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SUMMARY OF 12 CASE STUDIES ON HUMAN RESOURCES
DEVELOPMENT IN INDUSTRIAL MAINTENANCE
IN AFRICA *

Prepared by

the UNIDO Secretariat

* This is a translation of an unedited document.

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ABBREVIATIONS

IM	Industrial maintenance
HR	Human resources
NIC	New industrial countries
IT	Industrial training
UNIDO	United Nations Industrial Development Organization
UNESCO	United Nations Educational, Scientific and Cultural Organization
ILO	International Labour Organisation
SMIE	Small and Medium Industrial Enterprises

HUMAN RESOURCES DEVELOPMENT IN INDUSTRIAL
MAINTENANCE IN AFRICA

Summary of 12 case studies submitted to the Expert Meeting
on Human Resources Development in
Industrial Maintenance in Africa

Preamble

A Regional Expert Meeting on Human Resources Development in Industrial Maintenance in Africa was held in Nairobi (Kenya) from 23 to 27 June 1986 in preparation for the Second Consultation on the Training of Industrial Manpower, to be held in Paris (France) from 14 to 19 September 1987. African experts produced 12 case studies on the situation, projects and prospects in their countries in the field of human resources development in industrial maintenance (IM) for this preparatory meeting.

These case studies were written with the help of the guidelines produced by UNIDO, which suggest an approach, plan and standard content for case studies. The 12 expert studies were submitted to the Nairobi meeting and used as an initial basis for discussion. The countries covered by the studies were: Burundi, Cameroon, Côte de'Ivoire, Egypt, Ethiopia, Kenya, Madagascar, Morocco, Mauritius, Senegal, Tanzania and Zaire.

According to the guidelines, "the case studies are meant to serve as basis for exchange of information". Furthermore, the guidelines also indicate that "another important reason for the case studies is that UNIDO would like to engage experts from developing countries themselves, as they are the best to know and assess the situation in their countries, to identify difficulties and constraints and to propose down-to-earth recommendations which are practical and amenable to proper implementation".

This document summarizes the content of these case studies and also presents two tables giving general information on the 12 African countries concerned (data regarding education and industrial training). Finally, there is an annex summarizing each of the case studies.

In order to encourage the experts to express their views freely, the guidelines allowed them to go into some aspects more deeply than others and to include certain aspects specific to their country or to their own experience. The case studies therefore deal with the subject of human resources development in industrial maintenance from different standpoints, but they all refer to the current poor state of industrial maintenance in most countries, the low general level of awareness of the consequences of this situation, the need to remedy it and the priority which should be given to efforts to promote national awareness of the problem. Optimization of the use of installed industrial equipment clearly seems more essential today for industry in Africa than efforts to maximize the number of industrial projects at all costs.

After a brief introduction to the general problem of industrial maintenance and specific training in this field, the summary of the case studies is presented according to the plan proposed in the guidelines which was used as a basis during the discussions at the Nairobi meeting. These discussions led to conclusions and recommendations on each subject which are presented in the Report on the Regional Expert Group Meeting on Human Resources Development in Industrial Maintenance in Africa - Nairobi, Kenya, 23-27 June 1986. It is therefore advisable to read the two documents together, not only to learn the experts' opinion, but also to take account of the conclusions and recommendations of the Meeting.

INTRODUCTION

THE GENERAL QUESTION OF INDUSTRIAL MAINTENANCE AND INDUSTRIAL MAINTENANCE TRAINING

Industrial maintenance is a key development factor. Investment in industrial equipment has been considerable and costly. There has been investment not only in industry, but also in agriculture and the public services (electricity, telecommunications, transport, public works, airports, hospitals, universities and schools, laboratories, meteorology, etc.). It is therefore clear that it is not only manufacturing industry or the secondary sector but the entire national economy which should be seeking to make good and proper use of equipment, machinery and other capital goods. Specialists in IM therefore have a role to play in all enterprises, public establishments and other bodies which use machinery for the production of goods or services. The machinery invested in must last as long as possible and remain in good working order. It must be amortized through optimum utilization. Only IM is capable of fulfilling these requirements.

All developing countries suffer from a lack of foreign exchange and, in general, a shortage of financial resources. Industrial maintenance helps to achieve less costly production by obviating the need for excessively frequent replacement of equipment and disproportionate purchasing of spare parts. It also helps to ensure a regularity of foreign exchange earnings by ensuring continuous operation of equipment, which in turn permits a satisfactory level of utilization of production capacity and regularity in the quantity and quality of manufactured products. In this respect, the experts' reports indicate that inadequacy of IM in the industrial sector may be the reason for under-utilization of production capacity of as much as 15 per cent in Tanzania, 20 per cent in Ethiopia and 30 per cent in Madagascar, to mention only the industrial sector and the indications given by the experts. According to estimates given during the expert meeting in Nairobi in several developing countries the technical availability of industrial equipment rarely exceeded 50 per cent.

Some sophisticated equipment affects the entire economic and social structure and any shutdown, even of a temporary nature, may have catastrophic consequences. The same applies to equipment for power generation, transport, data processing, hospitals, etc. Although not all stoppages or shutdowns are solely due to a lack of IM, this is a contributing factor in very many cases.

Experience gained in IM helps to guide future technological decisions towards equipment best suited to local conditions and the use to which it should be put.

Industrial maintenance is confronted with special problems in developing countries

The developing countries produce few capital goods. As a rule they import them from a number of different sources. This lack of standardization, which has repercussions on procurement of spare parts (obtained from the same countries) increases the difficulties of implementing IM and is caused by the fact that the developing countries have an inadequate understanding of the technical requirements imposed on suppliers, finance for the purchase of capital goods being often provided by multinational funding sources, which impose the principle of international calls for tenders, or by bilateral sources, which seek to give preference to their national producers of capital goods.

Industrial maintenance may be deemed to be covered by the concept of "post-investment action", i.e. all measures designed to achieve the optimum return on capital invested, therefore including IM, rational choice, suitability and proper use of technology, repair, industrial training, etc. This concept of post-investment implies a whole set of factors which are of special importance in

an economic environment characterized by cut-throat competition, of which IM is either a resultant or a contributory feature. Quality control and guaranteeing of quality, reliability and compliance with technical specifications and standards of composition are the results of good IM and are determining for the enterprise's future. Preventive IM is essential to ensure that product quality is always according to expectations. A badly adjusted or defective machine will yield deficient products which will be rejected or will have a detrimental effect on the enterprise's reputation if they are placed on sale.

The level of awareness of the importance of IM in the management of industrial equipment varies greatly from country to country and from one to another user of equipment. Awareness of its importance is not universal and is not always reflected in practice. It depends to a large extent on the share of industrial equipment in investment by the country concerned and on the proportion of operating costs devoted to equipment maintenance. Once equipment maintenance costs begin to account for a high percentage of an enterprise's overall operating costs, the enterprise is likely to realize that something must be done to reduce these costs or, at least, to ensure that the expenditure yields tangible results. This is how such awareness develops in individual industrial units. Development of a national awareness depends on general appreciation, at the level of the national economy, of the real cost of repairs (including the cost of calling in local experts and trouble-shooters and outlay on spare parts) and of the losses caused by poor management of enterprises, production shutdowns and breakdowns, possible loss of markets and deterioration of the operating costs total production ratio. Until this awareness comes about, IM will involve only the carrying out of repairs, breakdown assistance, sporadic lubrication of moving parts ... even operations of a purely do-it-yourself nature.

The degree of technology employed and the sophistication of the equipment used affect awareness of the importance of IM. The more highly developed the technology of a piece of equipment, the sooner the need for IM is realized. The lower technology industries, on the other hand, tend not to regard planned IM as necessary. The need for IM will be more strongly felt in a country whose industries are relatively old and use equipment subject to frequent breakdowns. In Mauritius, for example, the contrast between the operational IM system set up in the sugar industry and the absence of generalized IM in the relatively recent industries in the Port Louis industrial free zone is very eloquent. However, Ethiopia and Madagascar are aware of the need for systematic IM organization in their new factories, after having experienced some setbacks in connection with their recent purchases of equipment from new suppliers.

In the case of small and medium industrial enterprises (SMIE), which may provide the skeleton for emerging industry in some developing countries, the introduction of IM is even more difficult because of these enterprises' lack of financial resources, particularly if the public industrial training system is non-existent or only embryonic. It is doubtless because their equipment very soon becomes obsolescent or ceases to function that the SMIE-based industrial sector in many developing countries is now experiencing such a rapid loss of industrial units (33 per cent have been lost through bankruptcy or for other reasons in Burundi in less than five years).

The land-locked position of some countries and the difficulties of importing and of obtaining foreign exchange are making countries increasingly aware of the need to develop a systematic IM organization.

The dependence of IM on the national infrastructure as far as technical and scientific training is concerned is apparent in all countries. The concept of technical training is here understood to include management techniques. Not only

skilled workers, technicians and operational engineers, but also managers, are cruelly lacking in the developing countries where industrialization is recent. Recourse to specialists is an expensive way of alleviating the problem and is acceptable only if, in addition to their IM work, the experts agree to train counterparts. It is thus clear why all reports, without exception, go into great detail regarding human resources development for IM and, more generally, industrial training systems.

The advent of multi-purpose technologies, with an impact not only on maintenance, but also on production and management, in all industrial sub-sectors, such as electronics and data processing has led to a demand for many specialists in these modern technical fields.

I. INDUSTRIAL MAINTENANCE POLICY AND STRATEGIES

Since the problem has been known and analysed for some years (absence or poor quality of IM) some measures have already been taken (either spontaneously or as a result of guidance) in most of the African countries which have been the subject of case studies designed to promote the implementation of IM systems among the various participants in industrialization. However, it is still rare for there to be any national IM policy, if there is one at all, let alone any coherent strategy in the field of IM to co-ordinate action or initiatives by industrialists and other users of equipment, the State, education and industrial training systems, outside financial sources, equipment suppliers and aid organizations.

1. The influence of the structure of the education system in collective or individual decisions to implement an IM system is considerable. Some reports go so far as to deplore the fact that the national education authority focuses its efforts above all on general training which gives priority to lengthy traditional training courses for intellectuals or "white collar workers", giving merely limited or ill-directed consideration to technical education. University courses are far too general and theoretical. The technical skills learned in technical education, where it exists, are often insufficiently diversified, do not necessarily correspond to requirements and relate only rarely, partially or not at all to industrial maintenance. Some IM training experiments have been made in the fields of mechanical or electrical engineering, and in electronics, but the establishments concerned have failed to co-ordinate their programmes and their activities.

2. There is rarely effective interaction between the two sides of IM training - supply and demand. Much of this training is still provided by the enterprises in their own industrial training centres and it is too specialized, leaving out some IM components, such as spare parts management, organization, capital goods procurement negotiations, etc. Some reports note a reduction of the efforts that must be made by several enterprises having common interests when they carry out comparable measures to implement human resources development in the area of maintenance, which raises the possibility of joint action by a number of enterprises.

There are also instances of maintenance training given in technical colleges or IT centres that have links with enterprises. These cover preparation of curricula, organization of practical training courses and testing, but all this is on a very spontaneous and sporadic basis and depends largely on the good will of the enterprises or the initiative of those in charge of the training organizations.

3. The evaluation of specific industrial maintenance requirements, a fundamental feature in defining a policy and determining the necessary training, programmes, areas and methods, is still in its infancy. It depends on the infrastructure for the collection and evaluation of data, which is inadequate, static and not equipped

to carry out the necessary research. Some evaluations are no more than sectoral or have not yet commenced. However, some countries seem to have made a good diagnosis, offsetting the lack of sufficient statistics by holding many seminars in conjunction with surveys to make those responsible for IM aware of the situation and envisage the launching of human resources development programmes in IM.

4. Some co-ordinating structures have been established for the development of a national IM policy, and even for HR development in IM. This is the case in Cameroon, Tanzania, Côte d'Ivoire, Ethiopia and Madagascar. However these structures are in many cases only for purposes of study, advice or suggestion or are brought into play only at the request of the enterprises concerned. This nevertheless represents one starting point. Another starting point could be to make use of the associations of industrialists or maintenance engineers in order to develop national awareness of IM, which could also involve the Government.

5. Government policy in favour of IM and implementation of HR development in IM varies from country to country. Only an overall policy can overcome the constraints of the problem posed by the lack of IM in African industries in general. It is not merely a matter of training workers and technicians to take charge of IM, wherever this may be necessary, but also of:

- Establishing contacts between the national education system, the industrial training system and the industrialists;
- Developing an appreciation of the value of IM activities, which are generally under-valued in comparison with the production function;
- Encouraging enterprises to invest in IM by showing them how profitable such investment is;
- Releasing or obtaining the release of the necessary funds for systematic organization of preventive IM;
- Participating in the effort to promote national awareness of the importance of IM.

Some reports mentioned the advisability of establishing a central unit, ^{1/} not just to co-ordinate, but also to organize, guide and decide on action to be taken. Such a structure exists in certain countries, while in others it has not yet been completed. Some countries have embodied it in texts without so far implementing it, whereas others would like to develop such a structure or are considering the idea.

