and blends.

2. Development of draft questionnaire

Based on the research objectives and the group discussions and depth interviews the draft questionnaire will be developed. For a good part of the questionnaire the scales used would be standard scales which have been used successfully by CORE in prior surveys in India, e.g. semantic differential scales; attribute importance scales; purchase intention scales; etc. This draft questionnaire will be discussed with the technical project team at ATIRA before finalizing it for pre-testing.

3. Pre-testing

The questionnaire will be pre-tested among small groups (20 to 30) of consumers in some of the selected centres. The results of the pre-test will be analyzed to identify necessary modifications for the final questionnaire.

2. Sample Selection

1. Consumer Survey

Since the consumer survey sample is stratified by income and has two equal sub-samples, a "household listing" phase will precede the questionnaire survey.

In the listing phase a large number of households (metros: 2,000; mini metros: 1,500) will be covered. From each household, data will be obtained on selected demographic and socio-economic parameters, i.e. age, education, occupation, monthly household income. For selecting these households certain starting points will be selected at random in each city and the field interviewers will visit a fixed number of households from each starting point, moving in a predecided direction.

The data obtained from the listing will:

- enable the drawing of matched sub-samples within each of the three income strata;
- provide "weights" for each of the three income strata, which will be used to weight the data in the analysis stage.

2. Trade Survey

This survey covers wholesalers, retailers of cloth and garment retailers. The wholesalers will be selected on a subjective basis. The sample of cloth retailers and garment retailers will be selected from the various shopping areas in the city.

3. Survey among Institutions (hotels and hospitals)

Since the sample for this survey is quite small, almost all the major hotels and hospitals in each of the selected survey centres will be covered.

3. Analysis

The data will be tabulated and analyzed separately by centre, income strata and sub-sample. It will also be analyzed collectively with appropriate "weightages".

Estimates of the potential demand for various new fabric types (easy-care cotton/cotton rich blends; poplin/twill weave, etc.) would be based on (a) consumer preferences; (b) consumer reaction/buying interest/intentions; (c) available data on consumer purchases of textiles. This data is gathered by the Textiles Committee, Ministry of Commerce of the Government of India and is available by income group for various garments and fibre types. The tabulation and analysis will be conducted at the Physical Research Laboratory (PRL) Computer Centre at Ahmedabad which has an IBM-360 computer. Statistical software package available at the centre will be used in addition to CORE's own software packages for analysis.

Phase II: Test Marketing

After the new fabrics have been developed and tested under both laboratory and field conditions, the fabrics will be distributed through selected market outlets as a test marketing exercise. We propose that this test marketing be conducted in three centres, i.e. a major metro and two mini metros. In these centres, after launching the products, two rounds of consumer research are planned. The consumer research would be among panels of "purchasers" of the new products (fabrics); the first round would be conducted three months after purchase and the second nine months after purchase.

Consumer Research Objectives

The objectives of the consumer research are to ascertain:

- consumer satisfaction/dissatisfaction with the fabric/garment purchased;
- how consumers compare the fabric/garment purchased vis-à-vis conventional blends;
- consumer opinions on fabric properties, particularly easy-care properties and durability based on usage;
- repurchase interest/intentions;
- socio-psychological associations with the fabric/garment vis-à-vis cotton fabrics and blends.

Survey Plan

In each of the test markets two consumer panels would be set up. These would be among purchasers of the new fabrics/garments.

Panel I: Purchasers of children's garments and bedsheets

Panel II: Purchasers of shirting material or ready-made shirts.

Each panel would comprise 400 purchasers. The panel members would be interviewed twice.

Round 1: 3 months after purchase;

Round 2: 9 months after purchase.

The total number of consumer interviews conducted would be 4,800, i.e. 3(test markets) x 2(panels) x 400(purchasers) x 2(rounds) = 4,800.

Methodological Aspects

1. Data collection

The data will be gathered via a questionnaire-based interview. The development and pre-testing of the questionnaire will be along similar lines as the consumer survey questionnaire in Phase I of the market research.

