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**UPGRADING OF MAINTENANCE AND
REPAIR PERSONNEL**

by

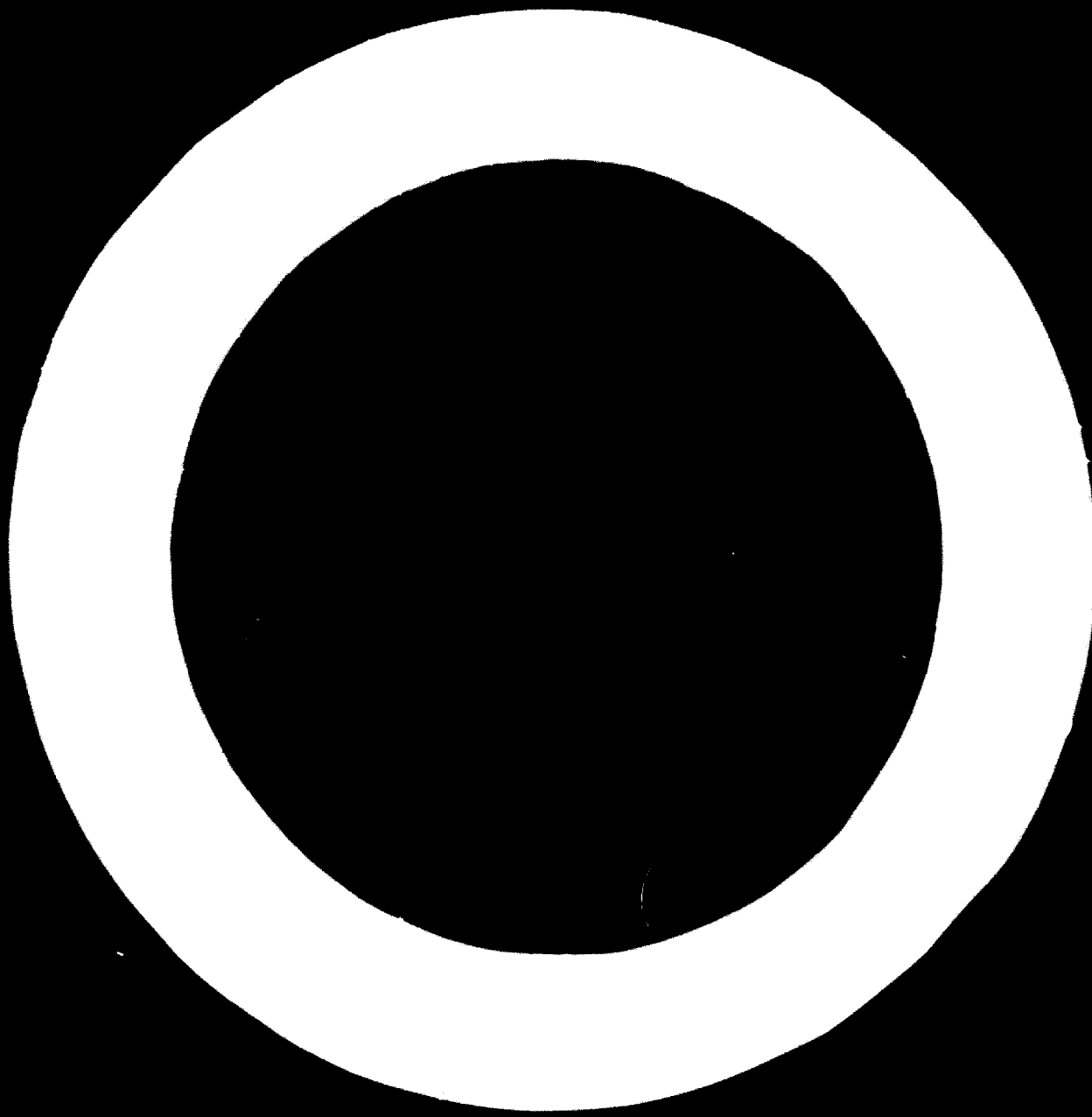
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UNIDO SYMPOSIUM: Item 4C

Upgrading of Maintenance and Repair Personnel

I. BROAD CONCEPTS

1. In its approach to training in maintenance activities and occupations, ILO is guided by conceptual and planning principles which underly all its attitudes to training. These principles are set out in Vocational Training Recommendation No. 117, 1962.

