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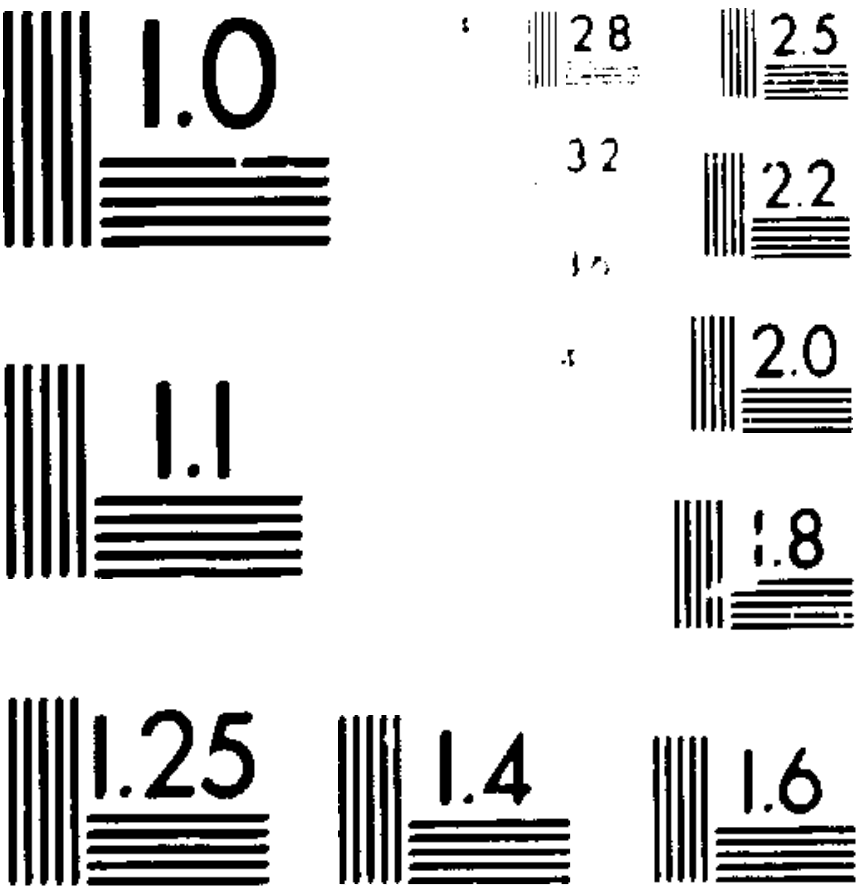
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



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INDUSTRIAL ADVISORY UNIT (UNIDO)

MINISTRY OF INDUSTRY

P.D.R.Y.

PDR of Yemen.

TECHNICAL REPORT

ON

AGRICULTURAL IMPLEMENTS FACTORY

BY

K.P. MAHALINGAM

PROJECT NO. PDY/76/014/A/01/37

This report has not been cleared with the United Nations Industrial Development Organisation, which does not therefore, necessarily share the views expressed.

November 30, 1979

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TECHNICAL REPORT
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AGRICULATURAL IMPLEMENTS FACTORY

1. INTRODUCTION

At the outset, the purpose of this report is to be explained. In July, 1979, the Industrial Advisory Unit, submitted an "Economic Evaluation Report of Agricultural Implements Factory." This report highlighted deficiencies in production, marketing and general managements and concluded by stressing the need for a total reorganisation of the factory, augmentation of production and marketing expertise and an early assessment of demand and export potential, among other things. As a sequal, a proposal was put upto the Government of PDRY by the Unit for the services of a Mechanical / Agricultural Engineer for a period of two years for studying the capabilities of the factory, production planning and processes, possibilities of diversification and reorganising the production patterns accordingly.

2. The object of this report is to look at the factory operations from a technical angle and highlight/the more important deficiencies with suggestions for their eradication so as to serve as a backdrop for the proposed expert to facilitate his study, without at the same time, overlapping or encroaching upon his functions. In other words, it is intended to be complementary to the Economic Report already prepared. It is by no means, exhaustive, but is indicative of the areas calling for in-depth treatment or attention. It is based on visits to the factory and discussions with the officials concerned. Considering the importance of this factory, this technical survey was considered necessary.

K.P. Mahalingam

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2. SUMMARY:

1.1. The actual outputs in 1977 and 1978 fall far short of the capacities in respect of the various Products. The figures between 1977 and 1978 also exhibit wide variances. The reasons can be attributed to operational deficiencies (including deficiencies in equipment / processes and human resources) as well as marketing. Except for the netting section, the entire factory is closed down since 1.1.1979.

1.2. Some of the products, notably scissors and knives, are too complex to manufacture, as they involve as many as 37 and 13 operations respectively. For want of offtake, large stocks have accumulated, and further they have been left unprotected, resulting in deterioration and heavy rust on the surfaces, which may render salvaging difficult when demand increases.

1.3. Successive equipment / processes have exhibited imbalance in capacities, resulting in inter-process accumulations of partly finished materials.