6. The idea of availing of international possibilities to enhance the IM situation is relatively recent. Some countries have already included intra-regional co-operation (professional associations, regional seminars, regional co-operation or exchanges of experience) in the formulation and programming of their IM initiatives.

Naturally, all developing countries make some use of experts, consultancy offices or foreign technical assistance, primarily in the field of IM. However,

^{1/} Which might be called the National Institute of Maintenance (Cameroon), OFPPT (Morocco), Industrial Promotion Centre (Burundi), Central Training Office (Mauritius), CENAFOP (Cameroon), National Maintenance Council (Ethiopia), SERDI (Madagascar), etc.

some have us i this requirement to seek help abroad in order to set up at the same time a system for the training of local counterparts by foreign experts.

Multilateral (IBRD, EDF, etc.) or bilateral (e.g. France, Italy, United Kingdom) funding agencies are asked to support the holding of seminars or the establishment of new IM structures. The various reports are unanimous in praising UNIDO, UNESCO, ILO and UNDP for the faithful support they have given to promoting awareness (seminars, conferences, training courses) or feasibility studies and start-up surveys for human resources development in IM.

Finally, it is clear from many of the reports that intra-regional co-operation in Africa has already begun thanks to structures such as the Inter-African Centre for the Development of Industrial Training (CIADFOR), the African Network of Scientific and Technological Institutions (RAIST) and the African Regional Centre for Engineering Design and Manufacturing (ARCEDEM).

II. INDUSTRIAL MAINTENANCE AND TRAINING POLICY

1. This aspect, partly summarized in the preceding chapter, was the subject of some specific comments in the case studies. One important comment concerns the nature of the personnel needed for IM. The dilemma is posed in the following terms: Is it necessary to train specialists concentrating on a specific area (mechanical maintenance of lorries, electronic maintenance, etc.) or does the maintenance function not rather require generalists capable not only of restarting a jammed motor or repairing a circuit, but also of adapting a component, modifying wiring and scheduling periodic inspection?

In any event, it is clear that the training of personnel for maintenance functions implies training, methods and interests quite different from those needed for manufacturing personnel. As yet there is no complete picture of the skills needed by maintenance personnel in a developing country. However, it is obvious that a "maintenance worker" is a worker or technician who needs broad, often multi-purpose, training and is capable of adapting himself to changing technologies. Such people are now very rare.

2. No exhaustive diagnosis of the training requirements for IM has been made in any country. This is an essential task and its success will depend largely on the readiness to co-operate of the Government, the education and training organizations and the enterprises, and on the objective aimed at and the IM methods to be developed.

3. The IM training structure and methodology to be set up have yet to be clearly defined in any country. Nevertheless, we do know that the following prior measures are desirable:

- Codification of the levels of maintenance personnel;
- Establishment of a grid to indicate the relationship between tasks, skills and training needs;
- Organization of diversified rates of training;
- Combination of the participation of the national educational system, universities, industrial training centres of enterprises or sectoral groups of enterprises and on-the-job training, as well as establishing numerous links between the various elements of the systems;

- Implementation of specific methodologies, if necessary, such as the "Result-Oriented Management Maintenance" (ROM.M), "Guided Transfer of Knowledge" (Ethiopia) or "Problem-Oriented Training" (POT) (Tanzania).

4. Is technical education, designed to provide young people with technical training before they find employment, part of the national education system or not (cf. the structural uncertainty in Côte d'Ivoire)? Despite some improvements in the programmes and the true needs of the economy, this is still not very well developed when compared with traditional education and still tends in all cases to be considered of lower social standing than a qualification gained in traditional education. In any case, technical education generally does not include any IM training, except in the case of certain establishments in Côte d'Ivoire and Mauritius, for example.

5. With regard to the higher education sector, university programmes are lagging behind the development of technology. This is the reason for the setting up of specialized institutes or "technical colleges".

6. A true industrial training policy is really only now being developed on the basis of improved and reformed technical education, associated with additional industrial training and re-training in employment, organized in response to the specialized knowledge requirements by enterprises, sectoral or industrial groups or agencies guided and financed in varying degrees by the State.

7. Exhaustive studies of the detailed technical education or industrial training needs have yet to be made. They should be carried out, systematically, with particular emphasis on skilled IM personnel requirements. Current and future needs should be accurately quantified in each specialist area and for each level, ranging from skilled workers to engineers. It is essential to determine the form of training to be carried out (technical education, adult industrial training, on-the-job training within the enterprise, introductory or specialist courses, etc.). Diagnoses and estimates of needs and resources should be centralized or at least co-ordinated in a central body, as mentioned in all the reports. This central body should bring together all of the economic participants, providers or users of training.

8. The emphasis placed on rapid and economic IM training methods calls for the training of trainers or instructors and the indirect transfer of knowledge (cf. the models tested in Ethiopia and Madagascar).

9. Exchanges of experience between African countries and the support of international organizations, such as ILO, UNESCO and UNIDO, are strongly urged in all the reports, which praise in particular the ILO project in Ethiopia and the UNIDO project in Madagascar.

10. It is recommended that there should be a continuous evaluation and follow-up of the results of all efforts to develop human resources for IM in order to monitor its effective tailoring to the needs identified in the diagnoses.

11. Finally, there are the financial constraints. The shortfall in IM training is due in part to the cumulative effect of the following factors.

- No financial priority has been given to HR development in IM;
- Industrialists instinctively regard IM as a source of costs, whereas closer examination demonstrates that preventive maintenance is a source of true savings and increased value.

It is therefore necessary for each of the beneficiaries of IM to make the necessary financial effort to ensure the provision of essential training: State budget, participation by trade unions and industrial associations (including chambers of commerce and industry) and industrialists, who now seem prepared to take on this financial burden. In this connection, some countries (e.g. Zaire and Morocco) have imposed a para-fiscal payroll tax. The State could also grant financial incentives, particularly of a fiscal nature, but also subsidies, to enterprises or sectors which set up industrial training programmes or units for IM.

III. INDUSTRIAL MAINTENANCE ORGANIZATION AND METHODS

1. There is no standard way of overcoming the deficiencies in IM, since each country constitutes a specific case with a particular economic structure. However, whatever steps are taken require the prior existence of a "maintenance" state of mind, which is only rarely spontaneous (all the reports).
2. Some reports confirm the idea that industrial maintenance is best ensured if it is entrusted to an independent unit, instead of making it a component of the production division.
3. IM must be organized even before the industrial project starts up. It is even most desirable that those involved in IM should take part in the decision to purchase the industrial equipment and that the requisites for good IM (sturdy equipment, rules for maintenance and for spare parts procurement, technical assistance and training courses) should be included among the criteria for evaluating tenders and awarding contracts.
4. IM is relevant to all types of enterprise, but the organization of IM depends on the circumstances of the unit using the industrial equipment. State industrial concerns are very dependent on government instructions in organizing their IM service. Once the State decides and allocates the necessary financing, a State establishment revises its organigram and, as far as personnel training is concerned, approaches the State agencies or, if the budget permits, private industrial training organizations.

Semi-State concerns generally do not experience any difficulty in establishing human resources development in IM, provided the State (the principal shareholder) is convinced of the need or the association with a private partner, generally foreign and connected with a multinational group, makes it possible to qualify for the organizational support of the parent company's IM services. In the case of the private sector, large-scale enterprises normally have an internal management control unit capable of identifying the costs of the non-existence or deficiency of IM, on the one hand, and the establishment of an IM service and an internal training service, on the other hand. All enterprises of this type are as a rule easily convinced of the need for a separate IM service and absorb the expense in the production costs.

The problems are far greater for small and medium industrial enterprises which often do not possess an IM service or the means of setting one up on their own. In this case, they often have to subcontract IM to small local enterprises specializing in maintenance, local or foreign IM offices or informal production or servicing units.

Whatever the type or circumstances of the enterprise, financial, customs and fiscal incentives may play a large role in the organization of IM, particularly by making it possible to reduce the actual cost of the IM service and of purchasing instruments and appliances to provide and evaluate the IM function.

5. Internal IM or subcontracting? In the case of large enterprises having large amounts of fixed assets in the form of industrial equipment IM may be set up as an internal IM unit. Subcontracting IM to public support organizations or public or private specialized enterprises may be envisaged. In some countries where there has been a local knock-on effect as a result of industrial development, with the ensuing establishment of a network of many small emergency service companies, the IM function may be contracted out to these small businesses more cheaply than having a full-time internal IM service.

6. Statistical information concerning the results of IM. Mention has already been made of the usefulness of ongoing evaluation of the results of IM and of being able to assess these results in terms of technical efficiency, utilization of industrial equipment and costs. This is why it is advisable for the IM function to be organized independently. Monitoring must be the task either of the IM service itself or of the unit responsible for the enterprise's internal management control. The recent development of diversified "user-friendly" software for computerizing the IM function with the aid of microcomputers (programming and evaluation) should help in organizing the evaluation function and system.

7. Increased efficiency of the IM function and of the personnel responsible for it is a key to success. However, there are many problems because of the inherent difficulty of altering psycho-sociological behaviour patterns and structures in the field of labour. Several reports mention, however, that since IM work requires a broader range of skills than production activities there should be some overhauling of the wage scales and incentive systems for maintenance workers.

IV. TECHNICAL DOCUMENTS

1. Possession of a full set of documents concerning each item of industrial equipment is a prerequisite of normal IM. In this regard, the main users of industrial equipment in Africa are in a very bad position:

- Either the technical documents are not supplied by the manufacturer selling the equipment, they are in a foreign language or they are incomplete, lacking drawings or plans, and are incomprehensible to personnel not properly trained to understand or adapt them;
- Or they have been badly handled or filed and have disappeared completely.

The reports speak of only 20-30 per cent of enterprises having usable technical documentation.

2. Proper technical documentation comprises a fairly voluminous set of documents, ranging from feasibility studies and calls for tenders, through documents regarding assembly and start-up, to those explaining the operation and maintenance of equipment.

3. The training of maintenance personnel must enable them not merely to understand technical documents, but also to use, manage, update and, if need be, adapt them, as well as to create new documents needed for IM in specific instances. In addition to a satisfactory level of technical competence, this requires special training (codifying, classifying and managing documents) which is still not provided in most countries and this confirms the high level of skills required of IM personnel.

4. The list of technical documents should be drawn up when the order is placed, if this was not already done when the call for tenders was issued. Considering the cost (estimated at between 8 and 20 per cent of the value of the equipment), supply

of the technical documents should be as much an obligation (and subject to penalties in the event of non-performance) as supply of the other "equipment" elements of the call for tenders. There can be no complaint about the absence of technical documentation if a sufficiently precise list of "technical specifications" was not provided in the call for tenders. The personnel of enterprises in developing countries are therefore largely responsible for the state of future technical documentation and, consequently, for future IM.

V. SPARE PARTS MANAGEMENT AND PRODUCTION

1. Temporary unavailability of spare parts is one of the main obstacles to IM. What is the use of planning preventive maintenance if, when maintenance is required, the necessary spare parts are not available? The problem is even more important in developing countries, since they are geographically remote from the main centres of production, are in some cases land-locked and are affected by rigorous exchange control and a chronic shortage of foreign exchange. The problem is aggravated by the great variety of sources of industrial equipment and, therefore, of spare parts and operating instructions. The lack of spare parts and inadequate IM constitute one of the main causes of shut-down of industrial equipment in developing countries. There seem to be many reasons for this frequent unavailability of spare parts in the industries of the developing countries.

2. The responsibility of the enterprises is often mentioned. Spare parts management is generally regarded as acceptable, but capable of improvement in the major enterprises in the private sector. However, the main State enterprises or non-industrial administrative structures with large quantities of equipment sometimes lack adequate stock control, particularly because stock control is entrusted to the wrong department (e.g. the sales department). It is worth selecting with care the department to be responsible for stocks and it must have some degree of independence. Finally, there is often no stock control, even of a rudimentary nature, in the small and medium industrial enterprises.

3. The State's responsibility is equally great, in view of the length of time required for the administrative procedures involved in the granting of import licences. The State also imposes a number of procedures (customs and financial) (authorization to export foreign exchange) which take more time and increase the difficulty of ordering spare parts. Enterprises are therefore obliged to hold very large stocks, which is a costly practice, or else to "cannibalize" certain machines in order to obtain spares from them, thereby reducing the enterprise's production capacity.

4. The industrial equipment suppliers also bear some responsibility, but it is limited, having regard to the excessive variety of spare part standards and the fact that any machine is very rapidly superseded by a new model, which means that the manufacture of spare parts for equipment no longer being produced is frequently abandoned and the parts are all too soon deemed obsolescent. Finally, in the absence of specific instructions (unequivocal contractual clauses or terms of reference) or adequate monitoring on the part of users, the equipment manufacturers, when they supply a selection of spare parts representing a certain percentage of the equipment delivered when the project is started, rarely base the selection on an accurate analysis of the specific risks of breakdown, accelerated wear or damage under the conditions of use of the equipment in the country of the client enterprise.

