PRODUCTION PLANNING IN TEXTILE INDUSTRY

by
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PRODUCTION PLANNING IN TEXTILE INDUSTRY

The topic of this thesis is production planning in the textile industry. The thesis consists of two parts, both of which use the data of a firm currently operating in the short fibre sector of the textile industry.

The first part consists of a dynamic linear programming model for the macro production planning of the firm under consideration. The linear programming model is then used to analyse a number of scenarios with the aim of determining optimal production, purchasing, inventory, and sales policies and directions for future investment.

The second part consists of the scheduling of the Finishing department. As this problem is of the classic "n-jobs m-machines" type which has no known analytic solution, a heuristic algorithm, which will not require any changes in the current system, is developed to help generate alternative schedules and obtain an insight into the workings of the department.

TEKSTİLDE ÜRETİM PLÂNLAMASI

Bu çalışmanın konusu tekstil sektöründe üretim planlamasıdır. Tez iki bölümden oluşmaktadır ve her iki bölümde de halen kısa elyaf sektöründe çalışmakta olan bir şirketin verileri kullanılmıştır.

İlk bölümde, ele alınan şirketin makro üretim plânlaması için geliştirilmiş olan dinamik bir doğrusal programlama modeli tanıtılmaktadır. Doğrusal programlama modeli, en iyi üretim, satınalma, stok ve satış politikaları ile yatırım kararlarının tesbitinde kullanılmak üzere çeşitli senaryolar için çalıştırılmıştır.

İkinci bölüm terbiye işletmesinin iş çizelgelemesini içermektedir. Bu problem klasik "n-iş, m-makine" problemi olduğu için ve bilinen bir analitik çözümü olmadığından, sezgisel bir algoritma, alternatif iş çizelgelemesi yaratılması ve işletme içi ile ilgili bilgi sahibi olmak için, mevcut sistemde herhangi bir değişiklik meydana getirmeyecek şekilde, geliştirilmiştir.

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I. INTRODUCTION

This study was performed in the textile industry, which plays an important role in the Turkish economy due to its large share in exports and employment, and which is developing rapidly.

Textiles constitute about 50 % of industrial products exported from Turkey. In 1981 800.000.000 US $ worth of textile products were exported and in 1982 this figure rose to 1.056.000.000 US $. The 11.500 firms operating in this sector employ approximately 254.000 people(1).

In the first part of this study, a model for the Macro Production Planning of a firm working in the short fibre sector is developed. A similar study for a centrally controlled group of several plants producing cotton has been done by Nebol, et al.(2).

This study employs an integrated approach which considers the units of the firm as a whole rather than considering each of them individually. Also, by illustrating the application of modern management techniques beyond time and work study, it is hoped to promote the application of such methods in industry.

When you take into consideration the whole system of a

firm, you will meet many problems at different levels of the organization. These problems are attempted to be solved by using information flowing horizontally and vertically through the organization. The firm studied in this thesis has a distributed planning approach, i.e. the plans of different departments are coordinated to result in an overall plan. The hierarchy in planning follows the hierarchy in the organization. Thus departments at the same level in the organization develop their own plans communucating with each other through horizontal flow of information. For example, Production, Finance, and Investment plans of the firm are developed at the same level. As will be seen later in more detail, production department consists of several units. Each unit is planned in an interdependent fashion with the others. The plan for each unit then is said to belong to one lower level than macro production plan (MPP). These plans are of operational nature planning the day-to-day operation of the units in the finishing department.

In this thesis we first consider MPP of a firm currently operating in the short-fibre sector of the textile industry. It should be emphasized that MPP is based on real data gathered as a result of extensive effort. MPP has a one year horizon covering three 4-months periods and consisting of two planning levels. The two levels are represented here by two models.

The first model representing the upper level takes into account the firms three main production centers, their capacities, the characteristics and capacities of available machinery, products which can be processed on these machines, and their constructions (weaving patterns), production costs, sales and purchasing prices, inventory holding costs, finished and semi-finished goods machine time requirements and quality and scrap levels.

A dynamic Linear Programming (LP)(3) model was constructed and used to analyse a number of scenarios.

In the lower level for each unit in the Production department there should be a seperate plan. Within the scope of this thesis the lower level will be represented by the scheduling model of the Finishing department. The presence of many multi-purpose machines and the large number of different processes leaves us face-to-face with a classical n-jobs, m-machines problem(5) which has no analytic solution for large scale problems. The large number of orders mostly in small quantities, and complexity of the production process lead to considerable problems.

A deterministic, heuristic model, based on the current planning system is constructed to perform the daily scheduling without requiring any additional changes in the current system. The heuristic solution procedure can be run for several days in succession to obtain weekly schedules. It is hoped that this model will help to generate alternative schedules and to gain an insight into the operations taking place in the Finishing department.

The first model is deterministic. The second model is designed to absorb the uncertainties arising during daily operations.

II. PRODUCTION PATTERN

This chapter presents summary information related to the production pattern covering the processes from the incoming raw material to the finished cloth in the three main production centers considered in this thesis.

A. YARN PRODUCTION

Raw material for yarn is fiber. Fibers can be grouped into two as natural and synthetic (man-made). Cotton and wool are examples of natural fibers whereas polyester and viscose are examples of synthetic fibers. The factory considered uses cotton as natural fiber.

Desired grades of yarn are obtained by applying the following processes.

1- Blending and opening
2- Carding
3- Drawing
4- Roving
5- Spinning
6- Winding

Following these stages different processes are used

depending on the type of yarn. Four different kinds of yarn, namely: (i) single-white, (ii) double-twisted-white, (iii) single-dyed, and (iv) double-twisted-dyed yarns can be produced in the operation.

Processes applied to obtain these yarns are presented following a sequence in Figure 1. General information on these processes are presented below:

1- Blending and Opening: Fibers which are brought into the factory pressed in bales, are unpacked, placed in order to get accustomed to atmospheric conditions. Later these fibers are combined in desired ratios and cleared by removing the dust by various subprocesses. At this staje combined fibers go through Multimixer, various Openers and Cleaners and finally arrive at Scutcher which they leave in form of lap.

2- Carding: Laps leaving the Blowroom department are carded in the card machines. During this process short fibers and neps, dusts and dulls are removed. Combined fiber which enters the card as lap is processed to take the form of web which is later shaped into sliver and placed into cans.

3- Drawing: In this process cans of card slivers are folded and drawn continously. Here the objective is to obtain a homogenous sliver, minimizing irregularities and making the fibers parallel.

4- Roving: It is the process with which the slivers are slimmed by a certain method of pulling to be able to process in the spinning frame. Roving is the final stage of yarn preparation.

5- Spinning: It is the basic process of yarn production. The number of yarn and number of twists per inch are

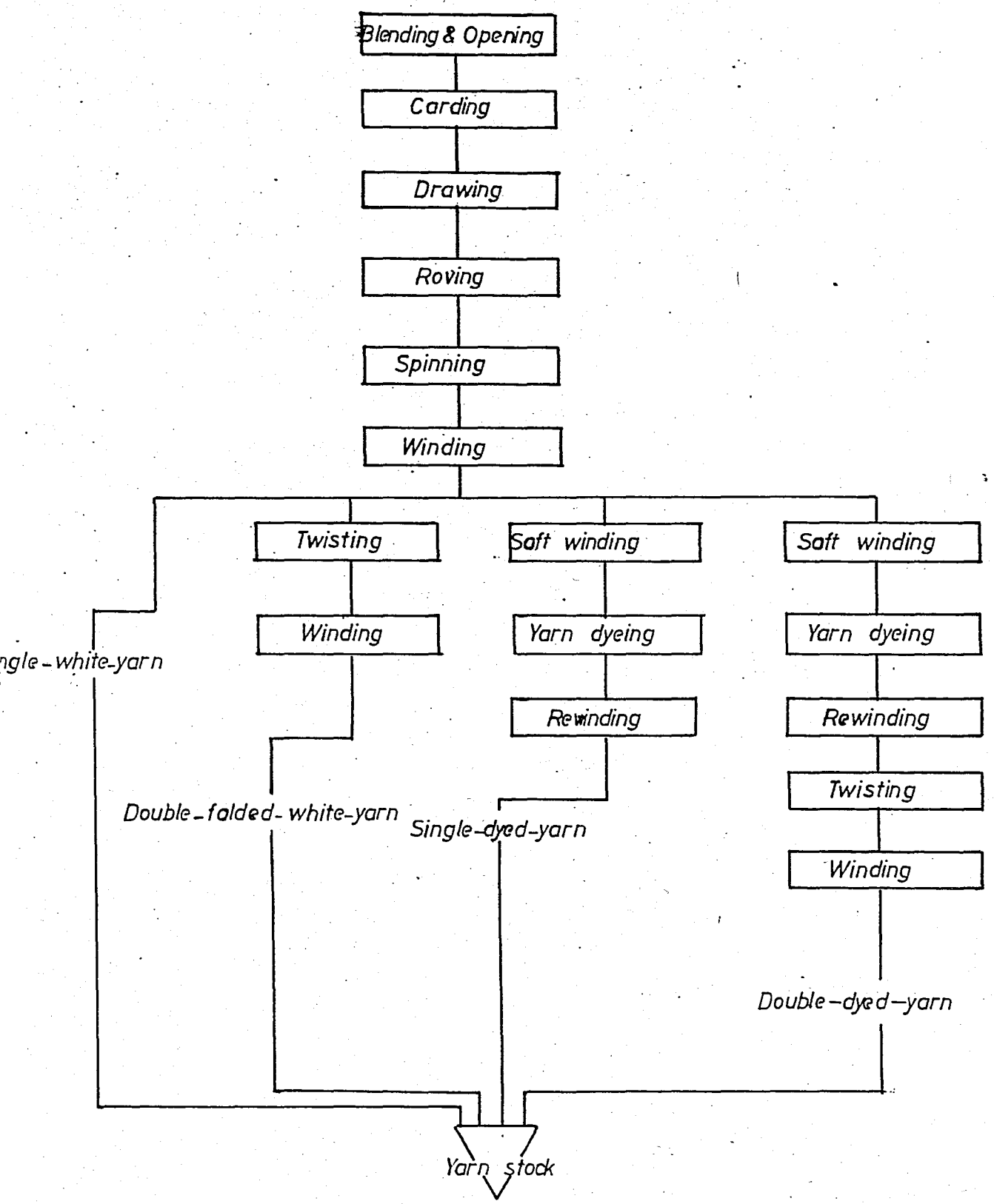

Figure 1 : Yarn production

important measures in this process.

6- Winding: Here the yarns which are on copses are winded on the cones in the desired quality. During this process some of the defects on yarns are corrected.

7- Twisting: Double-folded yarns are twisted by a certain twisting constant.

B. GRAY CLOTH PRODUCTION

Yarns are woven by the following process according to the given constructions.