1.4. Records of life of components, their detailed designs and specifications are not available impeding effective maintenance.

1.5. The Heat-Treatment section is reasonably well-equipped and can well find a place in future diversification programmes.

1.6. Owing to poor ventilation, the working conditions in the Forge shop, particularly in summer months, must be arduous, leading to low productivity.

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1.7. Standards of housekeeping leave much to be desired at all places. Substantial improvement is called for. If continued, rehabilitation of some of the equipment may pose serious problems, not to speak of precluding it altogether. Idle workers should be deployed to clean up equipment and working environment. Identification, codification and classification of tools and dies are called for in the tool store.

1.8. There are wide variances in respect of personnel as provided for in the original project report and current deployment. In such metallurgy-oriented engineering factories, adequate and trained metallurgical personnel must be provided, otherwise operations as well as quality will suffer.

1.9. Heavy stockpiling of products and consequent stoppage of operations are the direct results of absence of accurate and realistic assessment of demands. There are also serious lacunae in the selling practices. Market research is a continuous activity, vital even after a factory goes into full production, in order to determine criteria for expansion or diversification.

1.10. The immediate need is for an in-depth market study to accurately and realistically assess demands and to identify products to be taken up for manufacture in this factory. This must precede other activities.

1.11. The position of Mechanical / Agricultural Engineer, for which a Job Description has been submitted by the Unit to the Government, must be filled as early as possible.

1.12. After identifying the new products, processes, equipment, etc. The following supporting services must be established;-

Design and Drawing Office,
Production Planning and Control,
Preventive maintenance programme,
Inspection and Quality Control,
Training and Development.

1.13. Designs and layouts of building must ensure comfortable working conditions.

1.14. Imbalance in capacities of successive equipment and processes must be averted by proper designs and layouts.

1.15. Manufacturing processes should be simple and operations restricted to the bare minimum, as the transfer of complex technology is difficult to assimilate at this stage.

1.16. Manpower planning must ensure that personnel of the requisite disciplines are available commensurate with the processes employed.

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2. CAPACITY UTILISATION:

2.1. The factory was installed under a bilateral agreement with the Chinese Government, the installation having been completed by mid-1976 and the plant run under Chinese supervision until end - 1978. The orginal installed capacities as given in the Chinese report of 1973, prepared by the Shanghai Institutes of Design of Light Industry and of City Planning and Architectural Design, were as follows;-

Item	Specn.	Unit	Annual output
Combined hoe & chisel	½ lb.	Pce	150,000
Chopping hoe	2 & 2½ lb.	"	50,000
Serrated sickle	7½ lb.	"	150,000
Household scissors	5" & 7"	"	100,000
Butchers' knife	6" & 8"	"	150,000
Galv. iron wire	1.25 - 2.77mm	Tons	165
Iron wire	1.25 - 4.5 mm	"	300

The foregoing figures are based on 300 working days per annum, single - shift and eight hours per shift.

2.2. The actual outputs however, fell far short of the above capacity - figures, as is evident from the following statistics for 1977 and 1978;-

	1977	% Cap.	1978	% Cap.
Digger hoe	60,547	20.2	76,097	25.4
Hoe/spade 2½ lbs.	8,472	16.9	35,531	71.1

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	1977	% Cap.	1978	% Cap.
Hoe/spade 2½ lbs.	27,015	54	5,952	11.9
Sickle	56,587	18.9	91,634	30.5
Scissor 7"	7,183	7.2	15,138	15.1
" 5"	21,447	21.4	1,710	1.7
Knife 8"	41,543	27.7	67,320	44.9
" 6"	58,950	39.3	34,236	22.8

2.3. The production exhibited wide variations in respect of capacity utilisation between the two years. While teething troubles can be offered as an explanation to some extent, the fact remains that the gestation periods of such engineering industries geared for mass - production, are usually not long. Therefore, in about a couple of years, the rated capacities should be invariably attained. That they have not leads one to look for reasons, which in this particular factory, fall into two categories, viz., a) Operational deficiencies including (i) equipment / process deficiencies and (ii) deficiencies in human resources and b) marketing. The entire factory has been closed down since 1-1-1979 (except the netting section) for want of adequate offtake, presumably because of marketing problems. A wire-drawing section feeds wire to a separate nail factory located elsewhere as well as to the netting section, the range being 0.75 - 5 mm. dia. Since 1-10-1979, there has been no orders for nails, and therefore, the entire output of the wire drawing section is consumed by the netting section.