5. The general recommendations given in the reports are often similar from one country to another. They refer to:

- The need to give priority to the management of stocks of spare parts and to provide the personnel concerned with proper training;
- The need to entrust spare parts management to the proper department (i.e. the department that is also responsible for IM);
- The need to economize on spare parts by repair, remodelling or restoring, rather than "standard exchange";
- The need to compel those preparing calls for tenders to include the specifications of the initial spares stock, rather than leaving this up to the supplier;
- The need to take account, in the preventive IM programme, of the frequency with which rapid-wear parts (rotating parts, bulbs, etc.) must be changed;
- The need to entrust the department responsible for IM with the standardization of spare parts and to operate an in-plant manufacturing workshop if necessary;
- The need to stress, in industrial equipment or plant purchase contracts, the suppliers' commitment with regard to continuance of manufacture and/or supply of spare parts corresponding to the equipment supplied (an alternative solution could be an obligation to provide clients with manufacturing drawings in the event that the supplier ceases to produce the equipment sold);
- The need to stress internal basic and refresher training of staff responsible for spare parts management, in areas such as storage and handling methods, as well as coding, stock control, parts storage and the updating of documents: stock sheets, records of movements in and out, value of parts, continuous inventory, etc.

6. It is possible to manufacture spare parts locally in developing countries, either in large, specialized plants or in a large number of small craft-scale or SMIE enterprises, using drawings supplied by the users. There are, however, many constraints (manpower, materials, know-how, basic equipment, measuring equipment, etc.), so decisions must be taken with great care. In some sectors (mechanical engineering, electrical winding, metallurgy, etc.) success has been achieved in certain African countries. Some of them have developed projects for the local redesign of spare parts, while others are on the point of launching major projects for the local manufacture of spare parts (possibly with the support of ILO or other aid agencies). However, most of the case studies deplore the absence of a national policy in this field.

7. The State has its role to play in spare parts management. In addition to its role in improving the terms of invitations to tender for public contracts, the following are worth mentioning:

- Action taken (or envisaged) to relax the administrative constraints affecting the ordering of spare parts, with particular reference to import licences and foreign exchange allocations, which could become relatively automatic (list of priority goods for import). Mauritius, for example, has recently allowed industrial enterprises exporting from the industrial free zones to hold and administer their own foreign exchange account. This is an even better solution;

- Desire to establish a national policy to encourage local spare parts production (support in the form of subsidies, loans on specially favourable terms, tax relief), both in internal workshops in the major enterprises and in any SMIE in a position to work as a subcontractor for parts consumers;
- Hopes of including rational stock management in the programmes of the official systems of technical education and industrial training;
- Integration of industrial standards control services (and support from foreign standards organizations) in order to develop a redesign and systematic standardization policy for spare parts;
- Desire that international organizations and national or international providers of technical assistance to continue to be involved in this field.

VI. CAPITAL GOODS: CONTRACT NEGOTIATIONS AND PURCHASE

1. The maintenance function starts even before the start-up of the industrial unit. Those in charge of IM should in fact be already on the job and participating directly in the negotiations leading to equipment purchase, having already taken part in the project design, the feasibility studies, etc.

Where this is the case it is easier to include the following specific clauses in calls for tenders:

- Guarantees of equipment ruggedness and reliability;
- Facilities for IM;
- References (to be provided by the suppliers) to use of the equipment under similar conditions;
- Subsequent utilization of the equipment, e.g. technical documentation, after-sales service, technical assistance, continuous availability of spare parts, assistance with training, etc. (all these points must be covered by clauses binding on the suppliers).

In this regard, public contracts are ahead of contracts placed by private industrialists. However, it is true that, although the reform of the public contracts code does indeed envisage longer and more detailed negotiations, more exhaustive and technical study of the dossiers, as well as a more technical contract allocation procedure (reference to price is merely one of the selection criteria) than for private contracts, the contract allocation and negotiation procedures still do not really involve the maintenance personnel. More precautions are taken nowadays, but the IM function is still not systematically incorporated in these procedures. However, the participation in these negotiations, in a consultative capacity, of national design offices which are also involved in supporting IM in national enterprises, may be a guarantee that the IM aspects will be taken into account.

2. Some reports mention the fact that equipment purchase negotiations for projects financed from abroad seem to gloss over the equipment maintenance aspects. The funding agencies would seem to draw up the specifications without sufficient consultation with the future managers of the enterprise. This observation is linked to a more general criticism of the system of purchasing plants on a "turnkey" basis whereby, once the plant is ready to operate according to their plans and assemblies, suppliers and installers of industrial equipment hand the plant over as it is to the local people concerned or the future managers

without explaining the circuits, wiring or other technical features, without technical documentation and without any instructions for maintenance.

It is true, however, that the "turnkey" system is now seldom applied, at least as strictly as in the old days. Any "turnkey" purchase is now normally accompanied by a temporary technical assistance and training contract, even if only for IM, or there may be an agreement on "management" before hand-over. There appears to be a trend towards more widespread "products-in-hand" purchasing procedures that are far more binding on the suppliers.

Furthermore, the external financing used for industrial projects often takes the form of loans with repayments requiring that the plant makes a profit and, to do so, operates properly and is properly maintained. It seems that external financiers are now also paying close attention to guarantees concerning spare parts, training of management and maintenance personnel and, in general, local IM capability.

3. Some reports stress that there should at least be harmonization of equipment and spare parts standards in the local industrial sector. It will readily be seen that the current diversity (American, Japanese, British or continental European standards) constitutes a serious barrier to the provision of IM training which should, at the very least, be universal. However, this diversification does also obviate the need to submit to the economic, technological and financial dominance of a single country as far as equipment is concerned.

How can one insist that a supplier with whom one wishes to place a contract should adopt for the purposes of a single contract standards different from those normally used for mass production? In the circumstances, all other things being equal, this desire for rigorous standardization is likely to remain nothing more than a pious hope.

4. The reports all note that true training in the techniques of preparing and negotiating industrial projects is essential. Each country must have negotiating teams at its disposal, including maintenance and industrial training specialists, able to discuss matters on an equal footing with even the most powerful suppliers with a view to incorporating in the contract all necessary elements concerning not merely the equipment content, but also the financial terms, the conditions for acceptance of goods and equipment and conditions designed to ensure problem-free operation. These last conditions in fact correspond to all that has been included in the concept of "industrial maintenance".

The countries reported on mention the usefulness of "forums" on the negotiation of industrial projects. UNIDO, in conjunction with other organizations, could increase the number of support projects for the training of project analysts, purchasing specialists, financiers and equipment suppliers by means of specific national or interregional seminars.

ANNEX I

STATISTICAL DATA ON EDUCATION AND INDUSTRIAL TRAINING
IN 12 AFRICAN COUNTRIES

ANNEX I
Table I
Data on education and industrial training in the
17 African countries covered by case studies

Country	GENERAL DATA										NUMBERS EDUCATED				
	GDP in million US\$	2. Industry in GDP	3. GNP spent on education	4. State budget for education	5. Population (thousands)	6. Working population (thousands)	7. Modern sector working population (thousands)	8. Literacy level (%)	Primary Education (thousands)	Secondary Education			Higher Education		
										9. Total (thousands)	10. General secondary education (%)	11. Technical secondary education (%)	12. Total (thousands)	13. General higher education (%)	14. Scientific/technical higher education (%)
Algeria	1 256	15	1	15.6	5 000	1 700	49	90	169	23.5	76	26	1.8	66	14
Cameroon	6 000	27	3.5	21	9 900	3 800	181	66	1 600	316	75	25	16	66	66
Cote d'Ivoire	6 500	16	7.6	29.8	9 100	5 300	66	69	1 160	238	89	11	18.2	66	36
Egypt	19 821	66	6.5	9.6	46 000	9 900	66	66	4 768	2 862	75	25	567	66	66
Ethiopia	5 800	11	6.1	11.1	47 000	19 000	66	55	2 500	685	69	1	19	70	90
Ghana	5 330	13.8	6.5	16.5	20 200	7 200	1 200	55	6 326	503.3	68	2	15	50	50
Madagascar	2 230	16	6.9	66	9 800	3 000	120	50	1 608	339	97	3	35	96	6
Mali	12 150	20	7.1	18.2	22 000	6 000	1 100	65	2 300	1 165	96	6	135	89	11
Morocco	3 015	20	6.7	37	1 000	600	193	20	135	76	96	6	1	50	50
Nigeria	7 125	66	66	66	6 500	66	66	90	453	106	69	11	13.5	89	11
Tanzania	5 000	10	5.9	10.7	21 000	6 000	608	55	3 500	67.5	96	6	5	80	70
Zaire	5 000	1	66	66	10 000	66	66	66	4 500	160	96	6	60	87.5	12.5
Sample average	15.9	15.9	5.2	18.9	-	-	-	-	-	-	90	10	-	76	26

66 = not available

1/ Excluding mining industry

2/ Excluding sugar industry

3/ Ministry of labor industry only

Source: Case studies
United Nations Statistics (1983/1985 Statistical Bulletin)

Table 2

Significant percentages relating to data on education
and industrial training in 12 African countries

	Number in primary education in relation to total population	Number in secondary education in relation to primary education	Number in higher education in relation to secondary education
	%	%	%
Burundi	7	6.7	7.7
Cameroon	16	19.8	4.4
Côte d'Ivoire	13	22.2	7.1
Egypt	10	60.3	19.8
Ethiopia	6	27.4	2.8
Kenya	21	11.6	3.0
Madagascar	16	21.1	10.3
Morocco	11	50.6	11.6
Mauritius	14	54.8	1.4
Senegal	7	23.4	12.7
Tanzania	17	2.0	7.5
Zaire	15	3.6	25
Sample average	12.8%	25.3%	9.5%

The table in annex I was drawn up on the basis of information provided by the case studies, supplemented by statistics from the United Nations bulletins.

The purpose of this table is not to present the bases for a complete and detailed analysis of the situation in the countries concerned with reference to education and industrial training, but merely to give an order of magnitude of the importance attached by the governments to technical and scientific education in comparison with general or conventional education. This aspect of education policy is particularly important since technical and scientific education is a prerequisite for the establishment of an industrial training structure in specialized training institutions and provision of internal on-the-job training.

1. Numbers educated

Examination of the table shows that most of the countries sampled have developed relatively extensive primary education, since as much as 20 per cent of the total population of some of these countries attend primary schools. This reflects a 100 per cent level of school attendance for the age categories concerned.

However, the facilities for enabling young people attending primary education institutions to continue their education at secondary level are very limited and it is only, on average, one child in four who is able to make the transition from primary to secondary education (compared with an average of 90 per cent in the developed countries where, it is true, schooling is compulsory up to 16 or 18 years of age). The opportunities for those in secondary education to continue their studies at a higher level (university) are even more limited since the proportion of total students in secondary education averages a mere 9.5 per cent for the 12 countries (i.e. one in ten). This may be compared with the following figures:

United Kingdom	18 per cent
Japan	24 per cent
France	24 per cent
USSR	27 per cent.

However, in some of the African countries in the sample the situation is similar to that in the developed countries.

2. Technical and scientific education

With regard to the importance attached to technical and scientific education, as compared with general and conventional education, the proportion is 10 per cent on average in secondary education and 24 per cent in higher education in the countries studied. However, in Egypt and Cameroon, 25 per cent of those attending secondary schools or colleges are pursuing technical studies whereas in Kenya, Ethiopia or Côte d'Ivoire, more than 30 per cent of students in higher education are undertaking technological or scientific training.

It would be useful to be able to assess the scientific content of programmes of general and conventional education at secondary level which, in some countries, may be far more developed than elsewhere, thus offsetting an apparently low level of acceptance in strictly technical training courses. Likewise, any evaluation of the percentages given in the table must be balanced by the observation that there are many administrative or commercial branches of technical training in other countries. It nevertheless seems clear that, overall, the developing countries must be prepared to give increased importance to scientific and technical education as the basis for future specialized industrial training in specialist institutions or as part of a future industrial career.

