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DO1908

Distr.
LIMITED
ID/WG.62/50
29 October 1970

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Symposium on Maintenance and Repair in Developing Countries

Duisburg, Federal Republic of Germany, 10-17 November 1970

THE ROLE OF DEVELOPING COUNTRIES IN
UP-GRADING THEIR MAINTENANCE AND
REPAIR FACILITIES

by

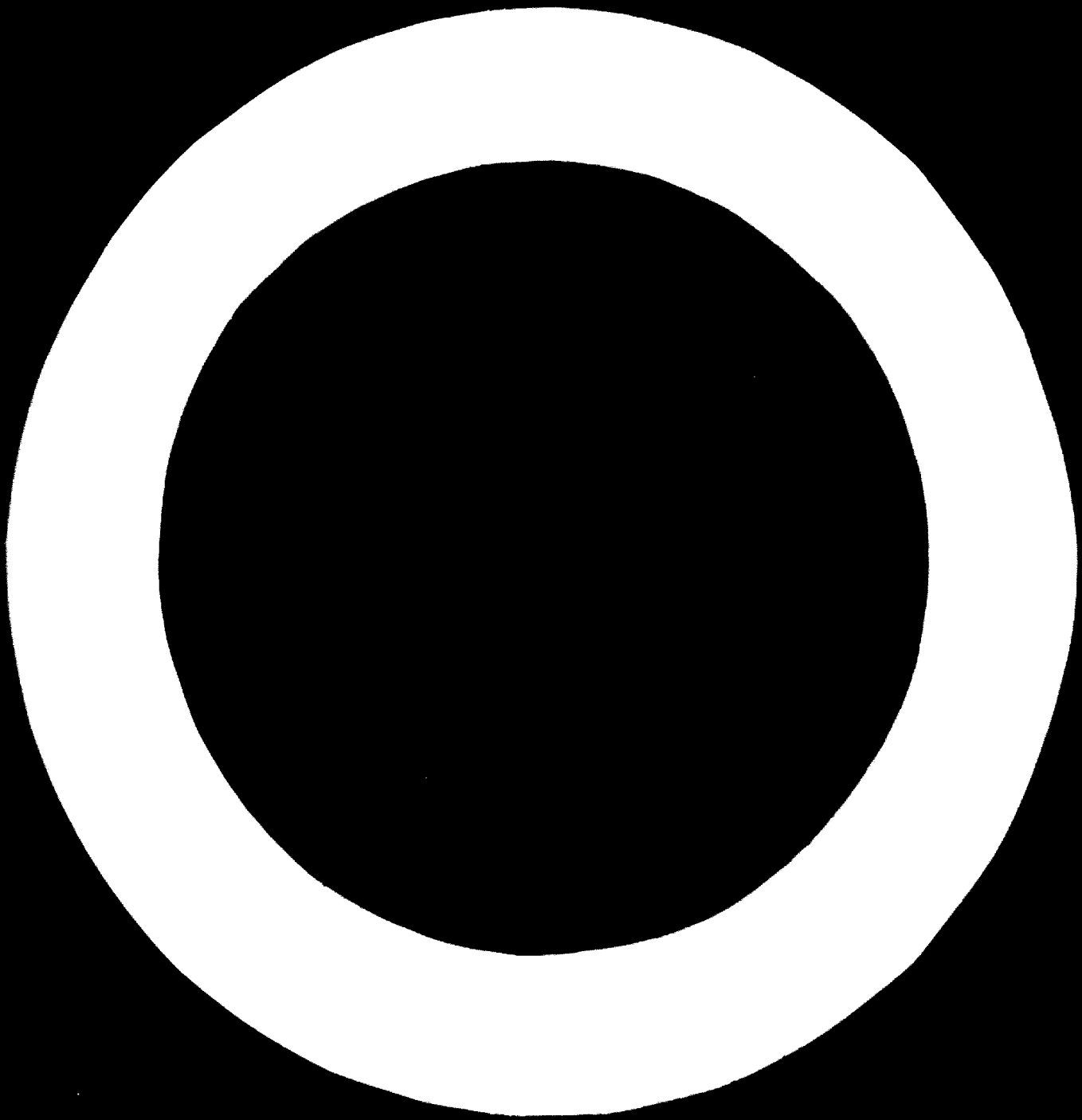
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Organized in co-operation with the German Foundation for
Developing Countries and the Association of German Machinery
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id.70-5996