3. OBSERVATIONS:

3.1. Raw materials

The Chinese report of 1973, prepared by the Shanghai Institutes of Design of Light Industry and of City Planning and Architectural Design, lists the following requirements of raw materials for the annual outputs envisaged and already stated;-

Product	Specns (Chinese)	Unit	Annual requirement
Combined hoe & chisel	45 # steel 25 mm. dia.	Ton	154
Chopping hoe	" " " 16x80 mm.	"	90
Serrated sickle	50 # " plate 3 x 1m x 1.5m.	"	22.5
" " handles	Timber	m^3	24.5
Household scissors	75 # steel 10-13mm. dia.	Ton	13
Butchers' knife	60 # Hn C.R. steel 1.5mm.x 75mm.	"	20
" " handles	Polypropylene plastic	"	7
Iron wire & galv. iron wire	Ord. low - C steel 6.5 mm. dia.	"	477

The procurement of these raw materials has not presented any problem, according to the Factory Management, as they can be imported from any country offering the best terms.

3.2. DESIGN AND DRAWING OFFICES:

3.2.2. Currently, there are no facilities for designing components, tools or dies nor has the need been felt as the operations were undertaken with the dies originally supplied with the main equipment in 1976.

3.2.2. Regardless of the actual products to be manufactured, mass-production techniques entail considerable use of jigs and fixtures, the design of which calls for high skills acquired by extensive training and experience. A well - equipped Design and Drawing Office will therefore, pay handsome dividends. As more and more sophisticated products are taken up for manufacture and as experience is gained in all their aspects, re-designing of the products will become necessary from time to time either to cut down costs or to facilitate manufacture or even to develop new products. Improvisations in manufacturing processes will also entail designing on the board. A Design and Drawing Office is therefore, indispensable for such an engineering workshop. This view is also shared by the Factory Management, who believe that a stage has now been reached, when dies for new products have to be designed, and also existing dies may have to be modified in the light of experience gained. Admittedly, until the requisite skills are available in the country, a start can be made with a modest effort by a nucleus of qualified expatriates and/or of some of the national personnel, who have the potential for growth and development in those vital areas of design and engineering development, and who should undergo training.

3.3. PRODUCTION PLANNING AND CONTROL:

3.3.1. The planning of production is now broadly done on the basis of division of a year into four quarters and each quarter into three months, subject to changes from time to time, depending upon priorities. No separate section for production planning exists. The functions are currently undertaken by shop-floor supervisors in consultation with factory management. In sound production management, the planning functions are divorced from the shop-floor production personnel, who should really concentrate on the techniques of manufacturing operations and technical problems arising therefrom. Production planning is not their function. It was gratifying to note during discussions with the factory management that they too, felt the need for an independent production planning set-up.

3.3.2. Regardless of whether it is decided to continue the existing pattern of production on a modified scale or to diversify into new lines of production, (after the proposed Mechanical / Agricultural Engineer completes his study), a well organised Production Planning and Control system for the entire factory is indispensable. The functions will cover (i) pre-planning of workload on the various sections with requisite documentation and drawings, (ii) scheduling including time - cycles of operations and operational planning sheets, (iii) progressing of work on the shop-floor to ensure smooth flow of material between processes and covering accurate allocations of time, hold-ups in manufacture and finally, (iv) collection and analysis of relevant statistical data including variations in times, costing and closure of completed job folders.

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3.3.3. Production planning and control entails maintenance of a number of records relating to the jobs received, machine loading, delays and hold-ups, times taken for various operations, etc. Some of the important forms and cards commonly used are shop orders, material requisitions, machine loads, work completion notices, daily production reports, daily time-sheets for machines and operators, process cards, man-hour and machine-hour capacity records and production schedules (monthly, quarterly and annually), some of which have already been developed by the Unit.

3.3.4. A good production planning and control system therefore, constitutes the nerve-center of any engineering manufacturing shop, and is indispensable for its organised functioning. Details of its organisation and administration will obviously depend upon the precise nature of the products envisaged.

3.4. COMPLEXITY OF MANUFACTURE:

3.4.1. A preliminary study of the operations involved in manufacturing some of the products leads one to conclude that they are far too complex to be processed in a general - purpose engineering workshop like the Agricultural Implements Factory not specially equipped for this purpose. As illustrations, manufacture of scissors and knives entail 37 and 13 operations respectively as listed below;-

Scissors

1) Cutting
2) Forming
3) Folding

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4) Pressing
5) Trimming
6) Arm cutting
7) Pressing
8) Trimming
9) Arm cutting
10) Pressing
11) Drilling
12) Boring
13) Forming
14) Stamping
15) Drilling
16) Turning
17) Softening
18) Heating
19-21) Grinding (3 times)
22) Pressing
23-25) Polishing (3 times)
26-33) Buffing (8 times)
34-35) Polishing (2 times)
36) Assembly
37) Electro-plating

Knives

1) Cutting
2) Forming
3) Stamping
4) Straightening
5) Softening
6) Heating
7) Polishing
8) Buffing
9-10) Polishing (2 times)
11) Joining
12) Grinding
13) Nickel - plating.

They could probably lend themselves well to manufacture in smaller units to start with, the types and quantities being limited.

3.4.2. Apart from complexity of manufacture, the large stocks of scissors and knives accumulated for want of sales outlets, showed marked signs of deterioration resulting from excessive rust formation. Protective oil •

grease or other preservation media should have been used to coat them before warehousing so that they could be retrieved for disposal anytime.

