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REGIONAL EXPERT GROUP MEETING ON HUMAN RESOURCES DEVELOPMENT
FOR INDUSTRIAL MAINTENANCE IN AFRICA

CASE STUDY FOR STEEL INDUSTRY IN EGYPT

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ABSTRACT

INTRODUCTION

The steel industry started in Egypt in 1947 by melting scrap, and simple rolling mills equipment for the production of reinforced concrete bars.

In 1954, the Egyptian Iron & Steel Co. was founded as the first integrated steel plant in Egypt, with the capacity of 300,000 tons of molten steel per year. The plant started its production in 1958 in its location at Helwan, 50 km south of Cairo.

The expansion of the plant capacity by 1.2 million tons/y of molten steel was completed in 1974 by adding all necessary utilities and facilities. The production line starts from iron ore extracted from Bahareya mines 320 km southwest of Cairo which are transported by railway through the Western Desert to the plant. The ore is sintered, then taken as pig iron from the blast furnace and transferred to steel by L.D. converters, then made by continuous casting and rolling to flats and sections.

Measures Taken for Human Resources Development

In view of the expansions of the Company as previously mentioned, the manpower has been increased to fulfill the continuous increase in production to reach the designed capacity, i.e. to increase the number of labourers from about 4,000 to 6 times this number and to be trained to face the modern technologies of the steel industry, as well as to fulfill the great demand for labourers for the 1st five-year industrial plan which started in 1958.

This problem was studied at a national level by the cooperation between the Ministries of Education and Industry.

A good number of industrial schools was established, besides a vocational training centre organization, which has many training centres all over the country.

The training centre near Egyptian Iron & Steel Co. covers all the Company's needs of skilled workers in all fields of iron and steel industry. In addition to this, a higher metallurgical institute was founded near the plant to upgrade engineers for higher studies and to get Master of Science degrees. The main thesis of research provided by the student at the termination of his 2-year studies, should cover one of the major problems of the Company and the suitable solutions thereof. Also, the student should consult and get the Company's approval on this thesis to carry forward his studies.

Maintenance Problems Faced by the Company

In developing countries, the economic development has started the idustrialization programmes associated with the necessary transfer of advanced technology developed in the industrial countries, while the developed countries have to cope with the continuous progress in technology and advanced science.

In both cases, more machines with complicated designs and electronic control systems are added each year to the equipment stock. As a natural result, the ratio of maintenance to production costs is continuously increasing. Also the ratio of maintenance personnel to production personnel is increasing.

The above mentioned was exactly faced by the Egyptian Iron & Steel Co. because before the expansions, the prevailing system in maintenance operations and manufacture of spare parts was on the basis of central activities. With higher capacities introducing more complicated equipment and controls.

The organizational skeleton of the Company has been modified several times to cope with the stages of expansion of production.

The decentralized system is applied and the plant is divided into separate production units; each one having its own income and output so that they can question the result and performance in each case.

A technical assistance programme with the help of UNDP/UNIDO was implemented under project Nos. DP/EGY/73/028 and DP/EGY/006 to develop and establish a computerised maintenance management system to help in the fields of:

1. Preventive maintenance programme
2. Spare parts scheduling
3. Inventory control
4. Information system

All production areas of plant were covered. This was achieved after extensive training for the staff allocated to the system inside and outside the Company and also some of them were trained abroad.

By such small staff, they started to train others in sister plants for implementation of the same project in other industries such as spinning and weaving, chemical, and engineering industries. Such selected companies will start up by themselves to train staff to spread the system also to other plants.

The Company will start very soon the last phase of the project to implement the system in some African countries.

UNIDO is now taking measures to assign a contract to the Company as a model of cooperation between developing countries in Africa.

The Egyptian Iron & Steel Co. realized through its experience that the best method of human resources development is training through definite systems for work.

INTRODUCTION

Steel industry started in Egypt in 1947 by melting scrap and simple rolling mills equipment for production of reinforced concrete bars run by the private sector.

In 1954, the Egyptian Iron & Steel Co. was established with a capital amounting to 19 million Egyptian pounds.

The main contract was made with the German firm Demag, for the supply, erection of metallurgical equipment and handing over of the project with the capacity of 300,000 tons of liquid steel per annum. At that time, the ore was obtained from that discovered in Aswan. The Plant was erected in Helwan, 50 km south of Cairo, by introducing units of blast furnaces, Thomas converters, electric furnaces, as well as blooming, plate, heavy and light section mills.

The operation started in 1958. In 1969, a hot strip mill with 300,000 tons capacity and a cold strip mill with 200,000 tons capacity were introduced.

