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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
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United Nations Industrial Development Organization

Regional Expert Group Meeting
on Human Resources Development
in Industrial Maintenance
in Africa.

Nairobi, Kenya, 23 - 27 June, 1986

HUMAN RESOURCES DEVELOPMENT IN INDUSTRIAL MAINTENANCE: THE CASE OF TANZANIA

by

G. Msolla

1986

FULL NAMES OF INSTITUTIONS/ORGANIZATIONS MENTIONED IN THE CASE STUDY:-

1. TANESCO = Tanzania Electricity Supply Company.

2. TP & TC = Tanzania Posts and Telecommunications Corporation.

3. METDA = Metal Engineering Industries Development Association.

4. TEMDO = Tanzania Engineering and Manufacturing Design Organization.

5. SIDA = Swedish International Development Authority.

6. TISCO = Tanzania Industrial Studies Consultancy Organization.

7. NORAD = Norwegian Agency for International Development.

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INTRODUCTION

. General Information

The United Republic of Tanzania (945,087 sq. km.) consists of the mainland, and the nearby islands of Zanzibar and Pemba. Tanzania lies on the east coast of Africa, bordered by Uganda and Kenya to the north; by Zaire to the west and by Zambia, Malawi and Mozambique to the south. Zanzibar and Pemba are in the Indian Ocean about 40 km. off the coast of the mainland, north of the country's capital, Dar es Salaam.

The population is estimated at 21 million and the growth rate has averaged slightly in excess of 3% over the past decade. The population is multiracial and multireligious.

The gross Domestic Product (GDP) was estimated at US $ 2807 million in 1984 most of it being contributed by the agricultural sector. The manufacturing GDP was estimated at US $ 190 million in 1984 and over the past decade the manufacturing share to the GDP has averaged at a little below 10%.

Tanzania's industrial sector is mainly in the manufacture of textiles; cigarettes; farm implements; transformers and switch-gear; pharmaceutical products; cement; billet casting; steel rolling and machine tools; and food processing.

Major export crops include coffee (30 - 40% of export earnings); cotton, tobacco, cashewnuts, sisal and tea. Cloves provide about 80% of Zanzibar's export earnings.

Labour force was estimated at 603,193 in 1984 and the percentage literacy is estimated at 85%. Population in Primary Schools was estimated at 3.54 million in 1981 while the population in Secondary Schools during the same year was estimated at 65,000 (Ref. No. 7).

The total number of students at the University of Dar es Salaam is about 3,000 while Sokoine University of Agriculture at Morogoro takes about 400 students. The Faculty of Engineering at the University of Dar es Salaam has about 540 students each year.

Industrial training institutes in Tanzania include:

- Dar es Salaam Technical College
- Arusha Technical College
- National Vocational Training Centre (Moshi)
- National Vocational Training Centre (Dar es Salaam)
- High Precision Technical Centre (Dar es Salaam)
- Kidatu Training College (for TANESCO)
- Karuji Training Institute (for CEMENT Industry)
- Sugar Training Institute (for SUGAR Industry)
- The TP & TC Training Centre (Dar es Salaam)

THE INDUSTRIAL MAINTENANCE PROBLEM IN TANZANIA

. An Overview

Low technological capacity to design and manufacture plant and machinery required in industry has made Tanzania depend on imported machinery/equipment for which the country has low operating and maintenance skills. With foreign exchange problems it has also been difficult to import spare parts and expertise required for equipment maintenance.

Loss of production time due to equipment break-down in industry is not only an issue of concern at enterprise level but it is now attracting serious concern of the Government. Loss of production time as a result of equipment break-downs is as high as 15% in some industries and generally break-down of equipment is causing loss of production time amounting to millions of shillings per annum.

As a result of these production losses there is now a general awareness of the maintenance problem in every industry. Most company managements now realise on the need for proper equipment maintenance. Each industry now has an average of 15% of its total employment engaged in equipment maintenance work and most industries set aside funds for maintenance and repair work in their annual budgets.

Fixed capital formation in Tanzania increased rapidly between 1975 and 1979, reaching the peak in 1979. Over this period investment grew faster than GDP (i.e. 7.4% per annum of to 5.0% for GDP). The import content of investment increased from 39% in 1975 to 58% in 1979. (Ref. No. 7). This was mainly in the form of manufacturing investment. This increase in manufacturing investment increased demand for imported raw materials and spare parts and other intermediate materials. By 1980 it is estimated that total fixed investment in industry was TAS 8,000/= million.

