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DEVELOPMENT OF EQUIPMENT DESIGN CAPABILITY AT THE HAWAMDIA EQUIPMENT FACTORY OF THE EGYPTIAN SUGAR COMPANY

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EGYPT

Technical report: A Study of the Design and Manufacturing Capability of Hawamdiah Equipment Factory*

Prepare for the Government of Egypt
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of J. Pearson,
consultant on design and manufacture of sugar processing machinery

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*This report has not been edited

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SUMMARY

This report is a preface to the study and recommendations by the expert on CAD/CAM systems.

It is based on the engineering consultant's experience as manager of a sugar machinery manufacturing works and fifteen years in the construction and operation of cane sugar factories in Africa and Pakistan.

Every part of the machinery and steel work is made in accordance with engineering drawings. These drawings are the means of transmitting information from the design department to enable other people to manufacture and erect the factory and make it work. Although they are not the end product of the Hawamdia Equipment Factory they are the output of the design department upon which the whole of the company's turnover depends.

The nature of this output is assessed in relation to the manufacturing and design capabilities of the works and areas are identified where CAD could be used to produce more drawings in a given time and maintain the quality and accuracy of the information they contain. An indication is given of the number, size and format of drawings that such a system should be designed to produce.

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1. Introduction

The background information supplied to the consultant is attached in Appendix A. It is assumed that the reader of this report is familiar with the facts and figures quoted therein.

2. Terms of Reference

The consultant was requested to:

i) Carry out a short diagnostic study of the design and manufacturing capability of the Hawamdia Factory with regard to its customers' present and future needs.

ii) Based on the above-mentioned diagnostic study, recommend actions to be taken to develop the design and manufacturing capabilities of the Factory.

iii) In co-ordination with the CAD/CAM consultant (11-01), plan the short and medium-term development of the Design and Drafting Department of the Factory.

iv) Give advice to the Factory Management in the related areas/subjects of his/her competence.

3. Historical Development of Hawamdia Equipment Factory (HEF)

The Egyptian Sugar Company (SSDE) has built up a chain of eight cane factories along the Nile Valley in Upper Egypt and a refinery at Hawamdieh to supply refined sugar for home consumption and for expert. The first of these plants was commissioned in 1953 at Naga Hamadi.

The factories were supplied as complete entities by several well-known sugar machinery manufacturers in Europe, and a few items have recently been acquired from Japan and the USA. The process technology employed in all cases is practically the same.

Cane milling and sugar production involve a great deal of heavy machinery which requires extensive maintenance after the annual crushing season. The factories are isolated from one another and this work has to be carried out at all of them at the same time, from approximately the end of May until October. Each one therefore needs to have a workshop of its own.

Over a period of years the manufacture of certain spare parts are in constant demand at all the factories has been centralised at Hawamdieh. This is the nearest workshop to Cairo and the sea ports and it has easier access to the necessary raw materials.

To cope with an increasing domestic demand for sugar SSDE has raised the output of its sugar factories by adding more processing units to the existing plant, and it has also installed new factories adjacent to four of the sites to make by-products out of the residues of molasses and bagasse.

The accumulated experience of SSDE staff in operating and maintaining these facilities is considered sufficient now to enable them to build their own equipment and not to rely on supplies of machinery from abroad. The engineering works at Hawamdieh is to become the main manufacturing centre for import substitution.

4. Present and Future Commitments of HEF

The company has already built up a regular turnover of products for the sugar factories. Typically, it manufactures between 10 and 12 kilometres of heavy steel conveyor chains every year, about 100 pumps of assorted sizes, and 400 bogies for railway cane cars. These are the normal replacements of corroded or worn-out parts which, after standardisation of design, are made and assembled on semi-automatic production lines. Further items are constantly being added to the range by the application of "reverse engineering" to replicate the best design in each case from a variety of examples in current use.

HEF also manufactures structural steel columns and beams of every size required by SSDE for the extension of its buildings, and fabricates vacuum pans, tanks and other process vessels, all from flat steel plate. The works currently deliver about 3500 tonnes of fabricated steel products per year.

There is an Iron Foundry with a regular output of 50-60 mill roller shells per year (some weighing upwards of 12 tonnes each) in addition to all the raw castings for the pumps, gearboxes, axle-boxes etc, which re finished in the Machine Shops. There is in addition a steady demand for bearings and other components which can be cast in non-ferrous metals.

The company is now adding to this basic turnover by undertaking major projects for the reconstruction of the sugar plants, some of which are more than thirty years old. The first of these, at Naga Hamadi, calls for about 7000 to 8000 tonnes of machinery and structural steel to be produced over a period of three years. This programme must be completed before the commencement of sugar cane harvesting in 1991.