In 1964, a protocol was signed with the Soviet Union to add a production of 1.2 million tons of liquid steel to the existing plant, so as to raise the total production to 1.5 million tons of liquid steel by exploiting the Bahareya Iron Ore Mines which lie 320 km south-west of Cairo in the Western Desert. The iron ore is to be transported to the Helwan plant by means of railway wagons.

Later, new facilities were introduced including sintering plants, blast furnaces, continuous casting for slabs & billets together with all other auxiliary facilities, as well as fully equipped workshops (foundry, wood, and pattern shops, metallurgical repair shops, steel structure manufacturing shops, machine workshops, surface treatment shop, electric motor repair shop, etc.), such that the manufacture of spare parts needed for the plant will be easy, power stations, water, air and oxygen stations.

Consequently, the capital was raised from 19 million Egyptian pounds to 500 million Egyptian pounds.

To ensure the continuity of the electric power supply, the iron and steel plants are fed by 4 different electric feeding lines; one from the High Dam, the second from Southern Cairo power generating station, the third from the South Tebbin gaseous station, and the fourth from the power generating station near to the plant and operating with blast furnace gases and/or mazout.

Production and Manpower

In view of the Company's expansions as mentioned previously, the manpower has been increased to fulfill the continuous increase in production to reach the designed capacities. This increasing of manpower was not an easy task to accomplish.

The following table illustrates the rise in manpower in relation to the increase in production.

Year	No. of workers	Basic salaries '000 pounds	Production for sale in tons
1960	4 590	719	57 450
1969	9 830	2 469	168 960
1974	21 372	8 853	332 656
1979	23 252	19 415	453 310
1982	25 520	15 235	760 092
1985	23 955	19 012	673 631

Measures taken to train technical manpower

The establishment of the Egyptian Iron & Steel Co. was the actual foundation of the industry in Egypt, and the starting point for its development.

Thus, it has been necessary for the Egyptian Iron & Steel Co. to train technical manpower to cover the lack of such skilled staff in this field, in order to avoid any problem or delay in the developing programs.

The Government Plan to Modify Technical and Industrial Education

A good number of industrial schools under the Ministry of Education has been established to encourage young people to follow this career, and to cover all fields of industry nation-wide. The Ministry of Education has originated a new educational level in the form of specialized institutes to train technicians after the termination of secondary grammar & industrial school education. This education level was created with the aim of training skilled foremen.

These above mentioned institutes are located all over Egypt and the graduates of these institutes have been given the chance to attend the universities to complete their education.

In the beginning, these institutes faced with some problems, such as lack of students, which was due to the rush of students attending the universities.Therefore, the Ministry of Education set limits for the attendance to universities to direct more young people to join these institutes. As a result, a more even distribution of students on all educational levels was reached, and good number of graduates have participated in the industrial and agricultural movements and other major developing projects of the country.

The Role of Ministry of industry

The Ministry of Industry together with the Ministry of Education has played an important role in the training of technical manpower in Egypt. A vocational training centre was founded, and training centres were opened all over the country. A student can join such a training centre after finishing his preparatory education, and the duration of studies is three years. Recently, the Ministry of Industry charged the big companies to supervise the training centres lying in the vicinity of their plants. Also, some training programs were modified to include practical training inside the production units side by side with the theoretical lectures.

These programs are increased to cover the maximum possible amount of technology in the third year.

For the time being, the training centre located adjacent to our Company, covers completely our requirements of skilled workers in all fields of iron and steel production, covering blast furnaces, steel converters, casters, rolling mills, heating furnaces, heat treatment, various professions related to spare parts production (foundry, hammering, filing, patterns, etc.).

The Egyptian Iron & Steel Co.signed lately a number of protocols with metallurgical companies for iron and steel industries in Egypt to provide them with graduates of this training centre.

Since the iron and steel industry constantly requires modifications in the production and maintenance technology, the Ministry of Industry has established a higher institute called "El Tebbin Institute for Higher Metallurgical Studies", adjacent to the Egyptian Iron & Steel Co. plant.

Those who join this new institute should be university graduates, with a working experience of not less than 2 years in the metallurgical industries. They concentrate on higher studies in all fields of production, maintenance and economics. The Universities' Higher Council has accorded that this institute grants a degree to its graduates, which is equivalent to the Master of Science degree.

The main paper of research to be presented by the student at the termination of his 2-year studies, should cover one of the major problems of his company proposing suitable solutions thereof. The student must consult his company and obtain their approval on this research paper to complete his studies.

The role of Egyptian Iron & Steel Co. in Training

When approaching this subject, it must be clarified that when when the iron and steel industry started in the 1950's in Helwan, it was an agricultural community, which created special circumstances for the training of staff. The presence of an integrated iron and steel industry at that time is to be considered as a penetration to this agricultural community and a sharp change in the environment as a whole to an industrial one.