ANNEX II

LIST OF NATIONAL EXPERTS' REPORTS FOR THE
NAIROBI PREPARATORY MEETING (June 1986)

- Burundi:** Développement des ressources humaines pour la maintenance industrielle, by Mr. I. Fulgence Kwayoya - REGIDESO, Bujumbura
- Cameroon:** Etude de cas concernant le Cameroun, by Mr. J.M. Etoundi, engineer, IDN, Chairman, ACIM, Yaoundé
- Côte d'Ivoire:** Etude de cas concernant la Côte d'Ivoire, by Mr. M. Ekra, General Secretary of the Chamber of Industry of Côte d'Ivoire, Abidjan
- Egypt:** Case study for steel industry in Egypt, by Mr. Dia Tantawy, Chairman of Egyptian Iron and Steel Cy., Helwan, Cairo
- Ethiopia:** National case study on human resource development for industrial maintenance, by Mr. Y. Teclé, Ethiopian Management Institute/Productivity Improvement Centre (EMI/PIC), Addis Ababa
- Kenya:** A national case study paper on human resource development in industrial maintenance: a Kenyan experience, by Mr. S.M. Ira, Director/Chief executive, The Kenya Association of Manufacturers, Nairobi
- Madagascar:** Etude de cas: quelques aspects du développement des ressources humaines dans le cadre d'un programme de maintenance industrielle à Madagascar, by Mr. J. Andrianasolo, Project Director, UNIDO/Eng/DP/MAG/82.008, UNDP, Antananarivo
- Morocco:** Post-investissement et maintenance au Maroc, by Mr. M. Bachiri, Director in charge of planning and industrial training, Ministry of Equipment, Rabat
- Mauritius:** Human resource development for industrial maintenance in Mauritius, by Mrs. D. Wong Ng, Director-General, Mauritius Export Processing Zone Association, Port Louis
- Senegal:** La mise en valeur des ressources humaines pour la maintenance industrielle en Afrique: le cas du Sénégal, by Mr. H. Racine Guissé, National University School of Technology, Dakar
- Tanzania:** Human resource development in industrial maintenance: the case of Tanzania, by Mr. G. Msolla, TEMDO (Tanzanian Engineering and Manufacturing Design Organization), Arusha
- Zaire:** Etude de cas concernant le Zaïre, by Mr. Kamba Wui'iyela, National Industrial Preparation Institute, Kinshasa

ANNEX III

SUMMARIES OF THE 12 CASE STUDIES ON HUMAN RESOURCES DEVELOPMENT
IN INDUSTRIAL MAINTENANCE IN AFRICA

BURUNDI

The report indicates that IM is an absolute priority for Burundi, a land-locked country with few resources. Since Burundi is not advanced in any specific area of technology, unlike a new industrial country (NIC), it must, like most other developing countries, find a means of optimizing the performance of scarce and costly equipment. Above all, this presupposes planning of maintenance and rational management of technical documentation and spare parts. However, Burundi has no national IM policy. Most industrial enterprises in Burundi are of small or medium size and the search for appropriate solutions is made all the more difficult because the industrialists, whose financial resources available for production are already limited, find the idea of investment and costs specific to IM an expensive proposition while they are still unconvinced of the productive function of IM. An exhaustive study of the practical situation regarding IM, and of possible improvements, with their cost and foreseeable results, is essential.

1. IM policy and strategy

Although technical training establishments have proliferated, this trend has been backed up by few reforms in the areas of quality and programmes. Various surveys recently carried out by UNIDO and ILO indicated that technical assistance was necessary to promote better training of middle and higher management staff in industrial enterprises and that the numbers involved in the training, refresher and further training programmes were considerable (more than 1,500) in relation to the population of the country. Insufficient competence in methodology, planning, quality control and management was highlighted. The interaction between systems of education and training and the production system is still very limited and informal. It is essential that an effort be made to inculcate an awareness among industrial employers an awareness of the fact that the requirements connected with accommodating trainees and internal industrial training or costs of external training services may have an impact on enterprise output.

As regards IM, nothing is done in terms of specific training and the only effort to make employers aware of the importance of this function when considering new investment projects consists of a modest technical assistance department in the Industrial Promotion Centre (CPI). However, at the project execution stage, precise evaluation of the training requirements for IM and the organization of the IM department call for an adequate awareness on the part of industrialists.

According to a recent survey, the inadequacy of maintenance apparently explains why nearly 33 per cent of new small and medium enterprises close within five years of their establishment. The report recommends that:

- Enterprises should participate financially in the training effort (percentage based on payroll);
- Training programmes should include training in IM;
- The CPI technical assistance section should be strengthened;
- There should be a system of monitoring the suitability of the industrial training system for meeting the needs of industry, with particular reference to IM;
- Efforts to promote awareness of the importance of IM should be continued.

2. Organization and methods

After an interesting review of the various forms of IM - corrective, preventive and remedial (repairs and troubleshooting) maintenance or disaster, routine, planned and preventive maintenance - the report adopts the first classification and indicates the content, the objectives and operations involved.

As far as IM is concerned, Burundi's industry seems to be satisfied with a spot of lubrication and action to deal with breakdowns. The reasons for this serious deficiency in IM are essentially organizational. IM is entrusted to the production sector which tends to push machine use to the maximum without concern for fatigue or wear and without agreeing to make preventive maintenance efforts which are seemingly costly in time and money. This organization means that it is impossible to make a real calculation of maintenance costs since these are in fact charged to production.

The lack of centralization of IM activities makes it impossible to carry out the essential analysis of the causes of breakdowns, of the choice of equipment based on output and, in general, of maintenance statistics.

The heterogeneous character of the IM structures limits inter-enterprise collaboration in the area of IM. Consequently, most work (repair, parts manufacture) is often entrusted to small external workshops and staff trained on the job, very frequently to the detriment of quality. Where very difficult work is concerned (e.g. precision welding) recourse is had to very expensive foreign specialists.

The report recommends:

- An exhaustive diagnosis of the IM organization in enterprises, to enable the CPI to adopt ad hoc measures.
- Inclusion of an IM programme in technical school courses.
- A more active consultancy role for CPI vis-à-vis enterprises.
- Assistance from international organizations, such as UNIDO, to help in financing external technical assistance;
- National personnel to be sent systematically for IM training.

3. Technical documents

As in many other developing countries, technical documentation concerning the equipment owned by enterprises, both private and public or semi-public, in Burundi is either non-existent or very incomplete and invariably badly managed. In this connection, the report also stresses the drawbacks of "turnkey" plants.

There are many recommendations:

- strict obligation for suppliers to provide this technical documentation and direct training of maintenance staff to take charge of equipment and carry out necessary preventive work;
- reform of the system of prior project analysis by including in the membership of the technical investment committee maintenance engineers and managers able to analyse technical documents, insist that documentation be supplemented if necessary and detect any potential maintenance problems;

- Appointment, at the start of planning, of the future head of IM, who will take part in the selection of equipment;
- Development of a good system for the management of technical documents, which should be centralized, classified, accessible and legible;
- Inclusion in the enterprise's budget of the cost of IM training and of technical document management;
- Regular updating of technical documents to include any changes in forms, assembly or method of operation of the machinery.

4. Spare parts management

The diagnosis deplores in particular the following:

- The country's remoteness and land-locked situation which increase costs and delivery times for spare parts;
- Production stoppages because of the lack of spare parts;
- The fact that there are numerous different suppliers of equipment, which leads to a multiplicity of spare part references;
- The fact that the existing maintenance personnel has not been specifically trained for this task.

Automation of spare parts management is included in the plans of the major enterprises, but it will require prior completion, translation, classification and follow-up organization work which has not as yet been carried out.

The recommendations are based on the idea that the aim of good management of stocks of spare parts is to minimize the likelihood of items being out of stock, while ensuring minimum storage costs, which is particularly difficult in a land-locked country dependent on foreign suppliers.

It is therefore necessary:

- For enterprises to train specialists in stocks management and for this aspect of training to be included in national and sectoral technical training programmes;
- For any intervention by external consultants to be considered a priority matter;
- For the Government to examine the possibility of promoting local manufacture of the most frequently needed spare parts;
- For Burundi to have a more precise definition of the official standards to which suppliers must refer;
- For specific clauses to be included in contracts with suppliers to guarantee the continuity of spare parts manufacture, even in the event that a machine itself should no longer be manufactured, and for a special set of specifications concerning spare parts to be inserted in the documents inviting tenders.

5. Negotiation and purchase of plant and equipment

The negotiations must not be carried out merely on the basis of price criteria, but also with reference to the sturdiness, operating reliability and IM suitability of equipment. It is therefore recommended that:

- Attention should be paid to the appropriateness of equipment for local operating conditions (climate, staff skills, remoteness, small size of the market);
- The supplier should be required to provide references to operation under similar conditions;
- There should be a thorough analysis of the suppliers' tender documents, with equipment operation and IM in mind;
- Those responsible for production and IM should be involved in the allocation of contracts;
- Suppliers' offers in the areas of "technical assistance" and "assistance with training" should be taken into account in allocating contracts;
- Senior local staff should be trained to negotiate contracts, initially with the support of reliable consultants.

6. IM training

There has been considerable expansion of technical training but, although the number of young people trained and the training areas included in technical university and industrial education courses have risen, some aspects of industrial training are still inadequate. The findings of the UNIDO survey in 1979 indicate that efforts should be made to offset:

- Inadequate competence in management and organization methods;
- Inadequate organizational, management and forecasting skills.

These deficiencies obviously include IM. A recent survey confirms that there are insufficient skilled workers and staff for IM. Burundi has sent a few representatives to IM seminars and even to relevant training courses provided in French-speaking Africa. However, this is not enough to stimulate awareness among all parties involved in the economy in Burundi.

The report therefore recommends that:

- Current and future IM training needs should be thoroughly identified;
- An IM seminar should be organized in Burundi or in one of the countries of the Economic Community of the Great Lakes Countries (CEPGL);
- The staff of CPI should be enlarged;
- More importance should be attached to maintenance in enterprises;
- UNIDO should finance a visit by an expert to evaluate the IM training needs;
- A co-ordinating body, such as a maintenance institute, should be established in Burundi or in the CEPGL region.

CAMEROON

A number of meetings and joint studies of industrial maintenance (IM) of equipment have taken place in Cameroon in the last few years. They reflect the real awareness on the part of enterprises, training bodies and the State of the importance of this function. However, the report indicates that the performance of industrial plants in Cameroon is still limited by a generally inadequate level of IM, and even by the non-existence of IM in some instances. The main causes would seem to be the operational inadequacy of maintenance and the lack of spare parts, technical documents and skilled personnel.

1. IM policy and strategy

The national education system is still primarily focused on general training, with only one young person in four being trained for a technical career. Furthermore, the success rate is lower in technical education than in general education.

Nevertheless, there are initial signs of interaction between education and industry, thanks to the participation of enterprises in drawing up technical education curricula and the organization of in-plant training courses. The existence of the National Industrial Training Centre (CENAFOP), set up in 1981, demonstrates the desire to centralize study and action related to the organization of industrial training.

Several seminars (in 1981, 1982, 1985 and 1986) generated in the economic, administrative and teaching sectors greater awareness of the need to reform the method and context of implementation of an IM policy, in particular by modifying the industrial training system and enhancing the maintenance function. One of the concrete achievements has been the creation of the Association of Maintenance Engineers (AIM).

Recommendations

It is necessary to set up the maintenance service before starting up the plant and it should be allowed to take part in drawing up the technical specifications included in the invitation to tender. In general, the status of personnel responsible for IM and of the wage-earning staff working in technical and manual jobs should be enhanced. Any basic industrial training received before starting employment must be supplemented by on-the-job training which could be organized by CENAFOP, the Chamber of Commerce and Industry or the Maintenance Institute (if one should be established, which is highly desirable). Some enterprises do have their own training centres. In order to avoid under-utilization of the capacity offered by these various structures, it is advisable both to plan continuous industrial training and to envisage the development of training carried out on an inter-enterprise basis.

Another recommendation is designed to alleviate the possible under-motivation of employers to organize continuous industrial training for their staff through establishment of a right to "training leave". Awareness of the need for IM could also be developed throughout the population in general and not only among the participants in the industrial sector.

Finally, the report notes that, although there are already structures capable of contributing to human resources development in industrial maintenance (CENAFOP, the national education system, the enterprises' training centres), there is still no national co-ordinating structure to identify, define and guide a national policy of training and support for IM, which might be called the "National Maintenance Institute".

2. IM organization and methods

There is no standard solution to the problems posed by inadequacies of IM. These are not only technical, but are also connected with the social and cultural environment and the natural conditions of the region. They vary from one enterprise to another. None the less, there are some similarities.

Even though the major enterprises (RNCF, railways; SN, electricity; ELF Cameroon, oil; etc.) do have a maintenance department or service, lack of resources usually obliges small and medium enterprises to entrust machinery maintenance to the production department.

The maintenance service (IM) can benefit more readily and more rapidly from the transmission of equipment maintenance know-how if the enterprise is a subsidiary of a foreign parent enterprise. However, all enterprises should be aware of the need to organize maintenance in such a way as to provide not only planned preventive maintenance, but also maintenance to deal with breakdowns. One way of ensuring this function is by subcontracting to maintenance workshops - the number of which has been increasing, e.g. in Douala.

This option is available in particular to small and medium enterprises. Moreover, such enterprises may also have recourse to such structures as the Centres for Assistance to Small and Medium Enterprises (CAPME). These can manufacture spare parts, repair or renovate components, make service calls or give advice. Use of a subcontractor or a CAPME enables the small or medium enterprise to avoid the very high cost of setting up a specific maintenance section. In particularly difficult cases, large companies may call on maintenance consultants, frequently subsidiaries of foreign groups, who are highly competent but also charge high fees. Large companies organize IM training either in-plant or by sending staff on courses with the manufacturers or in specialized schools abroad.

Recommendations

Thought must be given to maintenance as soon as the decision is taken to purchase equipment or plant and it must be operational when the production unit comes on stream. Maintenance must be a factor in the choice of the technology to be employed.

