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ACTIVITIES FOR PERSONNEL TRAINING AND DETERMINATION OF MANPOWER REQUIREMENTS IN CHIBA WORKS[1]

by

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SUMMARY

The importance of placing the right person in the right job in the operation of a steel plant cannot be over emphasized. In order to meet this requirement and thereby to attain satisfactory operation, it is necessary to carry out an extensive training programme for all manpower resources within the organization, in parallel with an effort for improvements in labour productivity, closely based on proper manpower evaluation, carried out at regular intervals.

This paper describes the experience in the development of manpower resources and manpower evaluation practised at Chiba Works, together with a new vocational training system and a labour productivity promotion activity. In his description of Japan's first post-war integrated iron and steelworks, now capable, two decades after its construction in 1951, of producing 6.5 million tonnes of steel ingots a year, the author explains, using data and illustrations, the manpower recruitment and training for various operating units at the start-up of the plant and during the successive deleopment stages, and makes the following recommendations :

1. Success in the operation of a steel plant depends largely on securing manpower resources at an early stage of operations, and the most effective investment is to employ as many young men with advanced schooling and executive potential at this stage, training them on the job.

2. The present age of rapid technological innovation calls for every employee to go through a systematic intra-company training scheme with successive stages. For this purpose it is desirable to have a scheme in which the training stages can be adjusted to the ability of each individual, in combination with simulator training. It is also important that each individual should make efforts to improve his performance level, as this stimulates general work morale at his post. To this end, the "JISHU KANRI" (employees' voluntary group for work performance improvement) activities, which have been extensively developed in the Japanese steel industry, are worthy of consideration. A voluntary group activity of this kind should, however, be encouraged in the manner most suited to each individual employee, having regard to special characteristics of his race, country, and business organization.

3. Adequate evaluation of manpower requirements is necessary because both over-manning and under-manning encourage low labour productivity, and the former in particular leads to difficulties in workforce reduction, including complex personnel transfer. At the start-up stage, great care is needed in assigning personnel to each post on a long-range labour productivity development plan based on the future management picture and technological development potential. For the scientific manpower requirement evaluation plan, it is necessary to bring in an adequate number of specialists in this field, especially in industrial engineering. Their co-ordination with senior management of the plant or company in complying with their recommendations is a great asset to the entire organization.

1. Preface

1.1 Chiba Works today

Chiba Works, one of the two principal steelworks of Kawasaki Steel Corporation, stands on 6.4 million square metres (Nov. 1972) on land reclaimed from Tokyo Bay in the city of Chiba, some 30km southeast of Tokyo. The Works, the nation's first postwar steel plant, has in operation five blast furnaces and BOFs and various rolling facilities to produce mainly flat-rolled products, with an annual raw steel capacity of 6.5 million tons which is planned to be increased to 8.5 million tons in future. An investment made up to the end of 1972 totalling $882 million marks a per ton raw steel construction cost of $136 for the Works. As of November 1972, it has a total work force of 13,528, consisting of 1,768 salaried and supervisory employees and 11,760 hourly-paid employees. Chiba Works also has about 5,200 contractors,mainly for in-plant transport, packaging, semi-finished product conditioning and machinery repair.

Average age of employees is 33 years 4 months (31 years 4 months for salaried employees, 33 years 7 months for hourly-paid employees.) Average length of employment is 11 years 4 months (9 years 6 months for salaried employees (4.5 years for women), 11 years 6 months for hourly-paid employees.) Based on full production capacity, raw steel productivity per man-year amounts to 480t/m-y when nct taking contractors into acount and 350t/m-y when counting them.

1.2 Brief history of Chiba Works

The Company, with its predecessor's steelmaking dating back to 1906, was effectively an open-hearth steelmaker in the Osaka-Kobe District until the early 1950s, mainly engaging in the making of ship plate with a three-high mill and hot- and cold-rolled sheet, as well as hot-dip galvanized sheet with pullover-type rolling mills. In those days when Japan's annual raw steel output was a mere 5 million tons, the Company, with its foresight as to a large increase in steel demand and fast-moving technological innovation, felt there was an urgent need for a modern coastal integrated steelworks which would make possible mass production of low-cost steel on self-sufficient pig-iron supply basis. The construction was started in February 1951, and in June 1953 the long-awaited No. 1 blast furnace was successfully blown-in. An initial plan for the construction of the Works envisaged a raw steel production of 500ktons/year.

In parallel with the subsequent development of Japanese economy, steel demand soared, calling for a marked increase in production at Chiba Works. A number of equipments were added during those years, as shown in Fig. 1, in order to meet such increasing steel requirements.

2. Activities for personnel training

2.1 Recruitment and training of personnel at the start-up stage

The Company, despite its long history in steelmaking and some technical experience in melting and rolling, practically had no experience in the construction and operation of a modern integrated steelworks. The technical level of steelmaking and rolling itself was inferior to the world's general standard at that time.

Aside from a large number of problems involving the construction and operation of a modern steelworks, the securing of manpower resources in quantity and quality for such construction and various operational units posed a great problem.

2.1.1 Appointment of engineers for the Chiba Works Project

For designing an initial blueprint for the Chiba Works Project, seven engineers were selected to report to the President. Three of them were specialists in steelmaking, rolling and designing, respectively, all brought up within the Company (one of them being the President today); the other four were specialists for blast-furnace designing, blast-furnace operation, raw materials pretreatment and coke making, all having worked at overseas steelworks before World War II. With these members as nucleus, the latest condition and the technical trends in Western countries were observed. Then, with the participation of some more experts, from within and outside, an overall construction plan of Chibe Works took shape steadily.

2.1.2 Manpower recruitment for construction at an early stage

Since it was only five years after the war that the construction of Chiba Works was planned, the scars of the war devastation were still remained in many sectors of the country. On a part of the plant site, there was an airplane factory, no longer in operation, with about 300 people making farm appliances for a hand-to-mouth living, using some machines which had escaped destruction. Under the circumstances, negotiation was not difficult for the Company quickly to take over about 400 machine tools and a total of 259 people who were hired by the Company. All these were airplane manufacture technicians, covering such types of work as designing, machining, forging and casting finishing, assembly, fabricating, welding, woodworking, and metalworking; many were technically excellent. Since they lived in the same district, the Company was spared the need to provide them with company houses, and it was convenient for them to keep good public relations with local people.

These ex-airplane manufacturers contributed greatly to the progress of an early stage construction of Chiba Works, and to the maintenance and repairs after the operations started. They each constituted a nucleus for the maintenance system that developed in various departments in later years.

2.1.3 Recruitment and training of Iron-making Dept. personnel

It was not easy for a new integrated steelmaker to find qualified technicians to operate the first blast furnace of the Company. As the group leader was to be key man of the operation, selection was made from among those who had worked in steel mills overseas before the war and repatriated to Japan. Being unable to find skilled operators, the Works was left with only one choice, i.e. to train college graduates into qualified operators in a very limited time. A total of 40 members, including inexperienced workers transferred from other plants of the Company, was divided into two groups, and placed in a 3-week field training at other domestic steel companies to learn blast-furnace operating procedures.

With these arrangements, the ABC of blast furnace operation was learned sufficiently to prepare for the impending blow-in, though this did not fulfil necessary number of manning. As a result of strenuous efforts by Labor Dept., however, various jobs at castyard and charging were filled up at least in number, though with unskilled workers.

This setup, however, was no guarantee for a smooth start-up operation following the blow-in. Therefore, the Company asked other domestic steel companies to extend technical assistance in a shift-operation of 20 experts, mostly in castyard jobs, for the most essential 3-week period following the blow-in. The training of unskilled workers was performed during the 3-week period. After these special instructors left Chiba Works, the necessary operational technique was steadily learned by college graduate technicians and workers with some experience through on-the-job training.