3.5. IMBALANCE IN CAPACITIES.

In any manufacturing process, the selection of capacities of the various machines and other equipment is vital to the smooth operation of the entire process, as if improperly done, it can result in accumulation of in-process materials, impeding operations. In this factory, there appears to be considerable imbalance between some of the successive operations with the result that working must have been intermittent. As an illustration, the 300 - tonne press is capable of an output of 2,500 scissor blanks per shift of eight hours, whereas the subsequent boring operation for cleaning up the eyes of the scissors, turns out only 1,500 blanks in the same period. The cardinal principle in fixing capacity of all engineering and metallurgical processes is that machines and other equipment must draw material faster from the preceding stages to avoid unnecessary hold-ups.

3.6. DIES AND METALLURGY.

3.6.1. The frequent breakages of dies used in hammers and presses posed serious problems, causing prolonged interuptions in operations. A direct consequence was the production of barely 11,000 scissors in 1978 against an annual capacity of 100,000 pieces. The original dies were either supplied with the equipment or were manufactured in the factory by the expatriate technicians. They left in November 1978, and the factory was closed in January, 1979, i.e., two months later. Even when the expatriate technicians were present, dies were breaking frequently, but no remedy was found.

3.6.2. The design and manufacture of dies for the work undertaken in this factory entails considerable metallurgical and engineering knowhow, but no expertise seems to have been transfered to indigenous personnel. Nor were records of their manufacture, use and life maintained at any time - vital for components of this kind, particularly when failures in service assumed alarming proportions. It must be said to the credit of the indigenous operators that some of them have retained in memory, the various operation involved in die-making, and are confident of making them today, but unfortunately, for want of expertise, they are unable to overcome the problem of breakages nor can they undertake original design of such dies. Credit must also be paid to the managerial personnel of the factory for having recorded from observations, while the expatriate technicians were making the dies, the various stages involved with some details.

3.6.3. Appendix 'C' lists the specifications and chemical abalysis of steels used for dies as well as for some of the products. The ranges and percentages of the alloying elements used and the consequent heat treatments necessary render it imperative for the factory supervision to include a substantial metallurgical element, which infortmately, is not a feature of todry's organisational structure. This lacuna is also supported by a typical heat - treatment process chart given for scissors in Appendix 'D', which also necessitates close metallurgical control. Other products are also subjected to similar heat - treatment processes.

3.7. ANNEALING COVERS:

It was reported that the cylinderical covers used for batch annealing the wire coils after being drawn into smaller sizes, were frequently failing in service through cracking or breaking. They were being manufactured indigenously from steel plates imported from China. The factory personnel did not maintain records of life of each cover nor were the detailed specifications known to them. Detailed designs of the covers too, were not available. What was being done was to patch-repair or manufacture them from the originals imported with the main plant. The temperature, to which they were subjected during the annealing process, was around 720^{0}C. These circumstances are not conducive to good and effective maintenance of the annealing equipment.

3.8. HEAT TREATMENT SHOP:

This shop is well-equipped with salt bath furnaces for hardening and tempering and oil-quenching tanks for dies and tools. Temperature control at all stages is provided by adequate pyrometric recorders. The facilities provided are quite satisfactory, and can w be utilised in any diversification programme, where heat-treatment satisfactory standards is demanded. Of course, currently, they to in a state of neglect, and like the equipment in the Forge Shop, need considerable "elbow-grease" for revival.

3.9. MAINTENANCE:

3.9.1. Maintenance of the facilities is not carried out systematically. Apart from 20 workers employed in the Maintenance Workshop, only seven have been provided for maintenance of the entire equipment, which will

be totally inadequate if the factory operates at full or near capacity. Currently, out of these seven workers, only four are available, two being on national service and one having left the factory.

3.9.2. To avert deterioration and frequent stoppages of machines and other equipment, a sound preventive maintenance programme is imperative apart from personnel. Its characteristics are periodic inspections in accordance with systematically specified schedules, regulated shutdowns for this purpose as well as to ensure timely attendance to defects, identification of critical spares and measures to ensure their timely procurement, proper maintenance and replacement schedules, analysis of breakdowns, proper documentation and their preservation, e.g., life of components, history of replacements, costs of maintenance, etc. It should be ensured that whenever new machines and equipment are procured, the relevant operation and maintenance manuals are obtained from the manufacturers and carefully preserved as they provide valuable information for maintenance.

3.10. INSPECTION AND QUALITY CONTROL:

3.10.1. No organised inspection and quality control exists. These functions are left to the shop-floor operators and supervisors, who relying on their visual judgment, segregate good from defective products. According to the Factory Management, more often than not, the personnel are unable to exercise effectively these functions with the result that the finished stocks contain both sound and defective products, which should have been rejected.