1- Weft preperation
2- Warp preperation
3- Sizing
4- Drawing
5- Weaving

Cloths to be woven follow the operations given in Figure 2.

1- Weft Preperation: Horizontal yarns of the cloth are called weft or filling. Wefts are inserted to the gray cloth by means of either shuttles or rapiers or projectiles. Weft preperation is the process where shuttles are winded.

2- Warp Preperation: Vertical yarns of the cloth are called warp. According to the given warp-report, yarns taken from the cones are winded on the warp beam at a certain rate. There are two types of warping machines in the operation. Plain products which will go through the sizing process later are processed by "direct beamer". "Conical beams" process

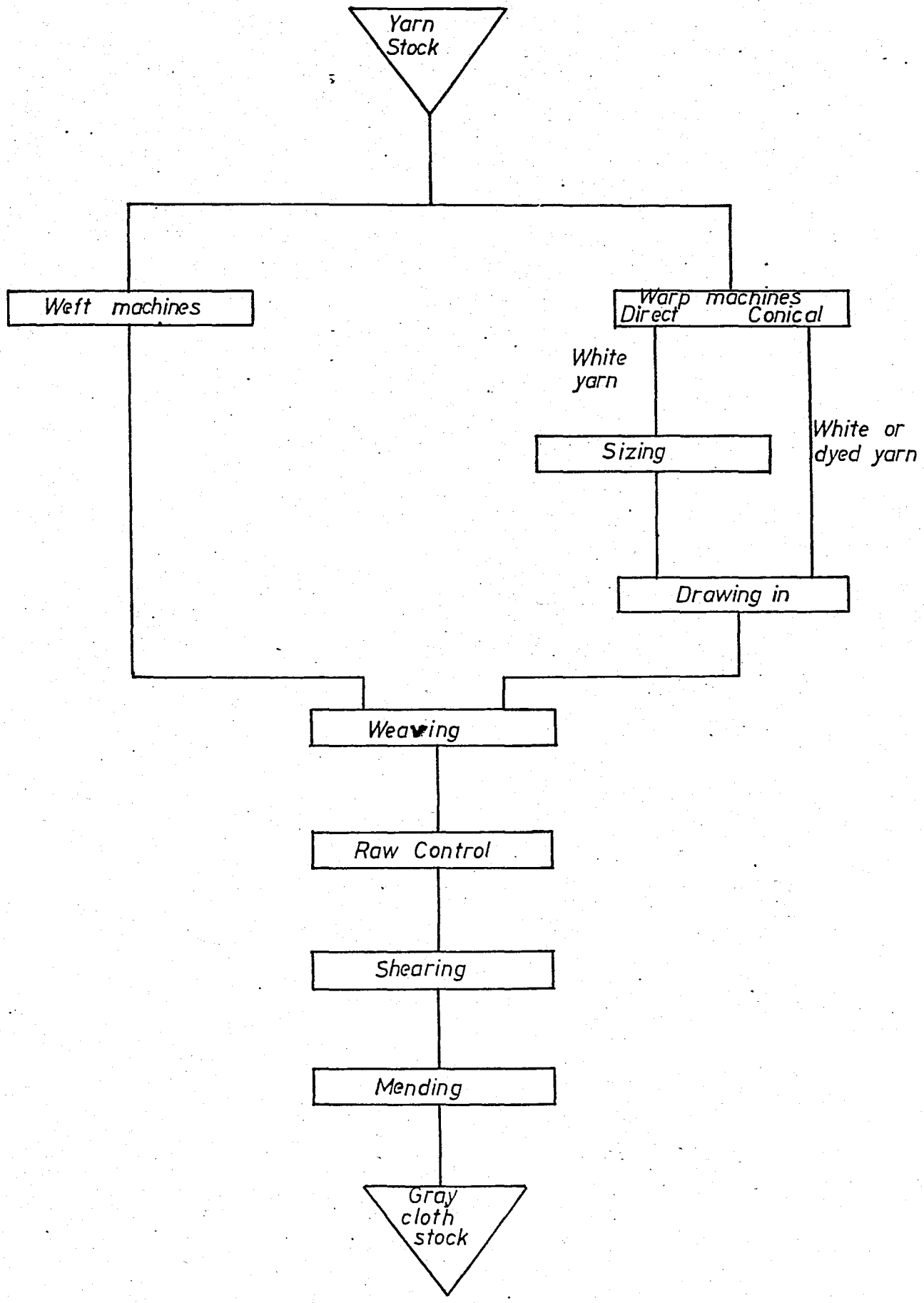

Figure 2 : Gray cloth production

dyed-yarns which shall not be sized, but directly placed on the beam.

3- Sizing: Beams processed on the direct beamer are used in the sizing machine where they are exposed to a chemical. The purpose of sizing is to give certain strength to the yarn to prevent collection of raising and to prevent formation of static electricity.

4- Drawing: In this stage, warp yarns are made ready for weaving. Frames are used for weaving cloth. In this process yarns with similar movements in the weaving report are collected in a single frame.

5- Weaving: Weaving is the basic stage of gray cloth production. Weaving is done by knitting weft and warp yarns, mounted on the loom beforehand, with respect to a plan. The gray cloth that has been woven is winded on the cloth beams placed on the loom and transferred to Quality Control department.

C. FINISHED CLOTH PRODUCTION

Cloths follow varying orders of procedure depending on the type and the specifications required of the finished cloth. Sequence of operations, as well as the speeds of machines and the number of times the products go through the machines change, depending on the type of the finished cloth.

Finishing center can generally be divided into four main groups.

1- Scouring and Bleaching
2- Dyeing

3- Printing

4- Chemical finishing

Information about these production units and their intermediary processes are presented below:

1. SCOURING AND BLEACHING

a) Burning and size removing: Here, some of the irregularities that have not been eliminated in the previous processes are removed with the burning operation. Also the yarns that had been previously sized are re-exposed to chemical reaction in order to remove the size on them.

b) Scouring and Bleaching: This process is applied in order to clean the cloth, increase its capability to maintain colors and whiten it for further dyeing.

c) Mercerizing: The purpose of this process is to increase coloring efficiency, obtain shiny colors, and give the cloth a good texture.

d) Equalizing: This process applied to make sure that cloths are opened at a certain width and making weft yarns neat and parallel.

2. DYEING

Depending on their type, products that will be plain dyed are either dried and fore-fixed, or just dried, and are ready to be colored. Several sub-processes are applied in this unit as well.

a) Fore-fixing: Colored cloths are given a certain form and stability to be ready for coloring.

b) First Dyeing: Depending on their fiber mixtures, synthetic, cellulosic, or natural fibers absorb color through different processes. Polyester of Polyester-Viscose (TV) and Polyester-Cotton (TP) goods are first colored by a different process, which is called "first dyeing".

c) Thermo-fixing: This process is applied to cloths that go through the first dyeing process. The purpose is to make the polyester color permanent on the cloth.

d) Second dyeing or Cotton dyeing: Hundred per cent cotton goods and second type of fibers of TV and TP products are dyed in this stage. Products may again undergo several various coloring processes. Some of the coloring process are the following: Reactive dyeing, Indanthren dyeing, Disperse dyeing, Cassulfon dyeing, etc.

3. PRINTING

Hundred per cent cotton products can be printed as well as dyed. Different color mixtures can be used in printing like dyeing. Preparation for printing is more difficult and time consuming than dyeing. A series of operations is necessary for printing a design. First the design is drawn and a pattern is prepared for printing.

For a design that will be repeated continously, a report of the design is prepared. Report provides repetition of a design. There are roller printing machines in the factory. Finally these rollers are prepared for the printing operation. The printed goods go through steaming operation. The cloths are washed after printing.

4. CHEMICAL FINISHING

In the last main process of finishing center, products are given desired specifications through various chemical operations. This operation gives certain characteristics to the cloth to increase selling opportunities, and helps to promote usage value. Finished cloths later go through Condense operation so that the finish becames permanent. Some machines with certain purposes are used in the process for chemical finishing. Some of these are explained below:

a) Raising: In this process, cloths can be raised as much as desired.

b) Sanforizing: It is necessary that some cloths do not shrink after they are washed. Sanforizing operation prevents shrinkage of the cloth.

c) Kalander: It is a process by which the finished product is given a softer touch.

Finished cloths processed in the finishing center are sent to the Quality Control department.

III. MACRO PRODUCTION PLANNING MODEL

III.A. MODELLING APPROACH TO MACRO PRODUCTION PLANNING

This part of the study is concerned with production planning in one of the country's large, integrated textile factories with a firm place on the market.

The Macro Production Planning (MPP) model considers the factory to be studied as a whole. The Spinning, Weaving and Finishing departments and their interactions are studied to give the firm's optimal production levels in each department, inventory levels and purchasing programs for raw materials and other inputs.

The model considers the capacities of the three main departments of the factory, the various types of products and their separate constructions, production costs, sale prices, buying prices for raw materials and other inputs, inventory holding costs, quality levels and waste (scrap) percentages. This information has been gathered from the various departments and has been included in the model after being checked against available statistical data.

Sale prices production costs and costs of raw materials and other inputs were determined by the departments concerned and the firm's 1984 Production Plan(6). Special

care was taken that these figures agree with the firm's production plan as far as possible.

A great deal of information above was obtained by interviewing the firm's employees. Due to the drastic changes in the economic policies since 1980 any statistical data before the year 1980 is not any more representative and is thus not used in the analysis here.

Due to the fact that the fast development of technology in the textile industry leads to the technological and economic life times of machinery being short, the models technology matrix has been designed to minimize the effort required to reflect changes of these sorts in the model.

Lack of data on various subjects has forced me to make several assumptions. These are listed in detail in the section of Model Inputs.

If the technology matrix is kept up to date with the necessary information, the model can be used as a long-term aid to decision makers.

The firm's production, sales and purchasing system, on which the model is based, is shown in Figure 3.

After products have been assigned to the Finishing department (T) the necessary gray cloth is drawn from the gray cloth inventory (DS). Products assigned to the Finishing department are either gray cloths produced in the Weaving department (DU), or gray cloths purchased from outside the firm (DM) or gray cloths being processed for another firm (piecework) (DF). Waste and stretching coefficients have been taken into account during the flow of goods from one department to another.

The same principles hold for the flow of goods from the Spinning department (I) to the Weaving department (D).

The yarn necessary for the production of gray cloth in the Weaving department is drawn from the yarn inventory (IS) which it enters either by being produced in the firm's Spinning department (IU) or being purchased from outside dealers (IM).

The Spinning department's requirements of fibers is drawn from the fiber inventory (ES).

All assignments are performed by the model simultaneously and are restricted by the capacities of the various departments.

As can be seen in the Figure 3 finished goods are sent to the finished cloth inventory (MS). From here they are either exported or sold on the domestic market. Export goods are first made into ready-made clothing in the Ready-Made Clothing department. The firm also exports a small amount of finished cloth, but this is negligible.

