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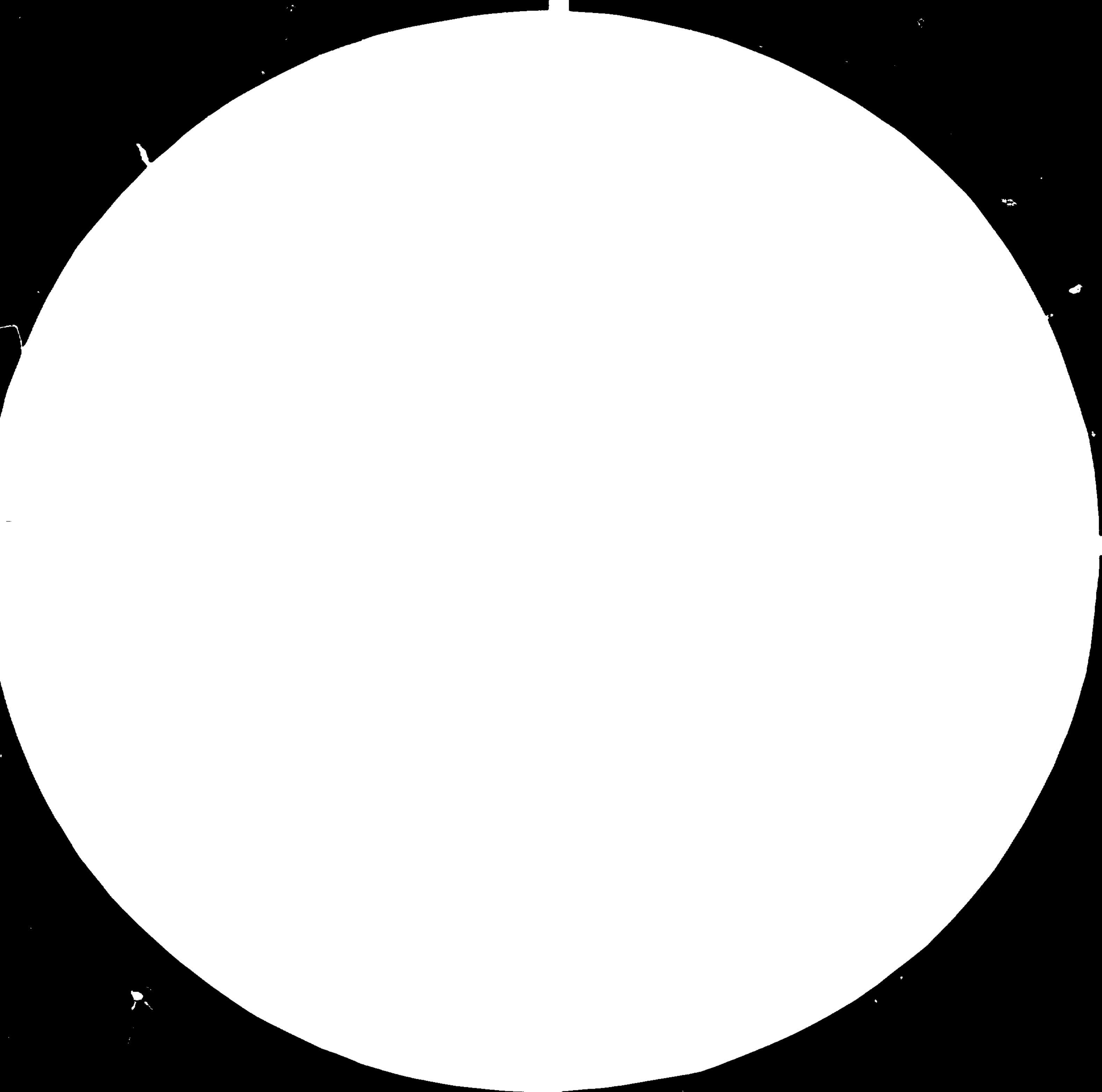
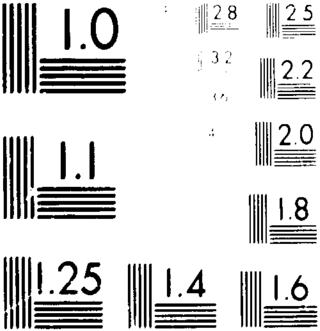
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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14 May 1979
English

ESTABLISHMENT OF A TEXTILE INDUSTRY DIVISION*

DP/THA/71/540

THAILAND

Terminal report

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

Based on the work of K.P. Moltu,
knitting expert

United Nations Industrial Development Organization
Vienna

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Explanatory notes

References to dollars ($) are to United States dollars, unless otherwise stated.

References to "pounds" (£) are to pounds sterling, unless otherwise stated.

TID refers to the Textile Industry Division.