3.10.2. The function of quality control is at times, subordinated to the over-riding consideration of 'pushing out' the products from the factory at any cost. This is not a healthy attitude, and it will pay any factory management hands down to instil in the workers and supervisors right from the start, the importance of attaining and thereafter, maintaining high standards of workmanship and material at all stages, regardless of consumer reaction. The craftsmen must exhibit a sense of pride in their handwork.

3.10.3. Publicity of the quantum and ratio of rejections on the shop-floor through the medium of simple charts, has been found to have a salutary effect, acting as a deterrent to the outturn of shoddy goods. Likewise, penalisation of substandard articles in any incentive scheme has a deterrent effect.

3.10.4. Continuous monitoring of raw material quality and shop-floor operations is called for. It presupposes that those vested with the task of producing the goods as well as those responsible for their acceptance / rejection are furnished with proper tools and equipment. This is clearly a responsibility of management.

3.10.5. Organisationally, the personnel comprising the inspection wing and responsible for acceptance or rejection of the product should not be a part of the production staff, but should be independent of them, reporting directly to the top echelon of the factory. This is a cardinal concept of a good factory organisation.

3.10.6. The concept of quality control cannot be brought about over-night, as it will undoubtedly take time. From modest standards, if properly nurtured, it can over a period of time develop to a stage, when "Zero-defects" will be the order of the day.

3.11. 3.11. VENTILATION:

The design of the Forge Shop does not lend itself to comfortable working conditions. It was not possible to assess the true impact of this deficiency as the factory was closed down, but in a country, where the ambient temperature in summer months is as high as 40 - 45°C., this could well contribute to poor outputs, particularly when operations involving high temperatures and manual effort, e.g. furnaces and forging, are involved. These items of equipment are spaced too closely, windows are closed and circulation of air is inadequate. One can easily visualise that when this shop is in full operation with all the furnaces, hammers and presses going all-out, working conditions must indeed be arduous and the operators would be hard-pressed to give of their best. Therefore, in any future design, this aspect must be given the importance and consideration it deserves.

3.12. HOUSEKEEPING:

3.12.1. The standard of housekeeping all over the factory leaves much to be desired. In the Forge Shop, the furnaces, hammers, presses, machines and other equipment were covered with dust, dirt, grime and cobwebs. There were large heaps of scrap metal and partly processed materials lying all over the shop in various nooks and corners. There was dirt

and dust everywhere. The entire shop was in disarray, and while it is realised that it has been in disuse for some length of time, it need not present such a picture. During a subsequent visit on November 13, there was noticeable improvement in some areas. The risk in leaving the entire equipment in its present state, is that when it is desired to reactivate the various machines and other equipment, the cost of doing so may be exhorbitant, or in some cases, the deterioration may even preclude any rehabilitation altogether. One has to take this important factor into acoount,as in the studies for diversification proposed for this factory, some of the equipment may well find a place, as their use may be far more economic that the procurement of new replacements.

3.12.2. As the workers are not fully engaged at present, they should be deployed in getting the entire factory with equipment thoroughly cleaned up, restoring some semblance of order and facilitating rehabilitation of the production machinery and premises at a later date.

3.12.3. In contrast to the Forge Shop, the maintenance shop presents a much better appearance. It is well-lighted and spacious. Although the machines in this shop also are hardly used, they were found well-oiled and greased, clean and generally well-maintained. Those machines, which were seldom used, were carefully covered with tarpaulin to prevent ingress and deposition of dust and dirt.

3.12.4. The Tool Store, where the various dies used in the hammers and presses in the Forge Shop were stored, presented an equally disorderly appearance. Housekeeping assumes an even more important role here, for apart from the dust and dirt, proper codification, identification and

classification of all dies, beside other tools, are indispensable for an engineering shop of this kind.

3.12.5. In the Wire Drawing Shop too, coils of wire, imported from Japan, were found lying haphazard all over the open yard, heavily rusted. While it is true that they are cleaned by pickling in dilute sulphuric acid and washing in water before being drawn into wire of smaller sizes, better care and attention can be bestowed on storage of such valuable raw material.

3.12.6. The scrap material as well as partly processed material lying all over the factory premises should be collected, sorted and useless material disposed off. Its segregation composition – wise, is important for future use.

3.13. PERSONNEL:

The original manpower requirements were given by the Chinese, and are listed below along with the current force;-

	Chinese Report		
	Total	Workers	Actuals on 15.10.79
i) Iron Wire Shop	16	15	16
ii) Forge & Press Shop	40	38	–
iii) Electroplating & Polishing shop	55	53	–
iv) Machine repairing, transforming & distribution	30	27	–
v) Laboratory	1	–	–
vi) Warehouse & Transportation	5	3	–
	147	136	

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vii)	Drivers, Phone operators, guards, clerical		28
	Grand total		175
viii)	Netting shop	-	- 16
ix)	Galvanising	-	- 14
x)	Drivers, phone operators, guards, clerical	-	- 28
			74
xi)	Maintenance shop (No work)	-	- 20
	ABSENT		
xii)	National Military service	-	- 11
xiii)	Study leave	-	- 4
		Grand total	109

Against a total of 175 employees, the current face is 74, excluding 20 maintenance shop employees who are said to have "no work", 11 away on military service and 4 away on study leave. No information was available, regarding the deployment of the rest.

