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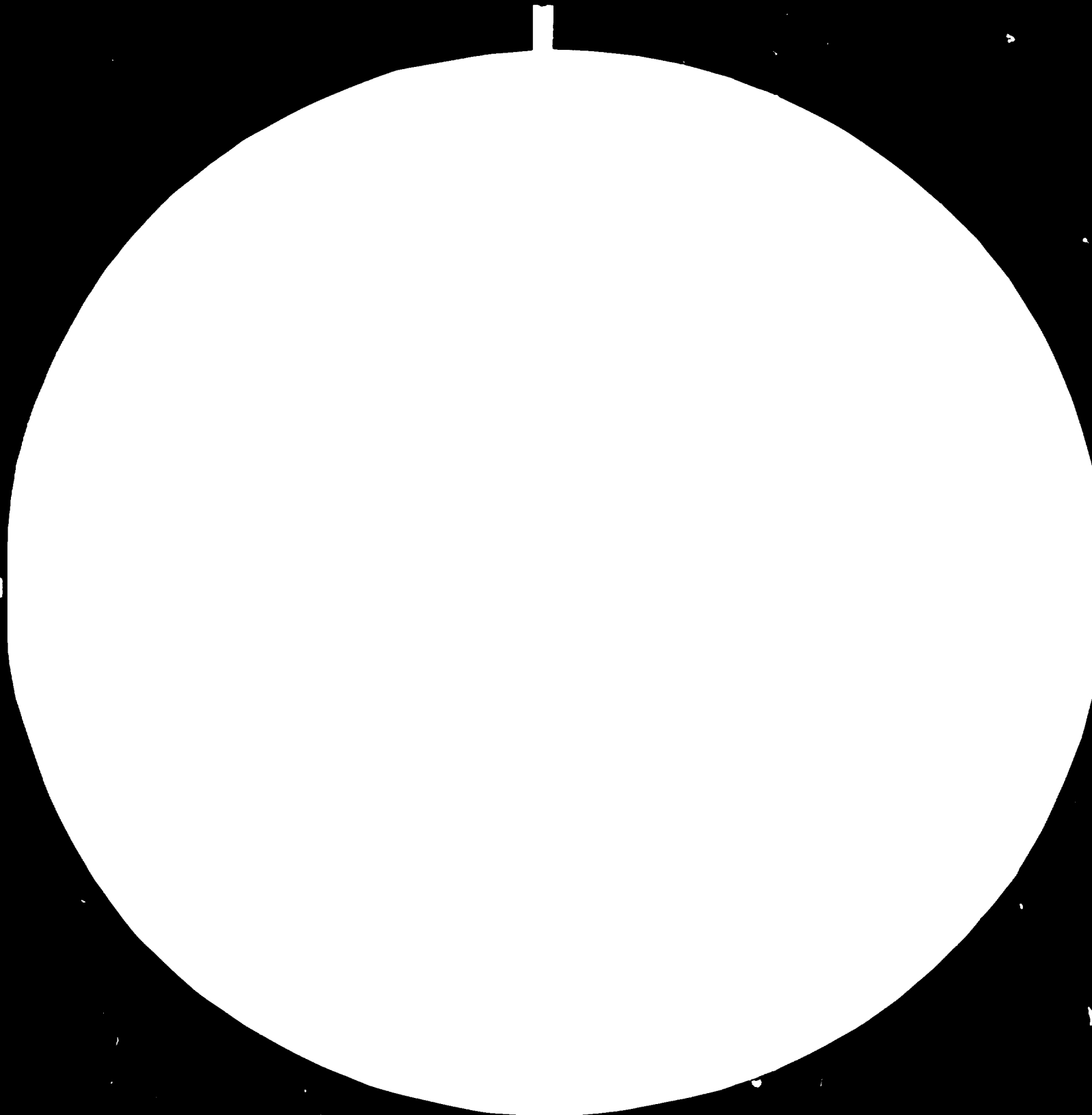

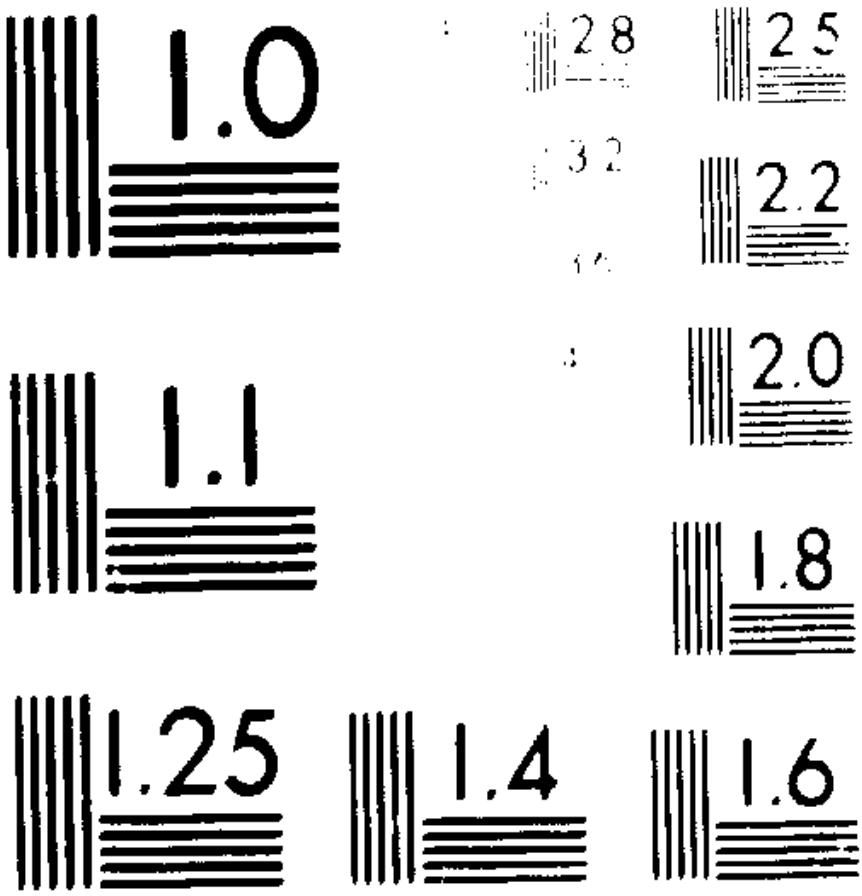
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SCOPE AND FUNCTIONS OF THE TANZANIAN TEXTILE INSTITUTE

DP/URT/78/018

UNITED REPUBLIC OF TANZANIA

Technical report: Assessment of the need for a textile institute in Tanzania with recommendations about its size, staffing, courses and other functions*

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

Based on the work of Philip A. Smith, expert in textile education

United Nations Industrial Development Organization
Vienna

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Explanatory Notes

1$ = 8.30 Tanzanian Shillings.

Form IV - A Tanzanian qualification obtained at the end of the fourth form at school, equivalent to the British 'O' level.

Form VI - A Tanzanian qualification obtained after leaving the sixth form at school, equivalent to English 'A' level.

ABSTRACT

An analysis of the requirements for trained personnel in the textile industry of Tanzania is made, including a forecast of the future needs. Even using a fairly conservative forecast for the future it is shown that a fairly large training establishment, to be called the Tanzanian Textile Institute, would be needed to supply these requirements.