Manning for Iron-making Dept., in January 1954 (6 months after the blow-in) was as follows:

Section	Engineers (incl. supervisory)	Workers	Total
Iron-making	9	72	81
Raw Materials	9	51	60
Sintering	8	55	63
Pelletizing	18	158	176
Total	44 (12%)	336 (88%)	380 (100%)

An abnormally high rate of engineers (salaried employees) as compared with those today is due to their participation in the front-line operation. Actual field experiences made by these salaried employees then played a great contribution to an increased operation rate of Chiba Works in later years. Some of those engineers have today climbed to top management of the Company, such as Assistant General Superintendent and Section Managers at various branch operations of the Company.

Remarks: Present ratio between salaried (incl. supervisory) and hourly-paid employees at Iron-making Dept. is 2.8 : 97.2.

2.1.4 Recruitment and training of coke-making personnel

The operation of coke ovens and facilities for treating coke oven gas and by-products was another field entirely unknown to the Company. How to acquire and train necessary personnel for coke-making had been a great problem since the early stage of planning for the Chiba Works.

In early 1952 about the time of starting construction for the coke ovens, it happened that a certain coal chemical company which had been in operating in Hokkaido, about 1,000km northeast of Tokyo, went bankrupt and was compelled to sell out its plant.

Fortunately, the coke-making equipment of the plant was of almost the same scale as the one planned for Chiba Works, with relatively good performance, well-kept maintenance, and complete drawings. In view also of the relatively low construction cost, the Company bought up and shipped to Chiba all the equipment usable in about 5,000 tons of steel over an eight month period just in time to meet the blow-in of the blast furnace.

Aside from the benefit of considerable savings in construction cost it was fortunate that most of the engineers and workers who had engaged in the operation and maintenance remained out of work. With volunteers called up from among these jobless people, the Company employed 11 engineers and 50 workers to assign them to help with the transfer work of the related equipment. They played a major role in starting up the operation.

As in the case of the Ironmaking Department (see above), the Company sent 20 graduates of colleges and high schools to other steel companies on a 3-week training program, though the training method was far from systematic : only to watch veteran operators at work and learn the ropes.

At the time of starting up the coke ovens, these college graduates and those transferred from Hokkaido gave on-the-job training to unskilled workers newly employed from the local district, while they improved their own technical level through their every-day work and experiences. In this way the operation was somehow started up. Engineers and workers then working became primary figures in the Company during the succeeding period of further capital investment.

Manning for the coke-making department at that time was :

Section	Engineers (incl. supervisory)	Workers	Total
Coal Preparation	7	28	35
Coke	12	68	80
Chemical By-products	11	47	58
Total	30 (17%)	143 (83%)	173 (100%)

Remarks: Present ratio between Engineers (including supervisory) and workers at Coke-making Dept. is 2.6 : 97.4

2.1.5 Recruitment and training of Rolling Dept. personnel

Based on the manufacture experiences with plate dating back to 1918 and with sheet using the pullover type mill to 1924, the Company decided to build modern hot- and cold-strip mills at Chiba Works, with an expected improvement (from 70% to 80% and over) in yield from ingot to cold-rolled products, in thermal consumption per unit product (54% saving), and in labor productivity (from 30man-hour/ton-sheet to 6.5man-hour/ton-sheet; currently 3man-hour/ton-sheet). There was, however, a great risk at the same time in a possible mass-production of rejects. At this critical stage, the Company in 1951 installed at Nishinomiya Works a hot strip mill and a cold-reversing mill, both 650mm wide, for the training of strip mill personnel, and basic technical study and training were conducted by use of these rolling mills. The actual experiences thus obtained turned out to be a great contribution to the construction, operation, and maintenance of larger-type strip mills at Chiba Works.

On top of this, the Company, in order to ensure complete success in strip mill rolling, concluded a technical contract with Republic Steel Corporation, U.S.A., and had an opportunity of training two 8-member teams of engineers and foremen in Warren, Ohio, for 100 days to master the latest techniques for the larger-type strip mill operation and maintenance.

With these members as the primary driving force, the workers were trained, and started up the hot and cold strip mill plants in 1958; it was able to enter into commercial production in a rather short period.

2.2 Recruitment and training of personnel at the developing stage

Chiba Works made smooth progress between 1954 and 1967, as shown in Fig. 1, to a plant having a six million ton annual ingot production capacity, with its labor productivity increased from 50raw-steel-ton/man-year to 430raw-steel-ton/man-year. Supply of manpower requirement during these years at various operational units was met by unskilled workers newly

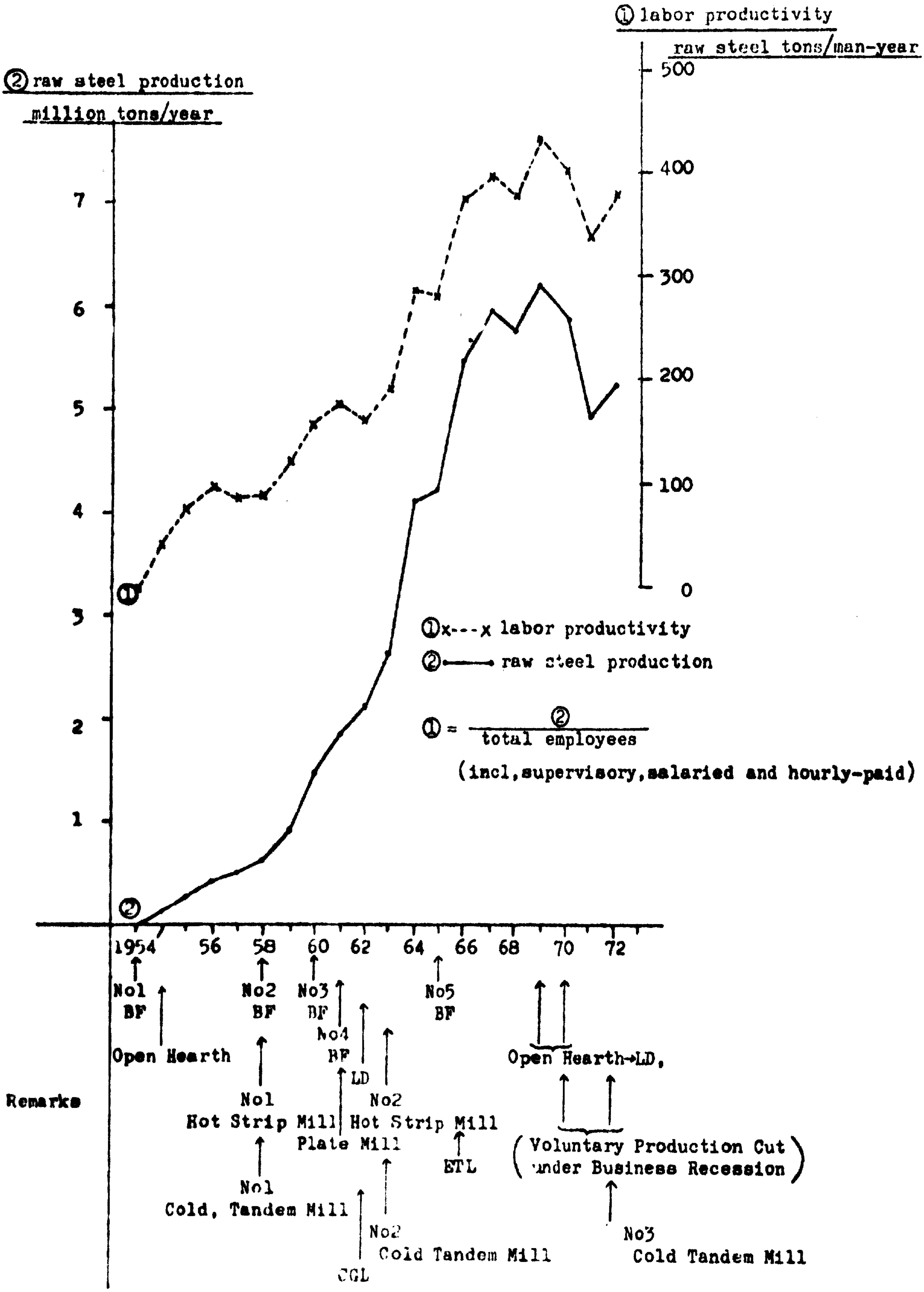


Fig. 1 – Development of raw steel production and labour productivity at Chiba Works.

employed and those transferred from other steel plants of the Company where major equipment were dismantled or shut down (such as the pullover type mill, the open hearth furnaces, etc.) due to technical innovation.