III.B. MATHEMATICAL MODEL

The mathematical approach used for the modelling of MPP process is dynamic linear programming, which is solvable even for very large problems and reflects perfectly the periodical structure of the MPP process.

The MPP model, mathematical details of which will be given later, considers the three main production and inventories of textile production, namely Spinning, Weaving and Finishing and their interactions (and inventories) as a whole.

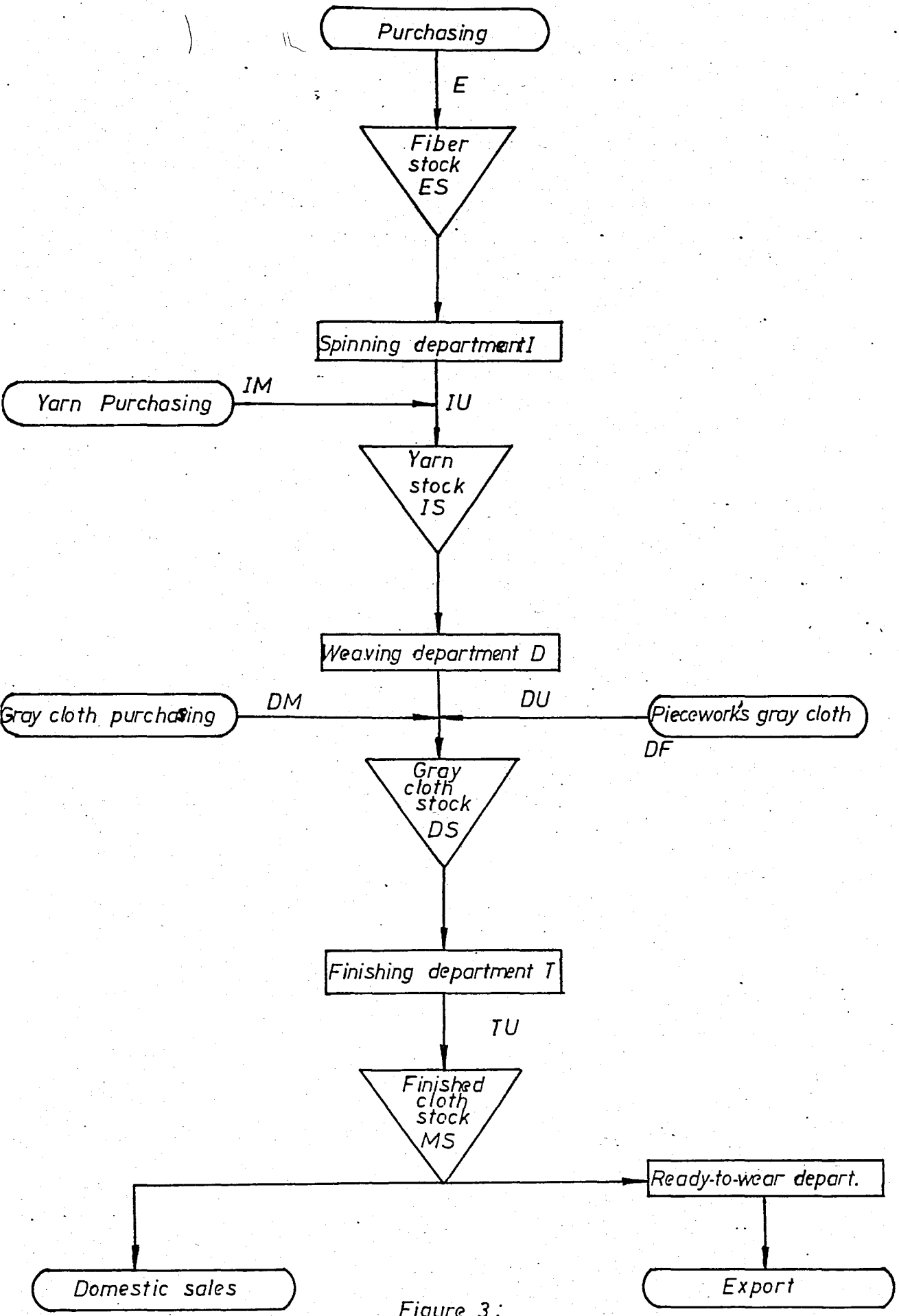
Purchasing
E
Fiber stock ES
Spinning department I
Yarn Purchasing
IM
IU
Yarn stock IS
Weaving department D
Gray cloth purchasing
DM
DU
Piecework's gray cloth
DF
Gray cloth stock DS
Finishing department T
TU
Finished cloth stock MS
Ready-to-wear depart.
Domestic sales
Export

Figure 3 :

III.B.1. Objective Function

Today no firm is managed with a view to attaining only one objective. In the current state of markets and world economy firms are forced to take account of multiple objectives. The basic objectives of the firm under study are;

i) Raise quality level
ii) Save energy
iii) Minimize financial costs
iv) Minimize overtime working
v) Maximize profit.

These have become the classical objectives of firms in the textile industry today.

The model attempts to take all these objectives into account. The following were noted:

i) Raise Quality Level

The MPP model does not try explicitly to raise quality level. However, the effects of fluctuations in quality levels, given by the first and second quality level proportions and used as parameters in the model, on production plans can be noted.

ii) Energy Savings

It is extremely difficult to incorporate parameters for energy conservation into a product-mix model since no data for energy consumption on a product basis exists. However, consumption figures for each department were found and energy costs included in the objective function. Energy conservation was not considered as a separate objective.

iii) Minimization of Finance Costs

Recent economic developments have left many textile firms face to face with severe financial problems which they have never faced before. A research by the Türkiye Sınai Kalkınma Bankası in 1982 states that finance costs amount to 9.4 % of production costs, and is the most important problem of 37.3 % of firms involved(1).

Due to the fact that this area is heavily dependent on economic developments and firm policy for managing its cash flow, it is not taken into account by the model. The financial burden of inventories is taken into account in the calculation of inventory holding cost which will be defined later.

iv) Minimization of Overtime

The model considers an ideal situation and thus takes no account of overtime. Overtime can easily be incorporated into the model structure but with the aim of keeping the model as small and the run-time as low as possible, overtime is not considered. In certain departments of the firm under study overtime is impossible due to maintenance considerations, and in other departments bottlenecks exist which can only be surmounted by overtime (For example, the winding unit can not meet the demand when the yarn dyeing unit is used at full capacity, the model takes account of this bottleneck).

v) Maximization of Profit

The most dominant objective for the model is the maximization of profit. For this purpose quality levels and sales prices for domestic and export markets were collected, and purchase prices for fibers, yarns and gray cloths were

forecast. Holding costs for finished product, work-in-process inventories in each of the departments were calculated and production costs for each department were calculated. A monthly interest rate of 5 % used in these calculations.

As profit margins are used in the objective function, the model works backwards from sales and production of finished cloth. Products with sales lower bounds (if any) are first assigned capacity in the Finishing department and the remaining capacity is allocated among other products according to the objective function and constraints.

Certain firms use maximization of production as a working objective. This may be a suitable objective for a public agency, but as in a product-mix model different products have different profit margins, maximization of production does not necessarily result in the maximization of profit. This model does not consider production maximization as an objective.

III.B.2. Constraints

1. Capacity Constraints

i) Spinning Department

The amount of single yarn produced in period t is restricted by the total ring-spinner spindle-hours available in that period. Firm policy is to use a given minimum of this capacity in each period.

The amount of double folded yarn produced in period t is restricted by the total twister spindle-hours available. There is also a lower bound on twisting utilization.

ii) Weaving Department

The amount of gray cloth woven in the j^{th} weaving unit in period t is restricted by the total loom-hours available. A given percentage of the looms have to work in all periods.

iii) Finishing Department

The amount of gray cloth to be processed on unit j in period t is restricted by the total working hours available for that unit in that period. No lower bounds on utilization are given, and as a result, some machines may work at very low utilizations.

2. Material Balance Equations

i) Finished Cloth

For each type of cloth and at each period the sum of beginning inventory and production in that period must equal the sum of ending inventory and sales in that period.

ii) Gray Cloth

For each type of gray cloth and period, the amounts of purchased, produced and piecework gray cloth and the amounts entering and leaving the inventory in that period must balance.

iii) Yarn

Purchased and produced yarn inventory must balance.

iv) Fiber

The fiber inventory must balance in each period.

3. Purchasing and Piece-Work (FASON) Restrictions

Firm policy may restrict purchases of yarn and gray cloth or amount of cloth to be processed for other firms in a given period.

4. Special Unit Capacity Constraints

As the effect of the capacities of certain units on production level is great, the capacity constraints of the model have to take these into account. Although some of these (e.g. washing units) may have already been incorporated into the technology matrix, these constraints are considered here explicitly.

i) Yarn-dyeing Unit

Due to the technology involved, the capacity of the yarn-dyeing unit cannot be ascertained with any great degree of precision. An average figure is 3500 kg/day, which restricts production of yarn-dyed cloths.

ii) Raising Unit

Here again a price determinatin of capacity is impossible. This unit consists of two machines through which the product passes. The number of passes depends on the product. A precise capacity figure on product basis cannot be given, but a figure of 10 000 m/day for Polyester/Viscose (TV) goods is considered to be a good estimate by the management.

iii) Winding Unit

As it is seen in the yarn production flowchart (Figure

1), the yarns pass through the winding unit once or twice depending on whether they are one or two-ply. Yarn-dyed goods have a different flow and constitute negligible proportions of total production. Thus dyed yarns are neglected and this unit is included in the special capacity constraints since it creates a bottleneck.

iv) Washing Unit

The washing machines are considered in three groups: The wide washing machines, the narrow printed washing machine, and the wide and finally all washing machines. Capacity constraints for each group are given.

5. Bounds on Sales

Sales of certain products vary seasonally. For example, since raised goods are used in winter they are produced and sold mostly in summer, with no sales in the first period. Certain other products are the firms well-accepted products and are sold at a certain level all year round. These are given lower bounds, while new products that cannot be sold in large quantities are limited by upper bounds on sales. As the firm markets its product both in the domestic and foreign markets and sales volumes can be forecast for both, upper bounds are set on total amount of sales on each market.

III.B.3. Mathematical Representation

The mathematical representation of the MPP model is given below.

1. Indexes

t: time index
h: fiber index
i: yarn index
d: gray cloth index
m: finished cloth index
j: machine-group (unit) index

2. Sets

A: Set of produced single yarns
B: Set of produced double folded yarns
C: Set of purchased yarns
D: Set of produced gray-cloths
E: Set of purchased gray-cloths
F: Set of gray-cloths processed for other firms
G: Set of finished cloths
H: Set of fibers
I: Set of products washed on washing unit 1
J: Set of products washed on washing units 1&2
K: Set of exportable products
L: Set of domestic-market products
B: Set of yarn-dyed gray-cloths
N: Set of raised products.

