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SI/IRQ/87/804

IRAQ

Technical report: Manufacture of corrugated board and boxes  
at State enterprise for pulp and paper industry, Basrah\*

Prepared for the Government of Iraq  
by the United Nations Industrial Development Organization,  
acting as executing agency for the United Nations Development Programme

Based on the work of Sture Ostlund, adviser on the  
manufacturing of corrugated board and boxes

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\* This document has not been edited.

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## ABSTRACT

This mission took place within the framework of project SI/IRQ/87/804: Advisory Service on Industrial Printing and Packaging. It was specifically aimed at the observation, appraisal and advice on corrugated-board and corrugated-board boxes manufacture at the General Company for Paper Industries.

The mission actually took place at the corrugated board and box plant of the State Enterprise for Pulp and Paper Industry at Basrah.

The consultant made a general examination of the factory's equipment, personnel and operation system, including maintenance and preventive/corrective repair, which is really required.

In spite of the very short duration of the mission, recommendations were made covering the main fields of the corrugating machine, new proposed lay-out, preventive maintenance system, quality-control laboratory, operation reporting and records system, housekeeping improvement, waste control, know-how upgradation at the different levels of the factory personnel and advisable purchase of new corrugating and converting machines.

A. INTRODUCTION

Iraq accords high priority to the development of its food and agro-industry sectors. These sectors are strongly inter-linked with the printing and packaging sector. High quality printing and packaging contributes considerably to the successful marketing of products both in domestic and overseas markets.

The quality of the corrugated board and boxes manufactured by the General Company for Paper Industries and used as transport packages needs to be improved considerably. The General Company for Paper Industries is the major supplier of corrugated fibre board boxes to the State Organization of Food Industries. The Government intends to take action to combat these problems and to particularly assist the printing and packaging enterprises belonging to the State Organization of Food Industries as well as the General Company for Paper Industries. The national institutional machinery does not dispose of the required expertise for solving the problem. Therefore, the Government of Iraq urgently needs the assistance of high level adviser to recommend actions to combat these deficiencies to improve the quality of corrugated fibre board boxes manufactured by the General Company for Paper Industries.

In the context of the regional project "Establishment of the Arab Regional Packaging Centre" (Project No. DP/RAB/83/U20) some technical assistance was provided to the country by UNIDO. Based on this successful assistance, the UNDP Resident Representative has endorsed the request stressing urgency and level of expertise required and specifically proposed the project to be considered within the SIS programme.

B. TERMS OF REFERENCE

The project's main objectives consist of diagnosing the causes that block the achievement of increase in production and quality of corrugated fibre broad and box manufacturing plant in Baghdad and making recommendations on actions needed to improve the working immediately.

The consultant will organise his activities in consultation with the General Manager of the General Company for Paper Industries and is specifically expected to:-

1. Study ways of improving quality and output of the plant.
2. Determine problems relating to printing of boxes in terms of materials designs, processes, quality control.
3. Elaborate on technical specifications in the field of corrugated board and boxes in the context of distribution system of the country and suggest ways to improve these.

C. CONDUCT OF THE MISSION

Upon arrival to Baghdad on 26 April the adviser was informed that the duty station was Basrah instead of Baghdad and he should be attached to the Corrugated Board and Box Plant at State Enterprise for Pulp and Paper Industry. Due to holidays the adviser arrived Basrah 2 May and left Basrah 15 May, for report writing Baghdad and debriefing UNIDO, Vienna, 19 May.

The Planning Manager at State Enterprise for Pulp and Paper Industry Mr. M.H. Al-Abbas acted as the official counterpart for the mission. The programme was not planned in advance but the adviser and Mr. Al-Abbas agreed upon that the first part of the mission should cover suggestions for immediate actions to be taken at the corrugator to improve the quality of the corrugated board, and the second part long-term planning for the corrugated board and box plant.

The adviser wishes to express his appreciation to Mr. M. H. Al-Abbas and his colleagues for their assistance.

D. OBSERVATIONS

1. General

Due to the very short duration of the field mission it is not possible to make a complete assessment of the corrugated board factory at State Enterprise for Pulp and Paper Industry and the problems encountered by this factory. However, the visit by the adviser provided enough background to allow certain conclusions concerning the most important problems the factory is facing at the present moment. In adviser's opinion, the overall situation is somewhat unusual in comparison to other similar corrugated board factories visited by the adviser.