Recommendations are made about the types of course, and the standards and timetables for the courses. Brief syllabuses are also given. Recommendations are made on the number, type and qualifications of staff needed to run the Institute. Suggestion are made concerning a twinning arrangement with a foreign university or college.

It is recommended that the Institute should run a consultancy service for the textile industry. It should also run a testing service and an information service, but it is suggested that all these services are minor relative to the educational function.

An outline plan is given of the size of all necessary buildings and a full list is given of the demonstration equipment needed for teaching the technology of the subject. A detailed costing of these facilities and the annual running costs shows that it will be much cheaper to train students at the Institute than to send them abroad. The saving in foreign currency will be even larger, because a fairly high proportion of the Institute costs would be in Tanzanian currency.

INTRODUCTION

The textile industry is the largest industrial sector in Tanzania and is expanding rapidly. About 90% of the industry is in the public sector and is controlled by the Tanzanian Textile Corporation (TEXCO). The whole industry is desperately short of skilled technicians and technologists. At present expatriates occupy most of the top management positions, and the policy of localizing these posts is proceeding very slowly. There is no institution for training either textile technicians or technologists in Tanzania at present, so students have to be sent abroad. Although there is no lack of suitably qualified students, the lack of foreign exchange limits the number of students being trained to such a low figure that it is not nearly big enough to satisfy even the current needs of the existing factories, let alone make up for the back-log of untrained people from the past, plus the additional needs of the new factories and to provide people to take-over the expatriates' posts.

Against this background both the Government of Tanzania and TEXCO have been pressing for the establishment of a textile training establishment in Tanzania to be called the Textile Institute. Over the past five years a number of studies have been made by consultants from various countries suggesting the size, location and layout of the Textile Institute. So far, due to lack of the necessary finance, especially in foreign currency the only progress that has been made has been the surveying and purchase of a suitable plot of ground just outside Morogoro. It is felt that the time has come to make an all-out effort to raise the necessary finance, because with every year that passes the situation gets worse, i.e.

1) due to inflation in the Western countries the foreign currency cost is increasing.

2) the backlog of untrained personnel is increasing every year.

3) the foreign currency cost of employing expatriates and training students abroad is not only continuing but is also increasing year by year.

The object of the present report is to analyse the need for an Institute and if desirable to recommend a suitable size and scope for the Textile Institute, suitable educational standards and courses, an outline of the staffing and physical facilities required together with a rough estimate of the cost.

RECOMMENDATIONS

1. It is recommended that a Textile Institute be established at Morogoro as soon as possible. Although this will be expensive it will lead to big savings in the future and will enable the textile industry to be fully staffed with trained personnel by about 1997.

2. It is essential that the Institute should be of the highest international standard.

3. It is recommended that a four year degree-level course, a two year diploma course and a six month diploma crash course should be run.

4. It is recommended that the Textile Institute should enter into a twinning arrangement with a foreign university or college.

5. Recommendations are contained in the text for the detailed timetable of each course, the staffing requirements, and the buildings and equipment needed for the Institute.

6. It is recommended that the Institute should provide a consultancy service, a testing service and an information service for the textile industry, but that these should be minor in comparison with the educational function.

I. THE TRAINING ROLE OF THE TEXTILE INSTITUTE

A. General

It is obvious that the textile industry in Tanzania requires more trained manpower, but it is necessary to decide just what levels of training could be undertaken by the Institute and whether the total training need is big enough to justify building an Institute. Although the organisation of a typical factory is divded into six or seven levels it is possible to simplify this slightly into four levels requiring different levels of training.

a) Managers, including the general manager, departmental managers and deputy managers. Salary levels MSU7 and above. Ideally this group should have a degree or degree equivalent in textile technology covering a broad range of the subject, so that each department fully understands the problems of other departments and so that any departmental head could be promoted to general manager. The training should have a solid groundwork in science and in the theory of textile processing, but should also have sufficient practical instruction so that any manager could take over the work of a supervisor if necessary.

Although the number of managers varies from factory to factory and with the size of the factory, it is concluded that the requirement of degree-trained personnel in Tanzania is 0.75% of the total work force.

It is suggested that one of the main roles of the Textile Institute should be the training of the future managers. It is worth pointing out at this early stage the great responsibility of the Institute. If the Institute runs well and provides well-trained personnel for the industry then everything should prosper, but if for any reason the Institute turns out students below an international standard of competence the whole industry will be severely hampered. It is therefore essential that the Institute must be up to the highest international standards.

b) Supervisors, including shift officers and assistant shift officers. Salary levels MSU5 and 6.

It is recommended that this group should have a shorter and more practical training, specialising quite strongly on the particular work that will be done in industry, but still having some broader education

in both pure science and textile technology. It is recommended that this qualification should be called a diploma and this training should also be carried out at the Institute.

It is recommended very strongly that the training for a degree-equivalent and for a diploma should be very different, one being more theoretical and the other more practical. Consequently, the entry to the two courses and most of the teaching must be completely separate. Though in some circumstances it may be possible for a good diploma student to transfer to the degree course this should not be the normal method of entering the degree course. Equally it must be possible for someone who enters the industry with a diploma to be promoted on merit to a position normally requiring a degree.

On the basis of the factory organisations it has been estimated that 3.75% of the total workforce should be trained to diploma level. In order to make a comparison with recognised practice in the U.K. the degree and diploma requirements can be added together giving a total of 4.5%. In the U.K. the average figure of trained personnel is 10% of the total workforce, which at first sight makes it appear that the Tanzania firms will still be running with too few trained men. However, it must be remembered that in Tanzania the manning level is roughly three times as high as in Europe. Hence a U.K. factory employing 1,000 people would have about 100 trained men, whereas the similar factory in Tanzania would employ 3,000 and would have 135 trained men. Thus the two figures are quite compatible when viewed as the number of trained people to run a factory.

c) <u>Foremen, chargehands, etc</u>. This group of employees needs to be trained above the level of a normal operative, but in a European mill he would gain this training simply by working as an operative. In Tanzania the same method would be possible, but the tendency would be to perpetuate the existing unsatisfactory mill conditions. The number of people involved at this level is far too high for the Textile Institute to supply any direct training, but it is recommended that the Training officers should be trained by the Institute in improved mill practice and should then pass on this training to the foremen.

d) Operatives. Again this group is far too large for the Institute to have any direct effect, but it is suggested that a positive influence can be obtained through the Training officers. It is normal industrial practice for each factory to have a training room containing for example an old drawframe, a short speedframe and a short ringframe etc. Operatives can then be individually taught on these small machines, possibly at lower speeds to begin with, without the distraction of the noise of the rest of the mill. Training officers may use skilled operatives to help in this training, but will supervise the process to make sure that only the best practices are being taught.

In order to calculate the requirements for trained personnel it is necessary to know how the industry will grown in the future. So far estimates only exist up to 1985, which is not far enough into the future for the purposes of the Institute, so a very brief manpower estimate follows.

3. Brief manpower forecast

At present the total number employed in the textile industry, including the newly opened Musoma mill is 22,700. When the planned factories are running in about 1985 the industry will employ 33,200. However, in order to plan for the size of the Institute, which if started now could only start producing students in 1986, it is necessary to estimate the manpower requirement in the year 2000 and beyond. It is suggested that ultimately the industry will grow until it processes the whole of the Tanzanian cotton crop, but it seems unlikely that cotton would be imported. Also the weight of synthetic fibres processed is not expected to be great. Using 1979 figures 19,700 people processed 14,000 tonnes and the total crop was 67,000 tonnes; hence the operatives needed to process the whole crop would be 94,275.