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Developing countries, without exception, starting from an agricultural and raw material producing base, are now concentrating their efforts in introducing greater diversification in their economies. Before a conscious, deliberate and planned process of economic development was undertaken most of the developing countries were producers and suppliers of agricultural commodities and primary raw materials. Their exports consisted entirely or primarily of such products. With the passage of time greater attention was paid and more resources diverted towards reducing dependence on agriculture as the main means of production and export. Development of infra-structure facilities such as power, means of communication and transportation, ports and harbours, industrial estates and institutional framework for providing loans and finances, training of workers, foremen and engineers and for conducting feasibility, pre-investment and market surveys, etc. was stepped up. In many cases a start was made in developing light and consumer goods industries based mostly on locally produced raw materials, providing a fairly high degree of import substitution. Attention was concentrated simultaneously or at a later stage on the development of export oriented industries based mainly on indigenous raw materials. This process of economic development is typical of a large number of developing countries and is well borne by the history of industrial development of Pakistan. It was only when an industrial base was set up that the need for development of engineering industries was felt with a view to meeting the balancing, replacement and expansion requirements of the industries. The agricultural sector during this period continued to develop and undergo changes in its requirements switching over from traditional methods of production to more modern. The increasing demand for tractors, harvestors, lift pumps, tubewells and other farm equipment, gave an added impetus to the development of the engineering industries. The developing countries, therefore, entered into the next stage of their industrial development when resources were diverted more towards the setting up of metallurgical and engineering industries. Side by side emphasis was also placed on the development of the chemical and petro-chemical lines of industry.

Up till this stage of development the main aim generally has been to set up new industrial capacity. The entire attention of the planners, the Government and the financing agencies was concentrated on additions, in physical terms, to be made to the industrial capacity within the country and in most cases this

job has been done with utmost devotion, self-less dedication and with a missionary spirit. Every possible encouragement and incentive was given to anyone having resources and the will to set up a new plant or factory. Special inauguration ceremonies by the distinguished personalities of the country were held with a view to emphasise the need for such a development.

In this zeal for industrial expansion some essential pre-requisites for the efficient working of the industry have generally been overlooked. Just as it was considered necessary to provide the basic infra-structure such as developed land, cheap power, better means of transportation and communication for the industries to be set up, there was also a definite need for providing organised facilities pre-requisite to the efficient and economic working of the industries already set up.

It is a matter of common observation and experience that industries in the developing countries have been unable generally to run to their maximum capacities, produce at internationally competitive prices and ensure standard quality of their products. This amounts to wastage of internal and external resources, so deficient in the developing countries. The reasons are various and diverse. There are shortages of raw materials particularly those to be imported; the labour is not skilled enough; the quality of management is poor; adequate attention is not given to the need for quality control mainly because of the sheltered and protected markets available to the local products; defective or inadequate market surveys lead to the setting up of excess capacities which ultimately prove a permanent drain on the resources of the country; adequate maintenance and repair facilities are not available and so on and so forth. The failure of the industry, in most cases, is thus due to a number of factors out of which lack of adequate maintenance and repair facilities can be considered to be no less a significant factor. This factor is now coming in the way of the efficient and economic working of the industry in a big way. Breakdowns on account of mechanical defects or other faults lead to suspension of operation in the whole plant or a part of the plant leaving the labour, capital and management to remain unemployed, during such periods of suspense activity. UNIDO has at a very opportune moment drawn attention to the need for improvement in this field and for arousing consciousness in the developing countries to pay greater attention to this aspect of industrial activity now. It is not possible to indicate an

estimate of loss of production caused as a result of stoppages and interruptions in plant operation on account of mechanical defects, breakdowns and maintenance problems but common experience would show that the loss to a developing country is fairly substantial in terms of fall in production and exports, loss of man-hours, wastage of raw materials and fuel, deterioration of machinery and increase in foreign exchange expenditure incurred on account of increased imports of replacements and spare parts.

WHAT IS THE PRESENT STATE OF MAINTENANCE AND REPAIR FACILITIES IN THE DEVELOPING COUNTRIES AND WHAT CAN BE DONE TO IMPROVE THEM?

The industry in the developing countries has, in most cases, still not developed a keen awareness of the need for proper maintenance and repair of plant and machinery. Maintenance and repair activity, by and large, is still taken to mean periodical oiling, greasing and lubrication of machinery, occasional replacement of spare parts and repair of defects in machines whenever actually occurring. The common tendency is to undertake repair when an actual breakdown or stoppage of production has, in fact, taken place. There is no concept of a preventive or planned maintenance aiming at the very prevention of the possibilities of occurrence of breakdowns or mechanical defects. The real task of maintenance and repair involves a planned action starting from the time the plant is installed or even before that and continuing up to the time it is scrapped and removed from the factory site, aiming at optimum and economic production through reduction of shutdowns and interruptions in production and through ensuring uninterrupted, continuous and faultless running of the plant. It is not merely a matter of periodical oiling and greasing or occasional repairs, but a continuous and ceaseless effort to keep the plant and equipment in efficient operating condition and to reduce the shutdown or breakdown period to the minimum.