The most serious constraints facing the factory are not related to the lack of equipment. Many of the constraints are rather related to the lack of maintenance, or rather preventive maintenance, lack of basic know-how of production techniques and to some extent the very irregular technical properties in the raw material (paper) such as grammage, moisture-content etc. Regarding properties of the paper affecting the function of the final box, such as Ring Crush Strength and Bursting Strength it has not been able to obtain such data. The laboratory is not equipped with equipment for maintaining a constant climate. The same applies for technical data, such as Flat Crush Strength and Edge Crush Strength of the corrugated board.



As the corrugator is the most important machine in a corrugated board and box plant, and as the duration of the field mission was very short the adviser spent most of his time to analyse this machine.

An outline of the major constraints identified by the adviser during the mission is presented in the following.

## 2. Corrugator General

Type BHS width 1,6m equipped with one Single Facer  
A-Flute, one Cut-off Knife  
Age 22 years (build 1967).

Quality problems of the corrugated board must be blamed mostly on equipment age and state of maintenance, coupled with absence of technical know-how of the operators and technical management.

Examples of equipment condition contributing to poor quality include, worn corrugating rolls, difficulties in the glue units (Single Facer as well as Double Facer), difficulties in setting the fingers, dirty belt on the double face unit. Most of these problems could be overcome by trained attention to machine wear and cleanliness coupled with defined and observed quality standards and programmes of preventive maintenance.

Following measures are to be taken immediately  
(no investments).

### 3. Single Facer Unit

The corrugating rolls are in very bad condition, they have certainly been producing more than 30 million running meters of corrugated board (a normal figure is 18 million meters). The two end slots are damaged to such an extent that the two end fingers can not enter, which means that full paper width (1.6m), must be run without end fingers, which in its turn means bad flute formation of the edges. Apart from the fact that the corrugating rolls are badly worn in the middle of the rolls, the rolls are badly damaged on the tips. The tempering of the corrugating rolls are certainly gone, which means that the wearing and damaging of the roll will accelerate very quickly.

The glue roll and the doctor roll are also worn and out of round which makes it difficult to get an even glue film. They have to be checked for parallelism frequently. A complete overhaul of the glue unit is a must.

Temperature must be checked on all heated rolls (180-185°C) The siphons on all heated rolls to be checked as well as the included glue roll and doctor roll.

The doctor roll and the glue roll should be rotating in the same direction and the doctor roll equipped with a doctor blade. (Necessary to contact the machine manufacturer BHS for this) Operator control panel should be checked for proper functioning.

Mill roll stand for liner and fluting to be checked for parallelism to the Single Facer.

A complete cleaning of the Single Facer and Mill roll stand is necessary.

4. Double Backer Glue Unit

This unit is not working properly Doctor Roll must be equipped with a scraper blade and should rotate in the same direction as the glue roll.

Glue roll and Doctor roll should be checked for parallelism. The whole unit should be little approximately 25 cm to ensure better bonding between liner and the single face web.

5. Double Backer hot-plate section

The hot-plates should be checked for proper level and the upper belt must be cleaned properly. The function of this belt is transporting the corrugated web through the machine and at the same time absorb moisture from the web. Because of the fact that the belt is extremely dirty (Glue, oil and paper) the belt can not absorb moisture and a friction between the belt and the web can cause leaning flutes. (Low flat-crush value of the corrugated board).

6. Steam system

The steam system must be working properly, if there is not enough temperature, it is impossible to make good corrugated board. The steam boiler must generate steam at approximately  $12 \text{ kg/cm}^2$  which means a temperature of  $185^{\circ}\text{C}$ . The temperature of preheaters corrugating rolls, hot plates must be checked frequently for proper temperature. At State Enterprise for Pulp and Paper there are several steam traps valves etc. which are not functioning properly. In general the whole steam system must undergo a complete overhaul including a check of the siphon pipes in all heated rolls.

7. Maintenance

The lack of maintenance at State Enterprise for Pulp and Paper and above all preventive maintenance is reflected very clearly in poor quality of the corrugated board and also in low production. Planned preventive maintenance performed regularly on all manufacturing equipment is one of the most important responsibilities of management. A maintenance department which must frequently turn to repair work is functioning very badly and maintenance cost will become high, repair costs are normally much higher than preventive maintenance cost.