ABSTRACT

The Government of Thailand requested assistance from the United Nations Development Programme (UNDP) with setting up a textile knitting laboratory. Accordingly, a knitting expert was sent to Thailand for one year from 2 June 1978. The United Nations Industrial Development Organization (UNIDO) was the executing agency.

The duties of the expert were to advise and assist in the planning, organization and development of a textile knitting laboratory. Specifically, to:

(a) Assist in carrying out extension programmes that aim at improving the knitting expertise of locally produced textiles;

(b) Train counterpart personnel;

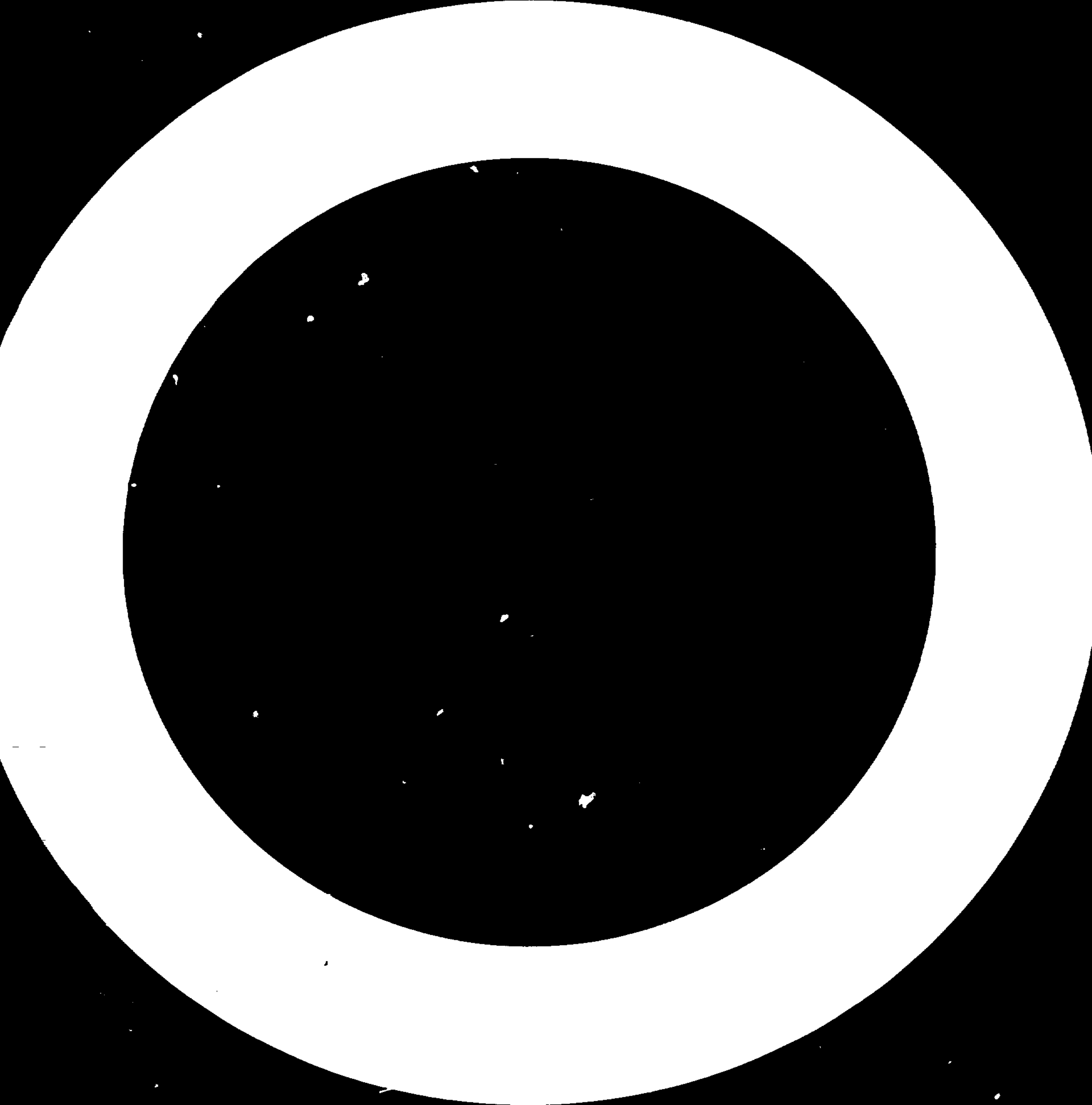
(c) Prepare a final report, setting out the findings of the mission and his recommendations to the Government on further action to be taken.

The recommendations were:

1. Staff should be further educated and trained abroad, if necessary.

2. Additional machinery should be obtained.

3. When sufficient qualified staff are available, regular visits should be made to the various knitting mills.



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INTRODUCTION

The Government of Thailand requested assistance from the United Nations Development Programme (UNDP) with setting up a textile knitting laboratory. Accordingly, a knitting expert was sent to Thailand for one year from 2 June 1978. The United Nations Industrial Development Organization (UNIDO) was the executing agency.