There is, therefore, need for a change in the mental attitude towards maintenance and repair, on the part of management, engineers, technicians, labourers and all those concerned with production activity. A considerable loss on account of fall in production as a result of stoppages in operation and substantial imports of spares, components and raw materials required for excessive replacements can be avoided through development of a new outlook towards maintenance and repair activity. It is for the reason of this lack of attention paid to the maintenance activity that one finds maintenance workshops attached to the

factories in dilapidated and neglected conditions, some times even without a proper shelter, inadequately financed, equipped and staffed. Nor is any attention given to the adequate provision of maintenance and repair facilities at the construction stage with the result that the maintenance section of the factory from the very beginning is not laid out properly and is deficient both technologically and financially. Some times workshops are fitted with machines which are seldom used, but at the same time they lack in essential testing and calibrating equipment so necessary for every day use. This is the result of bad planning. Second grade workers are put in the maintenance shops and insufficient attention is paid to their training and improvement of skills throughout their tenure. More often those workers who are not considered fit for work in the production sections of the plant are shoved on to the Maintenance Department.

This approach, on its part, pre-conditions certain requirements such as proper care of machinery through timely oiling, lubrication, periodical inspections and correct handling; maintenance of regular data in respect of each vital machine; maintenance of adequate stocks of essential spare parts and components and their timely replacement; analysis of breakdowns and failures with a view to adopt preventive measures in future and so on. This would, in turn, involve better staffing, financing and equipping of the maintenance section of the plant.

The lay out of the factory and the conditions under which it operates are equally relevant from preventive maintenance point of view. The lay out of the buildings and the environmental and working conditions in a factory are generally not up to the required standards, particularly in the case of medium sized and small scale industrial units. If the roofs are leaking or the floors are dirty or uneven, or the machine tools are not properly fixed to the floor, or there is not sufficient lighting and air, the maintenance difficulties of the factory are naturally aggravated. It has, therefore, to be ensured from the very beginning that the lay out and the operating conditions are such that they minimise and do not aggravate the maintenance problems. The factories some times have a tendency to make heavy investments in acquisition of land with an eye on expansion in future and are left with inadequate financial provisions for the buildings and other amenities. This is not a healthy practice and need be discouraged.

When placing orders for the plant, its maintainability aspect is, more often, overlooked. The management can either depend on its own personal past experience of using a machine or it can consult specialised agencies or at least make some investigation into the matter before placing an order for the machinery. This extra effort on the part of management can save considerable maintenance problems at a later stage.

Minor defects in plant and equipment are, some times, not given the same attention as major defects. These need be attended immediately because very often it is the minor defects which ultimately lead to the major defects.

Proper life records and history sheets of the machines are not maintained. Without such a record it is difficult for the management to evaluate the performance of a certain machine. Each machine should have a separate file in the records of the factory giving its make, capacity, design and other specifications followed by the minutest details of repairs and maintenance carried out from day to day and the problems, if any, posed by it. Such maintenance records may reveal that a certain machine gives rise to special or extra maintenance problems and can, therefore, at the time of replacement, be replaced by a better machine or a machine which has given a better record of its performance and maintainability to the management. In the absence of such data, the factory management has to go mostly by the reputation of the machine maker or by advertisements, both of which can be misleading. The technical assistance centres or such like institutions should help the industry in preparing standard forms for maintaining record or standard forms can be published and each industry can adopt them to its own requirements. Engineering universities can also give a lead in this matter.

Breakdowns and failures generally go unanalysed and uninvestigated although it is important that reasons for their occurrences are gone into in depth and a proper record thereof is maintained. The factory managements either do not appreciate the need for such an analysis or if they do, they find themselves lacking in the necessary investigation staff and/or testing equipment. Specialised laboratories and institutions which could undertake this work on behalf of the factory are also non-existent. The result is that failures and breakdowns remain unanalysed and they tend to repeat themselves. No proper preventive or corrective measures can be undertaken unless breakdowns are properly investigated and their

causes unearthed. The temporary, interim and incomplete repairs and stop-gap arrangements can only result in bigger breakdowns taking place later, thus causing a chain reaction which could ultimately reduce the life of the plant and machinery much to the detriment of the industry. Analysis of failure is one of the first steps towards ensuring future prevention of breakdowns. There is need for setting up of special research and testing facilities at the Government and semi-Government level to assist the industry in this respect. UNIDO can also extend necessary assistance - technical and financial - in the setting up of such facilities which may take the form of centres or laboratories.

The factory managements should also make use of the results of their investigations while placing orders for new equipment. This would steadily improve the quality of the future plant/machinery to be installed in the factory either as replacement or by way of expansion. It is also through this method that the maintenance defects in the machinery can be brought to the notice of the machine manufacturer and improvements in the design, which would suit the conditions in a particular country, can be suggested.

Mechanical failures can be of various types. There can be failures arising out of defective design or poor quality of the machine. Failures can take place as a result of mishandling or improper care of the machine. A more common form of failure results from natural wear and tear of the machine or its parts. In all types of failures, it is necessary to analyse the causes and adopt counter-measures to avoid them in future. Many a time, the defects of the design can go undetected for want of necessary investigation into the failures and breakdowns with the result that the repair expenditure is incurred by the factory, whereas it should have been shared or borne entirely by the manufacturer or supplier of the machinery.