The objective for the maintenance work can be expressed in the following.

TO MAINTAIN THE HIGHEST MACHINE RELIABILITY AT THE LOWEST COST. As the preventive maintenance of this factory is very much neglected the adviser will here give some recommendations on a simple but effective preventive maintenance system (PPS).

The factors that make failure of the production machinery very costly are:

- Lost production time
- Lost manpower
- Lost profits
- Lost customer relations (due to difficulties in meeting delivery time).

The primary objectives of preventive maintenance should be :

- To protect machinery and buildings
- To increase utilization of the machinery thus reducing downtime
- To maintain safety
- To control and direct the maintenance force
- To maximize utilization of labour and resources

- To prevent waste of tools, spare parts and materials
- To obtain cost records for budget

At State Enterprise the preventive maintenance is neglected because no formal programme exists.

The programme proposed by the adviser, provides the basis for planned preventive maintenance (PPM).

It contains a simple administrative and control procedure that alerts the management, when it is not followed.

A planned preventive maintenance programme will not entirely eliminate a machine break-down during a scheduled production run. However, a PPM programme can prevent many costly and untimely break-downs. A plan for periodic inspection of specific parts of equipment, to search for unusual wear or to look for possible malfunction of a moving part will often reveal the need for action. By anticipating those problems one can detect or take actions before they become troublesome and serious. A major breakdown is more costly and inconvenient to repair than a minor adjustment or the timely replacement of an inexpensive part, minimizing these problems through PPM can help a lot.

There are several basic requirements for establishing a preventive maintenance system.

- Machine history back records should be available for one or two years.
- Work order request and equipment records should be analysed to identify causes and frequencies of break-downs, this can determine the frequency of inspections of certain parts and machines

- Check lists, testing procedures, lubricating charts and cleaning methods must be developed
- An analysis of the spare parts inventory must be made, so that appropriate parts are on hand when needed.
- The need for corrective maintenance must be identified
- An effective and complete work order system must be initiated

Preventive maintenance is divided into two categories:

- (a) Machine crew's responsibilities
- (b) Maintenance department's responsibilities

(a) Machine crew

Because of limited time available, the crew should only be responsible for cleaning and making minor adjustments and checks that can be completed during and between run times. The operator is also responsible for reporting to the maintenance department concerning malfunctioning of the machine (see example on work order request, Annex I).

- The operator is responsible for completion of all assigned maintenance
- Preventive maintenance checklist for each machine are to be used. Each form should be installed in the appropriate block for the days on which each action is completed, initials should be those of person actually accomplishing the task. By the end of each week the supervisor must verify completion of all requirements by signing.

Supervisor's daily checklist

1. Temperature checks -----  
SF. Preheater -----  
DF. Preheaters -----  
Corrugating rolls - Upper -----  
Corrugating rolls - Lower -----  
Pressure roll -----  
Hot plates and cold plates -----
  
2. Lateral adjustment, moved -----  
(Corrugating roll)
  
3. Viscosity check SF -----  
Viscosity check DF -----
  
4. Caliper check across the web  
Operator side                      Centre                      Drive side
  
5. Feeler gauge check - Doctor roll/Glue roll  
SF: Operator side                      Drive side  
  
DF: Operator side                      Drive side
  
6. Check belts free from glue or paper -----
  
7. Check for bent fingers -----



Daily reminders

- Lubricate corrugating rolls whenever rolls without paper
- Remove pressure, corrugating rolls, when not in use.
- Check for gelatinized glue on fingers
- Whenever Double Backer stops, lift the belt. (Could be done automatically).
- It is also the responsibility of each department supervisor to have each piece of equipment under his control, cleaned and in first class condition when it is scheduled for the preventive maintenance check. This will require good communication and cooperation between the supervisors and the maintenance department.

Following form shows a typical work order request to be completed by the supervisors / operators.

WORK ORDER REQUEST	Date: _____
Emergency ... Non emergency ... Safety ... Regular .....	
Department ..... Machine .... Requested by ....	
Description of work:	

(b) Maintenance Department (Manager)

Responsibilities:

- Has primary responsibility for accomplishment of the preventive maintenance programme and all follow-up
- Maintain all records needed to support the programme to include historical and cost rate.
- Schedule preventitive maintenance inspections and repair work needed
- Coordinate with Scheduling and Plant Manager
- Review programme for efficiency
- Inventory and control spare parts
- Continually analyse high cost and repetitive work orders to eliminate cause.