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The original job description was changed. Among other things it was decided to write, and give, an internal course for the knitting staff at the Textile Industry Division (TID) (annex I).

This course will form a basis for a more thorough course for the training of Thai nationals enabling them to replace foreign textile technicians at present running the technical side of the Thai knitting industry.

Nine factories were visited, selected at random, to get a picture of the knitting industry as a whole. Reports of these visits are given on standard visits forms (annex II).

The additional machinery and equipment necessary for the knitting department to carry out sufficient training is listed separately in the report. At present, the knitting department is not equipped to carry out any valuable training of technical personnel. Neither is the present staff sufficiently knowledgeable to train others.

I. FINDINGS

The success that knitting firms in Hong Kong and the Republic of Korea have had has made it difficult for them to obtain the necessary work-force for further expansion within their own borders and several firms have therefore established knitting mills in Thailand where the necessary work-force is available. However Thailand, not having the educational establishments necessary to train knitting technologists, has been unable to supply the technical management for these foreign firms and has only been able to furnish labourers.

First, the dependency on foreign management creates insecurity; secondly, higher wages have to be paid to the technical staff to encourage them to live away from home, which influences the cost of products. Another factor is that in cases where the profit margin is low in the knitting sector, the danger exists that the subsidiaries in Thailand may have to close unless they can carry on production nationally. It would be good for Thailand, to produce its own textiles, and therefore the Government of Thailand has established a textile establishment at Soi Kluay Nam Tai, Bangkok.

Commonly used knitting machinery has already been installed for training purposes.

Recommendations for additional machinery and laboratory equipment are given in annexes III and IV.

To get a picture of the existing knitting industry in Thailand, a number of factories, selected at random, were visited. These were well run in nearly every case. The presence of foreign technical staff was very much in evidence. The quality of the goods and the modern machinery were surprisingly high. It is therefore not so much raising the standard of the products as of maintaining present standards that will be the main task in the future when the foreign staff are replaced by nationals.

The quality of the products was scrupulously adhered to in every factory visited, and most establishments had their own well-equipped quality control laboratories to secure and maintain standards. Most garments produced were not of the factories' own design and origin, but were copied to the purchasers' designs. This of course makes the question of quality control easier as factories receive exact specifications that can be followed.

Most of the goods inspected were in the higher price class and export was mainly to developed countries such as Canada, Scandinavia and the United States of America. One firm had an export rate of 80 per cent and had even, at times, exported its entire production. This in itself indicates that production is of the highest standard. Another factor verifying this was the claim that the customers seldom varied.

To maintain the high technical standard of the staff will therefore be the main task for the Thai Knitting Industry in the coming future.

Training of technical staff

Before visiting the various mills it was decided to plan and carry out the training of mechanics from interested factories. A training programme was planned and partly written, but when the low standard of technical knowledge of the staff at TID was learned, this plan was abolished and an internal course for the staff of the TID knitting department decided upon (annex I).

Because of the lack of English, communications between the staff and the experts were extremely difficult. Another problem of practical training was that only one of the machines was suitable for training purposes. The other machines either lacked needles or parts, and the yarns were either unsuitable or lacking. These matters have been or are being rectified.

Two circular machines have since been installed. However, their use having been discontinued in production, they are unsuitable for training purposes except to their working principle and to teach machine maintenance, cam setting etc. The remaining machines can be put in working order when needles and yarns become available.

The planned course was consequently based on teaching on raw materials and theoretical training.

The training of technicians from the industry according to the present level of technical knowledge cannot be recommended.

It is far better that selected staff, two technicians for each type of knitting (warp and weft) be thoroughly trained abroad before any knitting course is undertaken at TID.

Two polytechnics in England have been approached and are willing to give a thorough training in these two subjects; the only condition being that the students' knowledge of English be good enough to follow the course and not hamper other students.

If the cost of sending students to England is too high, it would be advisable to reduce the number of machines to be purchased to a minimum, and choose the kind of machines observed during our factory visits (annex 7).

At least one machine manufacturer (Mayer and Cie, Federal Republic of Germany) can offer fully reconditioned machines at greatly reduced prices. These machines should be quite satisfactory for the knitting section and reduce costs considerably.

Although the knitting room at TID appears adequate, the floor should be sealed to prevent dust and sand from the floor settling on yarn and machine parts thus causing knitting faults and possible damage to machine parts. Proper yarn storage facilities should also be made available.

Higher education recommended for the staff

Because of the low state of textile knowledge among the present TID technical staff, they cannot be expected to train either top or middle management for the industry to enable them to replace the foreign staff presently running the technical side of the knitting factories. The short course prepared by the expert will only give a foundation for further education. The purchase of new machines should therefore be kept to a minimum and any capital available should be spent upon further education abroad at reputable educational establishments for the knitting industry.