3. Decision Variables

S_{mt} : Sales of finished cloth m in period t
IU_{it} : Production of yarn in period t
DU_{dt} : Production of gray-cloth d in period t
TU_{mt} : Production of finished cloth m in period t
E_{ht} : Purchase of fiber h in period t
TUU_{mt} : Production of cloth m, from produced gray-cloth in period t
TUM_{mt} : Production of cloth m, from purchased gray-cloth in period t

TUF_{mt} : Production of cloth m, for other firms in period t

$DUUU_{dt}$: Production of gray cloth d, for which both warp and weft yarns are produced in t

$DUUM_{dt}$: Production of gray cloth d, weft of which is produced, warp purchased in period t

$DUMU_{dt}$: Production of gray doth d, weft of which is purchased, warp produced in period t

$DUMM_{dt}$: Production of gray cloth d, both warp and weft of which are bought in t

MS_{mt} : Inventory of cloth m at end of t

DS_{dt} : Inventory of gray cloth d at end of t

IS_{it} : Inventory of yarn i at end of t

ES_{ht} : Inventory of fiber h at end of period t

DM_{dt} : Purchases of gray cloth d in period t

IM_{it} : Purchases of yarn i in period t

DF_{dt} : Piece-work gray cloth type d in period t

4. Parameters

a_{mt} : Sale price of product m in period t

b_{it} Production cost of yarn i in period t

c_{dt} : Production cost of gray cloth d in period t

e_{mt} : Production cost of finished cloth m in period t

g_{it} : Purchase price of yarn i in period t

k_{dt} Purchase price of gray cloth d in period t

p_{ht} : Purchase price of fiber h in period t

l_{ht} : Holding cost of fiber h in period t

m_{it} : Holding cost of yarn i in period t

n_{dt} : Holding cost of gray cloth d in period t

o_{mt} : Holding cost of finished cloth m in period t

r_{ih} : Amount of fiber h needed to produce one unit of yarn i

s_{di} : Amount of yarn i needed to produce one unit of gray cloth d

x_{md} : Amount of gray cloth d needed to produce one unit of finished cloth m

v_{ij} : Time of machine type j needed to produce one unit of type i yarn

d_{dj} : Time of loom type j needed to produce one unit of type d gray-cloth

t_{mj} : Time of finishing machine type j needed to produce one unit of type m cloth

y_m : Number of passes of type m through washing machine

w_d : Average weight of one meter of yarn-dyed gray cloth

$VMAX_{zt}$: Available time of spinning machine j in t

$VMIN_{jt}$: Minimum working time of spinning machine j in t

$DMAX_{jt}$: Available time of loom type j in t

$DMIN_{jt}$: Minimum working time of loom type j in t

$TMAX_{jt}$: Available time of finishing machine j in t

$IMMAX_t$: Upper bound on yarn purchased in t

$DMMAX_t$: Upper bound on gray cloth purchased in t

$DFMAX_t$: Upper bound on order-processing in t

$IBMAX_t$: Upper bound on dyed-yarn gray cloth in t

$SAMAX_t$: Upper bound on raised cloth in t

$BOMAX_t$: Upper bound on winding capacity in t

$Y1MAX_t$: Upper bound on washing-1 capacity in t

$Y2MAX_t$: Upper bound on washing-2 capacity in t

$YMAX_t$: Upper bound on total washing capacity in t

LB_{mt} : Lower bound on sales of m in t

UB_{mt} : Upper bound on sales of m in t

IHR_t : Upper bound on exports in t

DAH_t : Upper bound on domestic sales in t

Objective Function

$$\text{Max } Z = \sum_{m\epsilon G,t} a_{mt} S_{mt} \quad \text{(sales revenue)}$$

$$- \sum_{i\epsilon AUB,t} b_{it} IU_{it} - \sum_{d\epsilon D,t} c_{dt} DU_{dt} - \sum_{m\epsilon G,t} e_{mt} TU_{mt}$$

(Production costs)

$$- \sum_{i\epsilon C,t} g_{it} IM_{it} - \sum_{d\epsilon E,t} k_{dt} DM_{dt} \quad \text{(Purchasing costs)}$$

$$- \sum_{h\epsilon H,t} p_{ht} E_{ht} \quad \text{(Purchasing Cost)}$$

$$- \sum_{m\epsilon G,t} o_{mt} MS_{mt} - \sum_{d\epsilon DUEUF,t} n_{dt} DS_{dt}$$

(Inventory holding costs)

$$- \sum_{i\epsilon AUBUC,t} m_{it} IS_{it} - \sum_{h\epsilon H,t} l_{ht} ES_{ht}$$

Constraints

i) Capacity constraints

(1) $VMIN_{jt} \leqq \sum_{i\epsilon AUB} v_{ij} IU_{it} \leqq VMAX_{jt} \quad \forall t,\ j=1$

(2) $VMIN_{jt} \leqq \sum_{iB} v_{ij} IU_{it} \leqq VMAX_{jt} \quad \forall t,\ j=2$

(3) $DMIN_{jt} \leqq \sum_{d\epsilon D} d_{dj} DU_{dt} \leqq DMAX_{jt} \quad \forall j,t$

(4) $\sum_{m\epsilon G} t_{mj} TU_{mt} \leqq TMAX_{jt} \quad \forall j,t$

ii) Material Balance Equations

(5) $MS_{m,t-1} + TU_{mt} - S_{mt} - MS_{mt} = 0 \quad \forall t,\ \forall m\epsilon G$

(6) $DS_{d,t-1} + DU_{dt} - DS_{dt} - \sum_{m\epsilon G} x_{md} TUU_{mt} = 0 \quad \forall t,\ \forall d\epsilon E$

(7) $DS_{d,t-1} + DM_{dt} - DS_{dt} - \sum_{m\epsilon G} x_{md} TUM_{mt} = 0 \quad \forall t,\ \forall d\epsilon E$

(8) $DS_{d,t-1} + DF_{dt} - DS_{dt} - \sum_{m\epsilon G} x_{md} TUF_{mt} = 0 \quad \forall t,\ \forall d\epsilon F$

(9) $TU_{mt} = TUU_{mt} + TUM_{mt} + TUF_{mt} \quad \forall m,t$

(10) $IS_{i,t-1} + IU_{it} - IS_{it} - \sum_{d\epsilon D} S_{di} DUUU_{dt} - \sum_{d\epsilon D} S_{di} DUUM_{dt}$

$$- \sum_{d\epsilon D} S_{di} DUMU_{dt} = 0 \quad \forall i\epsilon AUB,t$$

(11) $IS_{j,t-1} + IU_{it} - IS_{it} - \sum_{d\in D} S_{di}\, DUMM_{dt} - \sum_{d\in D} S_{di}\, DUMU_{dt}$

$- \sum_{d\in D} S_{di}\, DUUM_{dt} = 0 \quad \forall i\in C, t$

(12) $DU_{dt} = DUUU_{dt} + DUUM_{dt} + DUMU_{dt} + DUMM_{dt} \quad \forall d\in D, \forall t$

(13) $ES_{h,t-1} + E_{ht} - ES_{ht} - \sum_{i\in AUB} r_{ih}\, IU_{it} = 0 \quad \forall t, \forall h\in H$

iii) Purchasing and Piecework Constraints

(14) $\sum_{i\in C} IM_{it} \leq IMMAX_t \quad \forall t$

(15) $\sum_{d\in E} DM_{dt} \leq DMMAX_t \quad \forall t$

(16) $\sum_{d\in F} DF_{dt} \leq DFMAX_t \quad \forall t$

iv) Special Units Capacity Constraints

(17) $\sum_{d\in M} w_d\, DU_{dt} \leq IBMAX_t \quad \forall t$

(18) $\sum_{m\in N} TU_{mt} \leq SAMAX_t \quad \forall t$

(19) $\sum_{i\in A} IU_{it} + 2 \sum_{i\in B} IU_{it} \leq BOMAX_t \quad \forall t$

(20) $\sum_{m\in I} TU_{mt} \leq YIMAX_t \quad \forall t$

(21) $\sum_{m\in IUJ} y_m\, TU_{mt} \leq Y2MAX_t \quad \forall t$

(22) $\sum_{m\in G} y_m\, TU_{mt} \leq Y3MAX_t \quad \forall t$

v) Bounds on Sales

(23) $LB_{mt} \leq S_{mt} \leq UB_{mt}$ for some m,t

$$(24) \quad \sum_{m \in K} S_{mt} \leqq IHR_t \quad \forall t \quad \text{(for export market)}$$

$$(25) \quad \sum_{m \in L} S_{mt} \leqq DAH_t \quad \forall t \quad \text{(for domestic market)}$$

III.C. THE OPERATING SYSTEM OF THE FIRM AND THE MODEL INPUT DATA

The MPP model has been operationalized with the input data of the sample firm.

III.C.1. Production Centers

Four main centers make up the factory. The four centers are respectively Spinning, Weaving, Finishing and Ready-to-Wear (Ready-Made Clothing). The Ready-to-Wear section has not been considered within the model.

A conventional ring spinning system is utilized in the Spinning department where a total of 31 080 spindles are used. This means a production capacity of approximately 13 000 kg/day based on 24 Ne (Ne≡Number English). About 10 000 kg/day of the produced yarn is twisted. The final step of yarn production, which is winding, may create a bottleneck in the present production schedule, thus the winding machines are incorporated in the model as another constraint. The given capacity of the winding unit is taken as 18 000 kg/day.

The Weaving section consists of four halls. The number of looms vary in each hall. In the first hall, there are 277 loams that can produce only narrow products whose reed width is 110 cm. In the other three halls, looms of varying speeds produced gray cloths that are wider (normal). Approximately 65 000 m of gray cloth can be woven per day in the 619 looms in the four halls. All of the looms operate with the shuttle

system and some of them can shuttle in multiple colons (up to 4).

Finishing section can generally be analyzed in four units, which are respectively Bleaching, Printing, Dyeing and Chemical finishing. For the purposes of this study, the finishing section has been considered in a different way depending on the utilization of the machine lot and has been grouped into seven units. That are respectively called Bleaching, Printing, First dyeing, Second dyeing, Washing, Cooling and Chemical finishing. The machine lot of the finishing department is alloted in different ratios to the above stated production units. Although Finishing department has an approximate capacity of 95 000 m/day, it is directly proportional to the production mix that is undertaken.

According to the current production schedule, the daily capacity is 45 000 m. printed, 26 000 m. Polyester/Viscose (TV) and Polyester/Cotton (TP) products and 24 000 m. plain dyed cloth production.

As can be seen from the production data, capacities are ordered from the highest to lowest, which is contrary to the sequence of products. That is, Spinning section, which is the first one has the lowest capacity, whereas the final section which is Finishing has the highest capacity.

Differences in capacities between the production centers can be compensated by either purchasing or piecework.