A typical weekly preventive maintenance schedule for the corrugator could be as follows:

Mach. No.	Description	3	10	17	24	31	7	14	21	28	30	19
	Corrugator	x	x	x	x	x	x	x	x	x	x	x
	. Single Facer	x		x		x		x		x		x
	. Mill Roll Stands		x		x		x		x		x	
	. Bridge	x			x			x			x	
	. Double Glue Unit	x	x	x	x	x	x	x	x	x	x	x
	. Hot Plate Section	x		x		x		x		x		x
	. Cut off knife	x		x		x		x		x		x
	. Starch prep. system	x		x		x		x		x		x
	. Steam system	x		x		x		x		x		x

Steam system Single Facer (daily)

- 1 Check steam and condensate pipes for leaks,  
tag and report leaks
- 2 Check rotating steam points
- 3 Check By-pass (closed)
- 4 Check return pipes for correct operation
- 5 Check steam traps temperatures with pyrometer

Remarks : \_\_\_\_\_

Above work done by: \_\_\_\_\_

Date : \_\_\_\_\_

Preventive Maintenance Checklist according to schedule

CORRUGATOR

SINGLE FACER

- | | 1 Check lateral adjustment for freeness
- | | 2 Check parallelism adhesive roll to Low corrugating roll
- | | 3 Check parallelism doctor roll to glue roll
- | | 4 Calibrate all clearance indicators
- | | 5 Check and lubricate chains and gears
- | | 6 Check motors, clean and report overheating
- | | 7 Clean slots in top corrugating roll
- | | 8 Check all heated rolls for proper heating
- | | 9 Make sure all safety locks are working, repair as required
- | | 10 Check fingers for bent, replace as necessary
- | | 11 Check electrical wiring, control switches

Remarks: \_\_\_\_\_

Above work done by: \_\_\_\_\_

Date : \_\_\_\_\_

8. QUALITY CONTROL

The quality control at the corrugated board and box plant State Enterprise for Pulp and Paper is very limited. The adviser will here comment upon how to perform the quality control in a corrugated board and box plant.

In order to assure that the manufacture of corrugated boxes fulfil required specifications the plant must have a well organized quality control system.

The responsibility of the department for quality control is to make sure that the customers' specifications are fulfilled with regard to protection, storage, handling, advertising (printing) etc.

Quality control commences with the raw materials: paper and starch. The next step is to check that the quality of the corrugated board is acceptable for box manufacture and finally, the box itself must be checked. The quality control programme must include ocular inspection, checklists for supervisors and statistical sampling and evaluation.

Ocular inspection

The visual inspection can be carried out with a simple measuring tape, a micrometer but requires practical experience in the manufacturing of corrugated board and boxes.

Standards must, however be established and this can not be accomplished only by the quality control department. Supervisors, foremen and machine operators will all have to cooperate in this area. The standards could cover the following points that influence the manufacturing process of the function of the box.

(a) Raw Material

The condition of the paper rolls upon arrival (quality, loose winding, crushed cores, even paper caliper across the width of the roll etc.)

(b) Corrugated Board

- Crushed flutes
- Flute height (across the whole width of the web)
- High and low flutes
- Leaning flutes
- Liner cuts at the Single Facer
- Heavy glue line marks at the Single Facer
- Blisters and wrinkles
- Insufficient bonding
- Misalignment
- Sheet size
- Clean cut slitting and cut-off
- Scoring



(c) In-process Storage

Pallet stacks not aligned, causing crushing of the flute

(d) Converting Machines

- Caliper (checked before and after processing)
- Slitting: should be clean, not ragged
- Slotting: should be clean cut with a variation of max  $\pm 3$  mm from scorelines
- Manufactures' point: glue tap clean-cut not too long or too short
- Glue bond: fibre tear on 95% on area bonded, and well bonded at ends and edges
- Box dimensions correct
- Box squares up properly
- Top and bottom flaps

(e) Printing

- Legible, clean and sharp
- Correct colour and positioning
- Correct register, no smearing or ink stains
- Max caliper loss 0.1 mm

(f) Stitching

Distance between stitches, according to specifications

- no short or long legs
- no legs missing

(g) Bundling

- Number of boxes in bundles correct
- Square bundles
- Number of strings/straps
- Tension of strings/straps

Draft Procurement List for Testing Equipment

The following laboratory equipment is needed to permit an effective and versatile testing programme for paper, corrugated board and boxes.