Plant and equipment installed in industries in Tanzania have been imported from a large number of countries such as Japan, UK, USA, Italy, France, Belgium, Sweden, Norway, Finland, Holland, Bulgaria, India, Pakistan, Germany, China, Yugoslavia, Denmark.

Over 90% of industrial plant and equipment is imported and because of this position, Tanzania gets its equipment supplies from sources which can offer the best credit facilities. There is not much choice and the result is that there is in Tanzania a wide diversity of machinery even for similar applications. This makes interchangeability of spares and standardisation difficult. The textile industries, for instance, which are among the major industrial concerns in Tanzania have machinery supplies from five different countries i.e. Japan, France, Pakistan, China and Switzerland.

Despite the maintenance awareness mentioned in the previous paragraphs, 'maintenance culture' is still undeveloped in Tanzania. Also because of the level of industrialisation process and the small percentage (under 30%) of the country's employed population who are in contact with machinery in their daily work, 'machine culture' is not well developed.

In most industries repair is done after equipment break-down. Of a total of 12 No. industries sampled for this case study, only 4 No. were found to have effective equipment preventive maintenance systems in force. Most industries undertake only corrective maintenance of their equipment. Lack of effective preventive maintenance systems leads to higher maintenance costs, higher frequency of equipment break-down and spare parts replacement.

The biggest problem in machinery maintenance and repair is lack of spare parts. Since most of machinery in industry are imported spare parts have also got to be imported. But because of foreign exchange problems spare parts cannot be readily imported. The result is that vital machinery remain out of service for long periods causing losses in production time and also causing losses in production output which in turn leads into shortage of supplies of essential consumer commodities.

At the same time, lack of spare parts does not induce a good attitude towards equipment maintenance. Engineers and other maintenance personnel feel greatly frustrated when spares required for maintenance are not available. And yet the demand for repair and maintenance of equipment in Tanzania industry will grow in proportion to the growth of industry itself and the value of imported machinery. In 1966 cost inputs in repair and maintenance of industrial equipment was 12% of all input costs and in 1980 cost inputs into repair and maintenance were estimated at TAS 450 million. (Ref. No. 3).

In the sections that follow this paper describes the strategies that the Government is currently pursuing with respect to industrial equipment maintenance and training; maintenance methods and organization currently in force; spare parts management; spare parts manufacture; engineering design and maintenance; acquisition of plant and equipment. At the end the paper makes some recommendations on what the author thinks should be done to make human resources development in Tanzania even more successful.

INDUSTRIAL MAINTENANCE POLICY AND STRATEGY

. Policy

There is no clearly defined Government policy on industrial maintenance in Tanzania. A recently introduced National Science and Technology Policy for Tanzania has, however, underscored on the need for the establishment and/or strengthening of servicing and maintenance systems of machinery and other equipment in industrial firms, educational institutions, research institutes, etc. The Government has also on several occassions made several official pronouncements on the need for proper maintenance and repair of all industrial equipment.

Tanzania's National Science and Technology Policy has also given due emphasis on the need for human resources development in all technological areas related to industrial machinery and in particular with regard to the development of indigenous capabilities to design and adapt machinery to suit local conditions of use and maintenance.

The Ministry of Industries and Trade which is responsible for the development and operations of the majority of industries in Tanzania, recently issued some directives to all industries to:-

- form "innovations committees" which will spear-head spare parts manufacturing for each enterprises;
- set aside funds in each annual budget to finance innovations and R & D activities;
- introduce preventive maintenance systems for equipment;

. make use of facilities and skills available from other institutions and industries through sub-contracting arrangements;

. establish some documentation system on both maintenance and spare parts manufacture which can form basis of future maintenance plans and budgeting.

These are seen as serious efforts at Government level to push industrial managements to put more time and resources in equipment maintenance.

. Training

Repair and maintenance of equipment is not taught as a separate subject in Tanzania at degree or diploma level but it is included under machinery design considerations. At National Vocational Training Centres, however, artisans are taught specialised maintenance and repair courses of various equipment including engines, machine tools, instruments, etc.