The training at each unit was performed mainly by the on-the-job training system in which newly-employed junior high school graduates were trained at the special training center for three years to give them knowledge equivalent to that of technical high school graduates and one-year experiences at the work post.

In order to keep abreast with the development of technical innovation and to expect further reduction in manufacturing costs, one of the important qualifications is the qualitative improvement of personnel. With this recognition, a movement for the systematization of intracompany training became stronger.

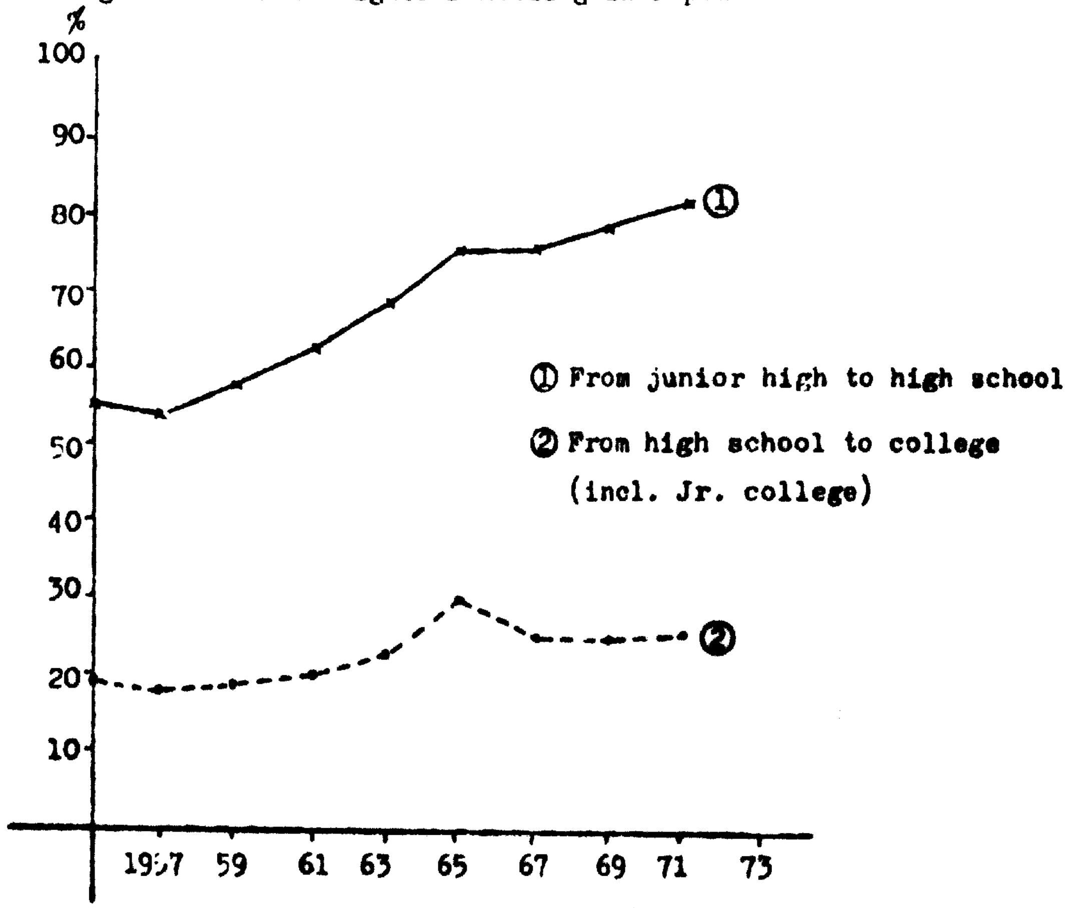
Systematic training of workers at an early stage of operations was a TWI (Training Within Industry) training given to supervisory and foreman level of operating units.

In 1958, group training was started for foremen and crew leaders since the influence of leaders on the improvement of technical level and cost-consciousness at all the work posts was deeply recognized. Such training covered, in the main, subjects concerning education, instructions to crew, and maintenance of good human relations.

2.3 Recruitment and training of personnel in recent years

An improvement of overall national living conditions in the 27 years since the war led to the development of an educational system in Japan. A declining trend in the junior high school graduates available for industry employment is quite evident, as shown in Fig. 2. Also evident is a rising trend for higher schooling of nations in recent years. ((Remarks: Japanese educational system includes 9-year compulsory course covering elementary and junior high school; 3 years for high school; (2 years for junior college;) 4 years or over for college)).

Fig. 2 - Trend of higher schooling in Japan



(Source : Ministry of Education)

Fig. 3 - An Example of Training Course for Leaders

First Stage of the Course

Task	Hours	Contents
1 Orientation	1.0	Opening ceremony and orientation
2 Quality Control	14.0	Fundamental QC method (Statistics, etc)
3 Work Improvement	14.0	Fundamental IE method (Ideation, etc)
4 Suggestion Plan	1.5	How to promote crews suggestion plan
5 Working rules	6.0	Responsibility of leader
6 Wages	3.0	Wage systems (Incentive Wage, etc)
7 Training of Crew	10.0	How to train own crew
8 Human Relations	6.0	How to maintain human relations
9 Safety Control	3.0	How to advise crew of safety work
10 Sanitary Control	2.5	Leaders job for sanitary work-shop
11 Test	2.0	Paper tests on QC and IE
Grand Total	63.0	

In view of the recent trend for higher schooling on the labor market, and the need to carry out a complex operation and maintenance with the minimum possible personnel, it was decided to employ workers only from among high school graduates, and the apprenticeship training system being terminated in 1974. Also, with the importance of training on maintenance techniques newly recognized, the Training Center added another curriculum for maintenance techniques.

This system is an advance over the on-the-job training in which new skills are achieved mostly by imitating the performance of senior colleagues. Starting with basic theory, it enables all the trainees to learn necessary techniques in a relatively short period of time by means of the program method and the practices using proper study equipment and instruments.

The system also expects each operator to learn as many necessary skills as possible for productivity increase, thereby contributing to reduction in force and operational downtime caused by human factors as a production operator can perform routine equipment check-up and minor repair and the maintenance worker can answer to more technical needs.

Training in each production department has been made more scientific and systematic on the learning of production techniques. Fig. 4 shows the training system for hourly-paid employees at Chiba Works. Training for leader-class technicians is now carried out in contents and hours, as shown in Fig. 3 after several modifications. This is performed at the Training Center on full time basis for 8 days in two sessions of four consecutive days for both the preliminary and the advanced training of group leaders.

2.4 Some examples of hourly-paid employees

2.4.1 Training system of crane operators (An example of simulator application)

Chiba Works has in operation 300 cranes which require more than 1000 licensed operators, not including other cranes requiring no license.