2. Sample Selection

Recent purchasers of the new fabrics/garments will form the consumer panels. In order to form the panels, either the shop listing method will be used or retailers will be asked to assist in noting down names and addresses of purchasers of the new fabrics or garments. From these lists, random samples will be drawn to form the panels.

3. Analysis

The data will be analyzed separately for each test market and for each panel. The analysis will be conducted by "end-use" based on the end use for which the fabric was purchased. Several hypotheses regarding the marketing of the new products developed after the first phase of the market research will be tested during this phase.

Time Estimates

Phase I: Initial planning/questionnaire design/pre-testing
Estimated time - 6 weeks
(After finalization of the questionnaire)

Field work	8 weeks
Tabulation/analysis	8 weeks
Preparation of report	4 weeks
	20 weeks

Phase II: After launching of fabrics/garments on the market:

Waiting period to allow purchase/ listing/formation of consumer panel	2 months
Interviews (first round)	3 months
Analysis/tabulation (first round report)	1 month
	6 months
Waiting period (between first and second rounds)	2 months
Interviews (second round)	3 months
Analysis/tabulation (second round report)	1 month
	12 months

Manpower Plan

The planning and co-ordination of the market research project and liaison with ATIRA will be handled by CORE's Bombay office. CORE offices in Calcutta, Delhi, Madras, Bangalore and Hyderabad will assist in organizing the field work.

In seven of the nine selected survey centres there are CORE division offices, in the other two centres CORE has regular panels of field investigators; the field work in all centres will be directly supervised by CORE Division personnel.

The manpower plan in terms of professional staff is as follows:

- A project team comprising a senior CORE executive in various centres, the liaison with ATIRA being handled by the Bombay based executive;
- A consulting group comprising of both individuals in CORE and consultants from the Institutes of Management (IIM) who have been involved in market research and have direct experience in textile marketing. This consulting group will review, consult and provide guidance to the project team at various stages of the project.

Appendix B.

India: Textile Purchases per Urban Households at Different Income Levels

(1974)

	Quantity (meters)			Value (Rs.)		
	Cotton	Non-cotton + mixed	Total	Cotton	Non-cotton + mixed	Total
Less than Rs. 1,500	45.46	4.17	50.17	206.10	63.86	270.04
Rs. 1,500-2,999	56.49	8.28	64.77	274.56	144.03	418.59
Rs. 3,000-5,999	67.12	16.54	83.66	356.45	299.41	655.86
Rs. 6,000-9,999	73.71	23.87	97.58	437.43	481.32	918.75
Rs. 10,000-19,999	76.92	29.03	105.95	521.73	611.05	1132.78
Rs. 20,000 and above	82.03	43.00	125.03	556.08	953.91	1509.99
Average	67.85	19.81	87.66	399.46	383.63	783.09

Source: "Consumer Purchases of Textiles", 1974, Textiles Committee of India.

Estimated Income Distribution of Households as of 1 July 1974

(in per cent)

Area	Income Groups (Rs.) Less than 1500	1500 to 2999	3000 to 5999	6000 to 9999	10,000 to 19,999	20,000 and above	
Cities	3.77	13.19	27.05	25.20	17.40	13.39	100%
Big towns	4.90	17.33	31.67	26.36	13.34	6.40	100%
Small towns	8.41	18.72	31.23	23.56	11.89	6.19	100%
Urban	6.82	17.27	30.37	24.37	13.35	7.82	100%
Rural	20.14	29.89	28.01	15.07	4.60	2.29	100%
All India	17.49	27.38	28.46	16.92	6.34	3.39	100%

Source: "Consumer Purchases of Textiles", 1974 Textiles Committee of India.