The Company has concentrated on preparing training courses to the existing workers in specialized centres attached to the Ministry of Industry aiming at raising the Company's productivity, and has now also started to provide special training courses both inside and outside the Company.

The Company succeeded to obtain special training equipment from two large German firms, one dealing in hydraulics and the other in instrumentation equipment. This special training equipment is used to train and upgrade technicians and engineers, not only from the Company's plant itself, but also from other companies by reduced fees.

In 1981, our Company got the approval of the Ministry of Education and Ministry of Industry to introduce a new vocational training programme for five years study courses as hydraulics, pneumatics, instrumentation, controls, etc. The number of candidates applying to the Company for this course this year shows that the training programme is going well.

MAINTENANCE MANAGEMENT

Maintenance is becoming one of the most important industrial activities both in developing and developed countries.

In developing countries, the economic development has started the industrialization programmes associated with the necessary transfer of advanced technology developed in industrial countries while the developed countries have to cope with the continuous progress in technology and advance in science.

In both cases, more machines with complicated designs and electronic control systems are added each to the equipment stock. As a natural result, the ratio of maintenance to production costs is continuously increasing.

Most of the industrialization and machinery are not the final aim by themselves, but only a means to achieve certain objectives for the good advancement as well as prosperity of the country.

However, if the machines are not kept properly and handled in a good way to yield designed capacities, the final result can be catastrophical.

It is even more important to a developing than to a developed country to look well after the capital equipmen and to get the maximum output of every dollar invested.

In spite of the above, the management attitude towards maintenance even until very recent years has not been quite up to the required level.

Maintenance has been considered as an activity which does not deserve any special attention and it seemed good enough to assign a few technicians and skilled workers to put the machine back to operation if it failed or was broken.

It is not very long ago, when a technician who did not prove his qualities in the production line was transferred to the maintenance group.

The most important consideration for management was to keep the machines running irrespective of maintenance costs and complications. With the introduction of quality control, the management realised that it is not enough to keep the machines running, but they must be able to produce within close specifications to avoid high rates of rejections. Moreover, it was realised that repair work must be done quickly and accurately to avoid long down-time together with high cost.

The earlier attitude changed and the urgency and accuracy of maintenance work accepted, thus resulting in the concept of advanced planning for repair work which was introduced by the second or third line of management.

In the beginning, it was difficult to implement production plans and schdules to meet the market requirements because no-one knew when some machine would break or stop. Emergency repairs represented 80-90% of the maintenance work. The sudden stoppage could result in the stoppage of a complete production

line or even the whole factory, and in addition, could cause damage to the product under processing.

Progressively, the concept of management changed from the attitude of coping with failures after they happened, to the control of stoppage and break down.

The basic principles of preventive maintenance were introduced ensuring the planning for equipment stoppages a little before they were liable to break. The main objective was to have the stoppages as planned. In this case, the management is controlling the machine instead of the machines controlling the management, and thus also the production plans can be controlled.

Maintenance and profitability

Industrial enterprises aim to make a profit. They use equipment and labour to covert raw materials into finished goods of higher value.

In the simplest terms the profit is the difference between the income from the sale of the product and the manufacturing and sales costs of the product. Costs can be classified as fixed (e.g. costs of equipment and building), or variable (e.g. costs of raw materials). Profitability is influenced by many factors, such as customer demand, product price, equipment output, equipment capital cost and life, equipment running cost, etc.

Maintenance is related to profitability through equipment output and equipment running cost. Maintenance work increases the level of equipment performance and availability, but at the same time, it adds to the running costs.

The objective of an industrial maintenance department should be the achievement of the optimum balance between these effects, i.e. that balance which maximises the departments contribution to profitability.

Over the last decade the dependence of profitability on maintenance effort has greatly increased. This is because the industrial plants have become larger, down-time costs higher, and maintenance work more sophisticated and costly.

MANPOWER AND MAINTENANCE PROBLEMS IN EGYPTIAN IRON & STEEL COMPANY

The Egyptian Iron & Steel Co. encountered the first problems in this field in 1958, since the start of the first step for the hand-over of the different equipment as to realize the guaranteed figures of the project which should conform with their production capacities.

There were many misunderstandings. Those who had supplied the units, attributed the deficiency in reaching the capacity to the lack of individual efficiency in both production and maintenance. The Company answered that all recommendations required were fulfilled. Workers were sent for training in Germany in both production and maintenance. Local programmes to teach the staff the fundamentals of this industry and how to deal with complicated technological instruments were made. This was in addition to the presence of foreign experts at all the production and auxiliary units.