Hinkley College of Further Education, Leics., England, has offered to prepare and carry out an eight-week course on weft knitting especially for the staff. At 35 hours per week this will give 280 hours of tuition. Normally, such a course lasts 900 hours but by creating a special course the necessary knowledge could be taught within the suggested 280 hours. The fee would be £750 per student up to a maximum of 10. However two students should be sufficient for TID. In addition, materials would cost £50 per student and a further £50 each for tools and overalls. Living expenses would amount to approximately £50 per week each and the return air fare is $792. The total costs therefore should be approximately £1,692 per student, £6,768 for all four. The Huddersfield Polytechnic has agreed to a similar course for two warp knitters; the exact costs have not been given but can be expected to be of a similar amount.

Housing, living and transport costs have been omitted and should be taken into consideration when deciding upon such arrangements.

As the number of staff is minimal and the manager of the knitting department has only a limited time left before his contract runs out, and does not wish to prolong it, it is vital that the continuation of staffing be considered. To leave the department without top management is not feasible after it has started educational courses, and this should be discussed by top management at the earliest opportunity. Furthermore, it is essential that job descriptions for the various employees be established so that the knitting department can be brought up to a reasonable standard and responsibilities for the various functions established.

At present, the department appears to be run in an undisciplined manner. As the director is extremely pressed in his work, it is important that he has a staff he can rely upon, and it is suggested that a works manager be employed with authority over all the different departments. This will take the pressure off the managing director and ensure that the various departments are under control and carrying out their functions in a satisfactory manner.

Furthermore, an assistant to the managing director would ease his work-load, and problems that at present need attention could be solved by the assistant and only in special cases be brought to the attention of the managing director.

II. RECOMMENDATIONS

Training

Emphasis should be first on the education of the staff rather than on the purchase of too many machines. It is important that the wages of the teaching staff are attractive enough to prevent them leaving private industry the moment their contract is up. Notice of leaving the institute given by teaching staff should be longer to enable management to get replacements without too long a break.

Technicians from various factories should not be taken on before TID staff has been given a thorough training along the lines recommended. One or possibly two candidates should be selected to train for full degrees in textiles at reputable polytechnics abroad so that TID can gradually be built up to a level equal to textile colleges abroad. Such candidates, if selected for degree courses, must have an educational background acceptable to whichever polytechnic they enter.

Polytechnics in an English-speaking country should be chosen as English is a compulsory subject at high school in Thailand. However, it is advisable that candidates sit an examination in English before being selected so that they can get the full benefit of their education abroad.

Several polytechnics specialize in knitting and it is to be preferred that the candidates should get their education at these polytechnics rather than universities with a more academic attitude to textile research.

Additional machinery

The following instruments have been budgeted for and ordered:

	$US
One washing machine	9,842.50
One course length tester	639.80
One yarn friction meter	2,903.50
Total	13,385.80

The following knitting machines are suggested:

One mini jacquard double jersey machine (the prices can only be stated approximately due to inflation and the fact that TID, being a non-profitmaking establishment, will benefit from discounts that have to be negotiated) price approximately $US 30,555.

In addition, some making-up machinery should be installed. TID already has an overlock machine, and it is suggested that the following sewing machines be purchased:

	$US (approximately)
One flatlock machine	5,000
Chain-stitch machine	1,000
Electric strength blade hand-cutter	2,000

Total cost of extra machinery is estimated at $US 97,210. This amount does not include the above sum of $US 13,385.80 already budgeted for.

Visits

When sufficient qualified staff are available, regular visits should be made to the various knitting mills so that TID can assist in solving any problems they may encounter and keep the various factories informed on fabrics and machinery.

This will make the industry take a positive interest in TID and give TID knowledge on the various problems the industry encounters and possibly enable TID to give advice from experience gained during visits to other factories.

Problems encountered during such visits should be recorded on the visit form (annex II) and where action has to be taken, the person best suited to solve the problem should be notified so that he can take the appropriate action to put matters right.

Annex I

A SHORT COURSE IN KNITTING FOR THE KNITTING DEPARTMENT OF THE TID

The subjects dealt with in the short knitting course given by the expert were:

1. Raw materials and their properties.
2. The various types of knitting machines and the fabric they make.
3. Needle types as used in the various knitting machines.
4. Knitting principles.
5. Machine gauge yarn count relationship.
6. Difference between single and double jersey fabrics.
7. Various jacquard knitting principles.
8. Fabric quality requirements.
9. Knitting faults; reasons and remedies.
10. Machine maintenance and practical knitting.

A timetable has been fixed for each subject.

Jacquard patterning

Jacquard is a term given to fabrics other than plain rib, plain jersey and plain interlock. There are so many types of jacquard that the less important one will be mentioned only briefly.