Industries with strong specialised interests have been more keen in training their own technical personnel. Such institutions include TANESCO, TP & TC, SUDECO and SARUJI. Other industries which are much more diverse have not been so oriented in developing their own manpower. At the same time a number of industries have no clear view of their technical manpower requirements and they do not therefore have any manpower development plans. The Majority of private sector industries, for instance, have not been keen in training their technical manpower. They have, instead, depended on their higher wages advantage to attract trained personnel from elsewhere.

There have been cases where Tanzanian technical personnel have been sent on training abroad by suppliers of equipment. These cases are few and training has been on operations and maintenance of equipment being supplied.

In 1980 MEIDA introduced Problem Oriented Training (POT) in maintenance. POT in maintenance is a pragmatic approach to try and tackle maintenance problems with the training being undertaken at the place of work. POT for selected industries is preceded by a survey to determine maintenance problems affecting specific industries. Specific tailor-made training programmes are then formulated and training is undertaken at the enterprises concerned. Training is contacted by training consultants from MEIDA who are currently being assisted by engineers from Idhammar Konsult AB of Sweden. The POT programmes are being financed by SIDA and the Government of Tanzania.

Between 1981 and 1986 a total of six courses have been conducted involving a total number of about 120 maintenance engineers and technicians from about 25 industries. The training programmes have included such courses as Maintenance Trainers Course; Maintenance Management and Organisation; Maintenance Welding; Hydraulic Maintenance and Brush Plating. The total expenditure of running these courses between 1981 and 1983 alone was TAS 7.22/= million. (Ref. No. 2).

In 1984 a team of engineers was sent on a survey to industries which had been covered under the POT Programmes and the general view of the evaluation team was that managements of the companies and trainees had found the POT Programme useful in their uniqueness in solving specific maintenance problems. It was also found that by and large the POT was educative as the technology taught was new or had long been neglected by management. On the cost effectiveness of the POT Programmes the results of the survey were disappointing as no records were kept by industries to show the savings that they had realised since introducing measures recommended under POT Programmes.

Appendix 'A' is a summary of the maintenance situation in 11 No. industries.

MAINTENANCE FACILITIES AND ORGANIZATION

. Facilities

Most industries in Tanzania have adequate facilities required for mechanical repairs. A survey carried out by MEIDA in 1982 involving 20 No. industries showed that all of them had some facilities to carry out mechanical repairs and that most of them also had facilities to carry out electrical repairs.

The equipment installed in these mechanical workshops include standard metal cutting tools such as lathe machines, milling machines, drilling machines, shaping machines and some welding equipment. Manufacturing and reconditioning of spare parts is restricted to small and medium-sized parts. Reconditioning of spare parts is mainly through welding and machining. Electrical repairs undertaken include rewinding of motors.

In order to assist industries in their equipment maintenance efforts, in 1984 MEIDA established a Maintenance Service unit as its sub-sidiary company called MEIDA Maintenance Services Ltd. (MMS) which offers both theoretical and practical services to industries. The services include consultancy and training of maintenance personnel while practical services include re-conditioning and repairs of machines, components and parts; condition monitoring and cleaning of hydraulic and lubrication oils. The aim of these services is to raise the skills of maintenance personnel in industry; introduce modern equipment maintenance systems and techniques which should result in increased production and a reduction in overall maintenance costs. Techniques on in-situ repairs are also being introduced in industry by MMS.

Of a total number of 12 No. companies sampled to find out whether any form of condition monitoring was being undertaken on their equipment, in 9 No. industries some kind of condition monitoring does exist. Most of the condition monitoring is done through visual inspections. Most industries do not have requisite instruments required for thorough condition monitoring techniques.

The MMS has acquired a wide range of instruments for condition monitoring with which it is providing services in industry. It is hoped that when industries have realised on the importance and benefits of condition monitoring they will make efforts to acquire instruments most relevent for their industries. So far the MMS has entered into a contract with 4 No. Dar es Salaam based industries whereby the MMS is providing condition monitoring services at regular intervals in cooperation with maintenance personnel at these industries.

In Tanzania there is a mix of both simple mechanical industrial equipment fitted with mechanical regulating controls, and industrial equipment fitted with electronics control. Electronics repair workshops in industry are few and the few available are poorly equipped. Since it is likely that most of the equipment to be imported will be electronic the need for local electronic engineers and electronic repair workshops should increase.