State Enterprise for Pulp and Paper Industry disposes of some instruments, but they are obsolete and some are not functioning for example the Box Compr. Tester. It is recommended to purchase new modern equipment

<u>Priority 1</u>	<u>Ref. No.</u>
1. Quadrant scale	07
2. Grammage scale, digital 0.1-180 gr	80-21
3. Micrometer, bench type, dial indicator	51
4. Micrometer, portable 150 mm	
5. Stopwatch	
6. Hygrometer/thermometer with recorder	
7. Modern Cobb tester	146
8. Portable moisture meter, digital	
9. Crush Tester, with attachments	506
- Circular cutter for Flat Crush	F123
- Sample puncher for Ring Crush Test	108
- Billerud Edge Crush cutter	08B
- Edge crush test holder	506
- Pin adhesion test holder	506
- Ring Crush Test Holder	506
10. Bursting strength Tester, combined for paper and board	
11. Small cabinet for conditioning of samples 65ZRH 27 <sup>o</sup> C/50ZRH 20 <sup>o</sup> C	
12. Small oven for moisture content test	

- |   |      |
|---|------|
| 13. Box Compression Tester, with recorder | CT30 |
| 14. Tensile Strength Tester               | 01   |

Priority 2

- |  |      |
|--|------|
| 15. Concora Medium tester/sample cutter (CCA<br>Model JKB) |      |
| 16. Puncture tester  |      |
| 17. Bending stiffness tester                               |      |
| 18. Ash content tester                                     |      |
| 19. Smoothness and porosity tester                         | F113 |
| 20. Thermopaper (140-190 °C)                               |      |
| 21. Tear Tester  | 09   |
| 22. Vibration table  | 46   |
| 23. Incline/impact tester                                  |      |

Reference numbers from the Swedish Instrument Manufacturer  
Lorentzen & Wettre's Catalogue

It is further recommended (necessary) to install an  
equipment for CONSTANT CLIMATE in the laboratory

TESTING WITHOUT PROPER CLIMATE CONTROL IS OF LIMITED VALUE

The properties of paper and their influence on  
paper quality

As paper properties are of great importance for the manufacturing of corrugated board as well as for the final performance of the box, it is important to know the definition of the properties of paper and their influence on the quality.

Grammage: g/m<sup>2</sup>

Definition: Weight in gram per square meter. Conditioned grammage is the grammage obtained in a standardized climate (i.e. 65%RH, 20°C test method SCAN-P6:63 or ASTM D646.

Importance: As uneven grammage profile over the width of the paper roll will give poor runnability on the corrugator, especially if the edges of the paper roll have great variations in grammage.

Moisture content %

Definition: The loss in weight (%) of a sample when dried to constant weight under specified conditions SCAN-P4:63 or ASTM D6:44.

Importance: High moisture content causes a capacity reduction on the corrugator  
Low moisture content causes greater brittleness of the paper, poor gluability and thus capacity reduction on the corrugator

Porosity: ml/min.

Definition: The volume of air that, forced by a specific pressure difference, escapes in unit time through the paper (SCAN-P19:66 ASTM D726)

Importance: High porosity gives better runnability but can cause problems in automatic box-erecting machines

Burst  $\text{kp/cm}^2$

Definition: The maximum pressure, applied at a right angle, that the paper can withstand under well specified conditions (SCAN-P25:68 ASTM D2529)

Importance: National or international specifications to be met

Ring Crush Test: (RCT) kp

Definition: The maximum load a strip of paper bent in a ring form can withstand when it is edgewise compressed (SCAN-P34:71 or ASTM D1164)

Importance: Is very important for the compression strength of the final box

Water absorption (Cobb) g/min

**Definition:** The amount of water absorbed in a given time (normally 60 seconds) by one side of a unit of paper placed under 10 mm water (SCAN-P12:64 or ASTM D2045)

**Importance:** A low Cobb value can cause problems when glueing liner to fluting in the corrugator

E. UPGRADING EXISTING CORRUGATOR

The existing corrugator is obsolete, built in 1967, and 1.6m maximum width with some investments there might be a possibility to increase the production by 15-20% which in the adviser's opinion does not justify the cost for upgrading of this machine. The adviser will anyhow give recommendations for investment on this machine.