This estimate is subject to three provisos:

1) At present the manning level in Tanzania is roughly three times as great as would be found in Western Europe for a factory of the same size. It is expected that as the level of skill of the operatives increases manning levels will tend to fall, though it may be decided to keep them higher than the European levels in order to keep more people in employment. However, as has been explained previously, this does not seriously affect the estimate of trained people required, since these are related more to the size of factory than the actual number of operatives.

2) At present the machine efficiency in Tanzania is significantly below European standards. There is considerable doubt about the figures, due to different methods of calculation, but if we take figures of 55-60% for Tanzania and 85-90% for Europe then as the machine efficiency in Tanzania increases to the European level the total number of operatives ultimately needed falls from 94,250 to 62,000. This would affect the number of trained personnel, since it affects the number and size of factories needed.

3) Obviously the estimate also depends essentially on the size of the cotton crop, which varies considerably from year to year. It depends on whether the peasants grow cash crops or food, which itself depends on many factors. When the irrigation schemes now being planned are working fully it is quite possible for the cotton crop to double or even treble. However, this is very speculative and it is safer to take a conservative figure. Table 1 gives estimates of the total manpower requirements based on 1980 productivities, together with calculations of the number of textile degree and textile diplomas required.

Table 1 Estimate of Manpower Required

Year	Total Manpower	Textile Degree Trained	Textile Diploma Trained
1980	22,700	170	850
1985	33,200	250	1,250
1990	48.500	365	1,820
1995	70,000	525	2,625
2000	100,000	750	3,750
Eventually	200,000	1,500	7,500

It should be noted that this table calls for a very drastic increase in the number of factories, but this is by no means impossible because Tanzania controls a fairly large cotton crop. It is also much more conservative than a previous UNIDO estimate, which gave a total manpower of 72,000 in 1986.

If the Textile Institute opened in 1983 and produced the first graduates in 1987 then a rate of 50 graduates/year would enable the supply to meet the estimated demand in 1998. Also the eventual number of graduates in the industry would be 50 x 30 years worked in the industry = 1,500, which is exactly the estimated eventual demand.

However, it is considered dangerous to plan on the very speculative figures of Table 1 and it is recommended that the degree course should be based on an intake of 30 students/year. Using this figure, if the industry does not increase beyond the mills already planned supply will meet demand in 1995. When more mills are planned the size of the degree course can be expanded fairly simply by building more hostels and employing more academic staff. A size of 30 degree students/year is a good economic size and also puts the Institute in the same category as the other important international centres. There is therefore no doubt that the Institute is viable on the size basis.

Using similar calculations to determine the number of diploma students gives $30 \div 0.75 \times 3.75 = 150$. It is thought that this number is rather too large as a single course for the students to receive the necessary individual attention, so some way of splitting the course should be found. Fortunately the idea of splitting the course coincides with another idea to speed up the supply to diploma students, which is thought to be the biggest weakness in the present management structure. It is recommended that short crash courses could be used to train relatively quickly people with good industrial experience, who in some cases may already be doing an assistant shift officer's work for example. Recommended numbers are crash courses of 120 students (2 courses per year) together with a normal diploma course of 90 students, making 330 diploma students trained per year. This more rapid approach would allow the total requirement for diploma trainees to be fulfilled by 1990, after which the policy of crash courses could be reviewed.

II. EDUCATIONAL STANDARDS

As has been stated in the previous chapter it is recommended that the Institute should educate degree-equivalent students and diploma students. It is also essential for the future of the industry that the education is of the highest standard.

A. The degree course

It is recommended that in order to keep academic standards high the basic entrance requirements should be Form VI with good passes in mathematics, physics and chemistry. Exactly similar university entrance

requirements are used all over the world and they have stood the test of time. There is a case in exceptional circumstances for a good diploma student to be transferred to the degree course, but this should definitely not be the normal method of entry.

The length of a degree course varies throughout the world, being three years in U.K. and U.S.A. and four, five or even six years in various European countries. However it is thought that the most important fact is that it is four years at the University of Dar es Salaam and for that reason a course of four years is recommended. In this way, even if the Institute 'degree' is never accepted by the University of Dar es Salaam it will be seen by most people as being of the same standard. It will also probably qualify for the direct award of Associateship of the Textile Institute, Manchester which is a qualification recognised and respected all over the world.

In order to monitor the standard of the 'degree' it is recommended that the third year and final year examinations should be externally examined by someone from one of the foreign textile schools. If a twinning arrangement is made, the external examiner could conveniently come from that University.

B. The diploma course

It is recommended that the entry requirements for this course should be Form IV with good passes in mathematics, physics, chemistry and English. In order to maintain the educational standard there should be no compromise over these requirements, but for the crash course different criteria should apply. For the short course the main criterion should be how well the candidate can do his job, together with his aptitude for further learning.

It is recommended that the crash courses should be of about five months, allowing two courses to be run per year. It is recommended that these courses should be highly specialised, bringing the student up to a high level in one particular subject but almost ignoring other non-related subject. Thus students with this type of diploma would not be suitable for transfer from one part of the mill to another.

It is recommended that the normal diploma should be of two years duration. It would thus be approximately equivalent in both entry standards and duration to the old Ordinary National Diploma, now

Ordinary Technical Diploma in the U.K., a qualification which is known and respected internationally, even though it was designed for the U.K. only.

It is recommended that both types of diploma should be externally assessed possibly by some Tanzanian working in the textile industry who has a personal interest in education.

III. PROPOSED COURSES

A. The degree course

It is very important that throughout the course the students should keep in close touch with the industry. It is hoped that the Musoma Resolution will allow the students to spend the required two years working in a directed way in the textile industry. If this is so they should be placed in the care of the Training Officer, who should ensure they get experience of all sections of the factory. (If the Musoma Resolution directs students elsewhere then it is recommended that an additional year be spent in gaining industrial experience, i.e. Year 1 and 2 at the Institute, Year 3 in industry, Year 4 and 5 at the Institute.)

It is recommended that the year should be split into four terms in the conventional Tanzanian way, leaving about 30 weeks for teaching, 3 weeks for examinations, 5 weeks for vacation and the remaining 14 weeks should be spent in supervised industrial work experience. In this way the student will have both a good theoretical knowledge and also a good practical knowledge of how the industry works.

It is recommended that the working week should be split into 35-40 periods of one hour each. There should be about 16 hours lectures, 16-18 hours practical, leaving a few hours for private study during the week. Students must also be given work to be done in the evenings, to be corrected and returned by the academic staff.

The timetables recommended for the degree course are shown in Appendix 1.

In the final year the students have rather more spare time, but should by then be accustomed to working on their own. It is recommended that due to the limited number of subjects covered in the final year the final average mark should be obtained by taking $\frac{1}{3}$ of the third year average plus $\frac{2}{3}$ of the final year average.

It is only possible to give a brief review of the total syllabus in this report, but it is hoped that this will give an indication of the range and depth of the subject matter. See Appendix 2.