Since the machinery is often imported and paid for with foreign exchange, it is advisable to give maintenance and repair preference over standard component replacement. In this respect, the maintenance service is the operational prop of the enterprise and the "repair mentality" must be widely disseminated by it within the enterprise. When resources are limited, the use of other possible methods must be encouraged: subcontractor, CAPME, etc.

3. Technical documents

The non-existence or inadequacy of technical documents hinders or prevents the organization of IM. The cost of producing technical documentation makes it prohibitive, in the event of loss, to ask for several replacement copies from the suppliers. IM training structures should therefore incorporate this aspect in their programmes: coding, classification and management of technical documents are maintenance techniques. Furthermore, the specifications for the technical documentation must be included in a specific specification document when equipment or plant is ordered.

4. Spare parts management

This is fundamental to the organization of IM. It is difficult to implement satisfactorily because of the remoteness of suppliers and the long time required for administrative procedures (import licences, transit, customs, authorizations to export foreign exchange) and stocks are therefore frequently too large. The management of stocks of spare parts is often entrusted to the administrative management, which is not in a position to determine the qualities and quantities of parts to be held in stock.

The recommendations include the following:

- Spares management sections, integral parts of the maintenance service, must possess both technical and administrative competence;
- Efforts should be made to achieve national standardization;
- The State should make administrative procedures connected with the import of spare parts more flexible;
- There should be support for national enterprises wishing to manufacture the most common "standard" parts locally.

5. IM training policy

Although no overall evaluation has been made of Cameroon's specific IM training requirements, CAPME and CENAFOP have taken steps along these lines in some sectors. Since IM of increasingly sophisticated equipment necessitates a sound theoretical grounding, as well as technical competence, it is clear that industrial training for IM will call for collaboration between the national education system and higher education in the formulation of the necessary technical curricula.

One of the first tasks will be to codify the levels of maintenance staff and to make a careful analysis of the points of correspondence between tasks and the nature and content of the necessary skills and, therefore, of the training needs at each level. What is needed is a national organization for study, co-ordination and guidance with a view to formulating a national industrial training policy for IM.

COTE D'IVOIRE

Summary of survey

The report sets out the results of a survey of industrial maintenance (IM) workers in the metallurgical, mechanical engineering and electrical engineering sectors.

Maintenance staff (both the skilled workers and the supervisors) are generally better educated than production staff. However, more than half of them were trained on the job, and had no specific prior industrial training. Nevertheless, 48 per cent of maintenance staff working on industrial machines received technical training before moving into IM.

Access to maintenance jobs is a question of internal promotion which is more rapid for employees who have received technical training (Industrial Training Centre - CFP) than for those trained on the job. It is precisely the staff trained by the CFP who will have more likelihood of reaching supervisory level. Immediate recruitment of skilled workers is based on technical certificates (Vocational Education Certificate - BEP), although workers trained on the job may also become skilled workers after several years of experience.

The requirements to be satisfied for employment in the maintenance of civil engineering equipment and vehicles vary depending on whether motor mechanics (a very specialized position requiring sound basic training plus specialized training) or other less highly trained maintenance mechanics are required. Analysis of careers in this trade confirms that there is a direct link between the training received and the job held, and that workers trained in general mechanical engineering have greater versatility.

Jacquerville Vocational College

The report cites the example of a recently established industrial training institution, the Jacquerville Vocational College, which trains IM workers, among others. The features of this training establishment are as follows:

- A 50/50 division between basic education (mathematics, English, technical drawing, business management and oral and written communication) and vocational education (workshops, laboratory, technology);
- A fairly broad range of specialization in the main branches during the third and final year: IM of heavy machinery and vehicles, electromechanical IM, mechanical IM and IM in boiler-making and welding;
- Compulsory practical courses in enterprises at the end of the second and third years;
- Strict requirements for award of the Technician's Certificate, account being taken of the final examination, as well as course assessments and appraisals by training course supervisors. The Jacquerville College also plays a part in continuous industrial training (on the job) by providing training courses based on the requirements of enterprises or industrial sectors.

Organization of the IM service in an industrial enterprise

Finally, the report gives an example of how the IM service is organized in a large local industrial enterprise (Huilerie B) which employs 1,025 workers to process 180,000 tons per annum and has a considerable amount of machinery (cumulative investment of 1,200 million CFA francs).

The IM sector occupies 125 people (i.e. nearly 12 per cent of the staff). Industrial maintenance is organized in such a way as to provide both:

- Scheduled annual preventive maintenance;
- Emergency maintenance.

The staff employed in IM appear to be satisfactorily skilled, as they are mainly recruited from among young people who had already followed CFP or technical college courses. However, the enterprise also organizes continuous in-plant industrial training and also regularly sends IM staff to take courses in enterprises manufacturing the equipment used. The enterprise is currently working on the development of a computerized system for maintenance which will permit:

- Automation of the store of spare parts;
- Automation of machine management so that each spare part may be coded and all preventive or emergency IM operations may be used for close monitoring of the useful life of each machine.

EGYPT

The report uses the specific case of Egypt's principal iron and steel enterprise to describe the way in which human resources are employed for industrial maintenance in Egypt.

General

The Egyptian Iron and Steel Company (EISC) is a State enterprise that produces some 700,000 tons of steel and employs 24,000 people (capital 500 million Egyptian pounds). The rapid increase in the size of the staff at a time when Egypt possessed neither an industrial infrastructure nor the skilled industrial personnel meant that a considerable initial in-plant training effort was required.

Industrial training

Nevertheless, the national industrial knock-on effect of the expansion of EISC has led the State to develop a number of industrial schools of various kinds to train skilled workers and foremen and to set up a level of further education beyond general secondary education in specialized institutes for the training of technicians. Graduates of these institutes may enter universities in order to become engineers. It is worth noting that the only way the institutes could develop was by the establishment of numerus clausus in the universities because of the initial reluctance of young secondary education graduates to enter an industrial training cycle which seemed a priori to be less prestigious than university training.

The industrial training system is operated under the joint auspices of the Ministries of Industry and Education and industrial enterprises have received specific instructions to provide senior staff for the industrial training centres located in the vicinity of their plants and even to participate in the formulation and implementation of technological training programmes. The setting up of an institute for further training in metallurgy near the EISC plant reflects the desire to combine industrial training and practice. This post-university institute will take young people who already have two years of industrial experience and the course of study will lead to the award of a certificate of the "master's degree" type requiring, in particular, personal research work on a practical problem in the industrial firm employing the trainee.

The report indicates that EISC initially established the conditions for the training of its skilled staff by organizing courses on specific subjects to satisfy its own qualification requirements. In addition to these measures designed to meet its own needs, EISC co-operates closely with the Ministry of Industry by facilitating the use of its technological base to provide students at the industrial training centres with experience before they join other enterprises or by awarding a number of scholarships.

Industrial maintenance

The priority given to industrial maintenance (IM) is a recent phenomenon in Egypt. It is now an established fact, specially tailored to the financial, economic and technical conditions of developing countries. It is all the more essential to establish it now that quality control is a major preoccupation of third world industries, with the requirement that equipment should be in proper working order at all times to permit strict and regular compliance with technological specifications and quality control standards.

EISC has implemented this maintenance policy with the inclusion of scheduled repairs and maintenance operations (preventive maintenance). Initially, no planning was possible because there was no real knowledge of the equipment and its foreseeable defects and "emergency" repairs accounted for 80 to 90 per cent of maintenance work. Now the main concern of the maintenance service is the upkeep of equipment to ensure that breakdowns do not halt production. There has therefore been a transition from a stage in which the varying condition of the machinery used to determine the way in which it was managed to a stage in which maintenance controls the condition of the machinery. This has had a beneficial impact on the profitability of the industry.

Strict IM operations, including preventive maintenance, are accompanied by steps designed to promote local manufacture of spare parts, either within the plant or by sub-contracting to small nearby workshops.

The complexity of maintenance methods and the important role industrial maintenance has come to play are reflected in changes in the EISC organization chart. Maintenance has become an independent department intervening not only in the production section, but also in auxiliary sections of the "energy generation, spare parts workshop, etc." type. The status IM has acquired is also the result of support projects by UNDP and UNIDO, particularly the projects on computerization of preventive maintenance, spare parts workshop and IM planning.

The existence of an IM department does not preclude a certain degree of decentralization. This is shown by the fact that there are maintenance units for checking and repairing equipment in the various sections of the plant and maintenance units within each of these sections which participate, with the central management, in drawing up IM programmes for each unit implementing them and carrying out repairs.

ETHIOPIA

The inadequacy of IM in Ethiopia affects all sectors of the economy using equipment and machinery and it diminishes the efficiency of State farms by an estimated 50 to 60 per cent, of transport by 30 to 40 per cent and of the industrial sector by 28 to 30 per cent. The growing economic importance of IM (due primarily to the greater sophistication of increasingly automated industrial equipment and the rising prices of spare parts) has led to many surveys and studies on this subject being made by the Centre for Improved Productivity, now a veritable "IM centre of excellence" (part of the Ethiopian Institute of Management). Other consequences of poor IM management are also mentioned: short useful life of equipment, excessive consumption of spare parts and problems in obtaining them, shortage of skilled labour, insufficient remuneration and general under-valuing of IM workers, lack of technical documentation and treatment of IM as part of production.

A. Human resources development in industrial maintenance

Intervention in three areas

1. Policy and strategy

The Ministries of Education and Industry, on the one hand, and the university and employers, on the other hand, are aware of what still needs to be done with regard to human resources development in IM. Various surveys, conferences and seminars have brought the different parties involved in IM training together without, however, giving rise to the development of a national strategy. Nevertheless, the role of the Centre for Improved Productivity (Ethiopian Institute of Management) as a focus for study and action in the field of IM has become established and reference may be made to achievements in improving IM services in the Ministry for State Farms and the State supply electricity company. The recommendations made deal with such matters as regular conferences, implementation of the University/Ministry of Industry agreement for university training more closely linked to the needs of industry, compulsory IM, participation of IM personnel in decisions concerning new projects, establishment of an association of IM engineers and experts, use of IM consultants and establishment of a national maintenance centre (using the Ethiopian Institute of Management). There should be more comparison with experience in other African countries (comparisons already made with Nigeria and Liberia).

2. Technical documents

In addition to the general finding that the management of technical documentation leaves to be desired, the report notes that:

- Although feasibility studies for new products are carried out by the Industrial Projects Service, with UNIDO support, invitation to tender documents are still produced by foreign consultants;
- Although spare parts catalogues and documents relating to installation and to diagnosis of breakdowns are provided by the suppliers of equipment, it is rare for documents concerning maintenance procedures to be provided, other than those concerning lubrication and adjustments.

Consequently, the Industrial Projects Service should be strengthened so that it can participate in the preparation of invitations to tender and all necessary documentation should be provided on IM for the lifetime of the equipment, including inspections and procedures for minor and more extensive repairs. This should be furnished by the suppliers of the equipment.

3. Spare parts management

This must be overhauled in order to avoid irresponsible ordering on the basis of unreliable stock sheets. Stocks management must be better organized and suppliers must agree to discuss with industrial users the composition of the initial spare parts stocks to be delivered with the equipment when the contract is executed.

The Government should encourage local supply of spare parts by specialized semi-State plants (there is a current project concerning 5,000 different parts) and should also provide incentives for the private or mixed-economy sectors and group together certain parts manufacturing workshops which are now dispersed.

The State must show greater readiness to allocate foreign exchange for spare parts orders and the Centre for Improved Productivity must expand the section of its training programme relating to spare parts management.

B. Results of the "Production and Maintenance" campaign

This campaign, launched by the Ministry of Industry (Centre for Improved Productivity/Ethiopian Institute of Management) with ILO support, involved 100 enterprises, of which 27 have quantified the results. It was designed to encourage industrial enterprises to establish guidelines for production and maintenance. The results have been quite appreciable. The application of IM measures has generated economies in increased production (reduction of under-utilization of capacity), reduced wastage (better equipment adaptation), foreign exchange savings on spare parts (local manufacture or repair of spare parts and better management of stocks) and on equipment (longer life) and, in general, a considerable reduction in the number of breakdowns.

The report evaluates the results obtained in 27 of the enterprises which took part in the "P and M" campaign. It can be seen that the gains or economies made are very impressive.

<u>Result 1:</u>	Increased production	11.831 million birr*
<u>Result 2:</u>	Reduced costs and wastage	0.447 million Birr
<u>Result 3:</u>	Foreign exchange saving on spare parts	0.997 million Birr
<u>Result 4:</u>	Foreign exchange saving on equipment	0.684 million Birr
<u>Result 5:</u>	Fewer breakdowns. 533 stoppages a month because of breakdown were prevented (number of breakdowns cut from 914 to 351). Although the number of hours of stoppage for maintenance increased normally (+6,000 hours), from 9,000 to 15,000 hours, accidental stoppages because of breakdown dropped by 19,000 hours - from 25,000 to 6,000 hours. The net gain in hours of operation for the equipment is thus 13,000 hours (19,000 minus 6,000), which is appreciable.	