.Organisation

Maintenance of industrial equipment appears under two forms of organisation charts in Tanzania. In some industries equipment maintenance departments or sections are separate and distinct while in others maintenance sections are subordinated to production departments. In a total of 20 No. industries and institutions surveyed by MEIDA in 1982, 60% of them had their maintenance sections as seperate departments while the rest were placed under production departments.

The two simplified charts below are representative of two cases described above

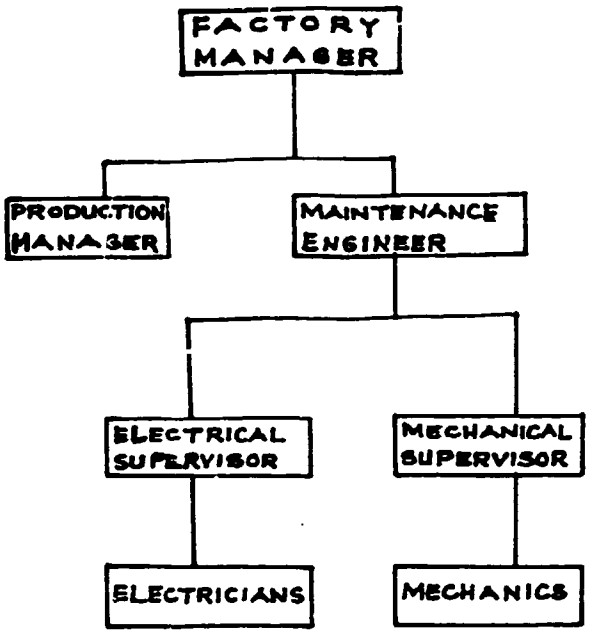

Fig. A

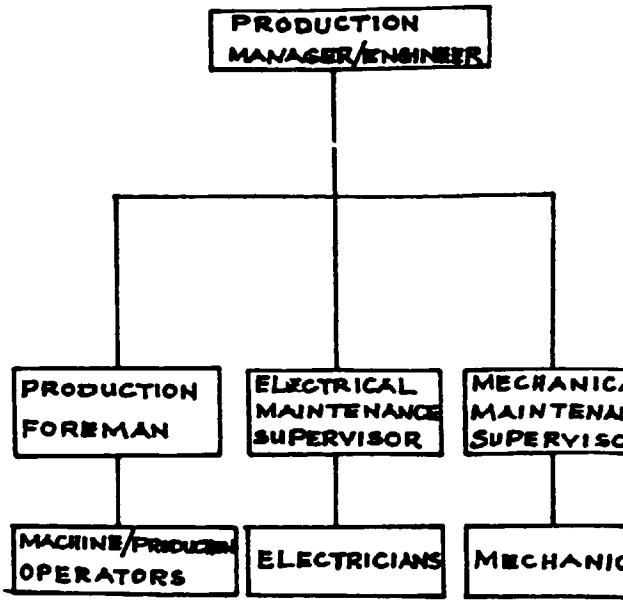

Fig. B

In a number of cases where maintenance departments are sub-ordinated under production departments, preventive maintenance systems have not been carried out properly. The tendency of a production manager or engineer has been to operate equipment until it breaks down. A production manager would rarely agree to stop machinery for some planned inspections or maintenance work to be undertaken. Cognisant of this problem, a number of industries are reorganising their maintenance sections to be seperate and to be directly answerable to factory managers or general managers. The survey by MEIDA also showed that industries whose maintenance sections were separate from production had better repair and maintenance facilities and tools.

In most of industries where the survey was carried out the maintenance method employs the use of work orders which originate from the equipment user section to the maintenance section or department. On receipt of a work-order the maintenance section prepares a job-card which is also used for costing purposes.

In a number of industries covered, equipment maintenance manuals were found to be available with instructions on both equipment preventive maintenance and corrective maintenance procedures. In some cases detailed and assembly drawings were found.
Appendix 'B' shows the maintenance organization, and facilities in some 11 No. industries.

SPARE PARTS MANAGEMENT AND MANUFACTURE

. Spare Parts Management

Most industries in Tanzania have adequate spare parts management systems. In fact the problem in Tanzania is not so much on the adequacy or inadequacy of spare parts management system but rather the absence of spare parts to be managed. Most industries do not have adequate spare parts in stock because of lack of foreign exchange.

The inventory system in use in most industries is through the use of bin-cards or ledger-cards, and in some industries the carder system is used. Spare parts are obtained by user section or department from the stores by first raising some REQUISITION FORM and the spare parts are issued through an ISSUE NOTE.