There is a second project of comparable size to coming along for the extension of a by-products factory at Abu Korkas, and two smaller projects are being planned. The Production Manager is confident that the workload can be handled and there is probably enough reserve capacity to be found in the shops by extending shiftwork and/or overtime if any bottlenecks should occur.

In short, the turnover of HEF is expected to continue at least at the present level, and to increase gradually if the design office capability can be augmented to match it. If this is achieved the company may then seek further profitable business by extending its product range to serve other food-related industries in Egypt or by entering the export market with its machinery for cane sugar production.

5. Potential Market for Sugar Machinery

Sugar has been in surplus on the world market for several years and the sales of capital equipment are currently at a very low level. At least one European specialist manufacturer has closed its works and others have set up licencees in India or Taiwan to make their products more cheaply. There could, however, be an opening for business in continental Africa where HEF should have a cost/quality advantage over even this kind of competition, if and when the market improves.

6. Manufacturing Capability of HEF

The workshops are spacious and well laid out. Materials follow a logical path through the manufacturing stages and there are adequate handling areas and lifting equipment for present and future needs.

Ideally, some improvements could be made by replacing certain machine tools which are obsolescent, but there are financial constraints and the company has invested wisely in the equipment it has. The general working conditions are good.

The factory comprises five main production departments: the Foundry, Heavy Machine Shop, Light Machining and Assembly, Plant and Vessel Fabrication, and Structural Steel Fabrication. There are laid out in adjoining parallel bays which have high roofs with good ventilation and light. The site is alongside the river, near to the sugar refinery which has jetty for loading and unloading barges, and the Nile is a natural highway for transporting heavy loads to all of the sugar factories in the group.

Except for the spare parts assembly lines already mentioned it is essentially a "jobbing" operation. Each order is dealt with as it comes and its progress through every stage of manufacture is planned and allocated an estimated time. Actual performance times are recorded and will be used to update the target times in future. The system for doing this has recently been installed as part of a technical support programme arranged with the Engineering Departments of the four major Universities in the Greater Cairo area. It follows well-established principles and is proving very effective as a production planning tool. Although at first sight it would appear to generate a great deal of handwritten paperwork the records are very neatly prepared and only the minimum of essential extracts are taken out into the shops. It is too early to suggest any specific changes but there will be scope for the introduction of pre-printed documents and word processing when the system has settled down.

Modern manufacturing techniques are employed where they are appropriate. There are three CNC machine centres which are all effectively utilised in the manufacture of batch quantities of components for different sizes of standardised products. These and a number of other machine tools are operated by day and night shifts and sometimes continuously for 24 hours.

Plant and vessel fabrication is carried out using up-to-date methods of welding which include submerged-arc, argon arc, and various jigs and fixtures to provide continuous control of the fusion conditions. There is also a portable X-ray set for the examination of critical points in the welded seams of pressure vessels.

The reason for manufacturing structural steel from flat plate is interesting. Unlike the more highly industrialized countries, Egypt does not have a Universal Beam rolling mill and only a few small sections are produced locally. The main product of the Iron and Steel Corporation is plate in a wide range of thicknesses. This is used by HBF to build up any H-Section they require, all by continuous welding, and after years of practice they have mastered the art of counteracting cooling stress so that the resulting members are as straight as if they had been rolled.

With regard to future plans it should be mentioned that although the conditions are perfectly acceptable for the present class of work it would not be easy to introduce the manufacture of smaller and more delicate equipment for the food industries without some special protection from the dust and grit which inevitably arise in the vicinity of heavy machine tools and grinding wheels. A separate clean area will need to be created and given some measure of air filtration, for which the costs should be taken into account when studying the economic feasibility.

7. Design Capability

All production is initiated from the Drawing Office which is divided into two main sections, one to deal with spare parts - which include newly designed components and assemblies as well as straight replacements - while the other section handles major projects. The projects section is made up of a number of specialised groups to cover the disciplines of Civil (i.e. structural), electrical, and mechanical design which have to be combined in the end product.

There is also a small process group whose job it is to see that plant designs do not deviate from the essential requirements in terms of performance and accessibility for cleaning and inspection in sugar factory conditions.

Each project design group and the spare parts section receives the individual attention of one or more of the University professors of Engineering, usually at least one per week, and the technical level of their work has been raised as a result of this. The staff are mostly young, recently qualified engineers and technicians, with some draftsmen and women who may be considered as trainees. Each group has a more experienced engineer as its leader. A degree of academic thoroughness goes into all their work and the quality of draftsmanship is well up to modern standards. Occasional inaccuracies are to be found but perfection is seldom achieved anywhere in this respect.

There is understood to be no shortage of young people coming out of the engineering departments of the Universities should the need to take on more arise, but the time and diversion of effort that is required to train them in the specific needs of the company should not be under-estimated.

The amount of repetitive work at the drawing board is felt to be excessive and if this could be reduced by CAD the present capacity of the two offices, which does not in fact appear to be particularly stretched as yet, might be increased more effectively to meet the requirements of the future.