B. The diploma crash course

It is recommended that this course should only be offered to people who have considerable practical experience and who in many cases may already be doing the actual job, though without any formal training. It is recommended that three courses should run simultaneously for 20-22 weeks, one in yarn manufacture, one in cloth manufacture and one in cloth finishing, dyeing and printing, so that in total six courses can be completed per year

Crash course in Yarn Manufacture

	Lectures	Practicals	
General Textile Technology	2	-	
Testing and Quality Control	1	-	
Communications and Report Writing	2	-	
Management Studies	2	-	
Blowroom	2	4	
Carding	2	4	
Comb and Comb Preparation	2	4	
Drawframe and Speedframe	2	4	
Spinning (including O-E)	2	4	
	17	20	Total 37

The main purposes of this course are to give the students a wider appreciation of the textile industry, to give them more theoretical knowledge about the yarn manufacturing process and to perfect their practical work and settings on the machines. The syllabus is self-evident from the timetable, but should be taught differently from the degree course, because the students are quite different.

Crash Course in Fabric Manufacture

	Lectures	Practicals	
General Textile Technology	2	-	
Testing and Quality Control	1	-	
Communications and Report Writing	2	-	
Management Studies	2	-	
Yarn Preparation	2	4	
Let off, take-up, beating up and timing	2	4	
Shedding Mechanisms	2	4	
Picking adjustments and Pirn change	2	4	
Shuttle-less looms	2	4	
	17	20	Total 37

Crash Course in Cloth Finishing, Dyeing and Printing

	Lectures	Practicals	
General Textile Technology	2	-	
Testing and Quality Control	1	-	
Communications and Report Writing	2	-	
Management Studies	2	-	
Singe and Bleach	2	4	
Wash and Stenter (particularly heat efficiency)	2	4	
Pad and Winch Dyeing	2	4	
Roller Printing	2	4	
Screen Printing (Flat and Rotary)	2	4	
	17	20	Total 37

In each case the general plan of these courses is similar to the yarn manufacture course, so requires no further comment.

C. The normal diploma course

The normal diploma course is intended for students with good Form IV passes in science subjects and English and with two years industrial experience. If the students' industrial experience was not in the textile industry, it is recommended that the course should be of 3 years. Year 1 in the Institute, Year 2 supervised in industry and Year 3 in the Institute.

The basic philosophy of the course is to give in the lectures the simple theories of textile processing and in the practicals to show how the machines work and how to set and maintain them. The syllabus for each course is similar to the degree course (see Appendix 2), but at a much more elementary and practical level; it will not be repeated here.

1st Year	Lectures	Practicals	
Textile mathematics	1	-	
Textile physics	1	2	
Textile chemistry	1	2	
Yarn manufacture	2	3	
Fabric manufacture	2	3	
Cloth structure	1	-	
Yarn preparation	1	2	
Cloth finishing	2	3	
Dyeing and Printing	1		
Testing and Quality Control	2	3	
Statistics	1	-	
Communication and Report writing	1	-	
	15	18	Total 33

For the second year there are two proposals to choose from. One has no specialisation and will produce broadly trained people who can be moved from one section of the factory to the other. The other alternative produces technicians more highly trained in one section, but who couldn't be moved easily from one section to another. The second alternative requires two more lecturers, so is slightly more expensive.

The second proposal is recommended since it will produce more highly trained technicians. The staffing requirements have been based on the second proposal.

2nd Year	Lectures	Practicals	
Operations Research	1	-	
Management Studies	1	-	
Communication and Report Writing	1	-	
Clothing technology	1	2	
Textile engineering	1	2	
Yarn Manufacture II	1	5	
Fabric Manufacture II	1	5	
Cloth Finishing, Dyeing and Printing II	1	5	
Testing and Quality Control II	1	5	
	9	24	Total 33

Alternative timetable with specialisation:

2nd Year	Lectures	Practicals	
Operations Research	1	-	
Management Studies	1	-	
Communication and Report Writing	1	-	
Clothing Technology	1	2	
Textile Engineering	1	2	
Specialisation			
Yarn Manufacture Fabric Manufacture Cloth Finishing, Dyeing and Printing Testing and Quality Control	5	18	
	10	22	Total 32

IV. STAFFING REQUIREMENTS

It is recommended that the organisational structure should be as simple as possible, and that it should not be divided into distinct parts, since these will tend to destroy the unity of the Institute, which it is important to create and foster.

In view of the fact that the lecturers will also be expected to do consultancy/research work it is recommended to use a lecturing load of about 10 lectures/week for lecturers and 12-16 practical periods/ week for technicians. To further develop this unity it is recommended that where possible lecturers teach both degree and diploma courses and are not segregated.

The recommended staffing requirements are as follows:

1. The Director who is responsible for running all aspects of the Institute.

2. An Assistant Director responsible mainly for administration.

3. Academic Staff as follows:
   a) 1 x Mathematician to teach Textile Maths, Statistics and Operations Research.
   b) 1 x Physicist or Chemist to teach Textile Physics and Textile Chemistry.
   c) 2 x Textile Technologists to teach Textile Testing and General Textile Technology.
   d) 3 x Textile Technologists to teach Yarn Manufacture.
   e) 3 x Textile Technologists to teach Fabric Manufacture, Cloth Structure and Winding.
   f) 1 x Arts graduate to teach Communications and Report writing.
   g) 1 x Engineer to lecture and demonstrate in Textile Engineering.
   h) 2 x Textile Technologists to teach Cloth Finishing.
   i) 1 x Textile Technologist to teach dyeing and printing.
   j) 1 x Management graduate to teach Textile Management and Accounting.
   k) 1 x Clothing Technologist to teach Clothing technology.

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4. Technical Instructors:
   a) 1 scientist to teach Textile Physics and Textile Chemistry practicals.
   b) 5 technologists to teach yarn manufacture practicals.
   c) 5 technologists to teach fabric manufacture and yarn preparation.
   d) 3 technologists to teach cloth finishing practicals.
   e) 3 technologists to teach textile testing practicals.
   f) 2 technologists to teach dyeing and printing practicals.
   g) 1 demonstrator to help with the management studies projects.
   h) 1 technologist to teach clothing technology.

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5. Junior Technicians:

a) One in Textile Science.
b) 2 in Yarn Manufacture.
c) 5 in Fabric Manufacture and Yarn Preparation.
d) One in Engineering.
e) 3 in Cloth Finishing.
f) 2 in Dyeing and Printing.
g) One in Clothing Technology.

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These figures are based on the specialist option in the diploma course. During the first year the diploma course is too large for practical classes and should be split, but this can be done without a significant increase in the technical instructors' workload.

The number of lecturers and technical instructors have been determined from the number of teaching periods to be given. An alternative method is to calculate the staff:student ratio. In this case it is exactly 11, compared with ratios of 9-10 in U.K. Universities and 12-14 in U.K. technical colleges. Since the Institute falls in status between a university and a technical college the ratio seems to be correct.

6. Other Staff:

About 6 secretary/typists, one for the Director, one for the Assistant Director and the rest shared between the other lecturers. A qualified Librarian and 2 assistant librarians are needed to run the library. Also 3 qualified workshop staff to work in the professional workship. Also cleaning staff, cooks, groundsmen, security staff etc. according to the customs of the country.

V. QUALIFICATIONS OF STAFF

It cannot be too strongly stressed that personal character is more important than academic qualifications. Important characteristics are an interest in teaching young people, enthusiasm for the work and the ability to work conscientiously without any supervision. With these qualities people with average or even poor qualifications can be

good lecturers but without them even the highest qualified person will be useless. Examples of this fact can be seen in any college or University, so that this should always be the first consideration of an appointing committee.

