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Background document

UNIDO'S TRAINING ACTIVITIES
IN THE AREA OF
INDUSTRIAL MAINTENANCE *

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I. INTRODUCTION

The Lima Declaration and Plan of Action set out a number of industrialization objectives and called for a total effort at the national and international levels to ensure that the developing countries would account for at least 25 per cent of world industrial production.

An effort of this kind implied that the promotion of technology in all of its complexity was to be regarded as an aspect of development leading to the acquisition of skills and expertise.

The Fourth General Conference of UNIDO, in its turn, focused particular attention on the development of human resources and laid stress on the importance of maintenance to industrial development, in the light, *inter alia*, of the recommendations formulated at the high-level expert group meeting held in preparation for that Conference. With specific reference to Africa, UNIDO IV also took into account the recommendations contained in the Declaration of African Heads of State that was approved at the meeting of the Organization of African Unity held in Lagos in 1981.

The purpose of this report is to briefly:

- (a) Outline UNIDO's training activities in the area of industrial maintenance;
- (b) Describe the philosophy followed by the Organization's experts in this field;
- (c) Discuss a number of basic problems affecting the target groups;
- (d) Provide examples of projects organized by UNIDO.

The problems facing the developing countries with respect to the maintenance of their industrial facilities are regarded as one of the principal reasons for their low level of equipment availability, their lagging productivity, the often poor quality of their finished products, and the premature deterioration of their plant and equipment.

The impact of equipment maintenance on the economies of the developing countries is, therefore, obvious, the fact being that poor maintenance triggers a sharp decline in national production. Moreover, this impact greatly transcends the industrial sector and is felt in all those branches of the economy that make use of equipment, such as agriculture, transport, public works, telecommunications, health, education and scientific research, etc.

Specifically, industrial equipment maintenance, the cornerstone of any process of technological mastery and, thus, of industrialization, has suffered very considerably from the absence of a technological absorption capacity in certain countries.

The truth is that it was only about 15 years ago that maintenance began to be accorded the importance it deserves. For some time, efforts in the direction of manufacturing rationalization through sophisticated procedures of all kinds have been accompanied by a fundamentally new perception of maintenance.

In the industrialized countries, the establishment of data banks containing information on the frequency of breakdowns, the time necessary to eliminate them, the type of malfunctions that occur, etc., has become increasingly popular, particularly since the evolution of miniaturized data-processing has provided management with an important tool.

For a long time, maintenance was regarded as merely an ancillary function, inevitably involving a loss of money. In the past, maintenance was thought of simply as a matter of eliminating malfunctions and repairing equipment subject to wear and aging.

In fact, the true scope of the maintenance function is far broader: maintenance has come to signify a ceaseless quest for a compromise between the "technico-economic" criterion and the "technico-financial". Still, much remains to be done in order that its productive function may be fully understood.

If it is to accomplish its task effectively, maintenance requires sizeable and sufficient human and material resources. It must never be allowed to become a kind of refuge for personnel unqualified for manufacturing activities, and it must be backed by an operating budget large enough to enable it to play a role beyond that of a simple breakdown elimination service. Planning, organization and methodologically sound procedures are prerequisites for the management of maintenance activities, particularly with respect to spare parts. Vocational training programmes along with programmes of research and development can make it possible for maintenance to improve the quality of production.

The maintenance function

Like the manufacturing function, so too the maintenance function has a productive aspect. One often speaks of productive maintenance, which is in fact a function to which as much importance should be ascribed as to the manufacturing function. The objective, in the case of both, is to ensure the continuity and uniform quality of production.

The training programmes cover the following forms of maintenance:

Adaptive maintenance is aimed at improving installed facilities by means of:

- Work designed to facilitate maintenance operations;
- Extension operations (new small-scale work) designed to improve the quality or quantity of production or of the service provided;
- Security and safety measures contributing to the avoidance of accidents.

The underlying principle of preventive maintenance is anticipation. Maintenance of this kind is pursued in two forms: systematic maintenance and conditional maintenance.