Fig. 4 - Training schemes for hourly paid employees at Chiba Works

For	Maintenance Engineering	Production Engineering / Job training	General / Self Development	Fundamental Knowledge
General Foreman			**Self Development Class** Foreman course (I) " " (II) Job Evaluation class	**Fundamental Knowledge (Self-Development Plan)** 1.Simple Drawing 2.Slide Rule (Calculator) 3.English (Reading & Writing) 4.Mathematics
Foreman				
Leader of Crew	**Maintenance Engineering Course** For Job Transfer 1.Gas Welding 2.Electro-Welding 3.Machine Repairing 4.Oil Pressure Control 5.Lubrications 6.Electricity 7. Rigging		Leader's training (I) " " (II) (See Fig. 7)	
Crew	**Maintenance Engineering Course** For Crew (Job experience 3 years over) 1.Drawing 2.Gas Welding 3.Electro-Welding 4.Machinery 5.Piping 6.Machine Repairing 7.Fabricating 8.Rigging 9.Crane Operating 10.Oil pressure control 11.Electricity 12.Electronics 13.Automation 14.Lubrication 15.Instrumentation 16.Combustion	**Job training course** (Eduction by mail) (self development plan) 1.Machinery 2.Electics 3.Production 4.Material 5.Drawing 6.Material Hydraulics 7.Instrumentation 8.Heat Treatment 9.Electrical Instruments 10.Electrical wiring 11.Electrical Drawing 12.Iron & Steel Making 13.Rolling 14.Machinery 15.Welding 16.Electrical Theory 17.Electronics	**Apprentice Instructors Course** (Human relations Job training method)	
Apprentice	**Maintenance Engineering Course** 1.Drawing 2.Gas Welding 3.Electro-Welding 4.Machine Repairing 5.Oil Pressure control 6.Lubrication 7.Electricity 8.Automation 9.Rigging	**Production Engineering Course** 1.Iron & Steel Making 2.Hot & Cold Rolling	**General Course** 1.Group rules 2.Citizenty training 3.Problem Analysis & Improvement training K.J. Technics (Ideation) Group Discussion	

For these cranes, many in type and purpose, no operators can be assigned unless they have specific license. In order to secure the necessary personnel to replace workers who retire each year and to meet any new cranes installed, new personnel must be trained by intra-company training.

It was a conventional practice that at each work post, unskilled new employees were given on-the-job training by the older employees using the easiest types of crane, and for the knowledge required for obtaining license, suitable engineers gave special training, with related laws and regulations taught by specialists. Any employees who failed in the licensing test repeated the training course mentioned above and tried it again.

Because of the 188 hours thus required for the training for licensing test, a study was started to cut down this training time and to design a training system which would lessen variations in technical level of trained personnel.

During 1965 and 1967, a development study was held at the Center of Ability Development Engineering (CADE) Foundation, where a study was started from the analysis of technical skills required of crane operators, followed by a research into the best procedures of the training to obtain sufficient techniques of crane operation. To this end, operation behavior of veteran crane operators was thoroughly analyzed and a theory for training was established. A new training system thus made is compared with the conventional method in Fig. 5.

The features of this new training system are the combination of the program study method and a crane operation simulator; in the former, a trainee can proceed with the curriculum in pace with his own ability of understanding and technical level, and in the latter, he can master operational techniques prior to actual field assignment. It also includes VTR (video tape recorder) system in which he can study sling operations, for instance, by repeated watching, slides, illustrations of crane structure and functions as well as actual parts.

Fig. 5 - Crane operator training scheme

- Old vs New -

Detail of training

Old System

Characterization

separation of classroom from actual field training
1. lecture lessons in classroom by text book
2. job training on the crane

Lessons (lecture)

fundamental lessons by engineer and foreman (each plant) — 3 weeks (126h)
↓
lessons in company — 5 days (30h)
↓
lessons out of company — 3 days (18h)

operators guide book, safty work training book } using

all in classroom lecture, sometimes same curriculum for everybody

Training on the crane

training under an instructor using a spare crane (incl, one temporarily not in action).
actual operation training
20-30 min/day x 30 days (14h)

Evaluation

paper test (after classroom lessons)
actual operation test
(after training on the crane)

Total training hours ; 188 h

New System

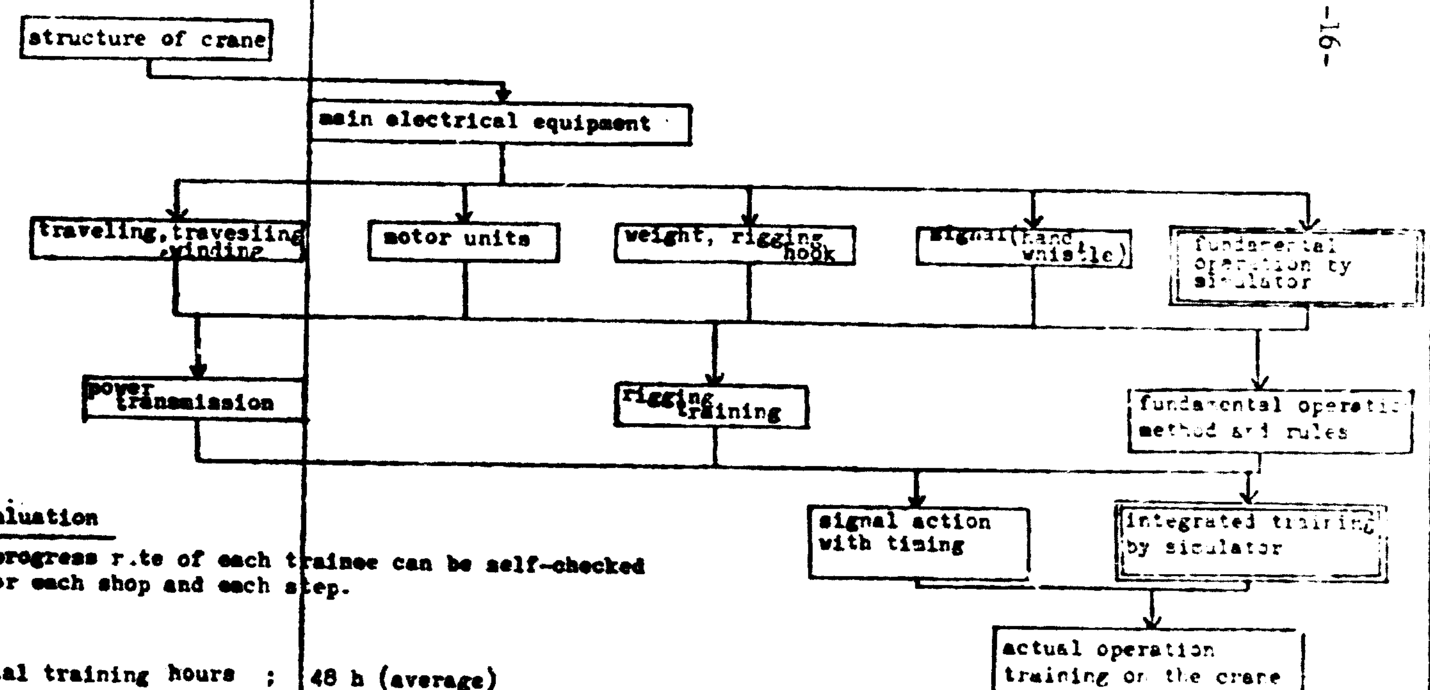
Characterization

special training shops for crane operator

Materials using → shops

machinary units	electrics units	rigging	signal	training simulator	crane operation
program text V T R miniatune of gear parts(model) crane(actual)	program text V T R simulator(1) motor parts(model) parts(actual)	program text V T R auto color slide models of cargos	V T R	auto color slide V T R simulator(1) simulator(2) simulator(3)	program text

Step of training



Evaluation

progress rate of each trainee can be self-checked for each shop and each step.

Total training hours ; 48 h (average)

Effect

Old System — Final technical level :
cycle time 4 min (average)

New System — Final technical level :
cycle time 2 ~ 2.5 min (average)

Closely resembling airplane pilot training system today, this training system is the most efficient educational system. By introducing these training system in 1970 and installing the crane operating simulator at the Training Center, the Chiba Works has since been undertaking complete training.