It is matter of common observation that the maintenance staff is not given the same treatment in respect of its training as the machine operators and the production engineers. There is also a tendency to employ technically less qualified personnel for maintenance duties. In the small and medium sized units, particularly, there is a discernible weakness for employing craftsmanship in preference to qualified engineers - probably for reasons of economy. These craftsmen learn their trade in the family tradition and through blind practice.

They have hardly any acquaintance with the modern technology and have a closed mind towards innovation. The result is that maintenance and repair done at the craftsman level is not up to the required standard and can give rise to further maintenance and repair problems. There is, therefore, need for employing technically qualified and trained staff on maintenance jobs, who should be capable of undertaking repairs and, at the same time, investigating reasons for the failures and providing guidance to the factory management for future action. It is obvious that the technical requirements of such a staff would be fairly high. The industry should be encouraged to employ technically qualified staff for the maintenance duties. Some sort of legislative cover could also be provided prescribing compulsory employment of the technically qualified staff, at least in a certain percentage. Opportunities should be provided to the maintenance staff for attending refresher and advanced training courses from time to time.

However qualified the maintenance staff may be, its job would be rendered difficult without the active cooperation of the machine operator and the supervisor. The production workers should be given training in proper handling of the machinery and efforts should be made to inculcate maintenance mindedness in them. Wrong and careless handling of the machinery results in premature wear and tear and frequent breakdowns. It is, therefore, important that the machine operators are given sufficient training in proper handling and running of machinery. They should be required to attend to the daily routine maintenance duties of machine as well. It should be one of their duties to ensure daily oiling, greasing and lubrication of the parts and to clean the machine at the end of each working day or working period. The daily routine maintenance work of a machine which is a simple operation and can be performed easily by the machine operator need not be left to the maintenance staff who should be put on more and more specialised and complex maintenance jobs.

Similarly, lack of proper supervision results in unnecessary maintenance and repair problems and there is an equal need for training of the supervisory staff also. The supervisors and foremen should be given necessary training in their jobs and also in the maintenance techniques.

Technical assistance centres set up by the Government should undertake special courses in maintenance and repair and the industry should be encouraged to utilise these courses for training of their production workers and supervisory staff in order to develop a maintenance orientation in them.

A serious M and R handicap from which industry in a developing country suffers is the result of inadequate availability of spare parts and components. The main reason, of course, is the balance of payments position which more often does not permit an adequate import of such parts. Another reason is that developing countries are forced to import machinery and plant from so many different sources all over the world that it becomes a difficult job for any one agency to keep stocks of such a variety of spare parts drawn from all over the world. This difficulty arises because there is no or very little local manufacture of capital equipment and the plant is obtained from wherever it is available. Even within one industry different plants are set up under different credit, loan or barter arrangements and machinery is imported from different countries. This results in a complete lack of standardisation which would necessitate blocking of a substantial amount of capital if various types of spare parts required even by one industry, have to be stocked. This is a limitation to which most of the developing countries are subject and on account of their foreign exchange resource position, they can hardly help it. They are obliged to import plant and equipment from whichever source credit or aid is available. This situation is one of the facts of life in the developing countries and has, therefore, to be accepted as such.

The difficulty can, however, be overcome, to a large extent, through adequate allocations of foreign exchange for this purpose provided there is a proper appreciation of the need for such imports and a higher priority is accorded to them. This would mean that lesser foreign exchange would be available for other imports with a lower priority.

Factories do not plan their stocks of spare parts in accordance with their requirements. A minimum stock of spare parts has to be kept at the factory site in order to ensure prompt replacements. Stoppage of machinery even for a few hours has to be avoided. If the inventories are not properly planned, these could either lead to excessive stocks or insufficient stocks. The requirements should, therefore, be worked out in advance with as much accuracy as possible.

Specialised commercial firms could keep stocks of spare parts and materials at the factory site. These stocks could, in emergency, be diverted to other factories and replenished soon. This arrangement would save blocking of capital so far as factory is concerned and at the same time it would allow utilisation of stocks by more than one factory. This system has yet to take a start in the developing countries and needs be given serious thought.

On account of import of machinery from diverse sources, it has not been possible for many developing countries to undertake, on a large scale, the manufacture of spare parts. Absence of standardisation makes local production of parts difficult and expensive. Another difficulty which comes in the way of local manufacture of parts and components is the high cost of basic raw materials such as billets, alloy steel, copper and rubber which in many cases are imported under loan and credit arrangements and which being more costly than cash imports make the local products quite incompetent vis-a-vis the imports. If the industries are allowed to import raw materials from the cheapest sources, they would be in a much better position to compete. Some sort of relaxation in the import regimes of the developing countries in respect of industries connected with maintenance and repair is called for so that they are in a position to buy their raw materials from the cheapest sources in the world. Within the constraints of foreign exchange resources it should normally be possible for a developing country to allocate sufficient resources for the purpose of meeting maintenance and repair requirements of the set up industries.