The following qualifications are only given as a guideline, on the understanding that a good man with lower qualifications could be appointed.

Director - Good Honours degree in Textiles, preferably research degree, should have both research and industrial experience, should also be capable of administration. Must be a natural leader.

Assistant Director - Good Honours degree in any subject. Previous experience and proved ability in administration.

Lecturers - Good Honours degree in the relevant subject. Since the course must be industry-oriented 3-5 years industrial experience in a European or similar factory is an essential requirement. It is felt that industrial experience in Tanzania, for example, would only tend to maintain the present state of affairs.

Technical Instructors - At least ONC/OND or equivalent qualification. At least 5 years industrial experience in a European or similar factory. Although the technical instructors have lower academic qualifications they will do about half the total teaching and it is essential that keen people with good teaching ability should be appointed.

The supply of good trained textile graduates, even on a world-wide scale is fairly limited, so it is recommended that at least one third and preferably one half of the staff referred to above should be Tanzanian. This would be possible either by selecting good graduates or diplomates from the factories or from existing students at present studying abroad. It is considered absolutely essential that arrangements should be made for them to work in European or similar mills for at least two years before starting to teach.

In many countries lecturers are given the security of life tenure up to retirement age. Although this is often defended as being essential for free speech, which is obviously important in any subject bordering on politics, it has the distinct disadvantage that it is almost impossible to dismiss an incompetent lecturer. It is therefore recommended that the terms of contract should be six months notice on

either side, with no tenure. (Expatriate contracts will normally be one to three years, but should be made renewable yearly for the same reason.)

VI. TWINNING ARRANGEMENTS

A twinning arrangement with a foreign university would be a good idea not only in the formative years of the Institute but also when it is well established, since it will help the Institute to maintain standards and to keep in closer touch with worldwide developments.

A. External examiner

It is recommended that a senior member of the University chosen should act on a rotating basis as external examiner for the degree students but not for the diploma students. Since the journey will be a long one the opportunity should be taken for other work to be done at the same time, for example special lectures to staff or to the whole Institute, research discussions with staff, informal discussions with students, etc.

B. Exchange of staff

Although this sounds an excellent idea in theory, in practice it often works out rather badly. One drawback is that the key staff who should be exchanged are too heavily committed at their home university to be released and it tends to be junior staff, who have less to offer, who actually go abroad. It has also frequently been observed that staff visiting a foreign university regard the time simply as a holiday from their normal duties.

It is therefore recommended that if this form of exchange is considered that adequate safeguards should be drawn up against these two major drawbacks.

C. Exchange of students

This form of exchange takes quite a lot of organising and leads to some disruption in the students' studies, because it is impossible for the course at the exchange university to fit in exactly with the home course. It also must be limited to one or at most two students per year, otherwise the foreign students would tend to form a group

of their own and would not integrate. It is concluded that this form of exchange is useful, but can only benefit a minority of the students.

A list of possible universities and colleges is given in Appendix 3.

VII. OTHER ROLES OF THE TEXTILE INSTITUTE

A. Research and consultancy work

At the present time most of the large textile firms and also the Textile Research Associations in Europe are cutting down very drastically on the amount of research work they are doing. The basic reason is that research is becoming increasingly expensive and the return for useful research is no longer big enough to justify the expense. It is therefore recommended that the Institute should not attempt any type of pure research.

Another form of research which is possible is that done by research students under the supervision of the staff in a University or Polytechnic. This is relatively cheap and can produce useful returns, though they generally go to the industry rather than the University. It also produces the very useful by-product of trained research workers. However, it does not appear that there would be any place for trained research workers in Tanzania at the present time (except in the Institute itself), so it is recommended not to start research work of this type at the present time, but to keep the situation under review.

In contrast to the position of research work it is thought that the Institute could fulfil a very useful task in investigating the causes of industrial problems and in putting forward solutions.

The size of these problems will vary and it is also impossible to forecast how much use the industry will make of this service. It is therefore recommended that the service should be done by the lecturers and technical instructors at least during the first years. It is recommended that the industry should pay to the Institute for the consultancy service, otherwise frivolous problems may be sent in. The payments will also help to finance the Institute. It is also recommended that the lecturers and technical instructors should receive a percentage of these consultancy fees in addition to their salary, which will give them a big incentive to do the consultancy

work quickly and well.

If the consultancy work proves too exacting for the staff already appointed, it is recommended that more lecturers not new research staff should be appointed. There are two reasons for this. Firstly the lecturer's contact with current industrial problems is very good both for his morale and for his professional knowledge, and it will show itself in better teaching later. Secondly, the creation of two sections in the Institute, academics and consultants, would destroy its unity and lead to unhealthy rivalry between the two groups.

B. Testing and quality control

Much testing work should continue to be done in the factories, but the Institute will be equipped with more and better testing equipment than any of the factories. It is therefore sensible to make these testing facilities available to the industry, but also on the basis of payment to avoid misuse.

It must be mentioned that the Tanzanian Bureau of Standards also has or will soon have a fairly wide range of textile testing equipment. However, it is understood that their main purpose is to set up Tanzanian Standards for textiles in the first instance and perhaps later to monitor a scheme like the 'Kite' mark run by the British Standards Institute. It is felt that this scheme does not overlap in any way the plans for industrial testing to be carried out by the Institute.

As in the case of the consultancy scheme it is difficult to forecast how much demand there will be from the industry, but at least in the initial stages it should be run by the lecturers and technical instructors. If there is too much work further technical instructors and juniors should be appointed as part of the teaching unit, rather than start a special testing section.

The main functions of the testing service will be

1) Testing fibres, yarns and fabrics with instruments not available in the factories.

2) Check testing to ensure the accuracy of testing equipment being used in the factories.

3) Testing or check testing fabrics against Tanzanian Bureau of Standards specifications.

C. Library and Information centre

A well-stocked library will be an essential part of the training role of the Institute. In principle the same library could be used by the industry; provided the borrowing is not too heavy there will be no difficulty in practice, but it is possible to conceive a situation in which the students were unable to refer to books because they were already lent out. No doubt if this problem does exist it can be solved using photocopies.

Information centres can vary from computer storage of information to simple card index systems. In this case a card index system is recommended but it is essential to have someone trained in both textiles and information storage and retrieval to run it. For instance any given article will deal with at least three main subjects and unless these three subjects are correctly identified and the article is classified under all three it could become 'lost' in the storage system. Such a system would be of great use to the lecturers, to the students and to the industry so its use is strongly recommended.

VIII. PHYSICAL FACILITIES AND COST

A. General

In view of the government policy to limit the number of institutes in Dar es Salaam, Morogoro is probably one of the most suitable sites. It lies on the direct route from Dar es Salaam to Dodoma, so that communications are good. Also the presence of the University Faculty of Agriculture will be useful in fostering inter-college sports, cultural meetings at staff and student level, etc. Finally, there will be at least two mills in Morogoro and this will be of great use in keeping close links between the institute and industry.

In spite of these advantages the fact must be faced that Morogoro is a fairly primitive agricultural area and it is difficult to transplant a sophisticated technological community into such an area. For this reason it is recommended to provide full social and sporting facilities on the campus of the Institute for both staff and students and to develop all possible links with the Faculty of Agriculture.