Appendix C. Fabric Variation and Property Checklist for Material Research

	Bed Sheets	Children's Clothes	Shirts: Formal	Shirts: Informal	Shirts: Fancy
A. Fabric Variations					
1. White Dyed Printed Coloured yarns					
2. Type of weave					
3. 100% cotton Blend cotton-rich Blend cotton-low					
4. Yarn number Yarn twist Yarn count (W/W)					
B. Fabric Properties					
1. Permanent folds (PP) - Precure - Post cure					
2. Easy-care (mainly wet creasing and dim. stability)					
3. Importance of dry creasing					
4. Wear resistance					
5. Strength demands					
6. Comfort Importance					
7. Cleanability, soil repellency					
8. Buy ready-made pieces fabric by yard					
9. Upopr cost limit of unit					
10. Size market segment					

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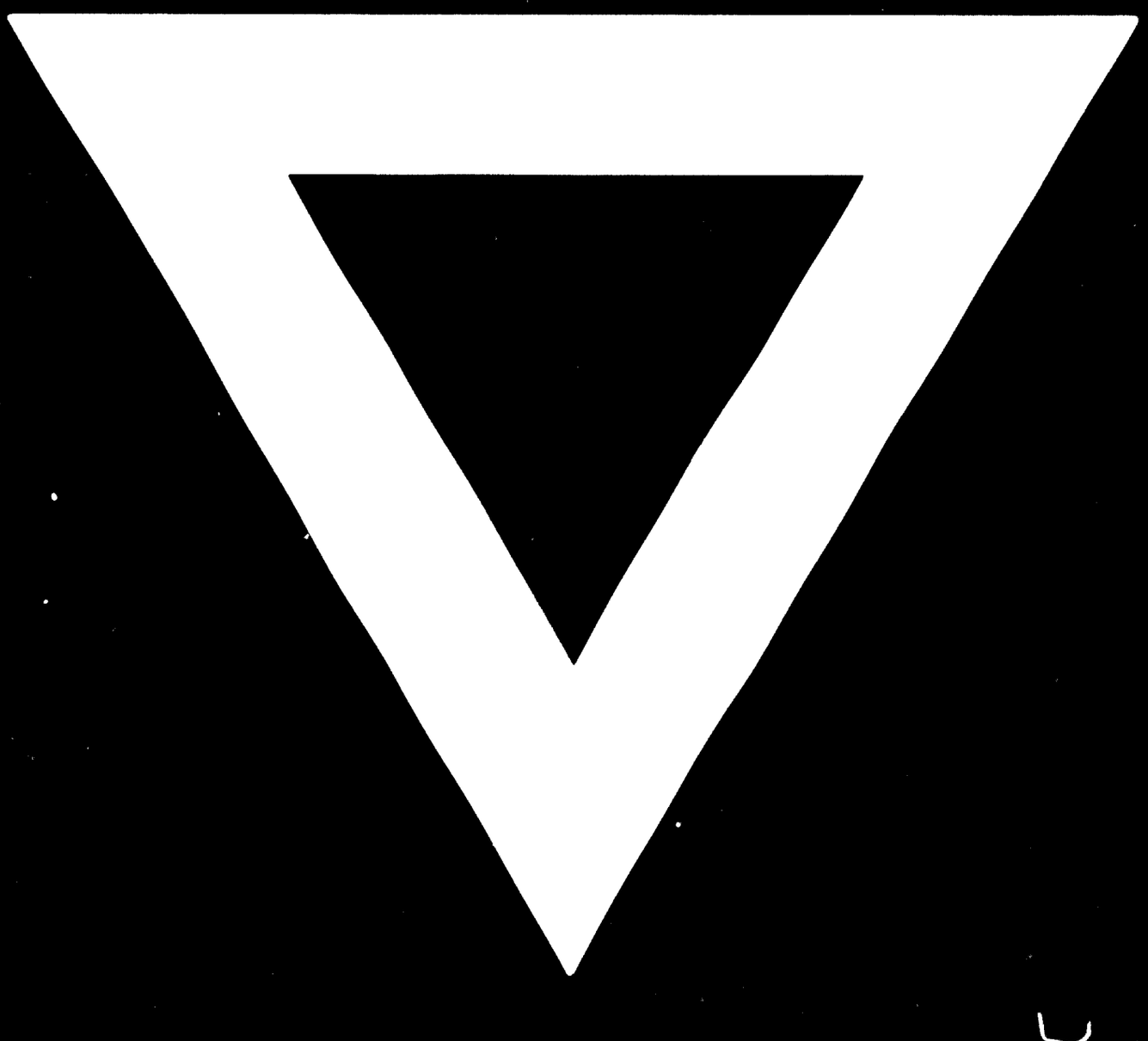

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