Because of inadequate time, the full benefits of this training scheme cannot as yet be fully verified, but so far, the period from the start of the training to the time for crane licensing test has been reduced to about 1/4 (188 hours to ave. 48 hours), and in the actual crane operation performance the cycle time under the same condition with the conventional system has been reduced from ave. 4 minutes to ave. 2.5 minutes.

It is also noticed that,under the same conditions, the variation of cycle time of the performance of crane operators, trained in the new training system,has been reduced as compared with the conventional method.

This is good evidence of the fine results of the program study method, in which the progress is adjusted to the ability and the speed of learning of individual trainee, coupled with the crane operating simulator which enables trainees to practise until they have mastered it.

Also, the crane operating simulator consists of the following three devices:

Simulator 1: Training from the basic posture to composite operation of handles

Simulator 2: Training of composite operations including traveling, traversing and winding

Simulator 3: Training of operation without deviation

The crane operation starts from a point where the controller notch can be freely moved without any special consciousness (simulator 1). Next, training is conducted on the movement of traversing buggy and the traveling of crane itself (simulator 2). Then the training of stopping swing by way of simulator, which can bring into practice any large load hung (simulator 3),can be used.

Other than the crane operation, the program study method combined with the simulator training method, as mentioned above, can also be used in varied forms for the training of various fields of maintenance techniques. (e.g. oil pressure, instrumentation, automatic controlling, combustion, etc.)

2.5 JISHU KANRI activities

Other than the routine control of supervisors through ordinary organizational structures, there are in operation "JISHU KANRI" activities at the Company level, with the purpose of improving job performance of employees by the voluntary effort of each employee at his job post. In the "J.K." activities, foremen or their assistants at work post act as leaders, and organize members with their crew. The group is organized on a voluntary basis for solving all kinds of problems at their post by themselves under appropriate help extended from the higher-level personnel. The aims of the J.K. activities are as follow.

1) To give all members of the post opportunities for self-betterment. Group leader makes an active self-improvement in order to promote the J.K. activities. The activities enable front-line supervisors to upgrade leadership and management managerial capabilities and, at the same time, all the members of the post to improve techniques for analyzing and solving problems.

2) The activities help increase work morale at the posts, generate desire for improvement (on quality, work performance, etc.), with the result that work posts are brought under a far more active managerial control.

3) Because problems specific to employees at their work posts are solved in a concrete manner, the activities lead to advantages like productivity increase, cost reduction, quality improvement, etc.

These activities, generally known as "small thinking group activities", at the Company level, are specially called "Work Post Technical Meeting" with intensive activities promoted at each post.

As of December 1972, 97% of hourly-paid employees participate in the activities, with number of groups reaching 1173, average number of one group being 9. As for salaried employees, the rate of participation is 58%.

Each group meets mainly in off-duty hours. The activities consists of meeting sessions and individual studies (including study for self-development). The subjects and topics cover many fields, the current trend of which being shown in Fig. 6.

For a smooth promotion of the activities, the administration office is set up, and a working party conference held between general foremen at each work post and the administration office exchanges information on activities of each department. All members are given a number of equal opportunities for expressing results of their studies. Conferences at departmental level are held twice to four times a year, some good applications screened out are further sent up to the Chiba Works Small Thinking Group Convention held twice a year.

Some better applications among them are further sent up to the Company-level Small Thinking Group Convention held also twice a year at various steel plants in turn , with the attendance of the President.

As these J.K. activities are widely held in Japan's industrial circles, contacts and exchanges with similar groups of neighboring steel companies and or steel-using companies are actively carried out.

These contacts and exchanges provide field workers with valuable opportunities where problems beyond the limit of their usual concern are brought home to them, such as ones involving both manufacturers and users, and this contributes greatly to product quality improvement.

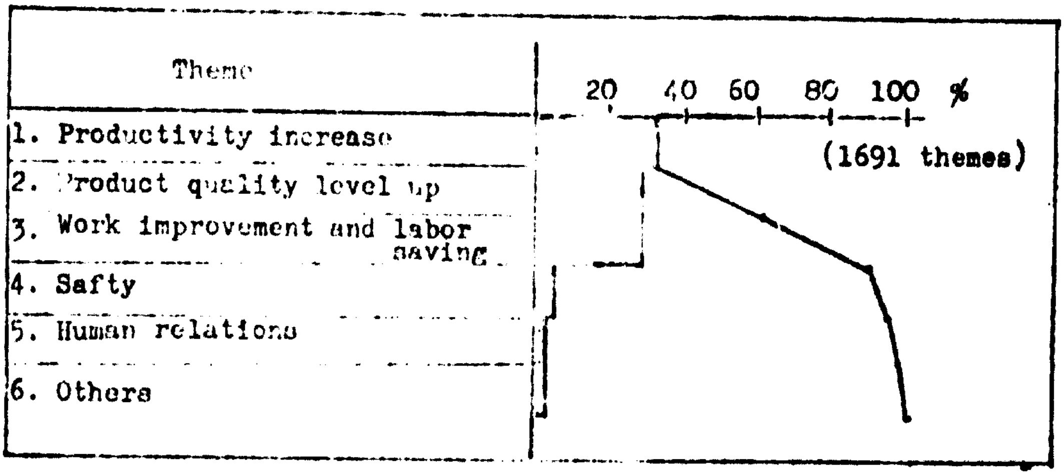


Fig. 6 - J.K. Activities in Chiba Works

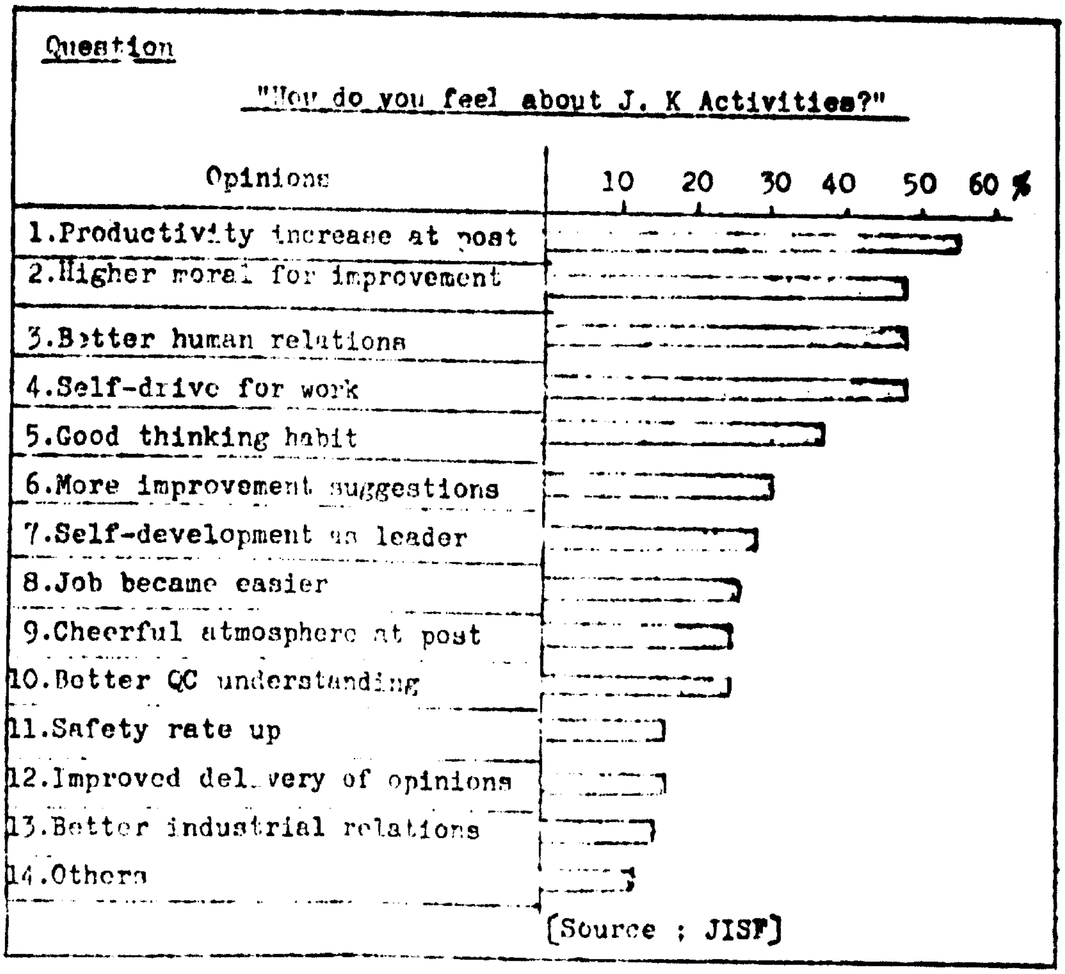


Fig. 7 - Leaders' opinions on J.K. activities in the Japanese iron and steel industry