Sporting and social centre for staff and students:

Estimated cost - 10,000,000 Sh.

The detailed costs of housing and college buildings will be found in Appendix 4 and 5.

B. Summary of costs

From Appendix 5:

The total area of essential buildings is 2300 m^2 at 2500 Sh/m^2.

Estimated cost: 5,750,000 Sh

The total area of desirable buildings is 800 m^2 at 2500 Sh/m^2.

Estimated cost: 2,000,000 Sh

Adding the cost of buildings from Appendix 4:

Total cost of essential buildings only	= 65,975,000 Sh + 10%
for infrastructure	= 72,600,000 Sh
Total cost including desirable building	= 67,925,000 Sh + 10%
for infrastructure	= 74,800,000 Sh

The equipment needed for the practical classes is listed in Appendix 6. Equipment is listed under two headings "essential" and "desirable". The total cost of this machinery taken from Appendix 6 is listed below:

Essential equipment

Professional workshop	1,118,000
Students workshop	430,000
Yarn manufacture laboratory	1,252,000
Yarn preparation laboratory	1,080,000
Weaving laboratory	1,982,000
Knitting laboratory	150,000
Cloth finishing laboratory	346,000
Dyeing and printing laboratory	482,000
Science laboratory	750,000
Clothing laboratory	50,000
Testing laboratory	1,535,000
	9,175,000 Sh

Desirable equipment

Yarn manufacture laboratory	3,010,000
Yarn preparation laboratory	1,400,000
Weaving laboratory	790,000
Knitting laboratory	400,000
Cloth finishing laboratory	340,000
Testing laboratory	642,000
	6,582,000 Sh

Hence the total cost of the Institute equipped only with essential equipment is estimated to be: 81,775,000 Sh

say 85 million T. Shillings.

If better equipped with all desirable equipment the estimated cost is 90,557,000

say 95 million T. Shillings.

IX. COMPARISON OF TRAINING COSTS

It would be sensible to make a comparison between the cost of training students at the Institute and the cost of sending them abroad for training. The main costs are interest on capital expended, daily running costs and maintenance, salaries of the staff and maintenance costs for the students.

1) Interest on capital invested at 8%

Case 1 - 85 million shillings at 8% = 6,800,000 Sh/year.

Case 2 - 95 million shillings at 8% = 7,600,000 Sh/year.

2) Maintenance costs, power, lighting, painting, repairs, etc. These will tend to be relatively small in the early years, but increase later. Taking a rough average, say a mean value of 5% of total cost.

Case 1 - 85 million shillings at 5% = 4,250,000 Sh/year.

Case 2 - 95 million shillings at 5% = 4,750,000 Sh/year.

3) Salaries of staff.

In the early years it is thought that it will be impossible to staff the Institute entirely with Tanzanians. For the purpose of calculation a ratio of $\frac{1}{3}$ Tanzanians to $\frac{2}{3}$ expatriates has been taken.

After a period of about 5 years it should be possible to localise all the posts. Calculations have been made for both cases (see Appendix 7).

Case A ($\frac{1}{3}$ Tanzanian $\frac{2}{3}$ Expatriate) the annual salary bill is estimated to be 8,515,000 shillings.

Case B (all posts localised) the annual salary bill is estimated to be 2,516,300 shillings.

4) Student maintenance.

The cost of student maintenance in Tanzania is not known, so an estimate will have to be made.

420 students at 5000 shillings = 2,100,000 Sh/year.

5) Total costs and costs per student per year.

Case 1A Lower level of equipment and $\frac{2}{3}$ expatriate staff.
Total annual cost - 21,665,000 shillings.
Annual cost per student - 51,580 shillings/year.

Case 2A Higher level of equipment and $\frac{2}{3}$ expatriate staff.
Total annual cost - 22,945,000 shillings.
Annual cost/student - 54,680 shillings.

Case 1B Lower level of equipment and all Tanzanian staff.
Total annual cost - 15,666,300 shillings.
Annual cost/student - 37,300 shillings.

Case 2B Higher level of equipment and all Tanzanian staff.
Total annual cost - 16,946,300 shillings.
Annual cost/student - 40,350 shillings.

It is interesting to note that these costs compare quite favourably with the University of Dar es Salaam, which has a cost of 45,000 to 60,000 shillings/student in a technological subject.

These costs should be compared with the costs of sending students abroad, but the costs, benefits and difficulties vary a lot from one country to another. In most European countries (France, Germany, Italy, Hungary, Poland, etc.) Tanzanian students have considerable language problems. This leaves only the countries studying textiles in English, i.e., India, Canada, U.S.A., New Zealand, Australia, South Africa and U.K. Of these there is little doubt that India will be the cheapest

but unfortunately costs there are not known. The costs in the other countries will be fairly similar, so the U.K. will be taken as an example. The current cost per year for either a degree of a diploma course in the U.K. is £3,500 tuition fees, £1,000 accommodation, £100 books, £500 meals and £300 allowance making a total of £5,400 or 102,600 T. shillings/year.

It is therefore concluded that it will be much cheaper to train students inside Tanzania than to send them abroad for training. Furthermore, even using expatriate lecturers less than half the total cost of tuition is made up of foreign exchange, so there is some help to the balance of payments problem.

Quite apart from the financial considerations the Institute will offer many advantages to the industry. It will form a centre of learning inside Tanzania, offering consultancy, testing and information services. Above all by making Tanzania academically independent from other countries it will lead to a greater maturity in the textile industry.

APPENDIX 1

Degree timetables

1st Year	Lectures	Practicals
Textile Maths I	2	-
Textile Physics I	2	3
Textile Chemistry I	2	3
General Textile Technology	2	-
Yarn Manufacture I	1	2
Fabric Manufacture I	1	2
Cloth Structure I	1	-
Yarn Preparation I	1	2
Communication and Report Writing I	2	-
Textile Engineering I	1	2
	15	14

2nd Year	Lectures	Practicals
Textile Physics II	1	2
Textile Chemistry II	1	2
Yarn Manufacture II	2	3
Fabric Manufacture II	2	3
Cloth Structure II	1	-
Yarn Preparation II	1	2
Cloth Finishing I	2	3
Testing and Quality Control I	2	3
Statistics I	2	-
Communication and Report Writing	2	-
Textile Engineering II	1	2
	17	20

3rd Year	Lectures	Practicals
Yarn Manufacture III	2	3
Fabric Manufacture III	2	3
Cloth Finishing II	2	3
Testing and Quality Control II	2	3
Communications and Report Writing III	2	-
Operations Research I	1	-
Dyeing and Printing I	2	3
Management Studies I	2	-
	15	15

4th Year	Lectures	Practicals
Basic Common Course		
Operations Research II	1	-
Management Studies II	2	-
Communications and Report Writing IV	2	-
Clothing Technology I	2	3
Accouting I	1	-
Specialisation - one course from:		
Yarn Manufacture Fabric Manufacture Cloth Finishing, Dyeing and Printing Quality Control and Testing Clothing Technology Management Studies	5	10
	13	13

APPENDIX 2

Degree syllabus

Textile Maths I

Simple textile calculations such as draft, doubling, twist and twist factor, production calculations etc. Setting theories for woven fabrics and cover factors for knitted fabrics. The application of mathematics to more complex textile problems, e.g. the mathematics of setting theory, the mathematics of balloon theory etc.