(a) Fundamental Principles

2. Training should be a life-long process starting before the working life and continuing at determined critical times to permit the promotion of the individual to tasks providing not only improved work satisfaction but also better social and living conditions which are, to a large extent, geared to improved income earning capacity. Within this over-all concept, training should be given to all people to enable them to use their abilities to the advantage of themselves and the community.

3. Training will be most effectively implemented when it is done within an over-all plan which takes due account of existing and planned national structures. Thus when sectoral training approaches are used in the initial stages, and this is frequently necessary in developing countries, these should as soon as feasible be integrated into the national plan for vocational training. At the same time the various levels of competence required and the techniques to be applied in the country must take into account not only economic requirements but also the human needs of society.

(b) Approaches to and Methods of Training

4. It is seldom that new ideas or inventions occur only in one country. Usually, these build up in several places simultaneously. So it is with new and improved approaches to training. The cost of training is increasing due to higher salaries of trainers, the more sophisticated equipment needed and the trend in many countries to pay stipends and allowances to trainees. Efforts to develop approaches to combat this increase are being explored.

5. Certain figures published recently seem to indicate that increased investment in general educational systems has not led to comparable increases in economic growth. If this is the case, it is obvious that education and training must be much more closely geared to employment needs and possibilities and to economic improvement. Systems of step-by-step training tied to employable skills may well yield the desired results at a lower cost than present block systems, especially if they are firmly based upon careful job analysis of the occupations in the country. However, in establishing such systems, care must be taken to make sure that training will be available at the correct time in every man and woman's career to avoid the phenomenon commonly called the "Peter Principle". (The promotion of people until they reach their level of incompetency.)

6. It is estimated that over 40,000 occupations have been classified but if we study the various training schemes available on a worldwide basis, it is doubtful whether specific training is available for more than one-quarter of these. This has been

brought about largely by the conservatism of trainers and educationalists and the tendency to establish self-perpetuating institutions and courses into which human material is fed on the basis of past attainment in a limited range of subjects rather than of aptitudes. After processing in these education machines, the product is fed into an end-usage market which is much more highly sophisticated and sensitive to change than is the producing machine.

7. There has been a traditional tendency to regard the job (the 'trade') as an established mould into which the individual must be fitted. Some success might be claimed for this system but it is probable that had work started with the man, even better results might have been achieved. For example, the so-called "drop-outs", (this is really an unacceptable term today) are frequently regarded as failures but in many cases they may represent the forerunners of those who see the "system" as being archaic, inflexible and destructive of human invention.

Employment markets act as efficient selection mechanisms and it is remarkable how many of these "drop-outs" not only find employment but frequently rise to success in their respective spheres. Thus again, training schemes must take full account both of the needs of the employment markets and the desires and potential of the individual. "Tap off" is also an important feature in developing countries in the numbers leaving training institutions before completing long-term training. "Tap off" occurs when the acquired skill already represents a marketable

commodity and attempts to improve the commodity (trainee) by the addition of further skills at the tap off time probably makes little or no additional contribution to the economy.

II. TRAINING FOR MAINTENANCE ACTIVITIES

8. With these basic considerations in mind, training for maintenance activities will be discussed under the following heads:

- (a) first-line maintenance - the operators;
- (b) the maintenance man;
- (c) supervisory functions in maintenance.

(a) The operator

9. It is well known that the driver of a motor car has a great bearing on its life. In fact, tyre, steering, brake and gear wear are directly related to driving habits and can within limits be controlled by driver training and driver supervision. The example of the motor vehicle has been used but most machines requiring manual control fall into this category. Therefore, training in maintenance starts with the basic training of the operator.

10. The depth to which such training should go is subject to considerable variation; obviously where the value of the machine is tentimes the annual salary of the operator, the training should be deeper than when the hand tool used is only valued at one hour of a man's salary. When considering this question, the desired standard of maintenance must take into account the period

of planned obsolescence for the equipment.

11. "Housekeeping" is a critically important factor as a determinant of the quantity of second line maintenance needed. If good housekeeping is practised - and certainly training can bring about better housekeeping - the maintenance needs caused by dirt and by bad materials, stacking, and handling, will be reduced. Good housekeeping, good operation and safety consciousness go hand-in-hand in avoiding the still too common "working to breakdown".