Jacquard knitting on flat knitting machines

Flat knitting machines are normally fairly simple in construction and are the forerunners to the many different and complicated types of circular knitting machines

Flat knitting machines offer scope for patterns with knit, tuck and miss designs made on double needle beds. Most machines offer a combination of all three which is obtained by changing the clearing cam to where the latch of the needle rises to a height where the old loops either slip below it or remain on the latch for one or more consecutive knitting courses. Often this is combined with feederchange carrying different colours. In this manner a blister or "bubble" design can be obtained in different colour combinations. The number of tuck loops applied in the hook of the needle are limited normally to three, to prevent needle damage and yarn breakage. This type of design is commonly used in children's jumpers and cardigans.

The most common type of design on these flat machines is tucking and clearing after each course on both needle beds, termed full cardigan stitch: or one bed only carries out tucking, which design is called half cardigan.

As most of these machines have a racking mechanism, i.e., one needle bed can be moved sideways (normally one needle space at a time) which produces a zig-zag pattern. When racking, the number of courses in tuck position must be reduced to prevent extra strain on yarn and needles. Patterning of this type is used mainly in course gauge garments. These machines are popular in the cottage industry as many of them are hand-operated and require no electric power. The coarser types are of little or no interest in the Thai domestic market but offer possibilities for the export market.

A large number of these machines, with attachments for automatic welts, are in use all over the world and to break into this market would mean new types of yarns being employed (may be silk mixed with other types of yarns) which would be unique to Thailand and should be encouraged.

True jacquard on flat knitting machines

The above method is the simplest form of making jacquard design on flat knitting machines. A more typical jacquard flat knitting machine is the one that has a lever under each needle. Metal strips with punched holes decide whether the needles are to knit or non-knit. These metal strips can be moved either forwards or backwards for each course. The machine will produce jacquard patterns either with "birds eye" backing or striped backing as found on the more modern circular jacquard machines. The needles are reselected after each knitted course.

Reasonably large coloured patterns or configurations can be made. However, the relatively slow production of this machine has reduced its popularity as faster producing circular jacquard machines with a large number of feeders have come into use. For long runs of a particular design, the machine still has its uses as the steel cards are virtually everlasting.

A great advantage of flat jacquard machines is that the width can be altered to suit the garment to be produced and thus reduce the problem of knitted waste that circular machines inevitably produce. The capital outlay of these machines also compares favourably with their circular counterparts and they should not be discarded as outmoded as they could lay the foundation for cottage industries in outlying areas if the right yarns and designs are choosen.

There are other types of flat knitting machines able to produce true jacquard designs, but with their relatively slow production rate they have lost out to the circular jacquard machine.

The simplest form for circular jacquard designing does not require any special mechanism at all; an ordinary interlock machine offers a variety of patterns by the use of high and low butt needles, selective needle layout, and manipulation with various yarn colours at various feeders, or a combination of them all.

Reference to jacquard machines usually means machines with special attachments that interact with the needles by various means to alter the stitches to form patterns. To start with, these pattern mechanisms were mainly applied to single jersey sinkerwheel machines using spring needles. Pattern drums containing pressing sinkers set out according to design would either press a needle off the yarn from its previous course or retain it to form tuck stitches. Other types of spring needle machines had a mechanism that moved the tip of one needle in alignment with its neighbour so that the two needles formed one loop together. However, these machines have now given way to the many other types of pattern devices on machines that offer higher speed, a larger number of feeders and more versatile design possibilities.

The main interest in jacquard knitting today is in double jersey or machines using two sets of needles, of which there are three main types:

(a) Purl machines, which use double-headed needles and superimposed cylinders. On these machines the designs are obtained by transferring selected needles from one cylinder to another. This method is common in both large diameter machines, but are more common in smaller diameter machines for men's socks;

(b) The stationary cylinder type, which operates with punched films acting though jacks onto the needles. The films are spaced round the machine to cover all the needles. These machines offer large pattern areas only limited by the length of the film they can accommodate.

However as revolving camboxes means that the yarn creel on top of the machine rotates as well, there is a limit to the weight of yarn the machine can accommodate and this type of revolving cambox machine is now obsolete despite its attractive pattern scope. Nowadays this machine is used mainly in 14 gauge for sportswear but also, to a certain extent, in the production of swimwear where Lycra is incorporated into the structure for form stability and figure controll;

(c) The revolving cylinder and dial type, which offers a great variety of patterns. Some of these machines act through pattern wheels directly onto the needles. These pattern wheels can be positively driven by gears under the wheels, but more commonly the needle butts on the machine act as the driving force.

Some machines use peg drums acting on needle jack butts. There are far too many types to go into detail. Others use continuous films with punched holes which determine the movement of the needles and when it should knit or remain inactive. Such a machine offers a large pattern area and was maybe the most versatile pattern double jersey machine until superseded by electronic machines.

Electronic machines offer virtually unlimited patterns and were heralded as the machine of the future. However, because of the many complications that arose in its construction, its complexity and high cost it did not revolutionize machine building, as had been anticipated. The fact that electronics were alien to the knitters and mechanics and added to their tasks did not help either. To the machine builders, the costs in developing the machine was, in some cases, ruinous and that it was introduced at a time when the economic climate was deteriorating did not add to its popularity.