Spare parts procurement and issue is under the jurisdiction of supplies departments normally headed by a supplies officer or manager directly answerable to the factory manager. Under the supplies officer there are two sections, one dealing with purchasing and the other dealing with stores.

. Spare Parts Manufacture

Lack of foreign exchange to obtain spare parts from outside the country has turned into some kind of a blessing in disguise in Tanzania. The situation has given so much challenge to maintenance engineers and technicians that there is now some degree of clever improvisation and redesign of some of spare parts for local manufacture. The Government is also urging all industries to look into all possible means of meeting most of their spare parts requirements locally.

Tanzania has a number of well equipped metal engineering industries which if fully utilised could produce most of the metal-based spare parts needed in the country. As already mentioned earlier most industries also have some mechanical workshops with basic metal cutting tools. What needs to be developed is the capability to design or redesign spare parts and components and to have the right skills to manufacture these parts with the accuracy that is required.

With respect to rubber and other plastic spare parts there is need to further develop local capabilities to design and make moulds. Tanzania, fortunately, realised on the need for the development of local capabilities in industrial design during the charting out of the third five-year national development plan (1975/76 - 1980/81). Tanzania realised that industrial design is an important element in the development of a national industrialisation strategy and establish TIRDO in 1980. TIRDO is already giving some limited engineering design services of moulds for manufacture of rubber parts and also in re-designing industrial spare parts.

Despite all these efforts in localising spare parts manufacture, lack of raw materials required still remain a serious constraint. Tanzania does not produce its own iron and steel and all requirements have to be met through importation. Use of poor alternative raw materials has resulted into poor quality spare parts. Also spare parts locally manufactured have been of poor quality because of lack of requisite tooling; lack of physical and metallurgical analysis facilities at industry level; poor workmanship; and lack of engineering drawings for use at shop floor level.

Appendix 'C' shows spare parts management position in 11 No. industries/ companies.

ENGINEERING DESIGN AND MAINTENANCE

Although engineering design is a real need for equipment/machinery maintenance work it is not yet a sufficiently felt need in Tanzania. There is need for proper design study on imported equipment to determine design considerations employed with a view of reviewing or drawing up maintenance policies compatible with prevailing conditions of use and maintenance. In order to undertake repair and maintenance of machinery effectively, it is important to be able to design or redesign technologies which are more appropriate to the Tanzanian environment.

There is, at the moment, very little engineering design work going on in Tanzania industry. There are very few enterprises that have design offices and most of these exist in public owned industries.

In a survey conducted by TEMDO in 1983, of a total number of 29 No. engineering industries and mechanical workshops visited only 10 No. had design offices. The biggest preoccupation of these design offices is copying of spare parts and components for production. These offices, normally manned by only a draughtsman,

are also used for self-keeping of technical documents and drawings prvided by equipment suppliers.

Realising the important role that engineering design can play in equipment maintenance and repair, TEMDO is making efforts to promote the establishment of these design offices and will also assist in the training of design engineers, technicians and draughtsmen at TEMDO design offices. The aim is to develop local capabilities to design and adapt machinery that are suitable for use and maintenance in Tanzania. At the same time when local design capabilities exist at industry level, effective co-ordination between design engineers and maintenance engineers can make equipment maintenance work more effective and economical.

NEGOTIATIONS AND ACQUISITION OF PLANT

There is no equipment purchasing policy in Tanzania and many people are involved in negotiations for the purchase of equipment from outside. Most negotiations on equipment supplies are not based on technical specifications prepared by recipient industries. In other words, no serious efforts are made to select equipment to be imported.

A typical example of a case where no proper considerations were made on the technology being imported is in Tanzania's Cement industry. Although utilisation of coal as fuel in the cement industry has become a standard feature world-wide, Tanzania cement industry still uses the expensive fuel oil. Two cement industries in Tanga and Dar es Salaam were designed for firing with fuel oil only. (Ref. No. 5).

In general engineers are not involved in equipment supplies negotiations. They do not also generally accompany their company managers on negotiations trips to supplier countries abroad. The only exceptions to this are TANESCO and TAZARA who seem to have established a system of involving their engineers and other technical personnel in negotiations on equipment supplies.