Single Facer

This machine was one of the first machines BHS (Manufacturer) constructed and the construction of the machine, makes it difficult to operate efficiently. Apart from the modifications necessary, described earlier in this report (change corrugating rolls, change of doctor roll to run in the same direction as the glue roll etc.) it is necessary to install a preheater (diameter 900 mm) for the liner and a preconditioner for the fluting. Automatic splicers approximately US\$ 180,000 to 200,000.

Double Facer

One preheater (diam. 900 mm) has to be installed with double wrap arms. The existing preheater for liner should be equipped with double wrap arms.

Modifications of the glue unit.

Automatic - auxiliary cut off knife to be installed

Installation of Automatic splicer for liner

Investment cost: US\$ 150,000.

Cut-off knife

At present time there is a single cut off knife. It is strongly suggested to install a double direct drive cut off knives in order to be able to increase the average width of the paper, by combining different orders and also to reduce the waste.

Investment cost: US\$ 350,000 to 400,000.

Those are the major investments to be made on the machine together with necessary repair cost a total amount of approximately US\$ 800,000 to 850,000 are to be spent on this machine.

It is important to bear in mind that still it is no possible to make Double Double corrugated board on this machine.



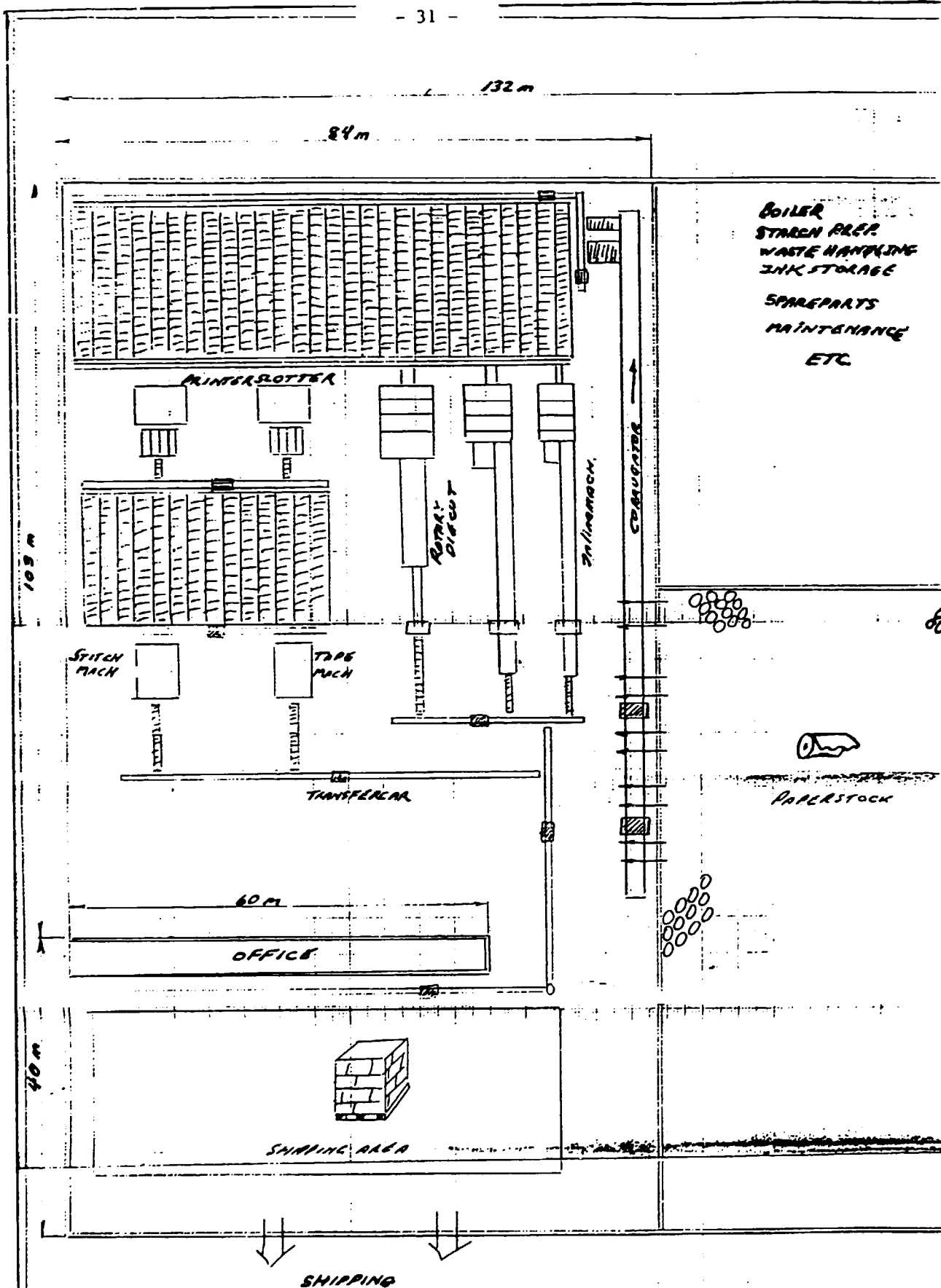
F. OUTLINE OF NEW LAY-OUT

The adviser has been informed that State Enterprise for Pulp and Paper has advanced plans on purchasing a new corrugator (width 220 cm), Inline-machine and rotary die cutter.

The adviser has therefore taken the liberty of proposing a new lay-out for the factory.

As the time spent on this subject has been very limited, this outline (see attached sketch) has no pretensions to completeness. The aim has only been to give an idea of how the new machines can be installed without interuption of the present production.

Once it has been decided to buy new machines, it is necessary to study the lay-out in detail. Great care must be taken in the calculations of proper space for the machines and areas for storage of paper (raw material), semi-finished and finished products as well as the proposed conveyer system.



OUTLINE OF PROPOSED NEW LAYOUT FOR  
STATE ENTERPRISE FOR PULP AND PAPER INDUSTRY

G. RECOMMENDATIONS

In the light of the observations made by the adviser during this mission, the following proposals are put forward to State Enterprise for Pulp and Paper Industry.

1. All of the production machines and especially the corrugator must undergo a complete overhaul.
2. A new and efficient lay-out must be studied
3. Introduction of an effective preventive maintenance system is a must
4. Upgrading of the laboratory and introduction of a quality control system.
5. Urgently introduce a reporting system outlined by the adviser