3.14. TRAINING AND DEVELOPMENT:

3.14.1. No formal training facilities exist nor has any organised training of the factory personnel been carried out prior to their deployment on the jobs in the various shops, in organisations elsewhere. Whatever little on-the-job training was given in the early stages of commissioning the factory, now appears to have been inadequate. In June 1978, four

operators were deputed to Czechoslovakia for 1½ years training in heat-treatment, general maintenance, electroplating and galvanising respectively, and will return by end - 1979. Four trainees from the Mansoora Technical Institute were employed on completion of their training in welding and machine tools trades, but their training having been for only a year, they have not proved themselves effective on the shop-floor.

3.14.2. On a par with material and financial resources in importance is human resources, vital for the efficient running of any enterprise in industry. The most serious bottleneck in injecting efficiency into the Agricultural Implements Factory will be the lack of suitably trained personnel at all levels. The needs of training and developing manpower to acquire the necessary skills, be it in management, supervision, shop - floor or supporting services will obviously depend on the patterns of production and shop operations envisaged. Nevertheless, the basic objectives should be rapid upgradation of existing skills and induction of new specialised talent and knowhow.

3.14.3. The areas which call for this basic input of resources, are broadly shop-floor machine operations, preventive maintenance, production planning and control, inspection and quality control, design and draftsmanship, supporting functions such as materials management covering purchasing, stores, inventory control, personnel selection and placement, and management information systems.

3.14.4. Apart from levels of personnel calling for induction of skills, the factors to be considered are identification of the individuals, nature of training, periods, costs, immediate and long-term needs.

3.14.5. The agencies through which training and developmental needs can be met, are indigenous institutions and industries (if available), assistance from developing countries, bilateral and multilateral assistance and expatriate assistance.

4. ROLE OF MARKETING:

4.1. There has been heavy stock-piling of some products of the Agricultural Implements Factory, viz, digger hoes, spades, sickles and knives, with the result that production of these items has been suspended and the entire factory virtually closed down since January 1979. In respect of scissors too, there would have been accumulation, had it not been for the operational difficulties in producing them, which led to the discontinuance of their manufacture. All this leads one to conclude that demand for these products in the country is well below the production capacity of the Factory. The export possibilities to neighbouring countries have not been properly explored. There is also probably some demand for the current products in other Governorates of the country, but not much effort at marketing seems to have been made. Therefore, if any attempt at diversification of this factory into other lines of activity is to be made, obviously the prerequisite is to undertake market research, to make an in-depth survey of the demand in the country for associated, similar or even divergent products (falling more or less within the capabilities of the factory). A limited survey of neighbouring countries can also be made simultaneously. These studies will enable

identification of possible areas of diversification to be made with economic scales of production, after which one can embark on feasibility studies and project reports. This is a logical sequence of action to be taken and has to have first priority.

4.2. The assessment of demand of such products is a continuous process even after a factory goes into operation, as only then, can Government take a decision whether it needs to be expanded in the same lines of activity or into diversified lines. One cannot therefore, too strongly emphasise the over-riding role of marketing in such industrial studies.

4.3. Associated with marketing is the "selling" function. As has been pointed out in the Unit's report on "Economical Evaluation of the Agricultural Implements Factory", the current sales practices leave much to be desired. No matter how good a product may be, it will not sell unless the selling functions are properly organised.

4.4. The Works Management were of the view that a market existed for hinges and door-knobs, which could well be included in the list of products for diversification. They were also confident of selling to neighbouring countries if the costs of production were reduced by modern manufacturing techniques and processes.

4.5. The foregoing observations clearly highlighted the need for an in-depth, comprehensive market study, which must necessarily precede any attempt at expansion or diversification of the factory.

4.6. Most of the machinery and equipment are not special-purpose items, and therefore, they can well lend themselves to manufacturing new

products for diversification. This can obviously, be confirmed only after deciding on the latter. The existing equipment is listed in Appendix A.

5. RECOMMENDATIONS:

5.1. A market research study in-depth must be undertaken in the first instance, to assess accurately the current and future demand and supply of the various types of agricultural implements as well as associated or similar products used in PDRY and neighbouring countries with the object of identifying items to be designed and manufactured in this factory. Since the expertise for conducting such a study is not currently available in PDRY, we may in the long run, have to go to specialised firms who undertake such work or to international agencies such as UNIDO or UNCTAD. The subject assumes urgency, as on it depends the entire future pattern of activities of the Agricultural Implements Factory.

5.2. A Job Description for a mechanical / agricultural engineer to be fielded for a period of two years is already under consideration of the Government and UNIDO. A copy is annexed as Appendix B. He is expected to conduct a detailed study of the capabilities of the factory to undertake diversified items (agricultural and others) for manufacture including work studies, production planning, processes, designs, etc. and gear it up for this purpose. This position must be filled without much delay, as his work will closely follow the market studies to be conducted.