Systematic maintenance consists in the periodic inspection of a facility, according to an established schedule, for the purpose of detecting irregularities or premature wear and of eliminating these problems before they lead to a breakdown. The purposes of systematic maintenance are:

- To limit the aging of the equipment;
- To improve the condition of the equipment before an occurring fault can negatively affect production in terms of either quality, quantity or price;
- To act before the cost of the repair becomes excessive;
- To eliminate or limit the risk of breakdown in the case of equipment for which failure entails particularly high costs;
- To reduce equipment downtime on the occasion of inspections or malfunctions;

- To make it possible to carry out repairs under optimal conditions;
- To avoid excessive input consumption;
- To eliminate the causes of serious accidents capable of resulting in civil liability on the part of the enterprise;
- To influence favourably the morale of the personnel;
- To bring about a reduction in the volume of maintenance required.

II. UNIDO'S ACTIVITIES IN THE AREA OF INDUSTRIAL MAINTENANCE TRAINING

Surveys conducted by UNIDO experts have revealed that, owing to the long neglect of the maintenance function, there is little suitable maintenance training apart from that given to workers in the basic occupations. This lack of appropriate programmes is particularly evident in the training of planning and methods specialists (for shops and, above all, plants), spare part inventory managers, component coding specialists, and maintenance managers and engineers. There are few maintenance training programmes specifically designed for higher-level and supervisory personnel even though the demand for this type of training greatly exceeds the supply.

In the developing countries, very few organizations have initiated training programmes in this field despite a growing awareness on the part of Governments and plant officials of the importance of the maintenance function to the national economy or the success of the enterprise.

The need for maintenance directors and managers is certain to become more acute in the years ahead. It should be noted that several countries, acting with UNIDO assistance, have already launched large-scale maintenance programmes.

For UNIDO there thus exists a training slot that has not been filled and for which there are important needs in the developing countries.

UNIDO training programmes

Although still modest, UNIDO's training programmes are designed to strengthen the training capacities of the developing countries at the national, regional and subregional levels. The programmes which I direct concentrate on the following objectives:

1. To support training activities aimed at improving a given country's national capability in the technical and managerial areas;
2. To increase substantially training opportunities in order to meet the relevant needs of specific groups, through, inter alia, high-level consciousness-raising seminars (for general managers, plant department heads, supervisory maintenance personnel, technical directors, training institution staff, etc.);
3. To strengthen the training institutions;
4. To prepare more training material suitable for these institutions;
5. To carry out direct training activities where appropriate counterpart institutions do not exist;
6. To promote co-operation among developing countries and between the latter and the developed countries, together with the establishment of networks designed to facilitate exchanges between them;
7. To encourage the establishment of associations or societies of maintenance engineers.

At the national level, the purpose of UNIDO's activities is to support the efforts of interested Governments in implementing a policy for the promotion of an integrated approach to training.

The planning of training of this kind requires:

- An evaluation of the country's level of economic and technological development;
- A study of future technology trends and their implications for training in the area of maintenance;
- The programming of training over the short, medium and long term, keeping in mind the requirements at the national, sectoral and enterprise levels;
- The surveying of manpower resources and requirements and the identification of existing possibilities in respect of maintenance personnel supply and demand.

The macro-economic analyses pursue two objectives with respect to the problem at issue:

- (i) To identify training requirements at the national level;
- (ii) To predict training requirements in the light of development trends and industrial projections.

These macro-economic analyses need to be supported by specific studies dealing with selected sectors.

A major organizational effort is required in order to mobilize a country's active forces and put into place the necessary structures. It is equally essential to establish and/or strengthen existing mechanisms for the co-ordination of the various activities to be undertaken.

With a view to enhancing training opportunities, a series of group programmes, seminars, and high-level (and relatively short duration) round tables are organized at the national, regional and subregional levels. One of the objectives of the programme is concerned with the formulation of a series of training modules designed for various target groups.

Particular attention is directed at programmes for the training of training personnel so as to encourage a multiplier effect. Case studies are an integral part of these programmes.