Jacquard machines with inserted manually filled bits

The simpler type of machines using tapered pattern wheels, is already installed at TID. It is very common in the knitting industry for various reasons. First, such machines are simple in construction and when correctly set and run, cause little trouble in production. They have their limitations in as much as the size of pattern wheel is limited, giving a limited scope of design. They are based on spirally constructed designs but with skilled designing the pattern scope can be increased. The design mechanism operates by an inclined wheel placed under each feeder that contains slots corresponding to the gauge of the machine. In these slots there are "bitts" that can have two different positions; when forward, the bitts will come into contact with the needle butts as the machine rotates and the needle will rise with the inclined wheel to a knitting position enabling a loop to be formed: when backward or in an inactive position, the needle butt will bypass the needle raising the cam and thus making a non-knit. The dial cams are set in a "birds-eye" position so that they knit or non-knit according to the number of colours used. This leaves the back of the fabric in a spotted pattern and the actual design appears on the front only.

Where the number of slots in the pattern wheel corresponds to the number of needles in the cylinder of the machine, small and geometric designs can be made. Where there are a larger or smaller number of slots in the pattern wheel, so that there is no correspondence with the number of needles in the cylinder, a common multiplier must be used to get a repeat in the design.

When designing patterns other than blister designs, more colours than one are used to obtain the pattern. If, for example, three colours are used in the design, it will take three feeders to complete the number of courses required; one for each colour. Other pattern mechanisms use discs on the same principle to accommodate the patterned needle selection. The discs may be inclined so that the "teeth" engage with, and lift, the needle butts in the same way as inserted bits, or they may lay in a horizontal plane and select the needles through needle jacks placed under each cylinder needle.

Warp knitting

Unlike weft knitting where each needle in the machine receives its yarn in turn from the same cone as the machine revolves, on the warp knitting machine each needle receives separate yarns so that the fabric is constructed from separate rows of wales and the ends of the yarns are given a sideways movement to combine them. This movement is called overlap, and as the guides move around their adjacent needle, the courses are bound together to form the fabric.

Usually a warp knitting machine works with more than one guide bar. The front bar makes its movement different from the back bar. The yarns are bound together by wrapping them around different needles at different courses forming an underlap. The size and direction of the underlaps are the governing factor in determining the fabric structure.

If the overlap is increased the small amount of yarn wrapped around the needles will have to make two or more loops, and since only the loop nearest the guide will have access to the wrap beam, it is seldom that overlapping takes place over more than one needle. The underlap is therefore the deciding factor in fabric structure and some form of notation must be used in order to record the movements of the guides when designing different fabrics.

Designing or notation must be depicted on point paper making it possible to translate the pattern in terms of guide bar threading when constructing the pattern-chain sequence that eventually will form the fabric. On this paper dots are placed at equal distances, and a horizontal line of dots will represent the needles or needle bar; each row of dots therefore represents the different courses that form the fabric. Vertical dots represent the wales contained in the fabric. Working up the paper from the bottom to top for each successive course, the path of each guide is shown by drawing a line around the dots as if looking down at the needle from above. If a line is drawn for each threaded guide, the design of the fabric may be built up.

Warp knitting machines are basically of two main types producing the same types of fabrics, the difference being that one uses spring needles and the other compound needles.

The spring needle type has been in use for a very long time, whereas the compound needle type dates back to just after the Second World War.

Although there is a third type of warp knitting machine, the simplex, this has virtually disappeared from the market and is of only academic interest in this course. It utilizes spring needles and bobbins or small beams that rotate around the machine whereas the usual warp knitting machine has stationary beams; the number varies according to the number of guide bars on the loom which varies usually from two to four; two bar fabrics being the most popular.

Although the compound needle warp loom may be expensive to purchase, its construction allows for the use of spun yarn to be knitted on the warp knitting principle far faster and with far fewer faults than achieved with spring needle warp looms.

Virtually all warp knitting machines operate with two or more sets of yarns although knitting with one set is feasible. Single-bar fabrics are usually unstable in construction whereas two or more guidebar fabrics can give fabric of great stability.

For standard fabrics, the yarn comes ready warped, i.e. wound on to beams with the desired ends of yarns required for each beam. The yarns are then threaded by hand through the guides from left to right before knitting can commence. In most cases, the yarns are passed through a point bar which separates all the individual ends and ensures that the correct relative positions are retained throughout the length of the warp, and also that the threads are led away from any friction points they may come into contact with on the machines. Tension rails or springs are provided for each set of threads and the excess of yarn that becomes available at various stages of each knitting cycle.

There are two methods by which the yarns are delivered to the knitting head:

(a) Negative, where the warp beams are dragged forward according to yarn demand from the needles;

(b) Positive, where the yarn beams are positively driven at the speed needed for each loop.