Another difficulty arises on account of the vast proliferation of the parts making capacity within the country. Maintenance and repair is essentially an engineering work and it should, as far as possible, be left to the engineering firms to specialise in this field and the individual factories should not, as far as possible, undertake the manufacture of spare parts needed by them. But a large number of factories go for the manufacture of spare parts in their own workshops. This system can never yield an economic production of the spare parts because it is not possible to utilise the installed capacity fully. The worst part of it is that facilities available in one factory are generally not available to the nearby factories which results in multiplication of capacities and hence wastage of resources. Each factory would try to have its own spare parts making

unit, its own foundry for castings and its own production of spare parts, if it can. Instead, the factories should depend on specialised engineering units for servicing their plants. Unless this is done, it may never be possible to promote an efficient maintenance and repair industry in the developing countries. Industries such as textile, leather, sugar and cement etc., should not be encouraged to manufacture their own spare parts or maintenance requirements nor should they be allowed adequate foreign exchange or other facilities by the Government for this purpose. This work should be left mainly to the engineering sector of the industry which should be given all opportunities to specialise in this field. The limited engineering capacity which has been set up in some of the developing countries is already finding it difficult to operate to its maximum capacity and the proliferation of the engineering capacity in this way adds to the problem. The existence of surplus capacity leads to under-employment of machines and equipment. An industrial survey conducted in Pakistan reveals that one textile mill made 90% of its loom spares and 10 - 12% of its spinning spares employing about 300 persons in its workshops. Textile industry alone in Pakistan, according to the survey, employs about 3000 machine operators and 1000 machine tools of various kinds. Same is true of other industries such as sugar. The maintenance workshops attached to industries should not be given any encouragement, whether by way of raw material allocation or otherwise to undertake manufacture of spares and those already producing their spares should be discouraged from doing so and they should limit their machine shop activities only to carrying out of essential 'first aid' maintenance and repair.

It might be necessary in some cases to manufacture spare parts in the maintenance workshops, but these should be kept to the minimum possible. The workshops should not go in for large scale production of standard spares for the purposes of stocks and this task should be left only to the specialised sub-contracting firms. To economise in the maintenance cost the factories should, therefore, be encouraged to get their maintenance/repair jobs done through the sub-contractors. This arrangement would ensure speedy and economic results and is being followed with success in industrially advanced countries of the world. Futility of trying to do everything in their own workshops even at the cost of quality and price should be impressed upon the firms and they should be encouraged to go more and more for sub-contracting.

It has also been observed that, some times, the local industries have a prejudice against the products of the engineering industry within the country. One reason, of course, is the quality factor. This situation should, however, be overcome through improvement of quality and more aggressive salesmanship on the part of local manufacturers of machines and spare parts. Government should also discourage import of such items which are produced within the country. Foreign exchange and credit resources should be made available liberally to these industries for meeting their raw material requirements.

In the interest of improving quality and reducing costs, it is necessary that the engineering works themselves should also specialise further in production of parts and components and should not attempt to produce all types of parts and components under one roof.

It should not, however, be the aim to produce each and every machine and spare parts within the country. This may also amount to wastage of resources. It may always be necessary to import at least some spare parts. The only thing to ensure in this respect would be to allow liberal imports of such parts at cheap rates.

Sufficient attention is not paid to the oiling, greasing and lubrication of the plant from the maintenance point of view and, at times, maker's instructions are not strictly observed. In some cases the maker also fails to provide a clear set of instructions which the staff may be able to understand and follow easily. Technical assistance centres set up by the Governments could assist the local industries in this job by maintaining liaison with international agencies like UNIDO or the foreign manufacturers and conveying the necessary instructions to the local industry.

Another difficulty which the machine operator in the developing countries faces is that no simple and straightforward books written in his language are available. A worker in an industrially advanced country such as UK or USA has a special advantage in his favour on account of availability of a large number of simple instruction books in English. Here again the technical assistance centres of the Government can help in preparing simple manuals which should be

understood by the machine operators. These should be written in the local languages. These instruction books can, for example, teach the operation of a lathe or a machine tool or can provide a lesson in proper oiling and lubrication of machines.

Another handicap is the absence of engineering directories giving details of the local manufacturing capacity of spare parts and machines. Although engineering units are being set up in many of the developing countries covering a wide range of products, other industries within the country are usually not aware of their production or production capacity. There is need for compilation of such directories in each developing country. The Government and the Chambers or Associations of Industries should also organise exhibitions and shows for display of the local products, particularly of the engineering industries. These occasions should be exploited for projecting the need for preventive and organised maintenance.

In the interest of promoting the establishment of light and consumer good industries, various Governments have been following tariff policies which have had the effect of retarding the rapid growth of the engineering and spare part making industries. Low or no duty on import of machinery and parts has resulted in discouraging the establishment of the engineering and part-making industries. Suitable tariff policies should be followed in support of the spare part and component-making industry. It has been noticed, in some cases, that their raw materials have been subjected to a higher rate of duty than the finished products. Such anomalies need to be removed. Government of Pakistan have set up a Fiscal Anomalies Committee to go into such cases where the duties on raw materials are higher than the duties on finished products and to take steps to rectify such anomalies.