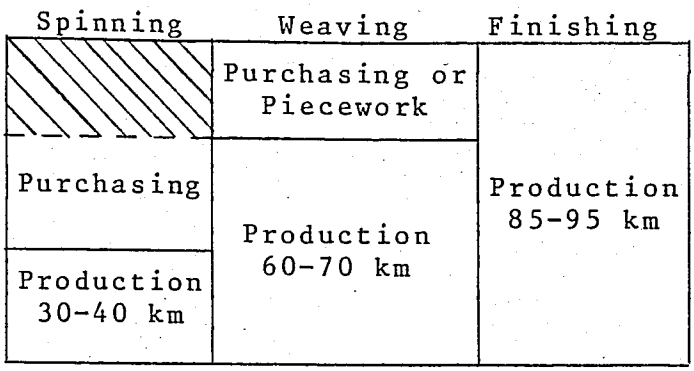

Figure 4: Daily capacities of the production centers

III.C.2. Products

The current machine lot makes the production of items that can be considered within the short fiber sector. Depending on the sales policy of the company and its position within the market certain product types are produced. These are: 100 % cotton; 67 % Polyester-33 % Viscose; % 67 Polyester-% 33 Cotton; and 50 % Polyester-50 % Cotton combinations. About eight different fibers are used as raw materials in the spinning section. The company purchases most of the cotton yarn while it produces the TV yarn. Seven to nine types of the total 20 types of yarn used in weaving unit are purchased. Since, Turkey is a producer of cotton yarn it is not difficult to procure it. The company faces more difficulties in purchasing TV yarn. Also in order to maintain the quality of TV yarn, it is suggested to be produced within the company,

Approximately 100 types of gray cloth can be woven having different constructions. 30 per cent of the gray cloths are narrow cloths. Wide and narrow cotton gray cloths are also purchased.

About 250 types of finished cloth are produced in the finishing department, 20 per cent of which is narrow cloth. Printed, plain dyed, brushed and other kinds of finished cloth can be produced from the same type of gray cloth.

The computer program used to solve the model does not incorporate all of the product types because of its memory limitations and the necessity to provide solutions as fast as possible. Product types with similar constructive structures have been grouped together. Moreover, those items that are not produced regularly and those that are produced for trial purposes are not included in the model. As a result of grouping 17 finished cloth types, 12 gray cloth types, and eight types of yarn have been formed.

III.C.3. Assumptions and Units Used

The following assumptions and units have been used in setting and operationalizing the model.

a) A year is 300 workdays.
b) A month is 25 workdays and a period is 100 workdays.
c) A workday is 24 hours. That is three shifts per day is accepted, which is also the current schedule.
d) Unit for yarn production is 1 Ne (Number English)
e) Unit for gray cloth and finished cloth is 1 meter
f) No overtimes can be assigned to compensate for maintenance, repair and accidents that might occur.
g) The following exchange rates are accepted for foreign transactions.

1 US $ = 2.7 DM
1 DM = 100 TL (1st term).

It is assumed that the value of US dollar shall increase by 13.3 per cent in each period, resulting in a 40 per cent in each period.

h) It is assumed that the export price of company products shall remain unchanged, and that the only

change would be due to exchange rates. It is also assumed that prices of imported goods would be constant.

i) In the MPP model which is operationalized for three periods, the ending inventory of the third period is assumed to be the beginning inventory of the first period.

j) For calculating the inventory holding costs, accepted monthly interest rate is five per cent.

k) According to the company policy the machines in the Spinning and Weaving departments should be operating at least 70 per cent of the time.

l) Quality of the finished products and the percentage of losses within and among production centers are based on company records. These percentages shall be presented together with the related parameters.

III.C.4. Parameters

a) Elements of the technology matrix

For the inequalities constraining production unit capacities, the following parameters related to working times of machines have been used V_{ij}: time of machine type j needed to produce one unit of type i yarn. Machine hours for the production of single yarn is the spindle hours on the ring spimers, whereas it is both the ring spinner spindle hours and the twister spindle hours for the production of double folded yarn. (j=1 for ring spinners, j=2 for twisters).

Machine hours for yarn machines are calculated from the production formula, which is given below:

$$G(\text{gr/spindle hr}) = \frac{0.9*n*R\%}{T" * Ne}$$

where

G : Production for unit spindle hour
n : Spindle speed (r p m)
Ne : Yarn number (1 Ne=1.693 m/gr)
T" : Twists per inch of yarn
0.9: Constant= $\frac{60 \text{ min}}{1.693(\text{m/gr}) * \frac{100}{2.54}(1/\text{m})}$
R : Efficiency.

As can be seen from the formula above three variables are used to calculate the parameter for yarn technology. Spindle speeds, and twists per inch of yarn are the average values. Efficiencies are taken from the lost year's actual production values.

Because the capacity for Spinning section is lower than the other sections, mainly TV group yarns are produced and TP and cotton yarns are produced to fill up the capacity. Yarn technology parameter is calculated for all types of yarn, assuming that all of the selected yarn types are produced within the spinning units. For those yarns that are not produced in the Spinning section, the necessary information has been obtained from technical experts.

Technical information and outputs related to selected yarn types, together with V_{ij} parameter values are presented in Table 1.

d_{dy} : time needed of loom type j to produce one unit of type d gray cloth.

Gray cloth technology parameters can be calculated from the production formula just like the yarn technology parameters.

TABLE : 1 UNIT : SPD.HR

SPINNING DEPARTMENT'S TECHNOLOGY PARAMETERS

I	NE	T"	RPM	E	V1	V2
1	12/1 C	13.5	7000	70	36.73	
2	20/1 C	20	7000	65	97.68	
3	20/1 TP	20	8000	80	69.44	
4	28/1 TP	21	8500	80	96.08	
5	14/1 TV	13.5	8000	86	30.64	
6	28/2 TP	21	8500	80	96.08	
		16	9000	94		29.42
7	20/2 TV	15.1	9000	88	42.37	
		12.9	9000	92		17.31
8	28/2 TV	20	9500	88	74.42	
		15.2	9000	94		27.95

$$D(m/hr) = \frac{n(r.p.m)*60(min)*R\%}{S(cm)*100}$$

where

D = Production per hour

n = Loom speed

S = Number of fillings per cm of gray cloth.

As stated earlier, there are four halls for four loom groups in the Weaving department. Information related to which type of gray-cloth would be produced in which hall and the output in a certain hall has been obtained from technical experts and compared with the yearly production data.

Number of fillings per cm for gray cloth types, in which hall they can be woven, and their output are presented in Table 2 together with d_{dj} parameter values.

t_{mj} : time needed of finishing machine type j to produce one unit of type m finished cloth.

Unit time for Finishing section is minutes. In this department, production of machines are directly calculated based on the speeds of machines. Speeds of machines are given as m/min and they vary depending on the product type that shall be processed, that is, the machines do not have constant speeds.

Finishing section consists of seven main units, each having more than one machine in the model. As the processing time of products through the sections, speeds of bottleneck machines in each unit, and the speeds of machines with no alternative, if any, are used to calculate t_{mj} values.

TABLE : 2 UNIT : LOOM-HR

WEAVING DEPARTMENT'S TECHNOLOGY PARAMETERS

D	S (CM)	EFFICIENCIES 1	2	3	4	PARAMETERS 1	2	3	4
1	14	86				.149			
2	21	87				.221			
3	23		85				.301		
4	17		85				.222		
5	24	95				.231			
6	20			80	75			.278	.202
7	17		80	80	75		.236	.236	.172
8	20			75				.296	
9	24			80	75			.333	.242
10	24			75	70			.356	.260
11	18			77	72			.260	.189
12	22			75				.326	

Table 3 presents the processing time in seven units of the 17 product types, selected with respect to the above information and their t_{mj} values.

b) Capacities

Capacities of main production units undertaken in the model are given below.

$VMAX_{jt}$: Capacity of unit j in the spinning section at period t.

Since the time unit in Spinning section is spindle hours, the capacity is related to the total spindle hours. Capacities of main units in the Spinning section are depicted in Table 4.

$DMAX_{jt}$: Capacity of hall j in the Weaving section at period t.

Capacities of weaving halls, presented in Table 4 are related to the number of looms in that hall.

$TMAX_{jt}$: Capacity of unit j in the Finishing section at period t.

The capacities in this unit are related to the total working time of machines in each section. Since the allocation of machines are not on a one-to-one correspondence basis, a section can have a capacity of 2.4 or 1.15 machine time. Capacities of units, presented in Table 4, are constant for all periods.

c) Semi-finished Goods and Raw Material Requirements

Certain losses occur in transfers within and among

TABLE : 3 UNIT : 10 MIN/M

FINISHING DEPARTMENT'S TECHNOLOGY PARAMETERS

M	BLEAC.	PRINT.	1-DYE	2-DYE	WASH.	DRY.	CH.FIN
1	12.5	50				10	12.5
2	25					14.3	12.5
3	12.5	50				10	12.5
4	25					14.3	12.5
5	25			25	12.5	81	25
6	25			25	12.5	81	25
7	25		33.3		25	47.6	12.5
8	25		33.3	25	20	135.5	25
9	25		33.3	25	20	135.5	25
10					12.5		50
11			55.5	25	70	112.5	45.5
12			45.5	25	25	50	35.7
13			45.5	25	25	50	35.7
14			55.5	25	70	112.5	45.5
15					20	27.7	33.3
16	25	50			25	62.5	56
17	12.5	50				10	12.5

TABLE : 4

CAPACITIES OF THE MAIN UNITS

DEPART.	J	NUM. MACH	CAP/PER	UNIT
SPINNING	1	76	74 592 000	SPD-HR
	2	30	24 496 000	SPD-HR
WEAVING	1	227	544 800	LOOM-HR
	2	96	230 400	LOOM-HR
	3	153	367 200	LOOM-HR
	4	143	343 200	LOOM-HR
FINISHING	1	1	144 000	MIN.
	2	2	288 000	MIN.
	3	2	288 000	MIN.
	4	0.85	122 400	MIN.
	5	1.15	165 600	MIN.
	6	4.60	660 000	MIN.
	7	2.40	345 600	MIN.

sections. The reasons for losses are different in each section. The following section presents the percentage of losses within and among sections, going backwards from the finished cloth.

i) Losses in the Finishing Section

Mainly two types of loss occur in this section. The first one is related to the constructive structure of products, and their shrinkage-stretching defects related to the processes they go through. The second type of loss occurs on the parts of the products that can not be used due to the final step applied. This is called "part loss". The percentage losses occuring as a result of either type of defect are presented in Table 5.

ii) Losses in the Weaving Section

Mainly two types of loss occur in this section also; one of which is again the "part loss". Part loss in the weaving Section is 2 % for each gray cloth(7). The second type of loss results from the towed yarns (üstübülü) used for gray cloth production. The required amount of yarn for each gray cloth is presented in Table 6.

iii) Losses in the Spinning Section

Percentage of losses in the spinning section is greater than it is in the other units. As shall be seen later, this is related to the fiber used. For example, there is 16 % loss on all the processes required to produce 100 % cotton yarn(8). The loss percentage varies for polyester and viscose. The amount of fiber required for the yarn types selected for the model is presented in Table 7. These amounts are based on both the actual values obtained in this section and data from various other sources.