5.3. Once the products for manufacture are identified and the processes, sequences of operations, machines and other equipment and infrastructure facilities are settled, attention must be paid to the establishment of the following principal supporting functions;-

a) Design and drawing office
b) Production planning and control
c) Preventive maintenance programmes
d) Inspection and quality control
e) Training and development

The details will of course, depend upon the precise nature of products to be manufactured, to be decided upon after the foregoing market and detailed engineering studies are completed.

5.4. In designing the buildings, layouts of machinery and other facilities, care must be taken to provide as comfortable working conditions as possible for the workers on the shop-floor as existing conditions in this regard leave much to be desired.

5.5. While determining the individual capacities of the equipment and processes, it must be ensured that capacities of succeeding stages exceed those of preceding ones to avert in-process accumulations of materials and consequent bottlenecks in production.

5.6. Bearing in mind the current state of industrial development in the country, the processes of manufacture adopted should be simple with ease of operation, as excessive sophistication or refinement in this area does not lend itself to adoption in the country at this stage.

5.7. The present heat-treatment facilities are satisfactory, and can well be used in any future programme of diversification with resultant economies in costs and operations. Similar is the case with some of the machines and other facilities, which are general - purpose types and not specialised.

5.8. Good housekeeping is complementary to good maintenance, and therefore, right from the beginning, after the new facilities are commissioned, this vital aspect must be instilled in the workers and supervisors. The entire factory must present a neat, clean and orderly appearance and the employees must exhibit a sense of pride in their working environment.

5.9. After the workers and supervisors reach acceptable levels of competence and standards of proficiency in their respective trades or areas of activity, refinements such as suggestion box schemes, safety and accident prevention campaigns can be introduced for overall plant improvement.

5.10. In planning for manpower (after the products for diversification and manufacturing processes are decided upon), careful attention must be paid to ensure that personnel of the requisite disciplines are available consistent with the processes employed. As an illustration, as has been pointed out, in metallurgy - oriented processes, qualified and experienced metallurgists must be available to ensure proper conduct of the operations. Obviously, if indigenous talent is not readily available, we shall have to fall back upon expatriate assistance initially for some length of time. One cannot stress too strongly this important aspect of manpower planning.

6. ACKNOWLEDGEMENTS

The writer appreciates the time and effort spent by Mr. Alawi, Director of Production, Agricultural Implements Factory as well as the other officials whom he met on the shop-floor, in prioiding him with all information and data needed for this report. He also briefly met Mr. Mohamed Abdul Rab, Director of the factory. They exhibited a genuine concern at the current plight of their factory and were anxious to see it back on its feet soon.

Mr. Mahfoud, the writers' counterpart, accompained him during the visits and participated in the discussions and was very helpful.

APPENDIX 'A'

LIST OF MACHINERY INSTALLED IN THE AGRICULTURAL IMPLEMENTS FACTORY

I. PRESS SECTION:

1.	Power press	- 300 tons	one
2.	" "	- 300 tons	one
3.	" "	- 160 tons	One
4.	Furnaces Big		Five
5.	" Small		Three
	Hammer	7?5 tons	Three
7.	"	150 kg.	one
8.	Power press	63 tons	one
9.	Preumatic Hammer	250 kg.	one
10.	Power press	210 kg.	Three
11.	" "	16 tons	two
12.	Sheet cutting machine upto 3mm		one
13.	Power Drills		Three
14.	Small lathe		one
15.	Plate straightening machine		one
16.	Friction screw press	63 tons	one
17.	Grinding machine		one
18.	Power press	10 tons	one
19.	" "	16 tons	one
20.	" "	20 tons	one
21.	Compressors		two

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APPENDIX 'A' (Contd....2)

II. HEAT TREATMENT SECTION:

1. Complete unit with salt baths, oil - tanks, abbealing furnaces, etc.

III. MACHINE SHOP:

1.	Lathe	615 mm	one
2.	Lathe	400 mm	one
3.	Lathe	900 mm	one
4.	Turret lathe	16 mm	one
5.	Shaping machine	500 mm	one
6.	Shaping machine	630 mm	one
7.	Power Drills		Three
8.	Hydraulic press	40 tons	one
9.	Radial Drill machine	1300 mm	one
10.	Milling machine		one
11.	Surface grinder		one
12.	Crank grinder		one
13.	Grinders		two

IV. GRINDING & BUFFING SECTION:

1.	Grinding machine	eighteen
2.	Edge forming machine;-	
	a) for scissors	five
	b) for knives	four

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V. HANDLE MAKING:

1. Plastic handle injection moulding machine — one
2. Plastic Breaker (granules) — one

VI. ELECTROPLATING SECTION:

Electroplating unit for nickle / chrome - plating with automatic control system.