The above account of the state of maintenance and repair activity in the developing countries would point out the need for greater effort on the part of industry to plan a better programme of maintenance and repair. This would obviously involve extra expenditure. A question that would become relevant here is how much extra expenditure should be incurred by the factory management on preventive maintenance. It is beyond question that improved maintenance programme would reduce the occurrence of breakdowns and mechanical faults with the result that loss in terms of production, man-hour, raw material, fuel, quality and costs would be minimised. There is, however, need for striking a

balance. If the maintenance standard is set too high, it is quite possible that the high maintenance expenditure may make an inroad into the profits of the concern. It has, therefore, to be one of the important decisions of the management to define the limits of a maintenance programme. It may not, for example, be possible to put all the equipment in the factory on preventive maintenance and it may be necessary for the management to select a few vital machines which have to be given a high priority. All important machines should be categorised for the purposes of preventive maintenance and a programme of inspection and maintenance chalked out in respect of each. Important machines which, for example, do not have a stand-by can receive special attention. The maintenance expenditure can be reduced by concentrating more on some machines and less on others. Similarly inspection standards can be prescribed differently for different machines. Some machines may have to be inspected daily while for others even a three-monthly or six-monthly inspection may be sufficient. Maintenance expenditure can thus be reduced through this method of selectivity. A balanced maintenance and repair programme has, therefore, to be evolved by the management with a view to ensuring maximum efficiency at minimum costs. The expenditure incurred on organised maintenance should, in the long run, pay itself with dividends. As already explained, proper emphasis must be placed on firstly, the recruitment of technically qualified staff for the maintenance work and secondly, on their constant training with a view to up-grade their skills. It should also be ensured that the machinery and equipment for maintenance purposes is of good quality. Essential spare parts for timely replacements should be kept handy in order to allow immediate and expeditious repairs. This would involve anticipating the need for such spare parts. Too big and unnecessary stocking of spare parts would only increase the cost of the maintenance work. The stocks would, therefore, be planned well ahead and kept to the minimum level. Last but not the least, the point of arousing a maintenance consciousness is stressed again as it would have an effect of reducing the maintenance expenditure. The lack of understanding of maintenance engineering is a big reason for breakdowns and failures. It is, therefore, necessary that the significance of the concept of preventive maintenance is impressed upon the entire staff employed in the factory and necessary training in maintenance engineering is also imparted to all in varying degrees.

WHAT ARE THE DEVELOPING COUNTRIES DOING IN ORDER TO IMPROVE THE MAINTENANCE AND REPAIR FACILITIES?

The answer is both a lot and little. A lot because a lot of investment is being made and a little because a little use is being made of this investment. Most of this investment, as explained earlier, is not productive enough although fairly substantial resources - internal and external - have been made available by the respective Governments and the financing agencies for investment in the maintenance and repair facilities. This investment is lacking a positive direction and a constructive aim. This investment is presently in a diffused form spread all over the industries in small, uncoordinated and incomplete pieces leading to excess capacity, wastage of resources and under-employment of capital equipment and manpower. This should be the state of affairs in most of the developing countries which have reached a comparatively advanced stage of industrial development. The need now is to give a positive direction to this line of activity and to organise it on a more specialised and institutionalised basis so that efficient expert services are available at least costs. Sufficient attention has not so far been paid to this aspect and this is evident from the fact that this concept has hardly found a mention in the Plan Documents of the various countries or in the economic literature issued by the Governments. The maintenance and repair activity is being treated more as an ordinary and routine function of the industry and greater emphasis is still being placed on installation of new capacity or expansion of the existing capacity. Substantial foreign exchange resources are allocated for the import of machinery for setting up new capacity but enough attention is not paid to ensuring the full utilisation of the installed capacity through adequate provision of raw materials, spare parts and maintenance facilities. This amounts to wastage of the scarce resources of the developing countries. The Governments and concerned agencies in the developing countries must now concentrate on improving the maintenance and repair facilities, introducing the concept of preventive or planned maintenance and encouraging the establishment of specialised and sub-contracting agencies in this field. It should, however, be understood in clear terms that mere provision of facilities on an organised and specialised basis for prompt and economic maintenance of machines may not take us too far unless there is a true understanding of the concept of planned maintenance in the industry itself. The developing countries are putting the last ounce of their effort and resource in mechanisation and capital intensification of industry,

agriculture, transport, communication and other services. This heavy investment would defeat its very purpose if the machinery and equipment installed are not properly maintained. This heavy investment is being undertaken with a view to increase productivity per man-machine hour and the expected advantage would be lost if there are frequent interruptions and breakdowns in the working of the machinery as a result of unplanned maintenance. This would have the affect of raising the cost of production, reducing productivity, delaying deliveries and even of deteriorating the quality. In order to make maximum use of the installed machinery it is imperative that proper maintenance and repair steps are taken right from the time of its installation. Planned maintenance and repair activity, as a matter of fact, has to start with the installation of the plant and end with its scrapping.