TABLE : 5

GRAY CLOTH REQUIREMENTS FOR 1 UNIT OF CLOTH

M/D	15 1	16 2	17 3	4	5	6	7	8	9	10	11	12	13	14	WASTE
1	1.03														2
2	1.04														1
3		1.02													2
4		1.04													1
5			1.05												2
6				1.05											2
7					1.04										2
8						1.07									3
9							1.07								3
10								1.04							2
11									1.05						1
12									1.05						1
13										1.05					1
14											1.05				1
15												1.03			1
16													1.02		2
17														1.02	2

TABLE : 6

YARN REQUIREMENTS FOR 1 UNIT OF GRAY CLOTH

D/i	9 1	10 2	11 3	12 4	5	13 6	7	8
1,15	.074	.113						
2,16		.161						
3,17		.239						
4	.322							
5				.118				
6			.296					
7						.393		
8		.230						
9								.407
10					.184			.268
11							.475	
12								.427

TABLE : 7

FIBER REQUIREMENTS FOR 1 UNIT OF YARN

I/H	1	2	3
1	1.16		
2	1.16		
3	.363	.697	
4	.363	.697	
5		.690	.353
6	.363	.697	
7		.697	.356
8		.697	.356

d) Sales Prices

Yearly sales prices for finished cloths are determined at the beginning of each year. Prices are dependent on the quality of the product. Products are both sold in the domestic market and exported. In the domestic market finished cloth is sold, whereas ready-to-wear items are exported. Domestic sales are grouped into two as 1 and 1A. When presenting the sales prices in the model, quality on the basis of finished cloth is observed over the past years, and the weighted average of the two qualities are obtained, giving a single product price. Although domestic sales are not cash sales, sales value is given as a single item since the objective function of the model does not give each one of the periods separately.

Export sales are based on cash sales of a number of ready-to-wear items. In fact the credit the company gets at the beginning of the year is regarded as part of the total payment. Since exports are recorded as the number of ready-to-wear items, they are converted to meter units for ready-to-wear which is not included in the model. Furthermore, it is assumed that only first quality products are exported and the second quality products are sold domestically at a lower price. Thus the export price is again calculated as the weighted average, depending on the quality. Qualities of products and the average sales prices by periods are given in Table 8.

e) Costs of Production

Only the general production costs are considered as cost of production. The general production costs are calculated as the average of two different sources; the firm's 1984 Production Plan(6) and studies of the Accounting department.

TABLE : 8 UNIT : TL/M

S A L E S P R I C E S

M	Q	T=1 1ST	T=1 2ND	T=1 AVG	T=2 1ST	T=2 2ND	T=2 AVG	T=3 1ST	T=3 2ND	T=3 AVG
1	90	280	150	267	317	165	302	354	175	336
2	80	280	190	262	317	200	294	354	210	325
3	90	280	150	267	317	160	302	354	175	336
4	80	350	200	320	396	210	359	442	220	398
5	70	700	400	610	792	425	682	885	450	755
6	70	750	500	675	849	550	759	940	600	844
7	85	500	225	459	566	250	519	632	265	577
8	70	720	440	696	815	475	713	910	490	784
9	70	980	784	921	1100	880	1034	1200	960	1128
10	90	700	560	686	792	634	776	885	708	867
11	90	1425	1140	1368	1550	1240	1488	1680	1344	1613
12	80	1400	1120	1344	1520	1216	1459	1640	1312	1574
13	80	1400	1120	1344	1515	1212	1454	1630	1304	1565
14	80	1450	1160	1392	1600	1280	1536	1720	1376	1651
15	95	1500	1200	1485	1650	1320	1634	1750	1400	1733
16	100	100	--	100	110	--	110	115	--	115
17	100	95	--	95	105	--	105	110	--	110

Raw material expenses of production centers are calculated within the model because of the structure of the objective function. Production cost does not include indirect labor, depreciation, and financing which is one of the highest cost items. General production costs of the production centers are given with respect to types in Tables 9, 10 and 11.

f) Purchasing Costs

The company purchases fiber, yarn and gray cloth. Polyester and viscose are the fibers that are imported. Although polyester is also produced domestically, it is imported as a company policy, because imported polyester is cheaper. It is important that the imported viscose has the specifications that enable it to be combined with polyester (All kinds of viscose can not be combined with all kinds of polyester/. Cotton of Standard 1 quality is purchased domestically. For some products a better quality of cotton called "Mintika Cotton" can be used. Possible values of Standard 1 Cotton are included in the model.

The values obtained are based on the information and suggestions of the Purchasing department authorities.

It has been stated earlier that because of differences in capacities between production centers, the company has to purchase yarn and gray cloth. These purchases are done on a cash basis. One of the basic items purchased is cotton yarn. Since Turkey is a cotton yarn exporter, it is sometimes difficult to find first quality yarn in the market. Also, because it leads to paying the yarn "production tax", twice, the company does not purchase cotton yarn from traders who buy and sell yarn and purchases only from large establishments and manufacturers. Purchase price of yarns vary depending on the rate of inflation, value of the US dollar, and exports.

TABLE : 9 UNIT : TL/KG

YARN PRODUCTION COSTS

I	T=1	T=2	T=3
1	110	110	130
2	215	215	256
3	195	195	228
4	246	246	294
5	121	121	145
6	268	268	320
7	190	190	230
8	268	268	320

TABLE : 10 UNIT : TL/M

GRAY CLOTH PRODUCTION COSTS

D	T=1	T=2	T=3
1	36	36	40
2	41	41	46
3	75	75	81
4	61	61	68
5	44	44	47
6	95	104	122
7	70	70	75
8	115	115	125
9	130	130	145
10	88	88	100
11	70	70	75
12	120	120	150

TABLE : 11 UNIT : TL/M

CLOTH PRODUCTION COSTS

M	T=1	T=2	T=3
1	89	90	97
2	70	70	76
3	90	100	105
4	66	66	72
5	95	110	115
6	110	112	120
7	68	69	75
8	135	135	150
9	120	120	130
10	160	190	250
11	165	165	195
12	138	140	160
13	145	147	170
14	170	175	185
15	250	300	350
16	120	125	135
17	85	85	90

Woven cotton gray cloth prices follow the movements of prices in the cotton yarn, and they are determined following a change in the yarn prices.

Purchase prices are given in Table 12.

g) Inventory Holding Costs

As the flowchart of the model (Figure 3) shows, there are four storage departments. Cost of stocking for each unit can be calculated with the following formula.

Inventory holding cost (monthly)=(Production cost)*0.05
+ Other costs

As stated in the assumptions earlier,interest rate for stocking is five per cent monthly. Other costs are based on the previous year's data and are calculated as follows:

$$\text{Other costs} = \frac{\text{Personnel cost + Energy}}{\text{Average stock level}}$$

Since all of the four storage rooms are within the factory, additional personnel is not required. Moreover, because average stock levels are high, other costs item is low.

When calculating inventory holding costs, company's own expenses for yarn and gray cloth production are used to calculate the production costs. Purchased products' prices are not included in the calculations

TABLE : 12 UNIT : TL

PURCHASING PRICES

TYPE	T=1	T=2	T=3
I= 9	642.5	725	825
I=10	787.5	900	1025
I=11	1000	1200	1350
I=12	1250	1400	1600
I=13	1350	1500	1750
D=15	185	245	310
D=16	185	245	310
D=17	290	375	420
H=1	550	625	650
H=2	635	695	750
H=3	595	655	700

III.D. SCENARIO ANALYSIS

The MPP model discussed above was run on the firm's Burroughs B 1955 using the Burroughs 1700/1800 TEMPO Mathematical Programming System(4) and results were obtained for eight different scenarios.

The model has 223 rows and 423 columns.

The scenario analysis was performed in two stages:

i) Product-mix
ii) Technological coefficients.

The product-mix stage was conceived as consisting of three scenarios. The first two of these S1 and S2 were run first. The analysis of their results led to the introduction of a new scenario (S3) which reflects the present sales position better and was run together with the fourth scenario (S3 and S4). The two scenarios considered most representative of the present sales structure were also analysed with respect to the technological coefficients and two new scenarios were generated from each (Scenarios 5 and 7 from S3 and, Scenarios 6 and 8 from S4) and run on the computer.

To facilitate comparisons, results for Scenarios 1-4 are given in Tables 13-17, those for scenarios 3,4,5,6 in Tables 18-21, those for scenarios 3,4,7,8 in Tables 22-25.

III.D.1. Scenario 1

This scenario makes use of cost and sales figures from the firm's 1984 Production Plan(6). No sales or market restrictions have been included in order to determine the most profitable products according to this data. An optimal product-mix is searched for.

TABLE : 13

CAPACITY USAGE RATES OF THE FIRST 4 SCENARIOS

UNIT	SCN.1			SCN.2			SCN.3			SCN.4		
	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
SPINNERS	100	100	100	100	100	100	100	100	100	100	99	100
TWISTERS	85	90	69	84	85	74	99	99	99	96	100	100
WEAV.HA:1	100	100	100	100	100	100	100	100	100	100	100	100
WE.HA:2-4	100	100	100	100	100	100	100	100	100	100	100	100
BLEACH.	100	100	100	100	100	100	100	100	100	100	90	100
PRINT.	0	0	0	0	0	35	0	8	0	52	59	67
1-DYE	49	48	74	52	52	67	26	34	34	24	34	36
2-DYE	100	100	100	100	100	100	100	100	100	100	100	100
WASH-1	100	100	100	98	100	100	70	92	90	69	92	90
WASH-2	65	65	65	64	65	97	46	67	59	68	100	100
WASH-3	71	84	78	73	74	99	71	89	86	71	91	96
DRYER	76	74	74	75	75	87	62	75	71	63	83	81
CH.FINISH	57	61	55	57	58	60	58	62	60	64	65	66
YARN-DYE	100	100	0	100	100	0	100	100	100	100	100	89
RAISING	26	71	22	18	26	67	0	100	100	0	100	100
WINDING	82	90	78	81	82	85	80	96	97	82	92	95

TABLE : 14 UNIT : TON

YARN TABLE OF THE FIRST 4 SCENARIOS

	SCN.1			SCN.2			SCN.3			SCN.4		
	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION												
COT.	0	0	0	0	0	0	0	0	0	0	0	4
TP	73	66	147	74	73	139	112	82	61	1	62	46
TV	1114	1183	1097	1101	1114	1166	1060	1192	1228	1133	1127	1199
TOTAL	1188	1249	1243	1175	1188	1305	1073	1274	1289	1134	1189	1252
PURCHASING												
COT.	334	334	334	334	334	334	714	694	671	810	700	747
TP	205	278	66	204	278	66	0	0	0	0	0	0
TOTAL	539	612	400	538	612	400	714	694	671	810	700	747