This also led to useful collaboration between the production and maintenance departments, which were formerly antagonistic. Furthermore it showed that the methodology of implementing IM was in fact not very difficult (this methodology is known as ROMM or Result Oriented Management - Maintenance), although it required a sustained and diversified training effort and lengthy contact between trainers and trainees.

* US\$ = 2.1 Birr.

The report goes into some detail on the content of the ROM.M methodology and shows that the different stages, from project initiation and identification of basic problems to assessment of results, require a continuous commitment by the principal sectors of the enterprise (management, administration, production and maintenance) and numerous interviews, discussions, reassessments, etc. Furthermore, the ROM.M method requires strict compliance with all the stages to be followed: identification of the problem, data base, internal seminar to identify solution, definition of the tasks to be allocated to external consultants and tasks to be assigned to key personnel within the enterprise, seminar on implementation of the ROM.M method, execution and follow-up, evaluation of the operation of the method and of the results achieved. All these stages may extend over a period of 29 to 46 weeks (7 to 11 months).

With regard to training, the ROM.M methodology has led to development of the concept of training by the guided transmission of knowledge (guided transmission training - GTT), which is based on training given by foremen and skilled workers. One advantage of this is that it overcomes the language barrier, with the intermediate trainers also being motivated by special remuneration to participate in this programme of transmission of knowledge.

C. Results achieved in local production, recovery and repair of spare parts

The report indicates that a plant for the manufacture of spare parts will start up in June 1987. A survey conducted by SIDA led to co-operation from Italy, which is financing the project, and the plant is designed to produce 3,600 different categories of spare parts. The project for a workshop for the recovery and overhauling of spare parts is the outcome of a joint study carried out by ILO and the Centre for Improved Productivity. It appears that ILO has agreed to finance the first pilot workshop for recovery and overhauling, which should then pass on the knowledge gained to enterprises wishing to set up similar workshops.

In conclusion, the report considers that, although obvious efforts have already been made in Ethiopia to improve the position of IM, there is still an insoluble problem - that of the status of the maintenance function, which offers very little incentive for workers. In an extreme case, a reduction in the number of breakdowns because of good IM may lead employers to reduce the wages of less busy maintenance workers. It is advisable to envisage a system of remuneration linking wages to the real productivity of workers in the maintenance section.

KENYA

Kenya is aware of the importance of industrial maintenance (IM) as a key development factor. The special features of IM in Kenya are as follows:

- (a) Industrial equipment from a wide range of sources;
- (b) Development of high technology industrial projects faster than the development of available local skilled personnel;
- (c) Great dependence on other countries for spare parts and IM expertise, with limited foreign exchange availability.

All this means that there are deficiencies in IM, but the national awareness of the problem has already led to a proliferation of new industrial training institutions.

1. Policy and strategy

A new feature of the strategy is the beginning of systematic interaction between the formal education system and industrial training aimed at specialization. The IM requirements are taken into account right from the evaluation and formulation stage of industrial projects. However, the great dependence on the expertise of funding agencies and suppliers as regards adaptation to the requirements of IM and to rapid changes in technology is delaying the adoption of a co-ordinated national IM policy. Kenya is therefore seeking to exchange IM experience with other developing countries. The strategy of human resources utilization in IM is thus still at the stage of defining options, although a number of steps have already been initiated.

2. Organization and method

Because of the adoption of a mixed economy policy initiatives can be taken in both sectors (private and public) with reference to adapting human resources to the requirements of the policy of industrial maintenance. Practical results have been achieved in individual enterprises (public and private), but there is still no true national or even sectoral policy. By way of example, there is still no indication that there has been any change in the attitude of workers and employers towards maintenance posts.

Likewise, there is considerable diversity between firms in the place occupied in the organizational chart by the maintenance department or unit and the collection of statistics on breakdowns or production losses due to inadequate IM or the results of improvements in IM.

There is thus an urgent need for an effort to centralize information. Firms providing research, studies and advice on IM, both local and foreign, offer their services to enterprises on a contractual basis. However, their contribution is often temporary and, in the case of foreign firms, the cost is sometimes prohibitive. The small and medium enterprises and the informal sector are beginning to play a role by performing maintenance and repair services. This role will continue to expand.

3. Technical documents for industrial maintenance

The preparation of such documents requires specific skills in the areas of design, technical drawing and drafting. Special training programmes to teach these techniques may be envisaged. Knowledge of these techniques gives ability to participate not only in the drafting of invitations to tender, when developing

IM programmes or technical equipment specifications but also in determining requirements for and adapting maintenance procedures and manuals provided by equipment suppliers, as well as in making IM diagnoses and classifying and managing technical documentation.

Such experts in the art of producing, analysing or adapting technical maintenance documents already exist in Kenya in many public or private enterprises or in consultancy offices. As a general rule, they have received training in an enterprise or with an equipment manufacturer. There is still no national policy providing for systematic regional or international co-operation.

4. Spare parts management

This is fairly well organized in the modern industrial firms. Classification, storage, utilization planning, budgeting, financing and, possibly, manufacturing workshops are features of this organization. The principal problems are:

- The extension of this management to all sectors and types of industrial firms, i.e. a national spare parts policy. In this respect, the State has already taken steps to provide incentives by including spare parts among the goods the import of which is facilitated by including them in the priority lists for foreign exchange allocations. However, training in spare parts administration is still not systematically provided nationwide.
- The high cost of spare parts can be remedied only by a policy designed to promote production of these items locally. The State now seems most interested in developing and implementing such a policy.

5. Negotiation and purchase of plant and equipment

Kenya recognizes the importance of being able to negotiate when purchasing plant or equipment from abroad, in particular so as to be able to include in the purchase agreement proposals concerning technical documentation, organization of industrial maintenance and technical assistance in equipment management when the plant is commissioned. However, the fact that the country depends largely on outside sources of financing for these purchases considerably limits this ability to negotiate, and the negotiators are not adequately trained in industrial maintenance and management. It would be desirable to examine this subject in a UNIDO forum.

6. Maintenance training policy

The use of human resources in IM is a key aspect of the development of Kenyan industry. Human resources development is a costly and lengthy process. Moreover, one cannot expect the spontaneous local development of appropriate technologies and the compulsory waiting period will increase the present time lag in the development of modern technologies. In the area of human resources in IM, an exhaustive survey should be made of the country's IM training resources and ad hoc training methods should be identified and tested. Although the beginnings of a technical training policy exist, these still do not add up to a national policy and do not have clear financial priority. Consequently, there is a crying need for competent and motivated personnel in the IM sector, which perpetuates recourse to improvisation, wastage and high costs in keeping the motley assortment of equipment in proper working order.

MADAGASCAR

The industrial sector in Madagascar is relatively modest (370 enterprises, including 100 major units) and concentrates on production of foodstuffs, textiles and leather goods. It is old (most of the plant was installed in the 1960s) and nationalized. The industrial sector is also still largely dependent on other countries for supplies and management. Industrial maintenance (IM) is deficient and this deficiency is probably the main cause of the under-utilization of capacity (30 to 40 per cent on average), which causes high costs, production losses and occasional market losses. When IM exists it is merely corrective or emergency maintenance, at best small-scale and sometimes merely a matter of do-it-yourself. In other words, IM is still seriously undervalued in Madagascar.

1. Technical documents

A national IM strategy was developed in 1983, however, with UNIDO assistance, and its main outlines are currently being implemented. Among the various factors affecting IM, the report pays particular attention to technical documentation, which is vital in carrying out maintenance work. In the developing countries, including Madagascar, only 20 per cent of industrial enterprises possess adequate documentation.

Three types of technical documents are important:

- (a) Those relating to project planning and design, collected together:
 - In a financing file also covering technical feasibility;
 - In a call for tenders including several sets of specifications designed to indicate the customer's requirements clearly;
- (b) Those concerned with the assembly and start-up of the plant. These are provided by the vendor;
- (c) Those used in the operation of the plant.

Although it is essential to possess all these documents, those in the last category (general documents and drawings relating to the various sections of the plant, machine maintenance sheets, wiring diagrams, machine service manuals, preventive maintenance information, operating manuals, lists of spares to be held in stock, detail drawings, etc.) are particularly necessary for equipment maintenance purposes.

The gaps in this type of documentation may be caused:

- Either by suppliers' failure to provide any documents, incomplete documentation or documents that have not been translated into the language of the country where the equipment is to be used or are incomprehensible;
- Or by the plant managers' failure to maintain a full set of the original documents relating to equipment in cases where manufacturers may have gone out of business. It is recognized that the establishment of reliable, comprehensive and operational technical documentation may cost as much as 10 per cent of the value of the equipment.

The other types of document are also most important because they determine the needs of the purchaser of the equipment (e.g. technical specifications) or the proper understanding of the equipment by the user (particularly the user's maintenance service) from the time of his participation in the assembly of the equipment or from plant start-up.

2. Importance of the maintenance worker

(Skilled worker/technician or engineer)

It is not sufficient merely to have proper maintenance documentation. Those responsible for IM have a major role to play. Their role in feasibility studies or in ordering, accepting, assembling or utilizing equipment guarantee constant good condition and smooth operation of production equipment, as well as production regularity in terms of quantity and quality.

Recommendation

Within the framework of an overall programme for promotion of maintenance consideration should be given to the following:

- The order contract should mandatorily include a separate set of specifications regarding the nature, number and content of the technical documents, as well as penalties applicable to suppliers who fail to comply with such clauses;
- Maintenance staff should be systematically involved in all operations, from the placing of the order to start-up, and the maintenance personnel of new plants should be present well before start-up;
- A specialized section should be set up, in both old and recent plants, with responsibility for completing, replacing, inventorying, holding and managing technical documentation.

These specific measures must be incorporated in an overall IM training and promotion policy. It should be noted that Madagascar is currently benefiting from a UNDP/UNIDO project whose immediate objective is the establishment of a team of engineering consultants to deal with IM (including local spare parts manufacture) able, at the end of the project:

- To advise the Government on IM strategy;
- To advise and assist enterprises with regard to IM;
- To train key maintenance personnel;
- To advise and assist with regard to equipment purchasing;
- To advise and assist with regard to local spare parts manufacture;
- To conduct a continuing campaign to inculcate awareness of and to promote IM.

This is expected to yield the following results:

- In the short term, an increase in output and/or productivity of existing equipment through reconditioning and improved industrial management;
- In the longer term, a guarantee that lessons learned from past mistakes will be applied in new projects.

MOROCCO

Industry constitutes quite an important sector in Morocco since the added value represents 28 per cent of the gross domestic product and the sector employs 23.2 per cent of the working population. Priority has therefore recently been given to:

- Industrial training, which accommodates nearly 65,000 trainees each year and hopes to accommodate as many as 220,000 by 1990/1991 (the training system aims to be of practical benefit for the enterprises, which are providing financing for it through a one per cent payroll tax);
- Industrial maintenance, following several surveys and a seminar since 1984 with the support of UNDP and other international agencies; IM must become a component of Moroccan economic policy aimed at "maintaining the status quo in order better to secure the future".

1. Reform of the industrial training system

In the industrial sector, the Industrial Training and Labour Promotion Office (OFPPT) is the prime contractor in industrial training and possesses a considerable training capacity. A recent UNDP-supported project is designed to place this capacity at the service of industrial maintenance by reorganizing its operations, through both basic training programmes and on-the-job training activities: establishment of maintenance training modules, consultancy for enterprises (particularly small and medium enterprises), enhanced status for maintenance work, etc. The role played by OFPPT combines its actions and effects with those of other State or semi-State agencies - the "Grands Offices", which are also involved in industrial training. Furthermore, there is insipient development of a private industrial training sector, encouraged by the State, which can already accommodate nearly 30,000 trainees.

2. Industrial maintenance: situation and prospects

An extensive survey and the major seminar held in Rabat in 1985 helped to promote the idea that post-investment and industrial maintenance activities are vital for the development of industry in Morocco, having regard, in particular, to the economic context of scarce foreign exchange and the country's foreign debt. Maintenance is a factor that can result in substantial savings. Consideration of Morocco's current deficiencies and specific advantages with regard to industrial training and maintenance management has thus led to the formulation of a national industrial maintenance policy having the following main features:

- Systematic introduction of maintenance awareness in industrial projects;
- Broadening of the concept of maintenance to take in the more general concept of "post-investment", including all activities designed to achieve optimum return on capital invested and thus covering not only equipment maintenance, but also rational choice of technologies, their appropriate use, overhauling (use of spare parts, repairs) and training.

The 1985 survey indicated that three quarters of the industrial enterprises have a post-investment policy, possess a specific unit or staff for maintenance and practise maintenance planning.

However, there are still considerable difficulties in obtaining supplies of spare parts and the only enterprises which claim they have access to reliable technical assistance or repair and spares supply facilities from foreign partners are the private concerns.