A number of these young engineers have taken introductory courses on the use of computers and spend some of their time running small programmes on four IBM desktop machines. There is no doubt that new methods and techniques such as CAD could be absorbed and exploited if thorough training is given and the right equipment is provided for the job.

8. Recommended Actions to Develop the Design Capabilities of HEF

The combined output of the two design offices is between 1000 and 2000 drawings per year. The amount of work in preparing one drawing can be many times greater than that in another and the nature of the work can vary also.

The maximum benefit to be obtained initially is in those operations at the drawing board which are very repetitive. When the same component, or something very similar to what has been drawn before, is required it could be called up from a prepared data store and save a great deal of drafting time.

The Civil Engineering group estimates that 80 percent of its man-hours are taken up in the production of manufacturing details for use in the workshops, and only 20 percent in the actual design of the structures. With a CAD system it should be possible to file a vast number of sections of steelwork, with hole drilling patterns and standard end connections so that they do not need to be redrawn every again. Upon inserting them in a drawing they can also be dimensioned automatically, and checked arithmetically to ensure that the figures add up correctly, and all in a fraction of the time taken by manual methods.

This principle can be extended later to include roof purlin details, side wall beams and windbrace modules, and eventually complete portal frames on drawings which will be used by the erectors at site.

At the same time the Electrical group would be able to compile a data base of the many standard components which go to make up a switchboard layout and the cable networks for each new project.

The first application to be recommended for the Mechanical group would be to use CAD to store the main international codes of standard dimensions which are to be found in the existing pipework of Egyptian sugar factories. This would enable the design engineers to insert the correct size of flanges (to DIN, ASME or British standard specification) without wasting valuable time in drawing them out, whenever the clearance of obstructions needs to be checked in a project layout. Once the system is established and the design engineers are accustomed to it many more applications will become apparent for items such as pipe supports, valves, conveyor details, and other repetitive work.

9. Plans for the Short and Medium Term Developments

It is important in the short term that not only should there be an introduction of new equipment into the Design Department but suitable training should be given to key personnel so that they and the staff responsible to them will know how to exploit it to the full. This has already been appreciated and the project co-ordinator for UNIDO has discussed with HEF the selection of candidates for two overseas study tours.

The CAD/CAM consultant will recommend the actual hardware and software to be provided, and to advise on any specific training that may be needed in order to get the system up and running in the shortest possible time after installation.

To ensure its ready acceptance by those who receive the finished drawings and have to work from them, it is strongly recommended that they be reproduced in as nearly as possible the same format as at present i.e. the majority in A0 size prints.

It has been suggested that smaller-scale drawings or part sections of the full scale print can more economically be reproduced on an A3 size plotter and that these may become widely accepted in future, but there are certain risks which must not be under-estimated. No matter how clearly people are warned not to scale measurements from drawings sooner or later they will do so. Increasing or decreasing the size of a print, which can so easily be done with CAD is nevertheless a dangerous practice where manufacturing drawings are concerned.

There are on the other hand many instances where the ability to reduce information onto small sheets can be very useful, as for example in schematic layouts of plant, electrical circuits, and process flowsheets for use at technical meetings for locating faults on site.

When assessing the requirement for CAD hardware it should be remembered that the output of drawings will peak at certain times during a project to about double the average rate for a year, probably reaching 60 drawings per week or ten per day. The very existence of CAD will make this possible without a proportionate increase in the labour force. It is recommended that two A0 size plotters be provided to make sure that the flow of work is never interrupted by an equipment malfunction.

10. Long-term Advice to the Factory Management

In the course of his visit to HEF the consultant found many subjects of common interest on which experiences were exchanged with the managers and staff. It is hoped that any contribution he was able to make will go a little way towards repaying them for the wealth of information that was freely made available to him for the purpose of making this report.

On reflection afterwards one subject does emerge for comment. It relates to communications on technical matters at all levels.

The company retains Arabic as the language of management and daily administration, but it has adopted English and the I.S.O. metric notation for technical drawings and documents issued by the design and drafting department. The engineers and technicians are receiving much valuable instruction from the Universities but it appears to be given almost entirely in the Arabic language.

They are becoming "computer literate" but little emphasis is placed on the need to understand the system instructions thoroughly. These are mostly printed in English (Arabic translations being rare, expensive and not always accurate) and the users of the systems in HEF are sometimes failing to fully appreciate the programmes they already have on the small IBM PC's. With the advent of CAD it is essential that as much of the tuition as possible should be carried out in the written language of the instruction manuals.

Furthermore it is suggested that a refresher course on the basics of computer operation might be set up by the University for the engineers and technicians of HEF and conducted entirely in English to ensure that the hands-on control of the machines is fully understood, and that the supplementary instructions attached to the outgoing drawings are clear to the end users.

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