VII. Wire Drawing unit.

VIII. Wire galvanising unit.

IX. Wire Netting unit.

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APPENDIX 'B'

JOB DESCRIPTION

POST TITLE:	Expert in production of agricultural implements
DURATION:	Two years
DATE REQUIRED:	As soon as possible
DUTY STATION:	Aden with occasional travel in the country
PURPOSE OF PROJECT:	The project envisages the removal of difficulties contronted by the Agricultural Implements Factory located in Aden in production of agricultural implements etc. and to divert the surplus capacity to new agricultural implements or engineering items technically and economically feasible.
DUTIES:	The expert will work on the spot as Project Manager of the Factory under the guidance and directions of the Director, Deptt. of Production, Ministry of Industry and the Board of Management in co-ordination with the Industrial Advisory Unit and will be specifically expected to;-

1. Review the production planning and control system currently in vogue in the factory.

2. Conduct a work study reviewing the present production processes, standardise the operations.

3. Examine the calibre of the enterprise to undertaken manufacture of other;-

   - tools for soil preparation
   - implements for sowing planting
   - implements for harvesting
   - equipment for processing output

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4. Examine the capabilities of the plant and operators to undertake manufacture of feasible items other than agricultural implements in relation to demand in the domestic market.

5. Organise and prepare the factory for and gear the factory into the production of items to be identified at No. 4 & 5 above under his own supervision.

6. Redesign the implements being manufactured if necessary, suiting the needs of the farm workers.

7. Study the problems of dies and develop the expertise of the factory personnel in this discipline; if necessary also indicating needs of the enterprise for training in die making abroad suggesting duration and appropriate sources of such training.

QUALIFICATIONS: Degree in Mechanical / Agricultural Engineering from a recognised University with practical experience of at least 5 years in the capacity of Production Manager in a factory engaged in the manufacture of agricultural implements and tools.

LANGUAGE: English, preferably with a working knowledge of Arabic.

BACKGROUND INFORMATION: The PDRY has a population of nearly 1.7 million. The agricultural structure comprises of;

- 35 state farms with an area of 344923 acres (214233 acres cultivable)
- 44 cooperative farms with a total area of 29398 acres (18030 acres cultivable)
- and small number of private farms in remote areas of the Republic.

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APPENDIX 'B' (Contd....3)

The state farms have about 3000 permanent workers whereas the coop. farms have 30000 members.

Keeping in view the needs of the agricultural farms, a factory for production agricultural implements was established with Chinese assistance in 1976, Commencing Operation on 1 July 1976. The factory has an annual rated capacity of 1.2 million pieces as follows on two shifts basis.

Agricultural & tools implements	1. Digger Hoes	- 300000	numbers
	2. Hoes 2½ lbs.	- 50000	"
	3. Hoes 2 lbs.	- 50000	"
	4. Sickles	- 300000	"
	5. Hatchets (Knives)	- 300000	"
Misc.	6. Scissors	- 200000	"
	7. The factory is also equipped with a wire drawing and wire fence making unit.		

In general the factory was operated on one shift only. Owing to small domestic market all the implements 1,2,3,4,5) produced till end of 1978 have been for exceeding the sales. Possibilities of exports are also slim owing to severe competition from other countries in the matter of prices, quality etc. The stockpiling has necessitated suspension of production since January 1979. In the case of scissors the factory is faced with the problems of dies for a large number of operations involved in the manufacture. The situation warrants an indepth technical appraisal of the capabilities of the factory and its personnel to go into diversification not only for the manufacture of new agricultural implements but also towards other engineering items economically and technically feasible.

APPENDIX 'D'

HEAT - TREATMENT OF SCISSORS

Annealing:

1. 230 to 390 scissors, depending upon their size are packed with iron filings (carbon - content not less than 2.5%) in a steel cylinder, about 250 mm. dia. 750 mm. long closed at one end. The top of the cylinder is then closed with a plate and sealed with clay to prevent ingress of air.

2. Four such packed cylinders are charged into an electric muffle furnace and heated to 800 - 810°C., soaked for five hours at this temperature and allowed to cool in the furnace to 500°C.

3. The cylinders are then, withdrawn from the furnace, and after sufficient cooling, the scissors should exhibit a hardness of 187 HB.

Hardening:

4. 15 scissors are suspended from a hanger rod (after the above treatment) and eight such hanger rods are suspended above a salt bath so that the scissors are immersed at a temperature of 250 - 350°C. for five minutes.

5. They are taken to another salt bath at a temperature of 790-810°C. where they are immersed for five minutes.

6. The bath is then oil-quenched for three minutes.
7. It is washed in ordinary water at room temperature.
8. The next washing is done in sodium silicate solution, where the oil is removed.
9. Finally, it is immersed in hot water and then, cold water. The scissors should then, attain a hardness value of 60 – 65 RC.

TEMPERING:

10. Quenching of the batch (after the above treatment) is done in an oil tank heated to a temperature of 160 – 180°C., and immersed for 20 minutes.

11. Washing is then done in sodium silicate solution and in water, after which the hardness of the scissors should be reduced to 58 – 63 RC.

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