The Japanese steel industry supports the J.K. activities of each company to such an extent that the JISF (Japan Iron and Steel Federation) hold a semi-annual convention at appropriate places in Japan. The JISF also sends some selected foremen from constituent companies to Europe and the United States for a month tour of study. From Kawasaki Steel, two foremen take part in it each time, this opportunity being a considerable incentive of the J.K. activities.

The effect of the J.K. activities include these tangible effect obtained from improvement activities and those intangibles on human relations improvement at the work post. The former was mostly the cases of manufacturing cost reduction through improvement of operation rate, material saving, yield improvement, work efficiency increase, quality level stabilization, etc. This particular aspect is also highly valued by the Management and top executives. Fig. 7 shows views expressed by 2000 member group leaders belonging to various companies in JISF to certain questionnaires.

3. Manpower requirement evaluation

3.1 Philosophy and procedures for manpower requirement evaluation

In performing all kinds of jobs at the plant, it is of managerial importance to evaluate and place the adequate level of manpower required. This, however, faces many difficulties. Over-manning resulting from an indulgent evaluation leads to not only a rise in labor cost, but also all kinds of problems involving work morale of the posts. In terms of long-range viewpoint, this has as great an effect as in the case of a reduction in production resulting from under-manning.

Furthermore, there are many factors strong enough to influence manpower requirement at various departments in the plant as the years go by. They are operational technique innovations, improvement in equipment and advance in control system, etc. Therefore, adequate evaluation of manpower requirement and the effort for adhering to it are the activities to be performed regularly, aiming at an improvement in labor productivity.

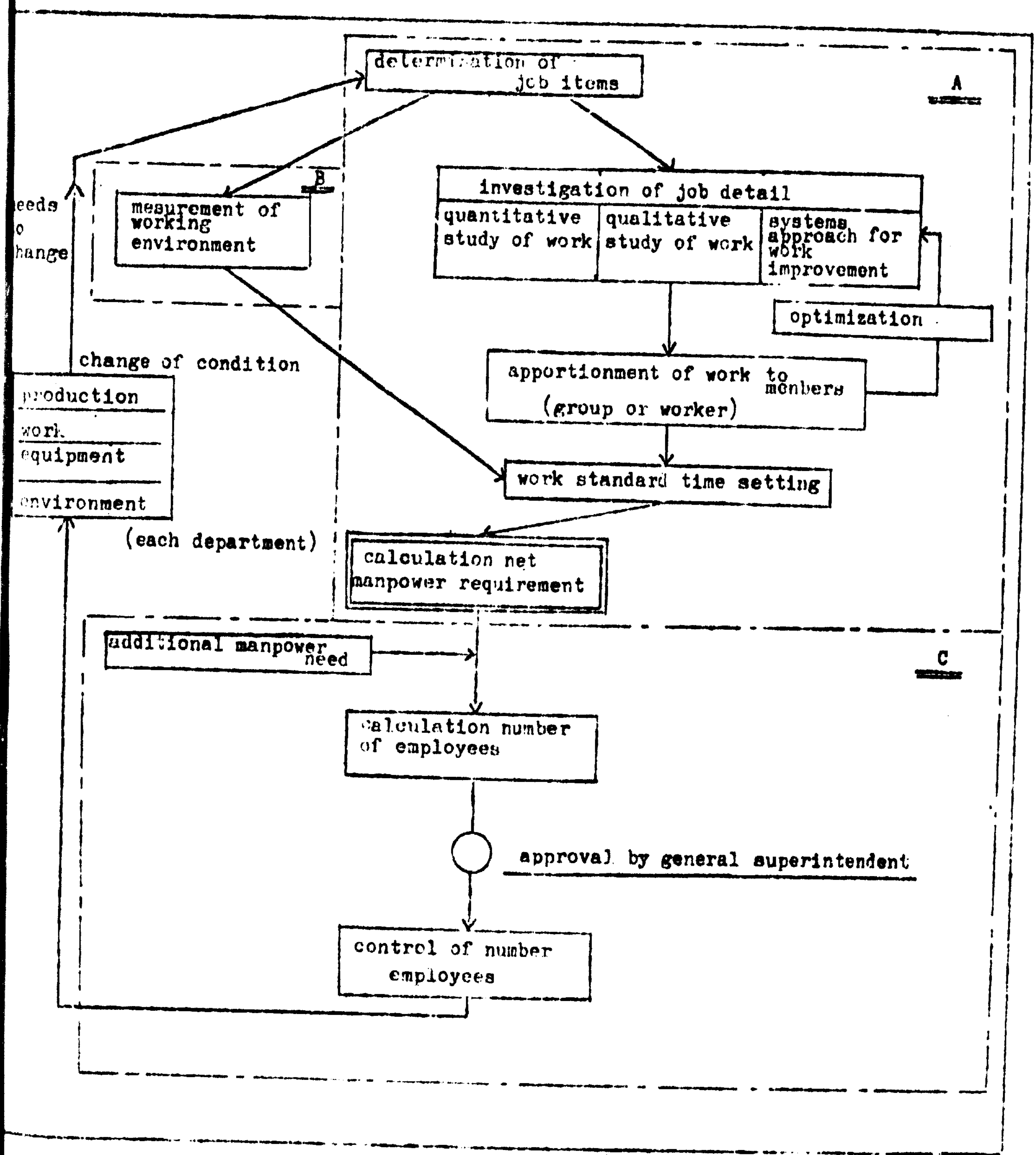
In this chapter, various activities for the evaluation of hourly-paid workers at steel plants will be discussed.

Generally, manpower requirement is determined by the amount of jobs to be done and frequency of such jobs. Hence, in evaluating adequate number of work posts, it is necessary to analyze "all the jobs to be done by manpower " at a post. To this end, scientific job analysis and study are required and this calls for an application of many procedures in the IE (Industrial Engineering) approach.

Since manpower requirement calculated on the basis of manpower evaluation is an adequate reflection of the amount of jobs, it is called "Net manpower requirement". When the manpower replacement requirement during mealtimes in the case of a continuing type of work or during leave of other workers are added up (these replacement personnel are called additional personnel), a total number of employees is determined. Fig. 8 illustrates a general procedure for manpower evaluation.

At China Works, A-zone up to the calculation of NET personnel is handled by IE Dept. B-zone, or Work environment measurement, is handled by the Environmental Control Dept. and C-zone or management of employees is done by Labor Dept. In case the change in conditions (production tonnage or quality, work method, equipment, environment, etc.) may affect number of manpower requirement, evaluation is performed again. Necessary standards for these manpower evaluations (standards for setting up standard work hours, job evaluation standards, work environment measurement standards, etc.) are established and ready for use. Calculation methods for speedy evaluation of manpower requirement and work simulation model by computers are developed.

Fig. 8 - System for determination and control of manpower requirements



3.2 Manpower requirement evaluation method

3.2.1 Method for evaluating adequate number of manpower for a new equipment and/or new production process

Where a new equipment and/or a new production process are entirely unknown to us, as in most of the cases in the history of Chiba Works and as is considered most likely to happen also in the future owing rapid technical innovation, the evaluation of an adequate number of personnel will be dealt with here in this Chapter.