The action that can be taken by the industry and the Governments in the developing countries has been broadly indicated in the preceding paragraphs. There is need not only to arouse an awareness in the industry, but also in the Government circles for improving the present state of maintenance and repair facilities in the developing countries. UNIDO has done a very useful service to the developing countries by focusing attention on this aspect of industrialisation which, by and large, has so far remained overlooked in the development programmes of the developing countries. A concerted effort on the part of the Government, the industry and the international agencies would be necessary to break the ground for introduction of a system of planned maintenance.

TO SUM UP, the present state of maintenance and repair facilities in the developing countries leaves much to be desired and there is need for a concerted drive on the part of the Government, the financing agencies, the industry, the technical assistance centres and other concerned institutions to bring about the desired improvements. The ball has been set rolling by the United Nations Industrial Development Organisation and it is now for the developing countries to carry it forward.

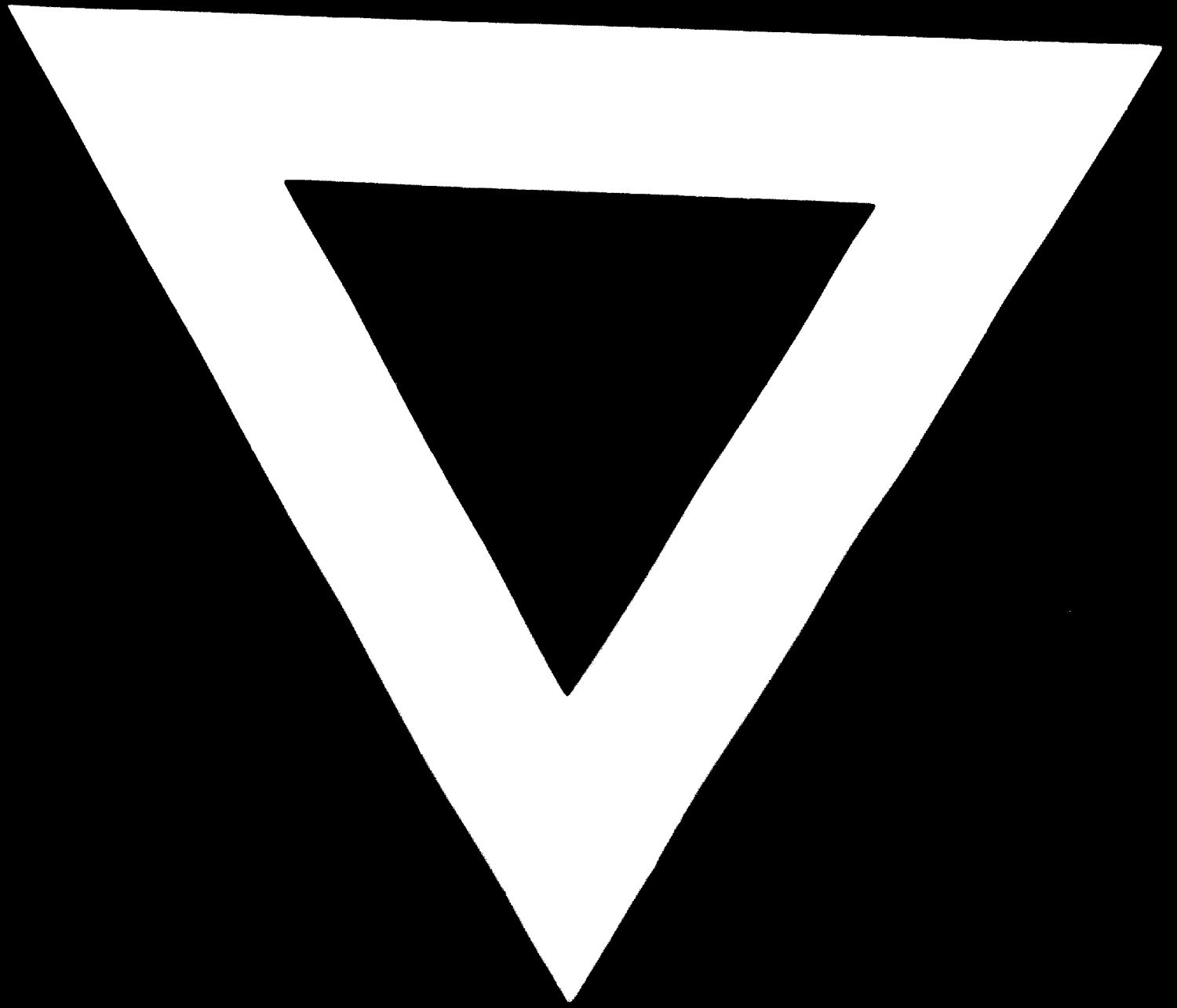
The primary duty for improving maintenance and repair facilities and bringing about a new approach in the concept of maintenance and repair should devolve on the Governments. Governments in the developing countries have at all stages to play a pioneering role in the development of industry. Suitable trade and