TABLE : 15 UNIT : KM

GRAY CLOTH TABLE FOR THE FIRST 4 SCENARIOS

	SCN.1			SCN.2			SCN.3			SCN.4		
	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION												
NC	0	0	0	0	0	0	2357	2357	2357	2789	2469	2456
WC	1038	1038	1038	1038	1038	1038	1038	1038	976	1038	903	1038
NTP	2358	2358	2358	2358	2358	2358	104	104	104	8	104	200
WTP	0	0	0	0	0	0	0	178	124	0	127	64
YDC	0	0	0	0	0	0	0	0	0	0	0	0
TV	1664	1792	2417	1641	1664	2543	1656	1796	1875	1616	1863	1942
YDTV	833	833	0	833	833	0	833	833	833	833	833	740
TOT	5894	6022	5911	5871	5894	5939	5987	6244	6199	6284	6299	6440
PW	0	0	0	0	0	2036	0	484	0	0	1859	1502
PURCHASING												
NC	1435	0	0	354	0	0	343	0	0	1202	0	0
WC	6438	0	0	6461	0	0	6656	0	224	6778	0	157
TOT	7873	0	0	6815	0	0	6990	0	224	7880	0	157

TABLE: 16 UNİT: KM

CLOTH TABLE FOR THE FIRST 4 SCENARIOS

	SCN.1			SCN.2			SCN.3			SCN.4		
TYPE	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
NCP	0	0	0	0	0	2036	0	475	0	3000	3373	3573
NCPD	0	1350	0	159	181	0	2341	2237	2550	895	276	585
WCPD	3492	3008	2596	3333	3311	2474	3319	3019	2994	3357	3003	2987
NTP	2268	1372	3164	2268	2268	2268	100	100	100	8	100	192
WTP	0	0	0	0	0	0	0	166	116	0	119	60
TV	2213	2697	2300	2372	2394	2422	2500	2519	2481	2500	2584	2416
TOT	7973	8457	8060	8132	8154	9200	8260	8517	8241	9760	9453	10113

TABLE : 17 UNIT : KM

SALES OF THE FIRST 4 SCENARIOS

TYPE	SCN.1	SCN.2	SCN.3	SCN.4
NAR. C PRT	0	2 036	475	10 245
NAR. C PL-DY	1 380	340	7 127	1 756
WD. C PL-DY	9 097	9 118	9 333	9 346
NAR. TP	6 803	6 803	300	300
WD. TP	0	0	283	179
TV	7 209	7 188	7 500	7 500
TOT. EXP	17 280	16 262	16 760	18 352
TOT. DOM	7 209	7 188	7 783	7 679
PIECEWORK	0	2 036	475	3 295
TOTAL SALES	24 489	24 486	25 018	29 326
OB FN (10**6TL)	9 670	9 606	8 950	8 489

In analyzing these scenarios, we shall first look at the capacity usage rates and then survey the finished cloth, gray cloth and yarn production, purchasing, and stock levels in that order.

Detailed results of the scenarios are given in the tables in the Appendix A.

i) Capacity Usage Rates (Table 13)

The first thing we note from Table 13, is that the Spinning and Weaving departments and the bleaching, second dyeing and wide washing units of the Finishing department are at 100 per cent of capacity. Thus all Major Production centers are working at full capacity.

The fact that the printing section is not used at all indicates that the figures of the 1984 Production Plan lead to printed goods being less profitable than plain dyed goods. Such a policy may be impossible when the firm's market policy is considered. But it should be remembered that in this scenario our goal was to obtain an optimal product-mix without market and sales constraints being taken into account.

Contrary to expectations, use of the raising section was low, meaning that little of the raised TV products considered profitable by the firm has been produced. This results from the fact that due to the bottleneck at wide washing the model finds in better to produce other types of cloths which use this machinery once instead of three times that the raised TV requires.

The extra capacity in the twisting section is explained by the fact that the cloth produced by the model has a high percentage of single yarn.

The rest of the capacity utilization is in an intermediate range.

ii) Finished Cloth Production (Tables 16, A11).

The, model has selected only seven out of 17 available products in the Finishing department. These can be classified as the most profitable products.

The model does not recommend production of printed cloth (m=1,3). Wide TP (m=8,9), yarn-dyed cotton (m=10) and piece work (m=16,17) are also excluded.

When we classify the seven products as wide and narrow, the most profitable turns out to be narrow TP (m=7). Remaining capacity has been allocated to dyed goods. Epengle (m=13) has the highest production of the TV group. Of the cotton group in the first two periods cloth no:5 and in the third period cloth no:6 are produced, the reason for this can be seen in the gray cloth purchasing policy suggested by the model.

In this scenario, a total of 24 483 230 meters of cloth is produced, almost all of which is plain dyed. Despite variations from period to period, an average of 81 500 m/day is produced, 24 000 m/day of which is TV.

iii) Gray Cloth Production, Purchasing and Inventory (Tables 15, A12)

Five types of gray cloth are produced and two types are purchased in this scenario. The first two halls (No:1 and 2), produce the same gray cloth all year and the other two (No:3,4) produce three different types in the first two periods and two types in the third period. Since the benefits of

keeping the type of cloth being processed as the same over-time are common knowledge, this result comes as no surprise.

Despite a stated capacity of 65 000 m/day for the Weaving department; only 59 000 m/day are produced in this scenario with all looms at 100 per cent. This is due to the fact that each gray cloth type has differing production rates and efficiencies on different types of looms.

Due to price increases throughout the year, all purchases are made in the first period. The two types, selected for purchase are type 16, used for narrow cotton plain-dyed cloths (m=2,4) end type 17, used for wide cotton plain dyed cotton (m=5).

This purchasing program calls for approximately 8 000 000 m of gray cloth to be bought in the first period, which is not contrary to firm policy.

When weaving and finishing programs are considered together, an interesting situation is revealed in the wide cotton godos. Ninety per cent of the production of cloth type 6 (m=6) is in the third period, and the rest is in the second period, while all production of type 5 (m=5) is in the first two periods. When we inspect the gray cloth situation, we see that type 4 (d=4) gray cloth needed for type 6 cloth (m=6) is woven in the second hall all through the year, while the gray cloth used for type 5 cloth (m=5) is purchased, thus resulting in the gray cloth woven within the firm being held in inventory for two periods. The reason is the impossibility of purchasing gray cloth type 4.

Although producing for inventory may be criticized integrated functioning of inventory and purchasing policies may prove this policy to be correct.

Apart from the above, no significant inventory is carried.

iv) Yarn Production, Purchasing and Inventory (Tables 14, A13)

TV yarns are not purchased due to quality considerations. Due to the high volume of narrow TP (m=7) production, there is a high demand for TP yarns (i=4,12). Part of this is produced (i=4) using capacity left over from the TV yarns (i=5,7,8), and the rest is purchased (i=12). Another purchased yarn is cotton yarn (i=9).

Due to high rise in the price of TP yarn (i=4,12) in the third period, purchases are low and production is higher. Note also that inventory of this yarn is carried over from period 2.

Purchases of cotton yarn (i=9) are equally distributed over the periods, and are not concentrated in period one like gray. Cloth purchases. This is due to the different inventory holding costs for yarn and gray cloth.

Daily production of yarn is 12 250 kg, 8 500 kg of which is double folded.

v) Finished Cloth Inventory and Sales (Tables 17, A14)

As stated previously, no market or sales restrictions are included in this scenario, thus even before the model was run, it was expected that rising prices would result in higher sales in period three. The sales figure for period one is not realistic, being very small compared to the other two periods.

vi) Objective Function Value

In this first scenario, the difference between sales revenues and production, purchasing and inventory holding costs is 9 670 000 000 TL. As this does not include fixed costs, financial costs, etc., use can not look on it as profit but merely use it to compare scenarios.

III.D.2. Scenario 2

In this scenario upper bounds for both domestic and export sales were given using the previous years' data. This led to a grouping of products. Cotton goods with codes m = 1 to 6 and TP goods with codes m = 7, 8 are exported, while TV goods coded m = 11 to 15 are sold on the domestic market. Cotton yarn-dyed goods (m = 10), are also export goods. The piecework, goods (m = 16, 17) and wide TP (m = 9) which can be sold both on the foreign and domestic markets have not been included in these groups.

According to the limited statistical data available and information from firm officials, the firm can sell a maximum of 2.500.000 m of TV cloth per period on the domestic market. In Scenario 1, the second period TV product sales are approximately 2.960.000 m which is above the given limit.

The firm's exports have expanded since 1980, both in terms of meters and of US dollars. Export figures are in terms of pieces of clothing (ready-to-wear). As the Ready-to-Wear department is not included in the model, export upper bounds were obtained by multiplying export figures by a meter/piece coefficient and taking order times etc. into account.

According to these figures, the highest level of production for export is in the first period, the lowest in the second. Export upper bounds are 8.500.000 m in period one, 4.500.000 m in period two and 6.500.000 m in period three.

i) Capacity Usage Rates (Table 13)

As in Scenario 1, all bottleneck units in the Spinning,

Weaving and Finishing departments are at 100 per cent utilization. The printing section is once again idle for the first two periods and only 35 % full in the third. Printed goods production in period three is all for piecework. The reason for this is apparent when we study the sales upper bounds. Both domestic and export sales are at upper bound, and the excess finishing capacity can be filled with either wide TP (m = 9) cloth or with piece work (m = 16, 17), and due to the bottleneck at wide washing unit, the piecework is selected.

The twisting unit is the same as in Scenario 1, which shows that single yarn production is preferred.

In other units the only noticeable change is the shifting of the raising unit workload from period two to period three.

ii) Finished Cloth Production (Tables 16, A21)

The same products are produced as in Scenario 1, with the only change being an increase in piecework (m = 17) in period three, the reason for which has been explained above.

Among cotton goods, production of wide plain dyed goods (m = 5,6) has increased by only 22.000 m, but narrow plain dyed goods production (m = 4) has decreased considerably (by 1.040.000 m).

The total production of narrow TP (m = 7) which is selected as one of the most profitable products does not change, but the distribution changes, production levels becoming equal in all periods.

Total production is 25.485.890 m, which is 81.400 m/day

in the first two periods, and 92.000 m/day in period three. There is a 1.002.600 m increase in total production compared to Scenario 1, with 2.036.400 m of piecework.

iii) Gray Cloth Production, Purchasing and Inventory (Tables 15, A22)

Gray cloth production is as in Scenario 1, production of cotton gray cloths is the same due to capacity restrictions. There is a little change in TV gray cloths.

Average gray cloth production is 59.000 m/day.

Gray cloth purchasing and inventory is as in Scenario 1. The drop in narrow cotton cloth production results in less purchasing. The even production of narrow TP cloth (m = 7) has resulted in no inventory being carried. Only wide cotton gray cloth has an inventory.

iv) Yarn Production, Purchasing and Inventory (Tables: 14, A23)

As in gray cloth, there have been no great changes in yarn production.