Audio-visual documentation, including films and video cassettes, ensures a wider dissemination of these programmes. In Egypt, for example, the television network has already associated itself with this work. This, however, is a long-term objective.

UNIDO has made sustained efforts to identify the training establishments capable of serving not only the country in which they are located, but other developing countries as well.

UNIDO's "centres-of-excellence" programme places a major emphasis on the strengthening of existing institutions. The intention is to rely on appropriate educational and training establishments, including the training centres affiliated with, or dependent on, industrial enterprises, research establishments, adult education institutes, well organized travelling seminars or mobile training services.

In the maintenance area, the results of UNIDO's pilot experiment in Cameroon, working through the Advanced College of Technical Education (ENSET) of Douala University, have been very encouraging.

The objectives of the in-plant training programmes are to enable the personnel to acquire, within a relatively short time, practical experience using existing facilities within the enterprise or organization itself. In certain cases, the reason for establishing an in-plant training service is to cover all training requirements, including those connected with industrial maintenance.

Co-operation among developing countries contributes to the establishment of a network of contacts for the exchange of experience and information. Such co-operation permits the more effective utilization of the training capacities of the developing countries and offers the possibility of more accurately defining the kind of training to be sought from the developed countries.

Furthermore, co-operation of this kind has the advantage of reducing the burden of training expenses on Governments, while at the same time making it possible to train a larger number of personnel charged with maintenance responsibilities.

In addition to the opportunities for co-operation provided by the so-called "centres-of-excellence" programmes, UNIDO, with a view to upgrading the maintenance profession and promoting the exchange of experience between maintenance specialists at the national, regional and subregional levels, is encouraging the establishment of associations of maintenance engineers.

Target groups

The various target groups at which maintenance training is directed may be summarized as follows:

1. At the level of ministries and public or semi-public agencies:
 - (a) High-level officials and technical staff of ministries involved in the use of equipment;
 - (b) High-level officials responsible for training programmes;
 - (c) Staff of investment and finance institutions;
 - (d) National planning personnel;
 - (e) Consultants to small and medium-scale industrial enterprises.
2. At the enterprise level:
 - (a) General Manager;
 - (b) Technical Director;
 - (c) Manufacturing Director and personnel;
 - (d) Maintenance Director;
 - (e) Maintenance Section Heads and intermediate-level staff; (shop, mechanical and electrical services, instrumentation, inventory management, technical office);
 - (f) Purchasing agents;
 - (g) Training officers;
 - (h) Personnel Chief.

3. At the study bureau and consultant engineering levels:

- (a) Design engineers;
- (b) Feasibility study specialists;
- (c) Engineers and engineering technicians;
- (d) Business engineers;
- (e) Various consultants.

Methods and means of training

UNIDO's training programmes rely on the following methods and means:

- Technical assistance (experts and equipment);
- Study tours;
- Advanced training fellowships;
- Seminars;
- Audio-visual documentation;
- Information (data bank);
- Training modules;
- Job training.

Sources of financing

As in the case of any proposed action, it is first of all necessary to examine the possibilities of self-financing and to determine to what degree the industries are prepared to finance their own training requirements and to what extent they are actually capable of doing this.

It may be useful to note that provision for this financing should be made when planning industrial investments. The amount generally planned for software ranges between five and ten per cent of the total cost.

In the face of the scale of the efforts to be undertaken, UNIDO should mobilize far greater financial resources in order to assist the developing countries in implementing their maintenance training programmes so as both to satisfy their most urgent requirements in respect of the reorganization of those of their enterprises which are in difficulty and to increase substantially their training capabilities.

The Governments of the interested countries can play a major supporting role in this effort. One such tried and proven approach in this connection is the system of tax abatements for enterprises with training programmes.

A number of agencies operating on a bilateral basis are already helping the developing countries, and they should be encouraged to step up their assistance in this area.

SOME BASIC PROBLEMS

For our part, we hope that this meeting will be able to examine the basic problems facing the developing countries in the field of industrial maintenance, while also considering the training measures that should be put into place to solve them. We are dealing, therefore, with a long-term strategy coupled with a short- and medium-term plan of action that can only be defined by identifying specific training requirements in the field of industrial maintenance.