fiscal policies can be followed with a view to encourage the establishment of an organised maintenance and repair sector and to discourage the proliferation of the engineering capacity, as is the case at present. Tax holiday concessions, adequate foreign exchange allocations for import of essential raw materials, lower or no duties on the import of such raw materials, adequate protection against competitive imports are some of the steps that can be taken by the Governments to promote this industry. The Governments and the financing agencies could also make it a condition for sanction of industrial units and advance of loans that the new factories should set up adequate maintenance facilities and should observe at least a minimum standard in the factory lay out and operating conditions. Technical assistance centres and testing laboratories can be set up by the Governments with a view to assist the industries in training of their production and maintenance staff, analysis and investigation of the defective equipment and for general guidance in maintenance and repair matters. Seminars, symposia, industrial exhibitions, shows and competitions can be held to promote interest in this field. Liberal imports of spare parts which are not or cannot be produced within the country should be ensured at cheap rates. As far as possible, efforts should be aimed at standardisation of machinery used in the country. Local manufacture of spare parts and machines should be undertaken, whenever possible. The maximum utilisation of the installed industrial capacity should have a high priority with the Government and resources should be diverted to this end on that basis. Research should be undertaken at the Government level with a view to improve the quality of the local manufactures and the industry should also be encouraged to set up suitable research facilities. The technical assistance centres should help in compilation of simple instruction books in local languages for guidance of the machine operators. This educational effort, in the long run, can prove very beneficial. Standard forms for maintaining data in respect of vital machines should be prepared and widely circulated in the industry by the centres. Industrial information should be made available widely through the compilation of industrial directories and other means. Public sector organisations concerned with production activity should be issued directives by the Government to undertake an organised programme of maintenance and repair and to play a pioneering role in this field with a view to demonstrate the usefulness of such a programme to the private industry. Last but not the least, the Governments should play their full part in arousing a maintenance consciousness in the industry.

No less responsibility falls on the industry in the private sector and, as a matter of fact, Government efforts can meet with success only if there is maximum cooperation and participation on the part of industry. The real task of implementing any programme of maintenance and repair has in the last analysis to be undertaken by the industry itself. The industry has to ensure that the factory lay out and operating conditions are conducive to efficient running of machinery with least maintenance difficulties; maintenance workshops attached to the factories are adequately staffed, equipped and financed; technically qualified staff is put on maintenance duties and its preference does not go in favour of craftsmanship; proper training is given both to the maintenance and production staff from time to time; maintenance records and history sheets are kept in respect of all the vital machines; breakdowns and defects are properly analysed, investigated and preventive action for future outlined; adequate stocks of spare parts and components are maintained but not to such an extent that the maintenance cost is raised unnecessarily; machines are given proper oiling, greasing and lubrication and are inspected in accordance with the manufacturer's instructions or the standards prescribed; more and more reliance is placed on the local sub-contracting and specialised maintenance and repair/spare parts making units; the policy of maximum manufacture of spare parts on the factory premises is not followed; and the maintainability aspect is borne in mind while placing orders for new machinery. Industry in the developing countries should, in short, make an all out effort to improve the status of maintenance work both technologically as well as financially. Lastly, it will be the primary duty of the industry to create maintenance consciousness in the management, engineering and supervisory staff, production workers, machine operators and all those connected with production activity directly or indirectly. It is only then that maximum use of plant and equipment can be ensured with minimum wastage. It has to be appreciated that an organised maintenance and repair programme would be the first step towards improving industrial efficiency in the developing countries. The developing countries must concentrate on improving industrial efficiency, otherwise they would be wasting their resources, and may find no place in the world markets on account of consequential high production costs and poor quality of their products. Most of the benefits of industrialisation would be lost if the industry does not operate at full efficiency and the developing countries would be poorer to that much extent. There should be much more emphasis on the part of the industry to make maximum possible use of the installed capacity than to go for expansion which is the general attitude at present in most of the developing countries.

International organisations can also play a substantial part in arousing maintenance consciousness in the industry and in assisting the setting up of an institutional framework for promoting the concept of planned maintenance. A beginning has already been made by UNIDO in giving a high priority to this aspect of industrial activity in their annual programmes and by holding symposia such as the present one. The UNIDO programme, however, need not stop at this and it should go further. Industrial surveys on maintenance and repair can be carried out on a country to country basis and the results of the surveys circulated to other countries for their benefit. Repair and maintenance centres may be set up in various countries as Special Fund projects to provide necessary training in maintenance and repair duties, to hold courses for the managerial, technical and non-technical staff and to conduct research. UNIDO can also assist in the setting up of industrial technical assistance centres and testing laboratories where investigation and research into the causes of failures could be undertaken and the industry given advice and guidance. In view of the importance of this programme, there should be adequate funds at the disposal of UNIDO to enable it to discharge its duties successfully and purposefully.





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