Textile Physics I and II

The application of microscopes, electron microscopes, X-ray diffraction etc. in the study of fibre structure. The theory of colour and colour measurement. The application of valves and transistors in amplifiers. Negative feed back. Automatic control by open-loop and closed-loop systems. Printed circuits and micro-chip technology.

Textile Chemistry I and II

The chemical structure and simple reactions of all the common fibres, especially cotton. Methods of fibre identification. Chemical aspects of the scouring and finishing processes.

General Textile Technology I

This course is intended to survey the whole textile industry to put each of the other courses into perspective. Ideally it should be given before the rest of the course, e.g. during the first week full time, but this is not often possible.

Yarn Manufacture I, II, III

This course should start with some discussion of the properties of the raw materials. There is then sufficient time to go into detail of both the theory and practice of each manufacturing stage. The course should logically spend more time on cotton and short staple processing, but it is important also to teach other spinning systems including texturing, converting, etc., since they may at some time have an important influence on the short staple system.

Yarn Manufacture IV

It is intended in this course that the student should be acquainted with all the important and recent research in the subject. In the practical work he should be set a piece of investigation to do, either completely original research or a subject which is little known. He should also write this work up in a professional manner for assessment. The same basic idea applies to all the specialist subjects, so this will not be repeated each time.

Fabric Manufacture I, II and III

This course should give the student a full understanding of the theory and practice of weaving, including all known types of shedding, beating-up and pick-insertion. Some time should also be devoted to warp and weft knitting and to the methods of production of non-woven fabrics.

Cloth Structure I and II

A study of weave structures of all types, including terry, woven carpets etc. Also a study of the structure of warp knitted and weft knitted fabrics.

Yarn Preparation I and II

A study of cone winding, waxing and clearing. The preparation of warps by sectional and direct warping. Sizing. Methods of reaching-in and sleying. Pirn-winding.

Communication and Report Writing I, II, III and IV

The purpose of this course is to improve the students' ability to communicate both verbally and in writing. It is thought that this course is a most important one, because modern scientists and technologists are so often criticized for being illiterate and unable to communicate.

Textile Engineering I and II

This course should be mechanical engineering applied to textile machines, chiefly concentrating on bearings, lubrication, linkages, gears and machine maintenance. Some practical work could deal with the manufacture of simple machine parts.

Testing and Quality Control I and II

Methods of physical and some chemical testing on fibres, yarns and fabrics. The principles of using test results to control the quality in a factory.

Statistics I

The theoretical background of Quality control. The application of 'u' test, 't' test, χ^2 test, correlation and regression, rank correlation etc.

Cloth Finishing I and II

Modern methods of cloth finishing applied to cotton fabric in great detail. Also the finishing of knitted fabric and wool fabric in less detail.

Operations Research I and II

This subject involves the application of mathematical techniques to factory management and is currently in great demand. The course could possibly include a section on the use of computers in the textile industry.

Dyeing and Printing I

A basic course covering the chemistry of dyes, methods of application by dyeing and printing, and fastness characteristics of different dye types. Some time should be spent on wool dyeing and the dyeing and printing of knitted fabric.

Management Studies I and II

It is very easy for a course of this sort to become too theoretical. It is most important that it should be taught by someone with managerial experience who can give practical information rather than theoretical.

Clothing Technology I

This course should just be long enough to give an appreciation of the subject to most students and at the same time serve as an introduction for the few students who specialise in this branch.

Accounting I

A short course to give students a better idea of the aims and methods of accountants. It is felt that this knowledge is essential for those who are going to be managers.

APPENDIX 3

Suggested Colleges and Universities for a twinning arrangement

The following addresses have been carefully arranged in order of preference and brief comments are given where applicable.

a) Professor P. Grosberg, Department of Textile Industries, University of Leeds, LEEDS LS2 9JT, U.K.

This is probably the oldest established and most famous textile department in the world. In the early years is concentrated entirely on wool but for the last twenty years has had a strong cotton section. It has at least three twinning arrangements at present.

b) Professor J.W.S. Hearle, Department of Textile Technology, U.M.I.S.T., Manchester, U.K.

This department has specialised on cotton since its foundation but is considerably smaller than a). It has at least one twinning arrangement already.

c) Department of Textiles, University of North Carolina, Raleigh, North Carolina, U.S.A.

This is the most famous American textile centre and is particularly noted for work on cotton.

d) Mr. J.H.E. Jackson, Department of Textiles, Bolton Institute of Technology, Deane Road, BOLTON, U.K.

This department concentrates mainly on cotton and teaches mainly diploma level courses, but has a significant number of students near to degree level.

e) Department of Textiles, Indian Institute of Technology, New Dehli, India.

Although relatively newly formed this Institute is already making a reputation chiefly in the cotton field.

f) Dr. M.S. Burnip, Department of Textiles, Huddersfield Polytechnic, Huddersfield, U.K.

This is a good college teaching both degree and diploma level, but it does tend to concentrate on wool.

g) Department of Textiles, Victoria Jubilee Technical Institute, Bombay, INDIA.

This college used to have the highest reputation in India for the study of cotton textiles, but it has since been superceded by the I.I.T., New Dehli.

h) Mr. W. Parkin, Department of Textiles, University of Bradford, BRADFORD, U.K.

This is a medium size department teaching only degree level and concentrating strongly on wool.

i) Mr. N.A. Atherton, Department of Textiles, Blackburn College of Technology and Design, BLACKBURN, U.K.

This is a medium size college specialising mainly on cotton, but teaches only to diploma level.

Further addresses could be added if necessary, but it is felt that the present list should give sufficient choice.

APPENDIX 4

Housing for Staff and Students

Houses or flats will be required for the director and 17 academic staff, 21 technical instructors, the assistant director and the librarian, i.e. 41 people and their families. House sizes will vary depending on family size and on status but it is proposed to take an overall average size of 160 m^2 and a building cost of 4000 Sh/m^2.

Estimated cost: 26,250,000 Sh

Flats for 17 junior technicians, 6 secretaries and 2 assistant librarians, assumed to be unmarried, say 40 m^2 at a building cost of 3500 Sh/m^2.

Estimated cost: 3,500,000 Sh

Student housing for 120 degree students, 120 crash course students and 180 normal diploma students = 420. Allowing 12 m^2/student and building costs of 3000 Sh/m^2.

Estimated cost: 15,125,000 Sh

APPENDIX 5

College Buildings

An auditorium to hold the entire Institute - to be used also for textile conferences etc. 500 seats, say 700 m^2 with building costs at 3500 Sh/m^2.

Estimated cost: 2,500,000 Sh

Classrooms/lecture theatres:

2 classrooms holding 90 diploma students 2 x 100 m^2	= 200 m^2
3 classrooms holding 40 crash course students 3 x 50 m^2	= 150 m^2
4 classrooms holding 30 degree students 4 x 40 m^2	= 160 m^2
8 tutorial rooms holding 6/8 people (specialist courses) 8 x 10 m^2	= 80 m^2
	590 m^2

Building costs at 2500 Sh/m^2.

Estimated cost: 1,500,000 Sh

Library including information storage and study space for students 450 m^2 at 3000 Sh/m^2.