The basic problems that have been identified as facing the developing countries may be summarized as follows:

Equipment

The equipment problems concern:

1. The state of the equipment

- (a) Excessive rate of unserviceability;
- (b) Great diversity of equipment suppliers;
- (c) Poor condition of certain equipment due to improper use or faulty maintenance;
- (d) Improper cleaning of the equipment (the importance of the "cleaning" function is poorly understood).

2. The purchase of the equipment

- (a) Problems in the selection of appropriate technology (e.g., sophisticated machinery, reliability of the equipment under the conditions of a developing country, etc.);
- (b) Problems relating to external financing with respect to the selection of equipment;
- (c) Failure, at the time of the purchase of the equipment, to agree on maintenance provisions in such areas as:
 - Standardization;
 - Technical documentation;
 - Spare parts;
 - Training of maintenance personnel;
 - After-sales service;
- (d) Insufficiently clear contractual clauses (e.g., penalties);
- (e) Problems of packaging, transport and storage;
- (f) Failure to cover the maintenance aspect during contractual negotiations.

3. Operation

- (a) Improper use of the equipment by the operating personnel;

- (b) Unsatisfactory maintenance (cleaning, lubrication, preventive schedules);
- (c) Operation of the machinery under improper conditions.

Problems of technical documentation

The technical documentation is:

- Incomplete or non-existent

- (a) Lack of descriptions for disassembly and reassembly;
- (b) Lack of exploded views;
- (c) Total lack of component manufacturing plans (if only for the components subject to particular wear);
- (d) Lack of preventive maintenance and lubrication schedules;
- (e) Incomplete lists of spare parts;
- (f) Lack of basic documentation regarding standard products and articles;
- (g) Lack of a technical library, standards and books on technology.

- Inadequate

- (a) Frequently delivered as a copy without the original to permit the reproduction of additional copies;
- (b) Explanations that are not always clear.

- Uncodified and unmanaged

The care that should be given to documentation, its updating, its filing in a proper place, and its circulation among users.

Problems with spare parts

The problems with spare parts, which are crucial, may be summarized as follows:

1. Inadequate and incomplete selection of spare parts in stock

- (a) Lack of information;
- (b) Poor knowledge of stock;
- (c) No inventory analysis;
- (d) Frequent failure to provide for first delivery at the time the equipment is purchased;
- (e) Stocking of identical parts in different places.

2. Designation

- (a) Incomplete designation;

- (b) Designation of standard parts not according to the part manufacturer or the standard (too often according to the equipment manufacturer);
- (c) Too little information communicated by the equipment supplier;
- (d) Lack of parts nomenclature on the plans.

3. Coding

- (a) Lack of an adequate system for the coding of parts by the user;
- (b) Inaccurate coding;
- (c) Many parts uncoded.

4. Management

- (a) Unknown management parameters;
- (b) Lack of follow-up of the consumption record;
- (c) Lack of a system for the collection and evaluation of data.

5. Resupply

- (a) Frequent long delays in the filling of orders placed abroad, particularly in certain countries;
- (b) Problems of communication with suppliers;
- (c) Problems of payment (particularly with respect to cash payments for urgent deliveries);
- (d) Problems of customs clearance;
- (e) Problems of storage;
- (f) Problems of after-sales service.

6. Storage

- (a) Inadequate storage facilities;
- (b) Insufficiently spacious warehouses;
- (c) No provision for the cleaning or preservation of components;
- (d) Lack of maintenance facilities.

7. Local manufacture

- (a) Lack of structures and facilities for the local manufacture of components;
- (b) Lack of information (shop blueprints);
- (c) Lack of raw materials (particularly special steels).

24. Problems of organization

Position of the maintenance service within the organizational structure:

- (a) Underestimation of the maintenance function;
- (b) Maintenance regarded as a secondary service;
- (c) Maintenance frequently subordinated to manufacture (maintenance chief lacks authority).