Moroccan enterprises generally have a maintenance budget, albeit an inadequate one. Nevertheless, they sometimes have difficulty in using it because of problems with the government departments responsible for administrative, customs and financial control of contacts with other countries. There seems to be some shortage of maintenance-trained personnel, a shortage which may be partly explained by the poor status accorded to maintenance work. However, industrial enterprises are generally satisfied with the effectiveness of their maintenance staff, who in some cases are given further training. Preventive maintenance and regular diagnosis are still used by only half of the enterprises.

It therefore would appear that the industrial enterprises are maintenance conscious and that the few practical problems which exist are connected with the economic and financial control exercised by the State. It should be noted, however, that this generally fairly satisfactory state of affairs does not apply to the government departments or to the public training or health institutions, which are hampered by their lack of independence and by strict public accounting rules in implementing a policy of regular and preventive maintenance - even though they have large numbers of machines and other items of equipment.

The inadequacies noted led the Seminar to recommend:

- Measures designed to make the population and the public authorities maintenance-minded;
- Measures to reform the industrial training system in order to introduce maintenance modules, to give preference to certain areas of "maintenance" training that are underdeveloped (hospital equipment, refrigeration industry, storage, etc.) and to develop contacts between industrial training centres and small and medium enterprises and the OFPPT's advisory role (some of these recommendations have already been acted upon);
- Measures designed to motivate maintenance personnel (review of their remuneration, compared with that of other workers in the enterprise);
- Measures of an administrative, economic or financial nature to promote maintenance, particularly by making maintenance enterprises and programmes eligible for certain facilities (investment code, fiscal incentives, more flexible administrative procedures) already granted to industrial investment projects stricto sensu;
- Various technical measures to ensure that maintenance is taken into account right from the feasibility study stage of an industrial project, that encouragement is given to the establishment of local units to manufacture spare parts and that there is co-ordination of the maintenance efforts and ideas of enterprises and other bodies having capital equipment.

In this connection there are plans to establish a "National Maintenance Commission".

MAURITIUS

Background

A small country with an emerging industrial sector, Mauritius has been able, thanks to the success of activities in its free industrial zone, to attract 277 industries, which employ 24 per cent of the total labour force and generate 20 per cent of the national value added, with exports representing 47 per cent of total exports, thus outstripping the sugar sector.

As regards this particular agro-industrial sector, it would seem that the maintenance of the sugar factories is satisfactory, having regard to the technology currently used, since the success of the annual crop is dependent on the factories being in good condition. The recent and continuing modernization of the sugar refineries is liable, however, to give rise to IM problems owing to the lack of trained maintenance personnel in certain fields, and particularly in electronics.

The remainder of the industrial sector comprises heavy and light textile industries, as well as a number of specialized engineering industries which are essentially export oriented. It was noted that these factories accord priority to maximizing production, and IM seems in some cases to be a secondary concern. However, those factories which use heavy plant are obliged to have well-organized maintenance management programmes.

The IM is generally of the "repair maintenance" type, and preventive maintenance is not widespread. In the case of engineering maintenance, the necessary skilled personnel is available, which is not the case for electrical or electronic equipment. The enterprises in the free industrial zone now seem to have a genuine interest in the question of IM.

1. Policy and strategy

Both primary and secondary schooling and technical education are well organized, and account for 14 per cent of the annual State budget. They are based on a structural organization comparable to that of the British educational system. The Mauritian educational system, however, is still oriented towards the acquisition of knowledge aimed at encouraging qualified young people to enter the private or public tertiary sector.

This does not encourage young people to opt for jobs in the industrial sector. However, there are a number of private and public vocational training institutions which endeavour to train young people for employment at the skilled-worker and engineering-foreman level. Three of these institutions, one supported by India, a second by UNDP, and the third and most recent (the Lycée Polytechnique) supported by France, train technical personnel, including personnel in sectors in which skills have been shown to be in short supply, such as electricity and electronics. Together with the other government training institutions, the potential training offered amounts to a capacity of almost 1,100 trainees per year. At university level, the training seems to be too general having regard to industry's demand for engineers. The large State enterprises have therefore introduced an internal system of "professional advancement and training", an example being the courses provided by the National Electricity Production Enterprise.

The sugar sector also has its own Technical College, whose courses seem to meet a demand, since an electronics section has just been opened in the College.

Some 160 vocational training centres in the private sector train almost 2,000 young people each year in various industrial sectors associated with IM. The principle of apprenticeship or the comparable procedures of training through practice in the workshop or branch of an enterprise (alongside a trained professional) have not achieved the anticipated success.

In training their personnel, employers generally rely much more on on-the-job training (or specialized in-service training courses) than on prior vocational training, which is often regarded as too theoretical. Only the Lycée Polytechnique provides training oriented towards industrial maintenance. In view of this relative disenchantment on the part of the employers, the various vocational training institutions lead a highly independent and unco-ordinated existence.

Links between industrial training and industry

The Government is aware of the importance of establishing such links. Although collaboration between the University and industry, which was provided for by legislation in 1981, has not yet been implemented, the State has established the Central Training Office (CTO), which is responsible for centralizing vocational training policy, monitoring its impact, and directing or laying down methods and procedures. The CTO is not yet operational.

A council for training in the private sector has been established by the Chamber of Commerce and the Federations of Industrial Employers. Certain institutions have established organizational links with industrialists in order to organize training courses or the participation of employers in developing curricula and training methods.

The IM problem

The fact that, except in the case of the sugar sector, industrialization in Mauritius is of recent origin (15 years) indicates why IM is not as yet regarded as a major consideration. It should be added that a large part of the industries in the free industrial zone consists of garment-making and hosiery enterprises which require only modest technology needing little maintenance. In the operation of capital-intensive industries, for which there is a shortage of locally-trained IM personnel, it is sometimes necessary to make use of expatriates - 1,200 foreign technicians out of 53,000 employees in the free industrial zone.

IM is considered an important national priority, and is regarded by the Government as also including the IM of all the plant owned by the State or the public sector, such as public transport, hospitals etc. The Government has just launched a national youth training programme in order to train the young unemployed. The recent establishment of the National Solidarity Fund, financed by the State and supported by the private sector, has already led to the in-plant and on-the-job training of 10,000 unemployed, most of whom have later been able to find work.

The Government also stipulates, when issuing work permits to foreign technicians, that alongside each indispensable foreign technician there should be a local counterpart who will learn the trade on the job. However, there is as yet no overall IM training policy capable of meeting the needs of industry.

Co-operation

In this area too, the organizational framework exists, but it is not yet being used effectively. This is particularly the case of co-operation between industry and the State, which is taking place within the framework of the periodic meetings on management and follow-up of operations in the free industrial zone.

This also applies at the regional level with the existence of the Indian Ocean Commission. There have been a number of instances of interregional technical co-operation in specific sectors (the fishing industry, the sugar industry, the health sector), where there have been exchanges of skilled personnel. A regional management training centre may receive support from the European Development Fund (EDF) and the World Bank has financed a number of studies aimed at improvement of the vocational training infrastructure. France and India are financing specific training operations, while UNDP has financed visits by experts and fellowships in the vocational training field.

The report recommends the establishment and operation of a central body (the CTO) to define an industrial vocational training policy which provides for the co-operation of public and private industry in official vocational training programmes.

A further recommendation is for a number of financial incentives for vocational training, including tax incentives, in order to make in-service training an automatic response among industrialists and employees. Regulations concerning vocational training diplomas or proficiency certificates would provide a yardstick for skills acquired. Technological apprenticeship should be included in secondary level programmes, and IM apprenticeship should be offered in all vocational training centres.

2. Organization and methods

Projects using high technology should allocate part of their budget to the vocational training needed for IM. This is already often the case in recent Government projects, where the invitations to tender include a significant component relating to the training of technicians. In the private sector, attention is still rarely paid to IM at project start-up, and when IM seems to be necessary, the attempts to organize it are often hindered by the lack of trained personnel.

The sugar industry attaches great importance to IM, which is divided into two sectors: mechanical maintenance and electrical maintenance, each of which is the responsibility of an engineer. The main concern of the IM engineers is to avoid any interruption of the factory's operation during the working season, and primary preventive maintenance is carried out during the slack season when the factory is not operating.

In the other industrial subsectors, particularly those in the free industrial zone, the priority given to IM depends largely on the degree of technical sophistication of the plant and on the financial repercussions of the technical troubles or breakdowns experienced by management. In general, preventive maintenance can be said to be virtually unknown, and a brief survey has shown that, in 30 textile factories, only 3 employees out of every 100 were involved in maintenance, whereas a ratio of almost 10 per cent may be regarded as desirable.

Maintenance operations are often carried out either by the equipment suppliers (with varying degrees of regularity) or by workshops specializing in this type of activity. A number of such workshops do maintenance work in the engineering and electrical fields. In-service training for IM staff is beginning to be organized by enterprises, which either use expatriate training personnel or send the local staff for training to the equipment suppliers or to well-known training institutes (local or foreign). Thus the main problem is the need to have, for IM purposes, both specialists with expert knowledge of certain equipment and trained non-specialist personnel. There is therefore a problem of deciding which type of training to provide. Some enterprises avoid this problem by recruiting staff

already trained by their competitors. The recommendations propose more seminars on IM in state industries, training for IM programming, tax or financial incentives for small-scale and medium-scale firms specializing in IM work, and generally to all enterprises which have an IM training programme.

3. Technical documentation for maintenance

The recent factories (those in the free industrial zone) have kept their technical documentation, and have therefore been able to institute routine maintenance (in 80 per cent of cases). Some even practise real preventive maintenance. The sugar factories have satisfactory control over their technical documentation. It is, however, recommended that some courses on technical documentation coding and control should be included in vocational training programmes.

4. Spare parts

Light industries generally have only a small stock of spare parts (5 per cent of the value of the plant), which means that in the event of breakdown they have to resort to "cannibalizing", to the detriment of the machines from which the parts are taken. It is generally considered that a three months' supply of parts should be held. Public contracts often require the suppliers to furnish up to 20 per cent of the value of the plant in spare parts upon delivery, but the nature of the parts should be specified in greater detail.

Stock control, being a costly process, must be carried out very efficiently, and in many cases it is. In addition, companies have often lent each other assistance and emergency help in connection with spare parts, thus encouraging the idea of a co-operative system of spare parts management. Some enterprises using sophisticated plant have set up workshops for manufacturing certain parts. Small private workshops have also begun to manufacture certain parts on the basis of specifications agreed with the enterprises, but they are few in number because of the inadequate financial incentives and the risks involved. There is no longer a problem of currency for the import of spare parts, since enterprises (particularly those in the free industrial zone) are entitled to have their own foreign currency account. It is recommended that the incentives for setting up workshops to manufacture spare parts should be increased, that a special customs service unit should be established for examining and updating spare part lists and that customs duties on imported spare parts should be reduced.

5. Negotiation and purchase of factories and plant

There is little local standardization of plant, since the investors, with their diversified technologies, have brought in equipment from different sources. Contracts for the purchase of equipment usually include the cost of initial IM training by the suppliers, who are also required to provide an after-sales service or technical assistance if needed. There are sometimes also clauses requiring the supplier to provide spare parts on a continuing basis, as well as regular staff training courses. In the public sector, attention should be paid to the training of negotiating teams for supply contracts, in order to avoid mistakes of the kind which occurred with a contract for an electricity generating system, which will cost the State 550 million rupees instead of the 360 million anticipated.

6. Vocational training policy for IM

The current situation is characterized by a vocational training system that is primarily directed towards turning out skilled production workers and technicians, training in IM being accorded second priority. Where it exists, it is carried out

on an in-plant basis in the enterprises. The conclusions of the recent training seminars organized by the Association of Industrialists of the free industrial zone, with the assistance of the Institute for Production Monitoring, should lead to the formulation of a new IM training policy tailored in particular to inter-enterprise training, which will cost less than in-plant training. The Lycée Polytechnique is already providing training courses in IM in a number of technical fields (engineering, electricity) at the skilled-worker and technician level. A long-term project is to establish an industrial maintenance institute. While there is not as yet any specific financing for IM at the State level, the World Bank, France, the United Kingdom and the United States are already financing IM training operations.

Annexes to the report

The report also contains detailed tables listing the machinery used in the textile industries (mostly in the free industrial zone of Mauritius); various tables on government efforts in the field of vocational training and on IM requirements in all industrial sectors, including those in the free industrial zone; a model survey of IM; and company organizational charts showing the status accorded IM in the different sectors.

SENEGAL

Government consideration of the importance of IM and the development of human resources in that field falls within the context of the medium-term adjustment programme, and in particular its "new industrial policy" and "new educational policy" components.

Industry in Senegal is concentrated in the Dakar region, which accounts for 89 per cent of the total number of enterprises, 73 per cent of valued added and 75 per cent of employees in the sector.