Since for the majority of cases non-technical personnel are involved in equipment acquisition a lot of equipment is imported in the country without due consideration of local maintenance and repair capabilities. Also a wide range of equipment types is imported into the country making it difficult to standardise maintenance and repair services. And because technical personnel are not generally involved in equipment acquisition process, local expertise in the preparation of technical specifications for machinery suitable for use in Tanzania, taking into consideration availability of spare parts and possibilities of repair, is undeveloped. Equally local expertise to appraise tenders that can facilitate better bargaining position with regard to machinery purchase is lacking.

There are a number of cases in Tanzania where equipment has been acquired through some foreign aid or grant. In these cases recipient industries have had no choice on the equipment or technology being supplied. The result is that equipment has been imported at the mercy of design considerations, and even plant layout, made by engineers in producer countries. There are many equipment failures in industry which are a result of design errors but it is rare that engineers in industry have attributed failures to possible design errors. The rupture of the shell at the outlet mouths of a kiln at Wazo Hill Cement factory in 19 in Dar es Salaam while in full production was attributed to a wrong design. (Ref. No. 5).

Turnkey projects have also brought into the country certain technologies not appropriate for use and maintenance in Tanzania. Even where recipient industries have doubted on the suitability of the core technology in the package it has not been easy to un-pack and isolate such technology for replacement.

APPENDIX 'A'

MAINTENANCE SITUATION IN SELECTED INDUSTRIES

S/N	NAME OF INDUSTRY	PRODUCT	PRODUCTION PER ANNUM ('000)	NUMBER OF EMPLOYEES	MAINTENANCE PERSONNEL (%)	DOWNTIME AS % OF PRODUCTION TIME OR COST (TAS)	ANNUAL MAINTENANCE BUDGET (TAS '000)
1.	Moregoro Tanneries Ltd.	Leather	5,000FT^2	350	20.0	6.7 million	469
2.	Kilombero Sugar Co. Ltd.	Sugar	76 t	8,500	41.2	10%	12,000
3.	Sick Saw Mills Ltd.	Timber Plywood	4.7m^3 3.6m^3	-	16.7	NO RECORD	2,700
4.	Tansania Oxygen Ltd.	Oxygen	385m^3	150	6.6	NO RECORD	466
5.	Tansania Crown Corks Ltd.	Crown caps	750,000	100	8.0	NO RECORD	INCLUDED IN PRODUCTION BUDGET.
6.	Perma Sharp Ltd.	Razor Blades	40,000 pcs	105	10.4	NO RECORD	INCLUDED IN PRODUCTION BUDGET.
7.	Friendship Textile Mills Ltd.	Cloth.	38,000m	6,000	6.6	15%	INCLUDED IN PRODUCTION BUDGET.

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8.	Tanzania Dairies Ltd. (DSM)	Milk Yoghurt Cream	20,000 litres 750 " 30 "	182	3.8	NO RECORD	800
9.	Tanzania Breweries Ltd. (DSM).	Beer.	40,000 crates.	1,500	14.8	15%	5,380
10.	Steel Rolling Mills Ltd.	Steel bars Angle irons	20 t.	350	22.0	30%	6,000
11.	Tanzania Portland Cement.	Cement.	520 t.	900	29.4	-	INCLUDED IN PRODUCTION BUDGET.

SOURCE: Study on a National Maintenance Centre by Idhammar Consult AB and TISCO for the Ministry of Industries (1982).

APPENDIX - 'B'

. MAINTENANCE ORGANIZATION, METHOD, FACILITIES

S/N	NAME OF INDUSTRY/ COMPANY	MAINTENANCE SECTION		USE OF CONDITION MONITORING METHODS	MAINTENANCE SECTION		FACILITIES
		UNDER PRODUCTION	SEPARATE		CORRECT-IVE	PREVENT-IVE	
1.	Moregore Tanneries Ltd.		V	YES	V		. Workshop available . Sufficient tools & equipment.
2.	Kilombero Sugar Co. Ltd.		V	NO	V	V	. Workshop available . Sufficient tools
3.	Sikh Saw Mills Ltd.		V	NO	V		. Workshop available . Sufficient tools
4.	Tanzania Oxygen Ltd.		V	NO	V	V	. Small workshop with few tools.
5.	Tanzania Crown Corks.	V		NO	V		. No workshop.
6.	Perma Sharp Ltd.	V		NO	V		. Workshop available with very few handtools.
7.	Friendship Textile Mills Ltd.	V		YES	V	V	. Good workshop facilities and tools.