6. Down time of the machines must be recorded.
7. Housekeeping has to be improved
8. Introduction of a waste control system outlined by the adviser

9. Upgrading of the technical know-how, management as well as operators. This could be done by sending selected people to corrugating plants in Europe. The adviser could be of help in selecting suitable plants.
  
10. As the only possible way of obtaining production, productivity and quality comparable with modern plants in other countries, the adviser strongly support the idea of purchasing new corrugating machine as well as converting machine.

ANNEX I

Production report

As production reports in the corrugated board and box plant are very scarce indeed, it is recommended that a reporting system be introduced in order to monitor the efficiency of the machine, and to help to programme future activities.

A management in possession of statistics based on different reports from the sales and production departments will be able to project and plan for future activities such as:

Sales:                      Sales volume  
                                 Order mix  
                                 Average order size  
                                 Sales price (different qualities etc.)

Production:                Machine performance  
                                 Production flow  
                                 Machine budget  
                                 Manufacturing budget  
                                 Volume of necessary investments  
                                 etc.

An efficient reporting system is the most important tool when making a yearly budget and production plan.

A typical example of a monthly production report for monitoring the performance of a corrugator is given below.

MONTHLY PRODUCTION REPORT: CORRUGATOR

	Jan	Feb	Year to Date	March	Year to Date	April
1. Production: $Mm^2$						
2. Production: linea /m						
3. Man hours						
4. Man hours per $Mm^2$ (3):(1)						
5. Machine hours						
6. $Mm^2$ per machine hour (1):(5)						
7. Utilization in 3-shifts %						
8. Total stop hours (when personnel present, excluding lunch						
9. Stop hours in percentage of machine hours (8)x(100):(5)						
10. Average speed (2)x1000: (5)x60 m/min						
11. Paper consumption kg						
12. Number slitter changes						
13. Average core board weight (11)x1000 : (1) $g/m^2$						
14. Average side trim mm						

Explanations to the columns: The column for the month could be weeks, days or any other time period. The most important factor is that it reflects accumulated year to date figures ( $Mm^2$  :  $1000 m^2$ )

ANNEX II

Reduction of paper waste

As efficient waste control system should be one of the most important steps taken by the management to reduce costs. Too much waste could mean the difference between profit and loss for a corrugated board and box plant. A normal figure for a competent box plant is 8% waste.