Spring needle warp looms

The knitting elements of the warp loom using spring needles consist of:

Spring needles mounted in leads

Sinkers mounted in leads

Guide bars

Presser bar

The actual knitting cycle is:

1. The sinkers are in a forward position and the tips of the needles are level with the guides which are in their forward position. The presser bar is at rest or backwards.
2. The needle bars remain as before while the guide bars sew around the needles.
3. The needle bar rises to clear its yarn.
4. The needle bars move downwards to a pressing position.
5. The presser bar moves forwards closing the beards of the needles.
6. The old loop is cleared and the sinker bar moves back to what is called its "landing" position.
7. The sinker bar then moves to forwards and the knocking-over or underlap is formed.

Compound needle warp knitting machine

In the compound needle warp loom there is no need for a presser bar during the loop formation but the needle must have an arrangement whereby it can open and close. This is called a tongue-bar.

Rashel machines

The term Rashel is applied to most types of warp knitting machines using latch needles, which, to a great extent, are used with single guide bars.

Most Rashel machines can be used for the production of bearded needle machines, but due to their slow running speed and their coarser gauge they are not used in competition with warp knitting machines. Rashel machines are therefore used almost exclusively on fancy fabrics containing effects that cannot easily be reproduced on bearded needle machines.

The Rashel machine is commonly used, with one needle bed, for all-over banded laces, curtain nets, elastic nets for corsetry, outer wear fabrics, hairnets and such because they normally process more guide bars than the conventional warp knitting machine. When two needle bars are used. the Rashel machine often comes in direct competition with faster producing double jersey machines, but they do at the same time often scope for specialized fabrics. Unfortunately, this is too specialized a field to go into detail here.

The Rashel machine also plays an important role in the production of carpets and should not be considered a machine of no importance.

Machine gauges and gauge/yarn count relationship

Variations in gauges of weft knitting machines are wide. Generally they range from as few as 2½ needles to the inch up to 22 and even higher. Although machines coarser than 2½ needles to the inch are seldom seen for flat and half hose machines, rib and double knit machines the range varies from 5 to 22 needles to the inch as a rule. For single jersey the gauge is much finer and interlock machines use finer gauges, usually 26 needles to the inch, but these are less common for outer wear fabrics unless they are intended for printing.

The very coarse gauge machines are only of academic interest in Thailand and first the machine gauges most common to the country are discussed.

To lay down firm rules for the exact gauge of each machine is not possible for various reasons; the pattern may consist of thick and thin yarns that may combine continuous filament yarns with spun yarns and the stitch variation in special patterns may require variation in yarn thickness. However, general rules for yarn counts in relation to various machine types and gauges are:

Flat and circular rib machines and interlocks

Gauge	Cotton count
6	4½
7	5
10	8
12	12
14	14
16	16
18	20
20	30
22	36
26	50

When using polyester and polyamide yarns on interlock and jacquard machines in the usual gauges starting from 18, the denier range varies from 100 to 150.

On a straight bar of the fully-fashioned type it is normal to refer to the worsted count. A general rule for these types of machines is:

Gauge	Worsted count
12	4
15	5½
18	7
21	10
24	14
30	16
36	25
40	30

On sinker wheel machines (French circular) again it is usual to use the term worsted count. The machines themselves have a number of gauges but the term of the gauge is given as fine or coarse. For a 26 gauge fine 2/50's worsted count would be used and for a 22 gauge coarse 2/20's worsted count would be the common counts. For plain web machines the common counts are:

Gauge	Worsted count
6	4½
7	5
10	8
12	12
14	14
16	18
18	24
20	30
22	36
26	50

The term gauge varies also according to the various types of machines. A 20 gauge interlock machine has 20 needles in one inch of circumference. On a fully-fashioned machine the gauge is the number of needles to 1½ inches of the needle bar. Other machines, such as the flat knitting machine, the gauge is the number of needles to the inch. For warp and Rashel machines a variety of deniers are used according to pattern and construction. The most common denier on a 28 gauge warp loom is 60, but it is impossible to state a rule as the constructions vary so much and the machine gauge must also be taken into account. Another factor of the yarn/count relationship is that, as a rule, a spring needle can normally accommodate coarser yarns than a latch needle.

Fabric quality requirements

In textiles, fashion is the overriding factor in most cases; fortunately it can often be combined with quality. Fabrics that are prone to snagging and pilling should be avoided. Dyed yarns must meet fastness requirements of washing, rubbing, perspiration, light etc. Other important factors are stability to washing, shrinkage, shape retention and wear, garments should not wear out before their expected lifetime.

Although garments made from polyester and polyamide will normally meet these requirements provided that correct heat settings and dyestuffs are used, incorrect designing can result in both snagging and filamentation of the garments rendering them unsuitable for wear.