12. If the basic training of operators includes also the elements of first line maintenance, it should be possible to arrive at a situation where a machine will, in fact, have a useful life sufficient for the purpose for which it was designed and manufactured. In other words, the operator will no longer be the first link in the chain of destruction. Such training should include:

correct operational sequences;

regular lubrication with the correct oil;

cleanliness;

maximum loading and speeds;

trouble shooting and the use of charts to diagnose simple problems.

(b) The Maintenance Man

13. To define the exact duties of a maintenance man is difficult. Certain occupations are wholly concerned with maintenance and repair e.g. the motor mechanic and related trades. The basic and further training is all concerned with keeping a vehicle on the road in a safe condition. In other occupations, such as

building workers, their training should permit them to construct a new building or part of it, but many of those trained will use their skills to maintain an existing structure. Many examples could be quoted from other occupations but it seems probable that training for almost all maintenance activities starts with initial training in specific occupational tasks not defined as maintenance. However, it is true that people who received their initial training through an institutionalised system may not be able to relate this specifically to maintenance without further training.

14. This further training may aim at (a) extending their range of skills for maintenance activities; (b) giving greater depth to the existing skills; or (c) relating these skills to a specific maintenance and repair type of activity. Such training might include for example:

for (a) the adding of certain welding skills to a fitter;

the adding of certain fitting skills to a welder;

for (b) the deepening of a machinist's skills to include a

greater understanding of tolerances, and fits and

limits; adding a knowledge of machine design to

eliminate breakdown due to improper machining;

for (c) to train a fitter in the understanding of the

principles of machine construction including the

necessary practice to permit him to dismantle and

assemble; to train electrical wiremen in the wiring

of electric motors.

15. It is established that of all probable causes of breakdown, approximately 80 per cent can be traced to some 20 per cent of possible causes. By using an analytical approach, training can be concentrated upon those factors which create the highest needs for maintenance. Thus, with this acquired knowledge, the training planner can gear training to produce maximum effectiveness with a minimum input and ensure that the correct numbers will be trained to undertake the various activities related to equipment maintenance. For example, in the automotive trade, many more mechanics must be trained to maintain braking systems than are needed for transmission maintenance.

16. The specialised training and upgrading of maintenance personnel is tied very closely to the type of equipment used in an enterprise. While the basic skills needed for maintenance can be taught in a training institution, it is obviously impossible either to provide the range of plant which is used in most industries or to simulate the conditions under which this plant operates on the job. For these reasons, much of the training must be done either in the operator's plant or in the enterprise which manufactures the equipment. The production of a newspaper, for example, requires large complex machines which cannot be duplicated in a training institution. Therefore, the training of the maintenance staff can only be done economically in the individual company or in the manufacturer's plant. As in most countries, the equipment has been in operation for several years and the supplier no longer has a responsibility, the training scheme will have to be established in the user's plant.

(c) Supervisory Functions in Maintenance

17. It should be remembered that maintenance applies to all organisations whether it is that of a one-man entrepreneur, a large industrial organisation, an office, or a farm, and the aggregate losses due to poor maintenance may well be greater in the sum of the small enterprises than in the sum of the large. This is particularly so in industrially developing countries where there is little background in the use of mechanical devices. Training schemes must therefore take into account the small unit. It is not the purpose of this paper to discuss the relative merits of promotion to supervisory rank of people from the workforce and of direct appointment of supervisors but the social implications of blocking promotion of the workforce must be faced. It is probable that the bulk of first line supervisors for maintenance activities come and will continue to come from the workforce; this is particularly true of maintenance supervisors where work experience and an understanding of machine failure are so important. If it is assumed that the supervisor will come from the workforce, will he have the necessary practical skills to make him acceptable to the workforce? If he has, his training should be geared towards man and materials management; if not, he must be given the opportunity to acquire new skills and to improve those he has. Considering specifically the maintenance activities, he must be trained:

- (a) to guide and supervise plant operation in general and to establish preventive maintenance schedules. A few simple case studies are appended to illustrate the fact that the maintenance of equipment is largely a matter of changing

the habits of people. This can most effectively be done through training or retraining operators or modifying equipment to fit in with the normal habits of the people;

(b) to instruct and supervise the operators or mechanics engaged in the first line maintenance of the equipment through cleanliness, correct lubrication, adjustment and control of the machines under his control;

(c) to advise upward in the management chain on the need for more specific maintenance or repair action.