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8.	Tanzania Dairies Ltd. (DSM).	V		NO	V		. No workshop; only few handtools.
9.	Tanzania Breweries Ltd. (DSM)		V	For boilers only.	V	V	. Workshop with good facilities.
10.	Steel Rolling Mills Ltd.		V	NO	V		. Workshop available . Good facilities
11.	Tanzania Portland Cement Co.		V	YES	V	V	. Workshop with facilities available.

SOURCES:
1. Study on a National Maintenance Centre by Idhammar Konsult and TISCO (1982).
2. Problem Oriented Training (POT) surveys conducted by MEIDA (1982).

APPENDIX 'O'

. SPARE PARTS MANAGEMENT POSITION IN SELECTED INDUSTRIES

S/N	INDUSTRY OR COMPANY	NUMBER OF SPARE PARTS ITEMS	VALUE OF SPARE PARTS IN STOCK (TAS '000)	VALUE OF LOCALLY MADE SPARE PARTS (TAS '000)	SPARE PARTS INVENTORY SYSTEM	SPARES RETRIEVAL SYSTEM	
1.	Moregoro Tanneries Ltd.	400	800	No manufacture	Bin/Ledger Cards.	Requisition forms.	
2.	Kilombero Sugar Co. Ltd.	60,000	115,000	3,000	Bin/Cardex System	Tally cards.	
3.	Sikh Saw Mills Ltd.	NO RECORD	6,400	800	Cardex system	Tally cards.	
4.	Tanzania Dairies Ltd. (DSM)	NO RECORD	747	No manufacture	Bin/Ledger cards.	Requisition forms/ Issue Notes.	
5.	Tanzania Breweries Ltd. (DSM)	5,000	14,600	350	Bin/Ledger Cards	Requisition Forms/ Issue Notes.	
6.	Tanzania Portland Cement Co.	50,000	20,000	Mainly reconditioning of parts/ components.	Bin/Cardex system.	Requisition Forms.	

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7.	Friendship Textile Mills Ltd.	4,712	NO RECORD	3,200	Bin/Ledger cards	Requisition Forms.	
8.	Tanzania Cordage Ltd.	2,600	2,000	Mainly re-conditioning of parts/ components.	Bin/Stock cards.	Issue Notes.	
9.	Mechanical Transport Depot (DSM)	1,000	10,000	Mainly re-conditioning of parts/ components.	Bin/Ledger cards.	Issue Notes.	
10.	Dar es Salaam Bus Transport Co. (UDA).	5,700	22,000	Mainly re-conditioning of parts/ components.	Carder System.	Tally cards.	
11.	Steel Rolling Mills Ltd.	2,700	6,300	2,000	Bin/Ledger Cards	Issue Notes.	

SOURCES:
1. Study on a National Maintenance Centre by Idhammar Consult AB and TISCO (1982).
2. Problem Oriented Training (POT) Surveys conducted by MEIDA (1982).

R E C O M M E N D A T I O N S

. Training

1. It is important that the Government, through the Ministry of Industries and Trade, directs each industry to formulate and implement training programmes for maintenance personnel. More efforts should be made to train specialised maintenance personnel. Industries must also set aside funds in their annual expenditure budgets to cater for training expenses. And in order to ensure that the private sector industries do not poach engineers from public sector industries and institutions, the Government has to remove disparities in salaries between the private and public sectors.

2. Top management in each industry must be made aware of modern maintenance techniques in order for them to realise the need for continuous training of their maintenance personnel. This will stop the current tendency in most industries in Tanzania where managements are relying on time-served tradesmen who are only capable of undertaking routine maintenance services like lubrication and repairing simple mechanical equipment after break down.

3. After training, some performance indicators must be set to show the effect of training to overall maintenance cost. The top management of the industry or company concerned must show interest in following up on the trainees performance to ensure that the training does result into maintenance cost saving and higher availability of equipment.

4. The Problem Oriented Training (POT), being conducted by MEIDA in Tanzania, has shown some good results but there is urgent need to strengthen the local staffing at MEIDA conducting the courses in terms of number and by further training them.

5. In order to retain trained maintenance personnel, each industry should evolve some incentive schemes for the maintenance staff which should include provision of adequate protective gear and some material or monetary reward for innovative maintenance workers whose work result into major cost savings.