Roughly speaking, there are two methods; the first method is the method by which a thorough degree of job analysis of all the possible jobs requireing manpower are analyzed and a total work amount is calculated, based on which individual job assignment and the number of personnel required for each particular field are calculated. To be more specific, the work load is determined by process analysis (products process analysis, worker process analysis, ledger analysis), combined with time study results per unit work.

In case of large variation in work load or when it is necessary to consider the timing between equipment and the performance of workers, the work performance simulation, a well known OR (Operations Research) method, is applied so as to calculate the effect of changes in work conditions upon the worload of workers.

Other examples of OR application are the evaluation of manpower requirement for spare parts control, emergency repair, operation of cranes at wharfs and warehouses, and number of diesel locomotives.

There are also some examples of optimum placement of construction workers by virtue of PERT.

While these methods are taken in general, it is usual that detailed information (condition on which adequate number of manpower requirement can be calculated under the above-mentioned No. 1 method) for the evaluation of adequate number of manpower is insufficient at an early stage of using new equipment and/or new production process. In these cases, we resort to the comparison method as the second method. This method is a method in which a detailed survey is made of personnel placement conditions in a number of other companies which use similar equipment and/or production processes. With such a company that uses the least number of personnel comparatively, taken as reference, a tentative value for manpower requirement is calculated, and this will be modified to the most adequate number after the operation with due consideration of actual operation conditions and incorporating the method study and the time study approach.

In most of the cases, method No. 1 can be applied as far as the evaluation of equipment operations is concerned, whereas method No. 2 is used for maintenance, repair and inspection.

3.2.2 Method for evaluating adequate number of manpower for reduction at an operating plant.

At a plant already in operation, it is still necessary to carry out various improvements so as to operate with minimum manpower. In this case, the evaluation of adequate number of manpower requirement is important in finding any problems needing improvement. The method popularly used in this case is IE method. Specifically, problems on proposed force reduction are brought out through the analysis of job of each worker using work process analysis, time study, work sampling, etc. and the analysis of combination work between personnel and machine.

Based on these data, automatization of equipment, improvement on work assignment method, control system etc. are performed. As a result, force reduction will become possible.

In case any proposed theme involves uncertainty, another method is taken whereby an active test is conducted first and various problems that may come out are solved to find a method for force reduction.

In the resolution of problems of this kind, the OR method is widely applied, as well as the traditional IE method mentioned above.

In the fields of simulation, LP and PERT, we have developed a number of analysis programs using computers, for a speedy examination of changes to various assumptions. We have specialist engineers in IE engineering for the study of these problems, but at each department, these problems are taken up as theme of the J.K. activities, with vigorous activities developed for the purpose of labor productivity improvement.

In April 1970, the 3-crew 3-shift system which had been normal was changed to the 4-crew 3-shift operation system. Before this, an activity for organizing a one new crew without much reduction in labor productivity was carried out at each department, and as a result of labor saving investment, work process improvement, control system improvement, examination of job assignment to sub-contractors, the aim was finally achieved.

Excess personnel generated as a result of personnel requirement reexamination activities were switched over as replacements for retired personnel at each department, and as additional personnel for expanding production capacity, operating personnel for new equipment at other department after retraining at the Training Center were used.

3.3 Present status of Chiba Works on manpower streamlining activities for effective management

One of the most important tasks in the management of a steel plant is how to control cost increasing factors by operation rationalization efforts. The factors that increase operation costs include rise in raw materials and fuel costs and labor costs, as well as environmental improvement (pollution control) costs, which have become ore serious in recent years.

Labor cost per hourly-paid worker for the last five years have been rising at a rate of 13% a year, with an estimate that it will show an unavoidable climb in future, even if the rate may be somewhat less.

In Chiba Works, the following measures are taken to overcome such cost rising factors:

1. Increase in production capacity and efficiency through equipment investment including replacement for old equipment.
2. Increase in production of higher added-value products with increased production capacity
3. Simplification and concentration of management information
4. Large reduction in equipment repair costs
5. Reduction in all the circulation costs of raw materials, finished products and semi-finished products.
6. Promotion of manpower reduction in all related fields.

These measures are incorporated into the Company's 5-year counter-cost rising project which started in 1971. In the case of manpower reduction activities, the following approach is being made from three sides: 1. Maintenance, 2. Information system, 3. Automation.

These activities are being pushed forward by each department where manpower reduction themes are found by the department concerned. For the themes covering multiple number of departments, a special project team is organized.

Labor productivity of Chiba Works at the time of the completion of these measures is expected to be 750 raw steel-ton/year-man for hourly-paid employees only (at present 480 t/y-man on the full production capacity).

3.3.1 Manpower reduction through maintenance efficiency promotion activity

This activity is being carried out by a special project team as a part of equipment repair cost reduction project. Equipment repair cost is divided into material cost and labor cost in roughly equal portions, using many methods called tero-technology, as shown in Fig-9.