18. In an enterprise, the needs of training and production are often in conflict and it has frequently happened that well prepared and effective training programmes have lapsed due to this conflict if the same man is responsible both for production and for training for maintenance. It is essential if training programmes are to be a useful instrument in improving plant maintenance that a training officer be appointed who would not be directly involved with the production process. Training must however be implemented with the full knowledge and support of production personnel so that stand-down time can be fully utilised for training. Training must not interfere with production but should lead to improved production, better application of good techniques and more effective machine utilisation. This in turn will bring about a decrease in lost machine hours caused by breakdown, or by planned maintenance shut-downs which have proved to be a very costly way of organising maintenance.

CASE I

In one Asian country, for example, it was found that over 50 per cent of the heavy-duty ore-carrying trucks were out of service because of breakage of the third gear. The first conclusion was that these vehicles had defective third gears. An analysis, however, showed quite clearly that the real cause could be found in two factors of operations: first, the ore trucks were consistently being overloaded by from 100 per cent to 150 per cent since the iron ore being mined was of such high quality as to make a full truck an overloaded truck; second, the drivers had not been trained to use the gears correctly and drove almost constantly using only two gears, the first going up, and the third going down. Because the down-hill trip was the loaded trip, the third gear fractured. A brief training programme for the shovel operators, as to loading limits, and for the drivers, as to upshifting and downshifting while driving, solved this hitherto unsolvable "maintenance problem".

CASE II

In a North African country a new batch of lathes was put into operation. The handbooks sent with the lathes were in a language not understood by the operators.

After three months of normal operation, it was found that 4 out of 12 lathes were out of action due to the leadscrew seizing in the head bearing. The operators and maintenance mechanics condemned the lathes as being badly constructed because they had received exactly the same treatment as all other lathes in the workshop.

After the handbooks were translated, it was found that the instructions called for oil to be inserted in the bearing after every four hours of operation. The other lathes in the workshop required lubrication only once each week. The operators and maintenance staff were given new instructions but within a few months, the same problem recurred because they returned to their old established practice.

The solution to the problem was found only after a drip feed lubricator was fitted which held a week's supply of oil so that long established routines could be maintained.

CASE III

In another Asian country a large number of marine diesel engines were supplied to the Inland Water Transport out of war surplus stock. These engines for war reasons were rated at a higher brake horsepower by the installation of special injectors and increasing the revolution per minute. After installation of the engines in ships and running them at a rating as prescribed in the manuals, high fuel consumption was the result. After putting one engine on the dynamometer test bench, the reason for the high fuel consumption was found and the right injectors were installed in conjunction with the proper phasing and calibration of fuel pumps.

In consequence of this, specialists were trained for making the proper modifications on all the engines in operation.

CASE IV

On a larger scale the example of the CHINA-7 UNDP/ILO project - Auto-Technician and Instructor Training Centre - could be cited. Any economy undergoing rapid industrialisation needs a well-developed transportation system, and this system is often a very costly sector of the economy particularly in that it usually involves the use of capital for the importation of vehicles and plant from abroad. In the Republic of China it was found that both on the score of capital costs and of frequent breakdowns, the transportation system posed a problem. Accordingly, international assistance was sought in expanding and improving the Centre for the training of auto-technicians and instructors.