6. The Government should consider establishing or strengthening existing training institutes in industrial electronics because there are obvious gaps in this area in Tanzania. This is necessary because there are a number of industrial machinery that incorporate a lot of electronic gadgets and controls for which maintenance and repair skills are lacking.

. Maintenance Systems and Organisation

1. Although some preventive maintenance is being undertaken in industries in Tanzania there is more need to strengthen the practice. Again top managements at each industry should take the lead in ensuring preventive maintenance is carried out at their enterprises. The Ministry of Industries and Trade which has already issued a directive on the establishment or strengthening of preventive maintenance systems for industrial equipment should establish a mechanism of follow-up on implementation. In this respect the Ministry should review its own technical staff position so that at least two experienced industrial engineers are in its employment.

2. To avoid clashes of interest between production and maintenance engineers, maintenance should appear as a separate department or section in each industry. This arrangement will not only motivate the maintenance personnel but it will allow them to carry out planned maintenance schedules without interference from the production department.

3. Each industry should have a separate annual maintenance and repair budget instead of lumping it together with the production budget. Maintenance expenses must also be separately kept to facilitate realistic preparation of future maintenance plans and budgeting.

. Spare Parts Manufacture

1. The Government should assist industries in obtaining foreign exchange allocation for the procurement of raw materials for the manufacture of spare parts locally. Efforts by the Government to obtain financial and technical assistance from international funding agencies and friendly countries for the exploitation of iron ore at Liganga in Southern Tanzania should be intensified. Lack of own iron and steel industry will continue to frustrate efforts on spare parts manufacture and development of a capital goods industry in Tanzania.

2. The Government should assist TEMDO in procuring equipment for a national Central Tool Room which will provide the metal engineering sector and mechanical workshops with requisite tooling.

3. Engineers in each industry must study and identify fast moving parts which can be manufactured locally and determine quantities required over a given period so that economical batch level production can be undertaken. The tendency of manufacturing a single spare part for immediate replacement is expensive and causes loss in production time.

4. Wherever possible spare parts must be manufactured from engineering drawings. Where equipment is supplied without detailed engineering drawings then the equipment should be disassembled to prepare such drawings. This work should not wait for equipment break-down.

5. Increased awareness is required on the use of TEMDO services especially in providing design services in spare parts manufacture. Company managements on the other hand must set aside funds for the establishment of design offices at their enterprises. When established these design offices will work with TEMDO.

. Negotiations and Acquisition of Plant

1. Local expertise to prepare detailed technical specifications should be developed. To supplement expertise at industry level, centralised expertise at national level to prepare technical specifications and to analyse technical tenders should be established. In the case of Tanzania, TISCO could further be strengthened to do this job for industries who cannot manage on their own.

2. Choice of technology or equipment must be done on the technical advice of the people who will maintain the equipment or plant. The tendency in Tanzania where top non-technical managers have involved themselves in negotiations for the acquisition of equipment without involving engineers should be discouraged by the Government. This will reduce/curtail importation of expensive to run and difficult to maintain technologies.

3. Negotiations and agreements on the acquisition of equipment from outside must include clauses binding the supplier to provide training on maintenance in the supplier country. Arrangements should preferably be made for engineers to witness part of the manufacturing and/or assembly work in supplier country so that they can have some idea on how the equipment is constructed.

4. Suppliers of equipment must supply all technical documentation to facilitate ease of maintenance and spare parts management. In particular suppliers must supply drawings specifying materials and tolerances.

5. In all agreements for equipment supplies arrangements on after sales service must be made.
It must also be agreed that during such services engineers from supplier countries train on-the-job local maintenance engineers.

LIST OF REFERENCES

1. MEIDA (1982): Problem Oriented Training Surveys;

2. Evaluation Report on Problem Oriented Training Programme (1984);

3. NORAD (1980): A Feasibility Study on a National Maintenance and Repair Centre;

4. Report on National Capacity for Local Manufacture of Machinery and Spare Parts (1984);

5. A.A. Makange: Institution of Engineers Annual Seminar (1985) - Industrial Rehabilitation and Maintenance: the case of the Cement Industry in Tanzania.

6. G. Msolla: Institution of Engineers Annual Seminar (1985) - the Inter-relation of Engineering Design and Maintenance of Machinery and Equipment.

7. Third Five Year National Development Plan (1975/76 - 1980/81).

8. Ingemar Konsult AB and TISCO (1982): A study on a National Maintenance Centre.

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