However, the Company succeeded actually in adding some equipment to enable reaching the designed production capacities.

Before the expansions of the plant, the prevailing system in maintenance operations and manufacture of spare parts has been on the basis of the central activities. It is obvious that this is acceptable in the margin of 300,000 tons annual capacity for the following reasons:

1. The presence of sufficient manpower and training programmes to raise efficiency.

2. Small area of the plant.

3. Manual control in planning production and maintenance programmes is possible.

4. Limited volume of maintenance work required.

5. Possibility of receiving help from small local outside workshops in the manufacture of spare parts, because of the small amounts required.

Since the expansion stage in the production started, the Company moved from smaller capacities to higher capacities.

This was accompanied by some difficulties which took a long time to be solved on long intervals and various efforts with the remarks which appear when applying any of these methods suited. These difficulties, problems or hindrances are given herebelow:

1. Addition of new technological equipment for the first time.

2. Application of complicated control instruments.

3. Application of advanced modified systems in the steel industry which has not been known before.

4. Expansion of the geographical area of the plant

5. Increased channels for internal transport for ores or finished products

6. Increase in energy used from 40 MW to 125 MW.

Naturally, these changes were accompanied by other developments in the manpower, which were:

1. A basic change in the organization skeleton of the Company.

2. A change in the management philosophy.

3. Finding out a suitable system for contacts and communications between different levels.

4. Full studies for the systems of production, maintenance, purchasing, pay-roll, etc.

5. Volume of manpower and how to prepare it to face the developments referred to previously.

6. Transportation of workers to their working places

7. Medical care for workers.

8. The problem of housing for workers who ought to be within reach to answer emergency calls in production or maintenance operations as the plant is situated 50 km south of Cairo.

9. Problems resulting from introducing a large industrial estate in the prevailing agricultural community

The management was expecting all these problems mentioned above. However, after the expansion and the occurence of the actual problems, it was not easy to solve them exactly as planned before. This is due to the presence of various substitutes that could be dealt with, since there is no unique solution as the factors influencing each subtitute cannot be fixed.

STAGES OF EXECUTION THAT ACCOMPANIED THE DEVELOPMENT OF THE COMPANY

The organizational skeleton has been modified with the changes that accompanied the increase in production during the various stages of expansion in the 1970's and under the following stages.

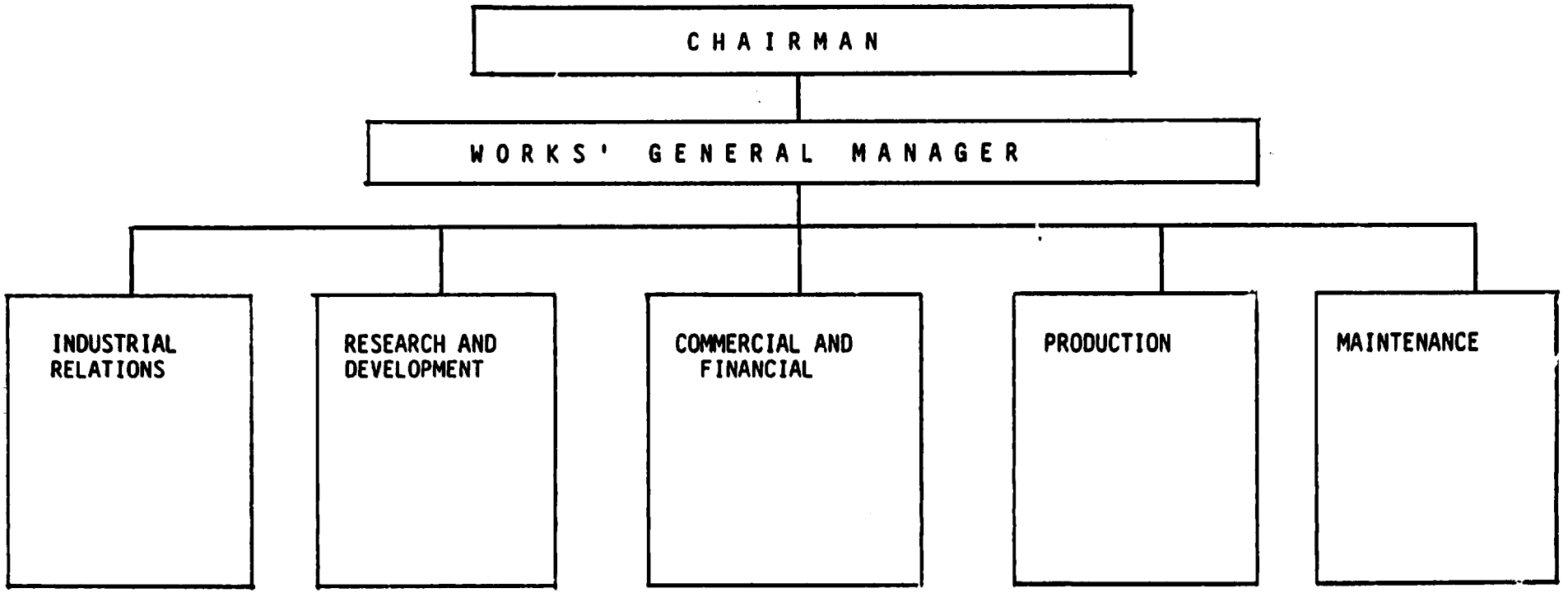
FIG. 1, shows the organizational skeleton at the start-up of the plant in 1958.