The IM situation

Many plants with machinery are no longer functioning, or are functioning unsatisfactorily owing to lack of IM. The main reasons are well known: the shortage of qualified technicians, spare parts and technical documentation; unsuitable or superfluous equipment; plant under-utilization or over-utilization; equipment of various different types and provenances; the lack of trained IM personnel; complex and cumbersome procedures for ordering spare parts; inadequate maintenance budgets; the high cost of maintenance by foreign agencies; management by personnel who are not conversant with IM, etc. The consequences are serious: social insecurity as regards health (due to poor maintenance of therapeutic and diagnostic equipment), time lost in industry, uneven quality of production, bottlenecks, poor organization of work (disruption of schedules), etc.

1. Policy and strategy

No exhaustive study has been made of IM deficiencies, their consequences and the skilled manpower situation. There is no relationship between training and the diversified requirements for skilled labour. However, the increasing awareness of these problems gives reason to believe that research in these areas will be undertaken under the Seventh Economic and Social Development Plan (PDES).

Some enterprises do, however, have staff with training (skilled workers and supervisors), or are organizing in-plant training sessions, and there are already a number of training establishments of a high standard which belong either to the national education system or to certain specific enterprises.

There are also practical industrial training centres:

The National Centre for Vocational Training (CNQP) has been reorganized several times, so that it is now able both to train young school-leavers for skilled jobs and to provide in-service training for those already in employment: this training will soon encompass all industrial sectors (engineering, electricity, electronics, refrigeration, metal construction, engineering drawing). One aspect given priority is plant maintenance.

The CNQP also organizes tailor-made training courses, both inter-enterprise and intra-enterprise, with ILO support.

The Senegal-Japan Centre for Vocational Training (CFPTSJ) also provides a three-year IM training course for young people in the electronics, economics and electricity sectors.

The activities of CNQP and CFPTSJ are not, however, co-ordinated, and the two bodies do not merely fail to co-operate - they are unaware of each other's existence. Although the new industrial policy strongly favours the disengagement of the State, it places emphasis on co-ordinated and planned efforts to train personnel in plant maintenance, with the aim of maintaining quality standards,

winning outside markets, promoting investment in industry, and ensuring that efforts made in the field of applied research bear fruit. Recognition of the importance of IM has increased since 1978, thanks to a number of UNESCO-sponsored meetings on the training of technicians and engineers in IM techniques. Several projects in the IM field providing for policy co-ordination bodies or specific training centres, whether national or international, have been suggested during this period, but none has so far come into being.

2. The experience of the Ecole Nationale Supérieure Universitaire de Technologie (ENSUT)

This school, which trains engineers to become industrial engineering technicians, lays stress on IM training and pursues a policy of co-operation with other African university bodies within the framework of RAIST (African Network of Scientific and Technological Institutions). Its specific interest in IM led it to hold a number of workshops, seminars and meetings on the topic between 1981 and 1986. Programmes of training in IM, emergency repairs, and the use of scientific instrumentation (a UNESCO project) have been devised and carried out, and in many cases the universities participating in the meetings have been encouraged to organize their own maintenance units staffed by their laboratory technicians who have received special IM training.

The most conspicuous success has undoubtedly been the organization of IM using technicians who have undergone retraining and refresher training in hospitals in the Cape Verde region. The IM refresher and retraining programmes have not only been carried out locally, but have also included a number of training courses given within the firms supplying the medical and hospital equipment to be maintained and in French hospitals, whose maintenance methods can be studied by the trainees.

However this experience, in a specific sector, also reveals the lack of outline policy guidelines of a State plan, and even of the specific political will to resolve the problem of IM as a whole.

3. Co-operation in the utilization of human resources for IM

At the national level, there is no co-operation among the various enterprises engaged in IM training.

At the regional level, some co-operation has begun to take place under the auspices of UNESCO, based on the various IM training centres which already exist (particularly in English-speaking Africa) and which accept a number of foreign students.

RAIST, which is more broadly based (50 institutes), operates a co-operative scheme for the training of IM technicians working for institutes and universities. There is also a project for a network of instrumentation centres in Africa (RCIA), whose aims will be, inter alia, "to organize training in IM, routine instrument repairs, major repairs, instrument calibration and the manufacture and modification of scientific instruments and spare parts" through vocational training courses. Immense scope for further co-operation between African scientists and technicians is thus opened up.

Conclusions and recommendations

While some action has been taken, the importance of IM in the production system is nevertheless still underestimated by the authorities, and serious gaps exist both in research and in achieving mastery in this area. Many projects have been launched, but they have not achieved concrete results. The policy of the "new school" may, however, open up prospects of:

- Multidisciplinary instruction combining theory and practice, instruction in production techniques and maintenance training;
- Linkage of informal educational structures with the formal educational system;
- Dissemination of technological training tailored to scientific and technical research.

The recommendations are aimed primarily at:

- Revitalizing the vocational training centres by modifying the training to suit the job requirements;
- Disseminating IM training as a specific subject, by including it in technical training programmes;
- Reviewing the machinery import policy, by insisting that purchase contracts cover maintenance aspects, technical documentation and maintenance procedures;
- Encouraging local production of spare parts, 60 per cent of which could, according to a recent survey, be manufactured locally;
- Encouraging enterprises to retrain some of their staff in IM techniques and generally to undertake continuous training on an in-plant basis;
- Establishing a national co-operation and co-ordination body to develop and establish guidelines for the country's IM policy and the local manufacture of spare parts and, in general, to plan human resources development for IM;
- Extending the opportunities for interregional collaboration and co-operation among employers, the State and training institutions in the area of IM training;
- Establishing a local pool of IM engineering advisers, possibly including specialist foreign consultants;
- Proposing the organization, with UNIDO back-up, of further seminars on post-investment.

TANZANIA

Background

Losses due to breakdowns or production stoppages resulting from inadequate plant maintenance in factories are estimated at at least 15 per cent of the industrial value added, or several million Tanzanian shillings per year. There is therefore a growing recognition of the importance of industrial maintenance. This would appear to have led each industry to allocate 15 per cent of its staff costs to plant maintenance, and budgetary provision for maintenance is now made annually in the principal enterprises.

The industrial capital (fixed investment in industry) of Tanzania is estimated at at least 8 billion shillings, but it gives rise to large-scale imports of raw materials and spare parts, since most of the investment is in equipment obtained from abroad. Because equipment is imported from many different sources, specification constitutes a problem when spare parts have to be ordered.

Although Tanzania's economic authorities and entrepreneurs have become aware of the importance of industrial maintenance, "maintenance consciousness" is still insufficiently developed. The lack of preventive maintenance leads to higher maintenance costs, and to the need for more frequent replacement.

Policy and strategy

Although no systematic national industrial maintenance policy has yet been defined, Tanzania has recently introduced a "national science and technology policy, in order to make better provision for the strengthening and follow-up of maintenance systems for plant in all industrial firms, training and educational institutions, research institutions, etc.". This policy also calls for the training of local personnel for carrying out maintenance and planning and adapting plant to meet local conditions of operation and maintenance. The Ministry of Industry has prepared directives for industrial managers and these should lead to the establishment of "innovation committees", provision in budgets for innovation, research and development, the introduction of preventive maintenance systems, more widespread subcontracting of maintenance, the preparation of maintenance documentation and the manufacture of spare parts.

Training

Specific maintenance and repair courses are being introduced in vocational training centres. The large-scale industrial enterprises (Tanesco, Telecom, Sudeco, Saniji) have their own training system, but most of the other industrial firms, with more modest resources, still do not accord the same importance to training, relying on the attraction of high salaries to recruit trained personnel from elsewhere. One specific method, POT (problem-oriented training) has been introduced by the Association of Metallurgical Industries (MEIDA) with the assistance of outside consultants: this has already resulted in the training of 120 maintenance engineers and technicians from 25 industrial firms since 1981, at a cost of 7.2 million shillings for three years. A survey has confirmed the effectiveness of this system of maintenance training.

Organization, resources and facilities

MEIDA has set up a service enterprise for the planning and establishment of maintenance services, with specific reference to reconditioning, repair and upkeep of machinery and plant. The enterprise also plays a role in the training of in-plant maintenance staff, and introducing maintenance systems and methods.

In Tanzania the organization of maintenance in an industrial plant generally takes two forms. Maintenance is either a specific department within the enterprise (66 per cent of cases) or is part of the production or plant operation department. The first form seems to yield much better results than the traditional system, under which maintenance falls within the responsibility of a production manager, who is encouraged to use his plant to the maximum extent possible, without paying sufficient attention to maintaining it in good working order.

Spare parts

Tanzania's industrial enterprises apply the traditional method of ensuring a supply of spare parts, with a stocks manager, continuous inventory, stock cards, and requisition orders. A particular problem in Tanzania is the limited availability of foreign currency for purchase of essential imported parts. To remedy that situation, the Government and industrialists have adopted a policy aimed at designing spare parts which can be manufactured locally by specialized enterprises. This policy has enjoyed some measure of success. An organization established for the purpose (Tanzania Engineering and Manufacturing Design Organization - TEMDO) has been functioning since 1981. However, the desire to obtain high-quality spare parts makes it necessary to continue buying from abroad essential raw materials (such as steel or rubber) which are not yet available locally. The emphasis in Tanzanian maintenance policy on the design of spare parts is a specific local feature which is expected to show expansion and is being closely monitored by TEMDO.

Negotiation and purchase of factories and plant

So far there have been no real efforts to co-ordinate or improve the methods employed in negotiating and contracts for the purchase of plants or new equipment. Engineers and technicians in enterprises do not as yet participate in negotiations, although there are exceptions (Tanesco and Tazara). As a result, important aspects relating to future maintenance of equipment remain a matter of strictly secondary concern or are ignored altogether in negotiations with the manufacturer.

Recommendations

Apart from the general recommendations on "maintenance consciousness", the introduction of a specific maintenance training course, the establishment of a maintenance department in each industrial firm with a budget and highly motivated staff and the introduction of follow-up of the results of any maintenance policy, the expert's report urges that priority assistance be given to specific initiatives already taken in Tanzania:

- MEIDA and its project for POT and the training of maintenance staff;
- TEMDO and its policy of design and redesign of spare parts;
- TISCO (Tanzania Industrial Studies Consultancy Organization) and its activities as an advisory body in negotiations for the purchase of plants and the acquisition of factories and equipment.

The report also identifies a number of strategic sectors in which maintenance problems will arise in the short term, such as the electronic equipment sector.

ZAIRE

The report draws attention to the main obstacles to economic initiative, including inadequate vocational training of workers, unsatisfactory choices of technology, and widespread waste due to the irrational use of human resources and poor plant maintenance. Upkeep is in fact maintenance, and this concept covers all the techniques capable of "maintaining the potential of the plant in order to ensure continuity and quality of production". There has been sharp criticism of the system of purchasing "turnkey" factories, which makes no provision for responsibility of the supplier after acceptance of the plant installed. On the other hand, the advantages of regular maintenance are such that it leads to savings in currency and resources, but also to local technology modifications.

1. Prospects for IM in Zaire

Awareness of the importance of IM is insufficient, both at the government level (no planning) and at the level of enterprises, which are content with only a small amount of individual effort. There has been no evaluation of the actual IM requirements, owing to the lack of effective tools for the collection and analysis of statistics. Furthermore, no national policy has as yet been developed for the standardization of equipment or the optimal utilization of national products and capacities. In this connection, despite the example of a number of African unions in certain sectors in which exchange of experience and interregional projects may materialize, reliance is placed primarily on international co-operation, and particularly on the activities of UNIDO technical advisory bodies.

2. IM training

General criticism is expressed on the following points:

1. A restricted concept of IM leads to a truncated policy in which the intervention in case of breakdown takes precedence over preventive maintenance to ensure continuity of operation.
2. The skills which are lacking are not so much high-level technical expertise as more general qualifications which would facilitate:

Contract negotiation and right choice of technology and equipment to be ordered;

Proper feasibility studies for new projects;

The introduction of preventive IM;

Specialization by workers according to the equipment used;

Staff training in the management of spare parts and technical documentation;

The establishment of a training system-enterprise link, with the enterprises taking advantage of, supporting and providing guidelines for the training given in the various vocational training centres.

3. The National Institute for Vocational Training

This body, whose function is to establish vocational training and to advise enterprises, operates under the auspices of the Ministry of Labour. It is State-subsidized and benefits from a special levy on industry (one per cent of

payroll). It organizes a variety of training courses at the request of enterprises. The list of technical sectors in which it can, theoretically, function, is quite extensive.

The Institute is able to foster awareness of the importance of IM in specific training courses requested by enterprises, by providing the official vocational training centres or higher institutes with some measure of financial support, by training trainers sent by enterprises (for later establishment of in-plant vocational training centres) or by advising enterprises in the organization of their IM services.

4. The Inter-African Centre for the Development of Vocational Training (CIADFOR)

Within the framework of its participation in CIADFOR (an inter-African training organization), Zaire seems to have confined itself to participating in the "plant maintenance" aspect, while not neglecting the fact that any improvement in the operation of an industry entails the setting up of a full IM department (preventive maintenance, breakdown service, in-plant service within the firm, subcontracting, consultancy, etc.) in all cases where costly equipment is used which will wear out, i.e., both in the rural sector and in industry and in the government departments responsible for transport, health and education, for example.