There are many different reasons for waste and they may be divided into three main categories.

At State Enterprise for Pulp and Paper Factor Industry there is no distinction the different categories which are:

- Paper transport waste (from paper mill to the box plant)
- Paid waste
- Avoidable waste

1. Paper transport waste

Normally covered by transport insurance

2. Paid waste

This waste consists of cuttings, the amount of which depends on the design of the box. This is paid by the customer/box user.

3. Avoidable waste

This type of waste can be reduced by careful planning and manufacturing in the box plant. How, when and where this type of waste is generated is discussed below and recommendations are made for its systematic reduction

4. Sources of waste

Any waste reduction efforts must be preceded by a systematic investigation into waste generation during the different stages of production. This will look into the following:

- (a) Raw material: external transport damages, moisture damages in paper stock, suppliers' waste
  
- (b) Corrugator: roll peel, bridge waste splicing, quality change overs, width change, corrugator steps, corewaste, edge trim, cut-off errors, edge misalignment, bonding defects, wrapped sheets
  
- (c) Converting machinery; slotters  
inline machines , etc.  
Start-up sheets, edge trim, feeding errors, manufacturers joint errors, unacceptable printing, slotting errors, creasing errors, out of register (printing), slot-waste, ink stains, wrapped sheets (corrugator waste) etc.



(e) Other: claims

All above-mentioned sources of waste are present in any box plant but produce more or less waste depending on order mix, average order length, type of machinery, lay-out and type of internal transport handling system.

5. Analysis and suggested actions

Raw Material

(a) External transport damage

This means transport from the papermill to the point of discharge at the corrugated box plant.

From the moment the box plant's clamp truck grabs the paper roll, the transport becomes internal and thus the plant is responsible for any further damage to the roll. It is essential therefore, that every delivery be carefully checked before unloading, not only to check for damaged rolls but also to compare the state of rolls arriving from the supplier. A report should be issued to the supplier(s) for every delivery. The following data should be recorded in that report: Supplier, type of waste, weight of damaged paper roll number and order number.

Apart from possible transport damage, the rolls should be inspected and the results of the inspection should be recorded if necessary with regard to the following

points upon arrival: even roll end, quality corresponding to specifications given, moisture damages, band, cores, clean marking (roll number, order number, etc), roll width corresponding to specifications given, and winding (loose or uneven).

(b) Internal transport damage

As much waste is caused by careless internal transport as careless external transport, which is absurd bearing in mind the difference in distances. In an effort to reduce internal transport damages, particular attention should be paid to the following points

- A roll should never be dropped from a truck/if necessary, old car tyres could be used as cushions
- A roll should never be dragged over the edge of the truck's platform
- The claws of the clamp truck should be sufficiently open when grabbing the roll
- Rolls should not be squeezed too much by the clamp truck
- Rolls should be transported with sufficient distance between the end of the roll and the ground
- Care should be taken when piles of rolls (other rolls may be damaged).

- The roll should be placed down with care
- The lighting in the stock area must be sufficient
- Rolls should be stored vertically on deals or battens in order to avoid moisture damages from the floor and prevent gravel from entering the roll end
- Truck drivers should be aware of the value of the paper they handle.

(c) Moisture damages

The roofs of the warehouses in which paper rolls are stored must be inspected frequently to ensure there are no leaks through which rain could enter

(d) Suppliers waste

This type of waste occurs when there are defects that starts in the manufacturing of the paper roll such as bad splices, wrinkles and stains

6. Waste Control System

Any waste reduction system must be studied carefully before it is put into operation and must be based on a study that looks into where, when and how waste is generated. Management must accept that the establishment and introduction of a waste control system requires the services of one person employed full time for approximately two to three months.

The following form may serve as an example of how to control different sources of waste in the corrugator:

<u>Waste Report</u>	
Shift (Circle one) 1. 2. 3	
Date: _____	
Machine : Corrugator	
Source	Weight kg
Core weight net	_____
Stripping weight	_____
Bridge drop	_____
Missed splice	_____
Paper Break	_____
Core Weight (Paper)	_____
Rejects at take off	_____
	Total _____

Carts or boxes of each work station and a scale are required for a waste control system. In order to encourage the workers and foremen to take actions against the waste problems, production staff should benefit from the savings.