FIG. 2, shows the organizational skeleton after start of operation of the hot trip mill late in 1969.

FIG. 3, shows the organizational skeleton after introducing the third blast furnace and the two steel converters in the production line early in 1974.

FIG. 4, shows the organizational skeleton at the final stage of expansion.(final scheme)

FIG. 1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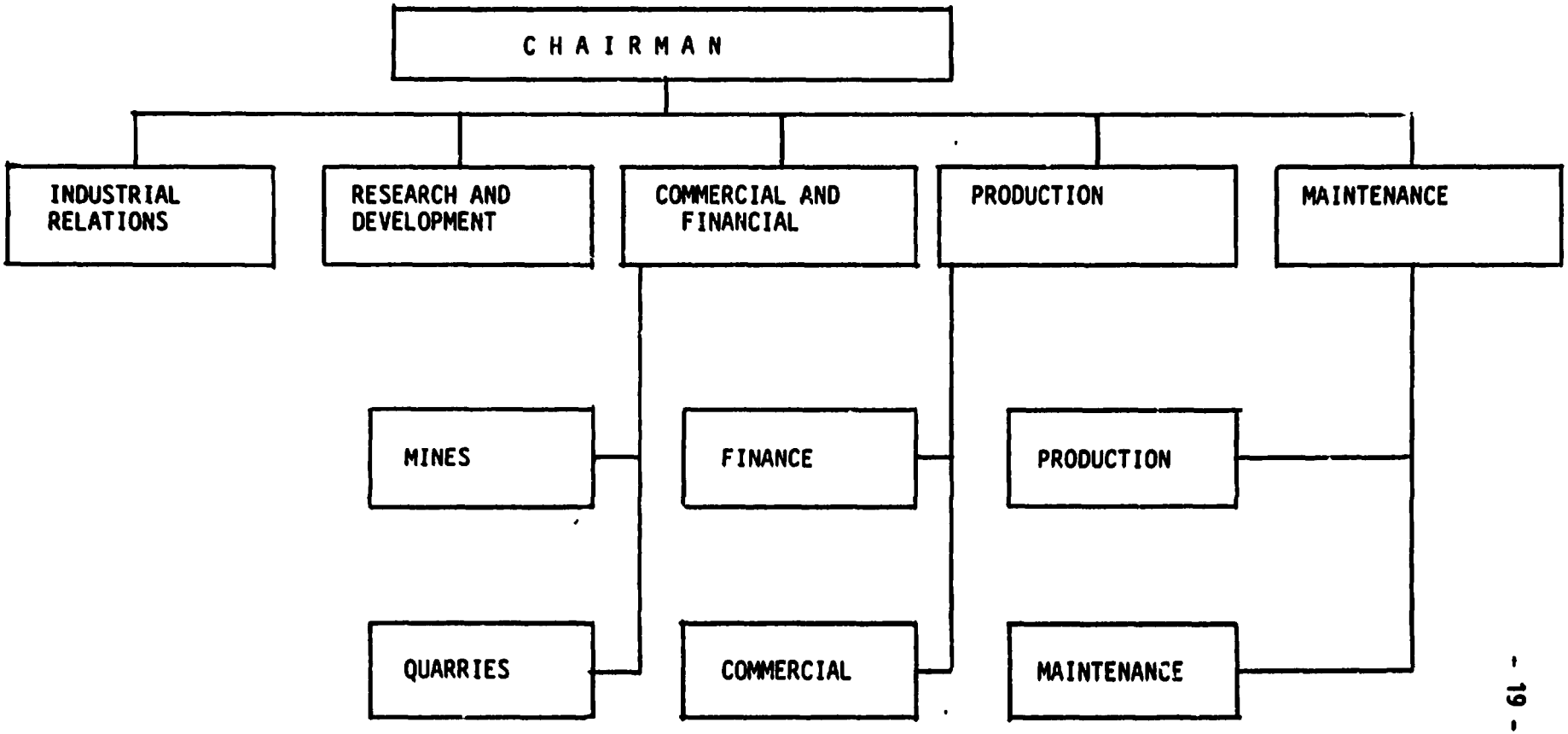
INDUSTRIAL RELATIONS
RESEARCH AND DEVELOPMENT
COMMERCIAL AND FINANCIAL
PRODUCTION
MAINTENANCE