Estimated cost: 1,350,000 Sh

Practical work rooms:

Professional workshop to make experimental parts	= 200 m^2
Student workshop for engineering practicals	= 300 m^2

Other workrooms are divided into essential, comprising the minimum equipment for running practical classes at all and desirable comprising equipment which should be present in a good college but which is not absolutely essential:

	Essential	Desirable
Yarn manufacture	200 m^2	200 m^2
Yarn preparation	100 m^2	150 m^2
Weaving	200 m^2	150 m^2
Knitting	50 m^2	100 m^2
Cloth Finishing	250 m^2	200 m^2
Dyeing and Printing	250 m^2	-
Textile Testing	300 m^2	-
Science laboratory	200 m^2	-
Clothing laboratory	100 m^2	-
Storage rooms for fibre, yarn, fabric and chemicals	150 m^2	-
	1800 m^2	800 m^2

APPENDIX 6

Equipment for Textile Processing Practicals

Professional workshop equipment

3 lathes	500,000
Surface grinder	225,000
Milling machine	275,000
Vertical drilling machine	20,000
Grinding machine	6,000
Belt sanding machine	10,000
Welding equipment (electrical and oxyacetylene)	40,000
Guillotine cutter	12,000
3 sets of benches with hand tools	30,000
	1,118,000 Sh

Students workshop equipment

It is intended to equip this for 45 students so that the diploma course can do practical engineering, even though this is not on the time table at the present time.

45 sets of benches with hand tools	430,000 Sh

Essential equipment for the Yarn Manufacturing laboratory

High speed card (to be fed by lap from mills)	320,000
Grinding and burnishing equipment	50,000
Flat grinding machine	100,000
High speed drawframe	220,000
20 spindle speed frame in 2 sections with different drafting systems	200,000
40 spindle ring frame with different drafting systems, different spindles and rings	200,000
Roller vibration tester	4.000
Roller excentricity tester	10,000
Cot grinding equipment	100,000
Apron setting gauges	2,000
Boxes of travellers	5,000
Wrap reel and balance	20,000

Shirley templates	6,000
Tachometer	4,000
Stroboscope	5,000
Digital Tachometer	6,000
	1,252,000 Sh

Desirable equipment for Yarn Manufacture laboratory

A short versatile blowroom suitable for cotton and man-made fibres ending with a scutcher	1,000,000
Tandem card	650,000
Converted card (second hand)	150,000
Metallic wire mounting equipment	60,000
Old type drawframe (second hand)	50,000
Modern sliver lap	400,000
Modern comber	450,000
Additional 40 spindle ring frame	200,000
10 spindle O-E spinning machine	250,000
	3,010,000 Sh

Essential equipment of Yarn Preparation

Manual cone winder 24 heads with various cone types	180,000
Ring twisting machine 20 spindles	150,000
Automatic pirn winder (6-8 head)	170,000
Beam warper and creel	580,000
	1,080,000 Sh

Desirable equipment for Yarn Preparation

1 single spindle automatic cone winder	100,000
1 x 4 spindle 2 for 1 twister	120,000
Assembly winder to wind cheeses and clip cones for the 2 for 1	80,000
Fancy twister	180,000
Shirley minature sizing machine	160,000
Automatic reaching-in machine	380,000
Automatic tieing-in machine	380,000
	1,400,000 Sh

Essential equipment for Weaving laboratory

1 x manual loom (second hand) (tappet)	20,000
1 x weft mixing automatic (tappet)	82,000
1 x 2 colour automatic (tappet)	90,000
1 x 4 colour automatic with dobby shedding	120,000
1 x Terry loom with Jacquard shedding	200,000
1 x Sulzer loom with centre selvedge device	800,000
1 x air-jet loom	200,000
1 x flexible rapier loom	400,000
1 x Stroboloom (for 'stopping' the motion of loom)	40,000
1 x Warp tension meter	10,000
Card cutting machinery for all looms	20,000
	1,982,000 Sh

Desirable equipment for Weaving laboratory

1 x water-jet loom	250,000
1 x rigid rapier loom	400,000
2 x weft accumulators for shuttle-less loom	40,000
Working hand-driven full-scale models of tappet shedding, dobby shedding and Jacquard shedding	100,000
	790,000 Sh

Essential equipment for Knitting laboratory

1 small hand driven circular machine (Griswold)	5,000
1 small single jersey machine (second hand)	10,000
1 hand driven domestic flat machine (electrical control) (Knitmaster)	10,000
1 simple half hose machine (second hand?)	125,000
	150,000 Sh

Desirable equipment fo Knitting laboratory

1 small double jersey machine	160,000
1 industrial hand flat machine	40,000
1 narrow width warp knitting machine	120,000
1 narrow width Raschel machine (table model)	80,000
	400,000 Sh

Essential Cloth Finishing equipment	
Small scale bleaching range	200,000
Pad mangle	50,000
Washing unit	50,000
Small oven with pin frames	46,000
	346,000 Sh
Desirable Cloth Finishing equipment	
Autoclave	140,000
Hydroexhauster	200,000
	340,000 Sh
Essential equipment for Dyeing and Printing laboratory	
Laboratory thermsol pad dyer	102,000
High pressure universal dyer	80,000
Winch dyer	80,000
Laboratory scale roller printer	60,000
Manual flat screen printer	100,000
Laboratory scale rotary screen printer	60,000
	482,000 Sh
Essential equipment for the Science laboratory	
Overall estimate for many small items	750,000 Sh
Equipment for the Clothing laboratory	
4-6 sewing machines of different types (second hand?)	
	50,000 Sh

Essential equipment for the Testing laboratory

Instron tenstile tester	300,000
Regain testing oven	12,000
Microtome	24,000
Microscopes	100,000
Micronaire	30,000
Fibrograph	120,000
Pressley tester	20,000
Uster evenness tester	300,000
Water repellency testing	25,000
Launder tester	50,000
Rubbing fastness tester	16,000
Abrasion tester	50,000
Shrinkage tester	125,000
Wrinkle recovery tester	3,000
Colour matching booth	20,000
Spectrophotometer	100,000
pH meter, fluidity tester	40,000
Miscellaneous small items	200,000
	1,535,000 Sh

Desirable equipment for the Testing laboratory

Uster single thread tester	300,000
Burst strength tester	25,000
Elmendorf tear tester	13,000
Perspiration tester	4,000
Xenotest	300,000
	642,000 Sh

APPENDIX 7

Calculation of annual salary bill

Annual salary bill (All Tanzanians)

1 Director MSU12	54,000
1 Assistant Director MSU11	52,800
17 Lecturers ranging from MSU7 to MSU11	824,500
21 Technical Instructors averaging MSU8	882,000
3 Workshop staff at MSU7	100,000
1 Librarian MSU8	42,000
2 Assistant librarians MSU5	42,000
6 Typist/secretaries MSU6	162,000
17 Junior Technicians MSU5	357,000
	2,516,300 Sh

For the purposes of calculation it is simplest to calculate with all senior posts expatriate and then take a ratio.

Annual salary bill (All senior posts expatriate)

Director (£25,000)	475,000
Assistant Director (£20,000)	380,000
17 Lecturers (£16,000)	5,168,000
21 Technical Instructors (£12,000)	4,788,000
3 Workshop staff	100,000
1 Librarian	42,000
2 Assistant librarians	42,000
6 Typists	162,000
17 Junior Technicians	357,000
	11,514,000 Sh

Hence with $\frac{1}{3}$ Tanzanian and $\frac{2}{3}$ expatriate the salary bill would be:

8,515,000 Sh