Remarks:
[R] ; Reducing
[U] ; Increasing or Upgrading
[I] ; Improvement

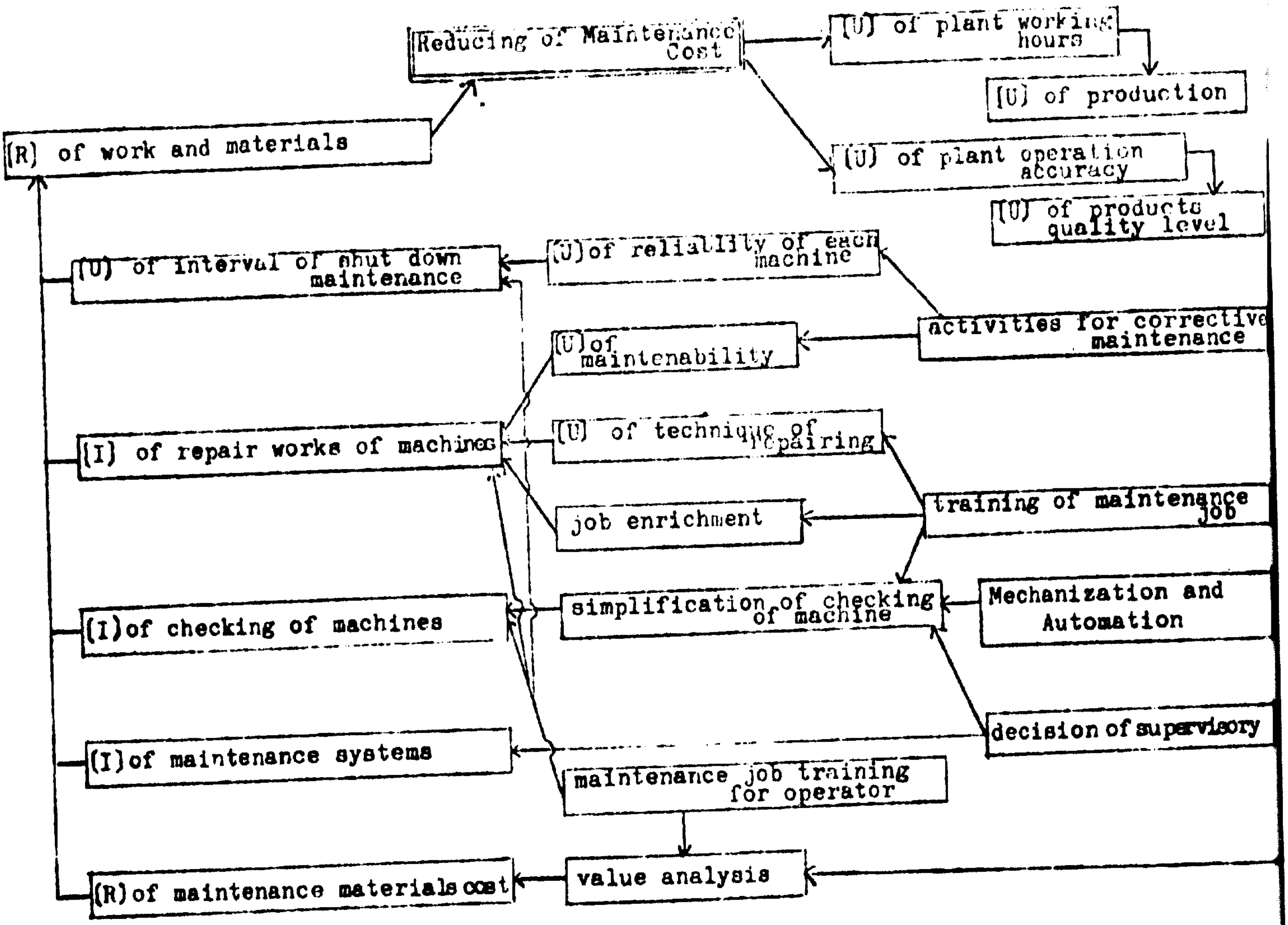
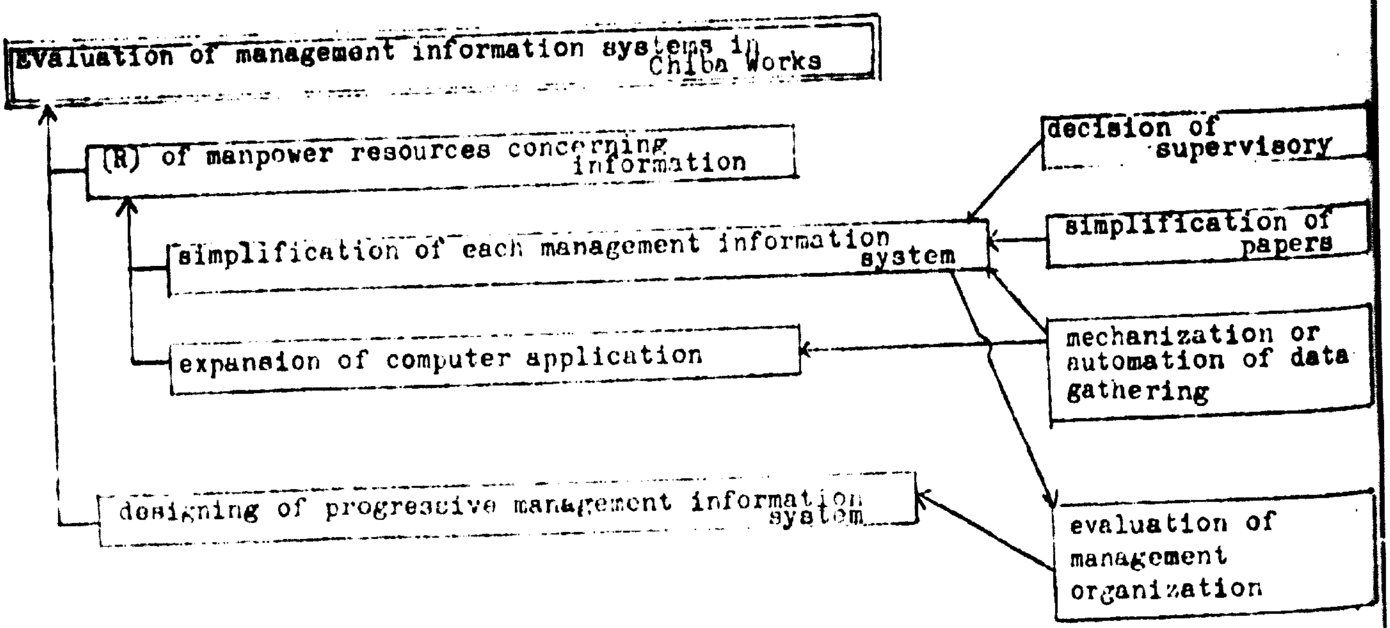


Fig. 9 - Activities for plant maintenance evaluation



- Activities for plant management information systems

3.3.2 Manpower reduction through efficient information system

For the management of a steel plant an enormous amount of information is produced and delivered at each department and level of jobs.

At Chiba Works, a special project team is organized and an efficency improvement activity is in progress, based on the philosophy that where there is information, there is a man; therefore, reduction in information leads to reduction in personnel. The basic appreach is shown in Fig. 10.

3.3.3 Manpower reduction through automation and mechanization

Activities for upgrading maintenance efficiency and information system resulted in a number of substantial manpower reduction in the supervisory and non-productive departments. For a wide range of manpower reduction, it is necessary to reduce number of productive employees such as operators of equipment like rolling mill, shearing line, crane, etc. Considerable effort which has long been made in this direction has not yet proved quite sufficient.

Therefore, a comprehensive examination of operators' jobs was made with an aim of an extensive force reduction. Since this activity aims at an unmanned plant on final basis, we call this M-Zero Project in general. A concrete method for promoting this activity begins with a setting up of a theme, followed by the organizing of a department team consisting of engineers for designing, maintenance, IE, and field engineers as soon as a concrete scheme is made for automatization and mechanization. Sometimes outside specialists manufacturers can be asked for help. Major themes to date achieved are as follows:

1. Saving in operators through remote control (cranes and diesel locomotives)
2. Saving in riggers by use of cranes, electric tongs and the burden center markers.

3. Saving in locomotive switch man by use of automatic rail switching equipment.
4. Development of automatic coil banding machines.
5. Centralization of machine operation through concentration of operating desks and the remote controlling.
6. Use of centralized watch-over system (power generating plant, power distribution plant, oxygen generating plant, water pump house)
7. Mechanization of slab surface conditioning
8. Automatic control by use of process computers
9. Automatization by use of remote controlling of oil cellar operation watch-over.
10. Use of continuous operation for products packaging work.

At present, a study is under way on materials handling methods which use as few cranes as possible to see how many crane operators will eventually be reduced at the overall plant level.

4. Summary

The reason for a large tonnage production of stabilized quality products at Chiba Works is to a large extent the ample stock of outstanding talent supported by its 20 year history, in addition to its excellent production facilities and equipment. The writer will be happy if this paper will be of some use to the growth and development of overseas iron and steel industries, and would like to made the following summary of his foregoing discussions:

1. Success in the operation of a steel plant depends largely on the securing of manpower resources at an early stage of the operation; the most effective investment is to employ as many young high-school educated potential executives as possible at this stage and train them through on-the-job assignment.

2. This age of rapid technological innovations calls for every employee to go through a systematic intra-company training program performed consecutively. To this end, it is desirable that a program where the steps of training is adjustable to the ability of each individual be carried out in combination with simulator training. Also important is an effort by each individual to improve his performance level as it will stimulate general work morale of his post. In view of this, the "JISHU KANRI (employees' voluntary group for work performance improvement) activities" that have been developed to a very considerable extent within the Japanese steel industry may be worth attention. Such a voluntary group activity should, however, be promoted in a manner most suitable to each individual employee based on the special characteristics of his race, country and business organization.

3. Adequate evaluation of manpower requirement is necessary because either over- or under-manning encourages low labour productivity, and the former especially leads to difficulties in reduction in force, including a cumbersome personnel transfer. At the start-up stage, the utmost care is required in assigning personnel to each post along a long-range labor productivity development plan based on future management picture and technological development possibilities. For the scientific manpower requirement evaluation plan, it is necessary to prepare an adequate number of specialists in this particular field, especially in Industrial Engineering techniques. Their coordination with top management of the plant or the company in supplying their recommendations whenever requested will undoubtedly be a great asset to the entire organization.

The writer would also like to express his hearty thanks to the Secretariat of UNIDO for the opportunity extended him to give this paper.

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