FIG. 2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INDUSTRIAL RELATIONS
RESEARCH AND DEVELOPMENT
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MAINTENANCE
MINES
FINANCE
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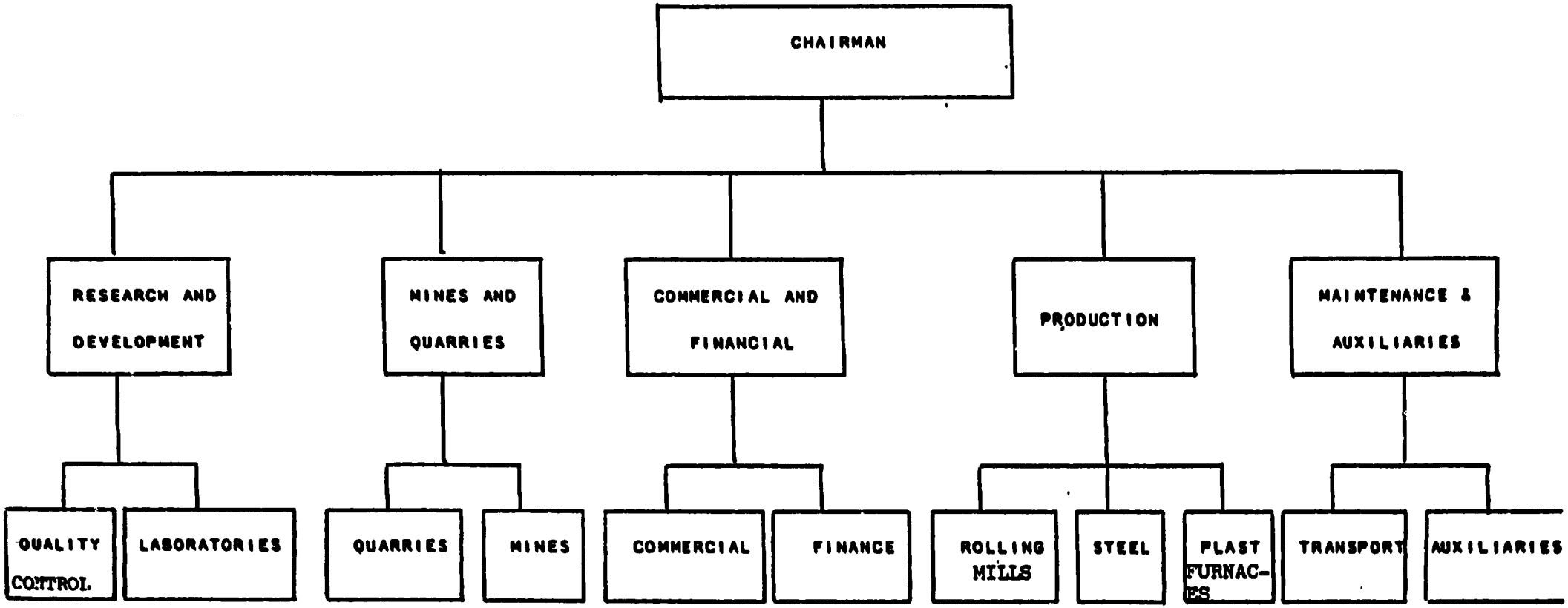
MAINTENANCE