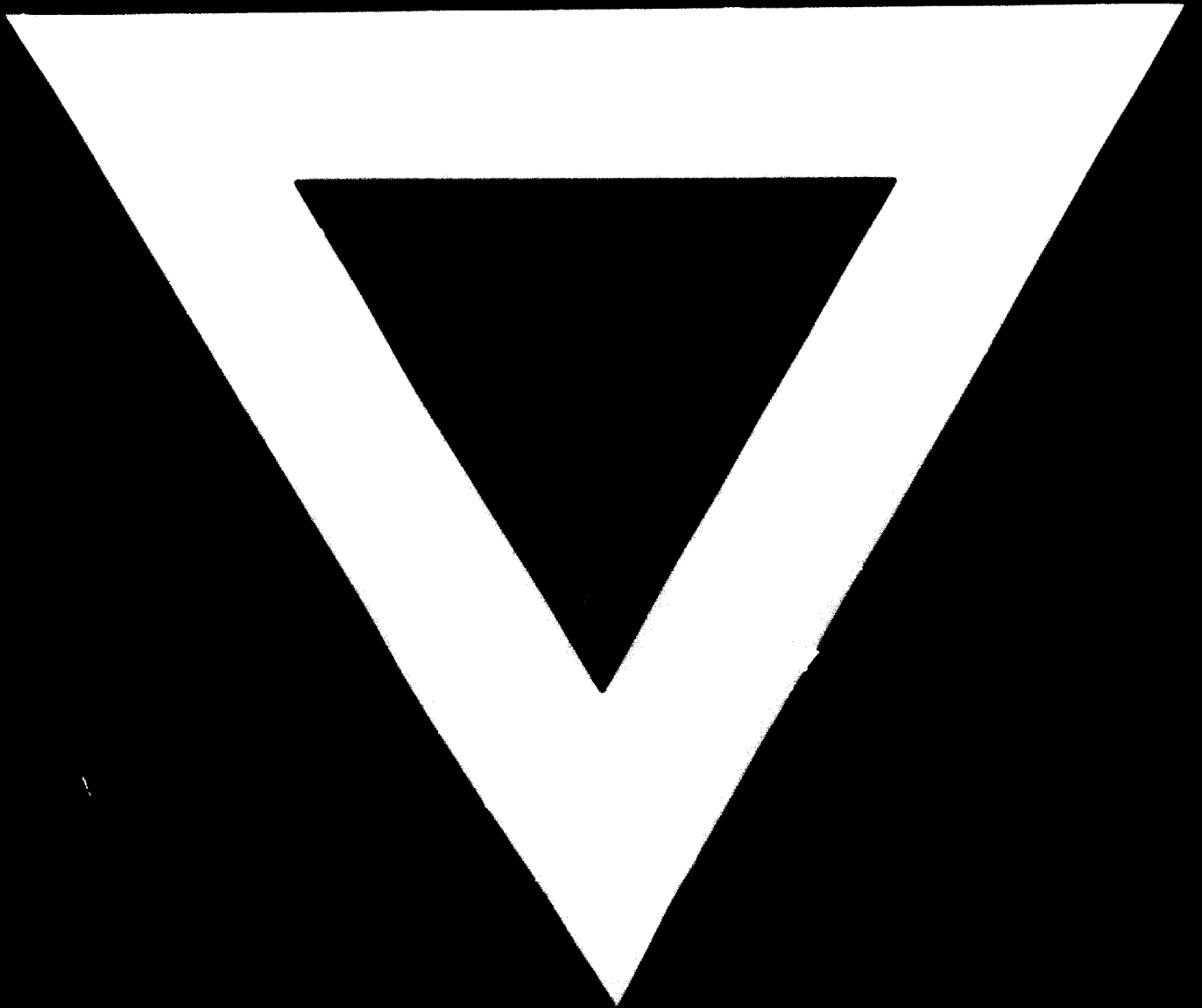
Very early in the life of the project evidence from transport operators and highway construction enterprises both in the public and private sectors established that substantial savings in operating costs were being made as the result of training. This in turn resulted in industry turning more and more to the Centre for help. Progressively, better technicians, better instructors, better supervisors, found their echo in longer life of engines and vehicles, fewer breakdowns, less frequent overhauls, lower fuel consumption, lower repair and maintenance charges, and lower labour costs.

To quote from the published final report on this project:

"It is estimated that since the establishment of the Centre, the service life of vehicles has been lengthened from 250,000 to 650,000 km. and the service life of engines

after overhaul from 30,000 to 120,000 km. The service life of batteries has been prolonged from 4 to 12 months and of tyres from 25,000 to 126,000 km. The gasoline consumption of buses has been improved from 2.6 to 3.4 km per litre and the road breakdown mileage has been increased from 15,000 to around 255,000 km."

It is pertinent to add that apart from the above benefits of training, on the personnel side, a large percentage of trainees received after graduation salary increases and promotions.



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