For natural fibres, however, there are many problems. Most natural yarns will shrink after washing, the amount, however, can be controlled to a certain degree by choice of structure, tightness of the knitted loops and correct tension when knitting. Provided that these criteria are met with, finishers have great help in the many chemicals that are now available and also mechanical devices to relax the fabrics and garments reducing their shrinkage potential.

Shortcuts to reduce quality (even if it may increase profit) will have repercussions for the producer. Customers demand quality and in such a competitive industry as textiles, poor quality can mean ruin for the producer.

Knitting faults and remedies

The knitters main headache is faulty fabrics. A modern knitting machine has so many built-in safety devices that, if the machine is properly handled, the fault rate can be kept low although some faults will occur. To go into these in a course of this nature is impossible, only general principles can be dealt with.

1. Follow the manufacturers manual, which will aid in preventing faults and prolong the life of the machine and its various parts.

2. Oil the machine frequently but sparingly.

3. Keep the machine clean and free for fluff and lint.

4. Do not try to use needles that have been damaged.

5. Keep needle tracks straight and clean.

6. Stop the machine for a period and clean all parts with which the yarns have been in contact.

7. Replace worn or cracked porcelain or ceramic guides.

Machine maintenance and practical knitting

A modern knitting machine at today's prices is a very costly item and as such must be treated with the utmost care. Each machine comes with manuals and running instructions.

Annex II

VISIT REPORT FORM

<table>
<tr><td colspan="3">VISIT REPORT FORM</td><td>Report No.:</td></tr>
<tr><td colspan="3">Name and address of firm:</td><td>Category:</td></tr>
<tr><td colspan="2">Date of previous visit:</td><td>Date of visit:</td><td>Planned revisit:</td></tr>
<tr><td colspan="2">TID personnel present:</td><td colspan="2">Person(s) seen:</td></tr>
<tr><td>Remarks</td><td colspan="3">Subjects discussed and action to be taken

Signature:</td></tr>
</table>

Annex III

ADDITIONAL MACHINERY REQUIRED

Type of machine	Pattern wheel or drum	Double knitting machine	Gauge needles per inch (n/100 mm)	Diameter (cm)	Number required	Country of manufacture
Jacquard circular knitting machine	P.W.		20 (80)	30.7" (78.0)	1,920	Czechoslovakia
Miyake knitting machine (MYK)	D		20 (80)	20 (50.80)	1,240	Japan
Inamoto machine	D		18 (72)	20 (50.80)	1,188	Japan
Flat-bed knitting machine	D		14 (55)		2,000	Federal Republic of Germany
Tricot knitting machine (laboratory unit)	D		28 (111)		1,176	Federal Republic of Germany
Rib knitting machine (stocking)	D		14 (55)	4 (10.16)	168	Japan
Fibre analysis knitting machine	D		54	4 (10.16)	200	United States
Flat knitting	D		7		504	Hong Kong

Annex IV

LABORATORY EQUIPMENT REQUIRED

As the testing laboratory has been built up for woven materials, the following items should be added:

Tensile pendulum type tester with ballistic attachment

Diaphragm type tester (intended for knitted fabrics)

Cubex international shrinkage tester

Mace snag tester

Unfortunately, prices for these items are not available at present. Consequently TID should try to locate the agents for each item so that prices can be added to the total amount.

These items should be placed in the testing laboratory, which is air-conditioned.

Annex V

EXISTING MACHINERY AT TID

MYK rib knitting machine (circular)

Stoll flat knitting machine type JBOM/b-14 gauge, 180 cm

IDZI NOV jacquard machine, 20 gauge, 30 in.

Overlock sewing machine

Domestic tumble dryer

Hwa fung hand flat knitting machine (7 gauge, 36 in.)

FAK fibre analysis machine (hydraulic, three feeders)

Karl Mayer-type KL 4, warp knitting machine

"INMT" Inamoto circular rib machine, 18 gauge, 20 in.

"MYK" Milake circular interlock machine, 20 gauge

Of these machines, the first four listed are in fairly good condition. The remainder must either be overhauled or only used for demonstration machines because of their condition.

BIBLIOGRAPHY

1. A knitters' guide to occupational safety and health.
2. Single knit. Fabric primer.
3. A primer on circular knitting machine lubrication.
4. Double knit fabric primer.
5. How to reduce Baree' in knitted textured yarn double knits.
6. Basic primer on warp knitting.
7. Weft insertion: a primer.
8. Dyeing and finishing tricot fabric.
9. Dyeing and finishing of polyester knit cloth.
10. Language of knits for men's wear cutters.
11. How to cut warp knit fabrics.
12. Facts about knits; a cutters' guide to basic fabric types.
13. Overcoming needle cutting in sewing textured polyester double knits.
14. Feeding principles for sewing knitted fabrics.
15. What a cutter should know about knitted cloth.

All these books are available from: National Knitted Outer Wear Association, 51 Madison Avenue, New York, New York. 10010, United States of America. (cost unknown)