FIG.3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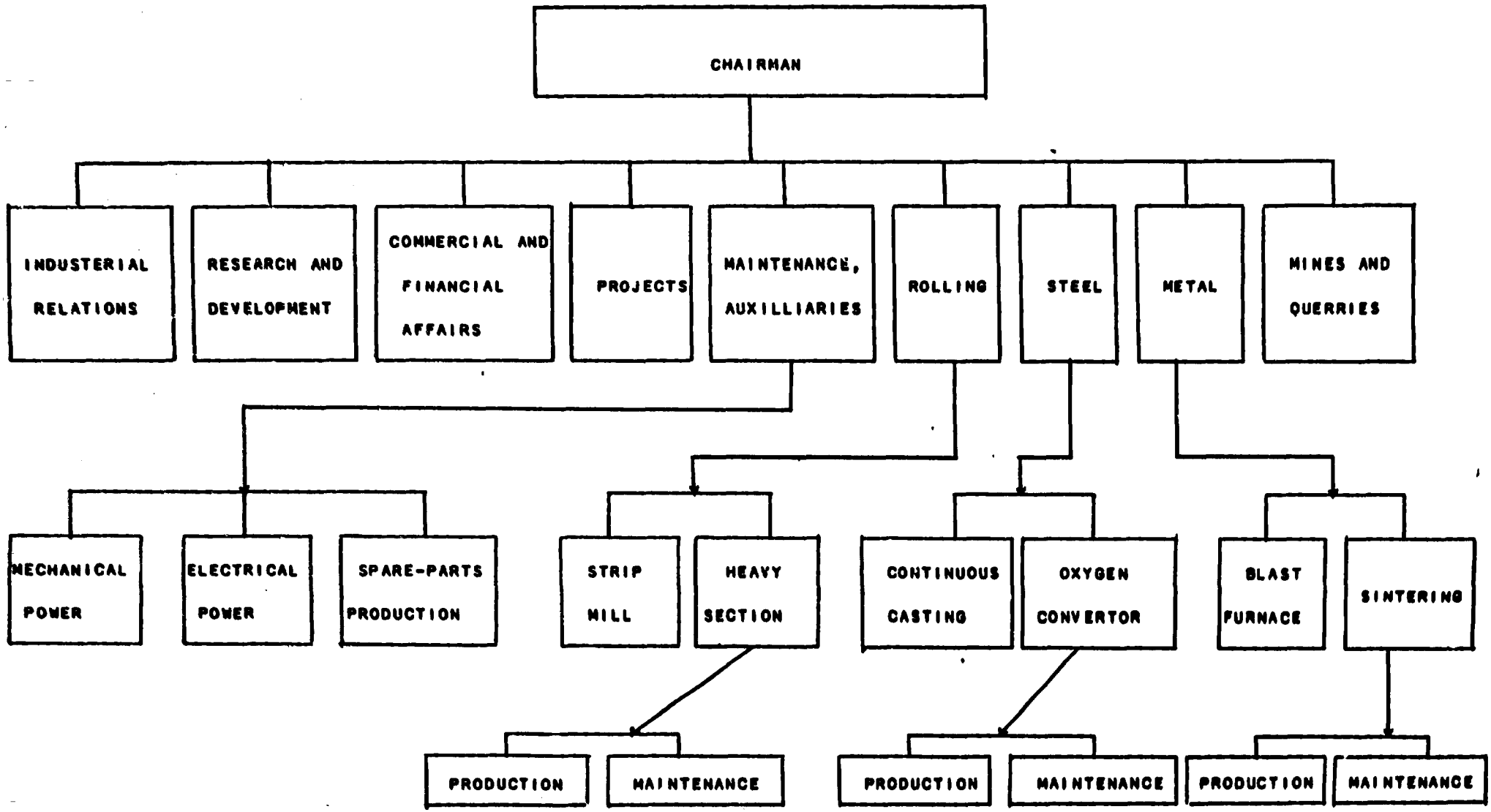
QUARRIES
MINES
COMMERCIAL
FINANCE
ROLLING MILLS
STEEL
PLAST FURNACES
TRANSPORT
AUXILIARIES

FIG.4

AT FINAL THE STAGE OF EXPANSION THE ORGANIZATIONAL SKELETON HAD TO BE REVISED ONCE AGAIN AND THE FIG SHOWS THE FINAL SCHAME



The last organizational chart as shown in FIG 4, has been reached after a number of trials. Previously, centralized management was adopted, but it was found more suitable later to adopt the decentralization system. This delegating all powers, either financial or administrative for the following reasons:

1. Dividing the Company into separate production units; each one having its own income and output, so that the results and performance can be obtained when requested in each case.

2. Easier method of determining responsibilities.

3. Giving a chance for new leaders to appear.

4. Avoiding centralized decisions which take a long time to be executed.

5. Distribution of responsibilities on various levels relieves the top management from this burden. The top management will dedicate its time to the policies of the future to realise the plans of development.

In this respect, I take interest to highlight the developments which have taken place in the field of maintenance and spare parts manufacture.

But before that I must refer to the excellent assistance extended to the Egyptian Iron & Steel Co by UNDP and UNIDO through the technical assistance programme implemented under the project no. DP/EGY/73/028 and DP/EGY/006 to establish and develop computer based systems for preventive maintenance planning and follow-up and also for spare parts planning, production and stock control.

Encouraged by the successful results of these projects, the Egyptian Iron & Steel Co. with the help of UNPD and UNIDO took up further development and implementation of computer based system for planned repairs, on-line production planning and process control in oxygen steel making under project no. DP/ EGY/81/012.

Maintenance started in a centralized form and transformed gradually into a decentralized system. Finally, it settled down, after the final organizational skeleton, into the combination system, which comprises mainly the following:

1. Central maintenance, responsible to lay down the plans and programmes for major overhauls and big repairs for all the units of the plant and for many years to come. On the basis of this plan, strategic raw materials are ordered and and operations of spare parts manufacture are controlled. The central maintenance participates in the execution of major overhauls, new constructions and repairs.

2. Area maintenance, which is a specialized group with highly skilled members, working as consultants in the various areas. From the technical and administrative point of view, it belongs to the central units. They operate, control and repair the equipment located in the different areas of the plant.

3. Assigned maintenance, which belongs directly to the production units and undertakes the following responsibilities:

   - participating with central maintenance in fixing maintenance programmes and major overhauls.

   - executing programmes of preventive and planned maintenance.

   - undertaking troubleshooting repairs and exerting every possible effort to keep the equipment in good condition.

4. Contractors, who lend their help to the Company in major overhauls or specialized operations to avoid appointing of new labour for this type of work.

5. Cap system, which is used by the Company in executing the critical operations which influence directly the taryets of the Company.

DIFFICULTIES ENCOUNTERED WHEN IMPLEMENTING THE DECENTRALISATION SYSTEM

It has not been an easy task to proceed in implementing the decentralisation management due to the following facts:

1. Each department made great internal success, but when the matter is related to anything out of their department, some problems due to the incorrect understanding of the system are encountered.

2. Heads of departments finding themselves at top of management, working independently within the general policy of the Company, started to request for enlargening of the organizational skeleton of their departments to assist them in the management.

3. An incorrect belief generated that such a system was created only for the promotion of personnel.

4. An inefficient communications system between the different departments.

5. Inflection of responsibilities between the centralized and decentralized departments.

To solve the above mentioned problems, the top management held two meetings weekly headed by the Chairman of the Board; one meeting for following up the production, while the second one was held for discussing all the maintenance problems. All suitable decisions were taken. By time, only one meeting weekly seemed to suffice, and the number of labourers could be reduced from about 27,000 to about 24,000.

COOPERATION BETWEEN UNDP/UNIDO AND EISCO

Cooperation with UNIDO started in 1975 as mentioned before with the aim to develop and establish a computerized maintenance management system (CMMS) which comprises the following activities:

1. Preventive maintenance programmes
2. Spare parts scheduling
3. Planned maintenance and capital repairs
4. Inventory control system
5. Informatics system

It is obvious that by such systems a data bank of information is built to help in developing centralized and decentralized systems beside the top management.

The programme of preventive maintenance started manually between the years 1975 and 1978 in one of the departments of the plant as a pilot project for study, and then by 1979 started the computerizations. The whole Company is now covered by this system.

Spare parts scheduling and shop loading for production of spare parts is now in operation. All technical data of spares, related technological studies, and inventory control connected with spare schedules for machines are all now being fed to the computer.

Having all such data, we have started a new programme for norms and standardisations which reduces maintenance costs and minimises storage of interchangeable units.

Such achievements have been realized by training through the systems indoor and outdoor, and also by the help of UNIDO abroad, by introducing an attractive incentives system. The Company has now a well-built personnel which started two years ago to implement the same project in other industries. This was made by choosing one company for each group of industry as a nucleus to spread the system in the companies of the same industry, i.e. one company was chosen from the spinning and weaving industry, one from the chemical industry, one from the engineering industry and one from the refractory industry.

Now, we have begun to spread this system to the food industry, which will be followed by the mining industry.

The most important point is to train the staff in each Company to bear the full responsibility for the other companies, and we hope to cover the whole industrial sector in Egypt up to the year 2000.

During the past years, UNIDO has been following up the project and considers this one of its most successful projects.

Now, UNIDO and the Egyptian Iron & Steel Co. are studying the last phase of the project which intends to spread the system to some other African countries.

RECOMMENDATIONS

Following our experience referred to above, we would like to make the following recommendations:

1. Human Resources Development should be carried out through certain planned systems.

2. Any system to be applied must be well understood and supervised by the top management to ensure its success.

3. Application of new systems necessitates studies, reports, follow-up, and some restrictions, in order to be aware of the opposition to them, and thus, to enable the top management to face such opposition and take the necessary measures.

4. Every new system must be accompanied by a suitable organizational skeleton to be adopted in such a way to ensure easy understanding and to be operated either manually or to be computerized.

5. The preparation period for any system is one of the most important stages, because this period includes the training of the staff in charge which needs at this point to be convinced of the advantages of the system to guarantee its success.

6. Another important point in any industry is that all maintenance and production systems should be well connected together to ensure the integrity of the whole operation.

Production Maintenance System