There are also no changes in yarn purchasing over the periods. As in Scenario 1, there is an inventory at the end of period two of TP yarn (i = 4), used for narrow TP cloth (m = 7). Due to price increase in period three, the inventory is laid up by producing yarn.

Average yarn production is 11.800 kg/day. Since purchases are lower in period three, average production in this period is around 13.000 kg/day.

v) Finished Cloth Inventory and Sales (Tables: 17, A24)

The upper bounds on sales have changed the inventory levels considerably. Finished goods inventory is only held of codes 7, 13 and 14. The irrational sales program of Scenario 1 has been remedied, and a reasonable policy has been achieved. When we survey the sales bounds, despite the fact that upper bounds are not reached in period one, production has reached 7.449.540 m as compared to 1.949.160 m in Scenario 1. Both domestic sales and exports are at their upper bounds in period two and three.

There is a decrease in narrow cotton sales due to export upper bounds, and piecework is present. Production of narrow cotton which is the least profitable product produced has decreased, and consequently sales have declined.

vi) Objective Function Value

In this scenario, despite an increase in production there is a decrease in objective function. This is due to increased sales in period one where sales prices are low. The objective function value is 9.605.500.000 TL. There is a 0.67 per cent decrease compared to Scenario 1, which is too small to comment on.

vii) Note (Tables: A12, A13, A22, A23)

When we study the yarn and gray cloth production figures for Scenarios 1 and 2, the first period of Scenario 1 and the second period of Scenario 2 are identical. In Scenario 1 sales figures are dominant, which results in the first period being least attractive. In Scenario 2 both sales revenues and upper bounds are active, so period 2 is least

attractive. The model's constitution results in similar results for two different periods of two different scenarios.

III.D.3. Scenario 3

Discussion with firm executives revealed that narrow TP cloth (m = 7), which emerges as the most profitable and highly sold product in both scenarios 1 and 2, is a new product and has very low export sales. Thus we have added an upper bound to this product's sales. Due to its profitability it is assumed that it can sell 100.000 m/period.

The model was run with these changes and the results below are observed.

i) Capacity Usage Rates (Table 13)

The Spinning and Weaving departments and the bleaching and second dyeing units of the Finishing department are at 100 per cent utilization. There is no change in printing utilization except for a small amount in period two.

Production of yarn-dyed cloth and raised TV has been brought to upper bound. This is a result of these products emerging as most profitable after the most profitable narrow TP (m = 7) good has been restricted.

The 100 per cent dyed-yarn production and increase in utilization of the winding unit leads to a bottleneck developing at the winding section which can be remedied by sunday overtime.

The highest incerase in utilization in this scenario is in the twisting unit where a 99 per cent use all year round is required. This is the main reason for the incerase in

demand for the winding unit.

A considerable excess capacity has developed at the washing units, due to the drop in TP production. The limited amount of narrow printed piecework (m = 17) has filled this excess to a certain extent.

ii) Finished Cloth Production (Tables: 16, A31)

The first thing we notice in this scenario is that type 7 cloth which was given an upper bound of 100.000 m/period is produced at upper bound throughout the year. The excess capacity due to restriction of this product in the Finishing department is filled with other goads.

The narrow cotton plain dyed goods (m = 4), which are second in order of profitability are assigned to the machines capable of processing narrow cloth. There is no change in the levels of production of wide cotton goods.

There are several changes in production of TV products sold on the domestic market. Production of raised goods (m = 14) which was formerly restricted due to the bottleneck on the washing unit is at its upperbound in periods two and three. Yarn-dyed TV goods (m = 15) which were not produced all year round in the previous scenarios are produced here in all three periods and absorb all the capacity of the yarn-dyed unit.

Production of Epengle (m = 13) group which was formerly highest of TV's has dropped to half its original level in all periods. As there is no raised good production in period one, the excess capacity in this period is taken up by Serj (m = 12) group products. In period one the sale price of Serj and Epengle is the same but Serj (m = 12) is slightly more costly.

Thus the model seems to prefer the more expensive product. The reason for this becomes clear when we see that Serj's gray cloth (d = 9) takes loss time to weave than Epengle's gray cloth (d = 10). Thus the higher the production of Serj leads to its choice for period one.

As sales' upper bounds are reached in periods two and three, production of wide TP (m = 9) and piecework (m = 17) which have no upper bound takes place.

Piecework is only done in period two, and even then very little. However, wide TP (m = 9) product which emerges as an alternative to piecework due to the sales' upper bounds is only produced in periods two and three in this scenario. While we would expect the idle capacity to be filled with this due to its profit margin. Here, as in previous scenarios, the bottleneck on wide TP production are the washing units. In this scenario the idle capacity left from other products is filled with wide TP.

In this scenario a decrease in production of approximately 470.000 m is observed, due to drop in narrow TP (m = 7). As expected, the greatest increase in production is in the narrow cotton plain dyed goods (m = 4).

Daily production is 83.400 m an average, 25.000 of which is TV products.

iii) Gray Cloth Production, Purchasing and Inventory (Tables: 15, A32)

The increase in product types has reflected on the gray cloth production. The gray cloth needed for the restricted type 7 finished cloth production is woven, and the cost of the capacity is used for narrow cotton product in the first hall.

As the narrow cotton production is not enough for meeting demand, 343.110 m of this gray cloth (d = 16) is purchased.

There is no change in production, purchasing, or inventory policies for wide cotton goods (d = 4,17).

Weaving of TV goods (d = 9, 10, 11, 12) is the same as its finishing. Some yarn-dyed gray cloth is carried over into period one from period three due to market conditions. This gray cloth is processed and sold in period one where sales do not reach upper bound.

Average daily weaving is 61.500 m, and purchases have slightly increased.

iv) Yarn Production, Purchasing and Inventory (Tables: 14, A33)

The production and purchasing levels of TP yarn (i = 4,12) which was previously both produced (i = 4) and purchased (i = 12) have declined as expected.

For the first time type 6 TP yarn is produced, despite the possibility of purchase, for use in wide TP (m = 9) good. With the drop in production of Epengle (m = 13), type 5 TV yarn production has decreased, and type 7 and 8 yarns' production have increased.

Purchased cotton yarns (i = 9, 10) are once again purchased throughout the year with an even distribution. There is no yarn inventory in this scenario.

Daily yarn production, which is low in period one, increases in periods two and three to 12.800 kg. Twisted yarn production increases especially in the last two periods

(average 11.000 kg). In period one all twisting capacity is assigned to type 8 yarn.

v) Finished Cloth Inventory and Sales (Tables: 17, A34)

There is almost no finished cloth inventory carried. The only instance is when in period two sales bounds are reached. Then a certain amount of sales is carried to period three.

Domestic sales are at upper bound all year round. Export upper bounds are not reached only in period one.

Wide cotton plan dyed goods are sold most and sales are more or less evenly distributed.

vi) Objective Function Value

The 1.8 per cent decrease in total production, with respect to Scenario 2, has led to a far greater drop in the objective function.

The 6.8 per cent drop in objective function is due to the drop in sales of the profitable narrow TP (m = 7) and its replacement by less profitable goods.

III.D.4. Scenario 4

In the previous scenarios, upper bounds on the firm's sales had been established without regard to product type. In this scenario the sale possibilities of each type of product and the firm's current orders have been taken into account. This has resulted in the firm's "classic" products to be sold at a certain level in order to maintain the firm's place on

the market, which has led to seasonal lower bounds being placed on these products.

These bounds are shown below:

m	t=1	t=2	t=3
1	1.000.000	450.000	800.000
3	2.000.000	1.100.000	1.600.000
11	-	100.000	100.000
12	380.000	380.000	380.000
13	200.000	200.000	200.000
14	-	200.000	200.000
15	400.000	400.000	400.000

i) Capacity Usage Rates (Table: 13)

For the first time in this scenario there is a slack capacity in one of the main production centers, namely on Spinning unit in period two. The reason for this is the increase in cotton cloth production due to the lower bounds, and the model's preference for purchasing rather than producing these yarns.

Due to lower bounds which take into account the high sales the firm's printed products have achieved in the past, for the first time we see 60 per cent utilization of the printing unit. Due to the high setup times 100 per cent efficiency in the printing unit is impossible. Another consequence of the increase in printed goods' production is seen in the washing units, where the machines capable of washing these goods are loaded to full capacity in the last two periods.

As in the Spinning department, the bleaching unit has idle capacity in period two. The reasons for this are the

same as stated above. The second dyeing and washing units are filled to capacity, which results in no further production being possible.

The increased utilization of the twisting unit shows an increase in production of double folded yarns.

ii) Finished Cloth Production (Tables: 16, A41)

The Finishing department's capacity has been first allocated to the product types with sales lower bounds, and excess capacity has been used to produce more of the profitable products.

Of products with lower bounds on sales, 1, 3 and 11 are produced for the first time and that at lowest possible level, as was expected. The Serj group (m = 12) of products is also produced at lower bound. We have seen in Scenario 3 that 12 and 13 are alternatives and that the model preferred 12 to 13 due to the shorter weaving time. In this scenario 12 is produced at lower bound and all remaining capacity is allocated to the more profitable 13.

In the cotton group, the level and the times of production of wide cotton plain dyed (m = 5, 6) products have not changed, while there has been a drop in production of narrow cotton plain dyed goods (m = 4). This is a result of the increase in production of narrow cotton printed goods (m = 1, 3).

There has been a slight decrease in wide TP (m = 9) good's production but no major change in policy has been observed.

All capacity not used for products for the domestic or export markets and type 9 product has been devoted to piece-

work (m = 17). Due to the extra capacity the amount of piece-work has increased in this scenario.

In this scenario which attempts to show the firm's present policy the total production has risen to 29.325.851 m with the inclusion of the printed goods. This is an increase of 4.308.321 m over the previous scenario. Average daily production is 98.000 m, 25.000 m of which are TV and 34.000 m printed cloths.

iii) Gray Cloth Production, Purchasing and Inventory (Tables: 15, A42)

Nine out of 12 types of gray cloth fill the Weaving department in this scenario. The uniformity of production in the previous scenarios has disappeared due to the increase in product types. This is not good for quality, but is the best the model can do.

The narrow looms (hall 1) are all assigned to gray cloths for the printed cloths and a little narrow TP (d = 5). Although it is possible to purchase gray cloths needed for printed cloths, the model prefers to produce them.

Production of the TV group (d = 9-12), is distributed according to the requirements of the finished cloths.

Average daily production has increased to 63.500 m.

iv) Yarn Production, Purchasing and Inventory (Tables: 14, A43)

There is no great change in the Spinning department. There have been small changes in production in accordance with finished cloth's production.

All yarn for printed cloths is purchased, and purchases increase in periods one and three.

Due to the impossibility of purchasing TV yarn, the production programs are more or less the same in all scenarios.

v) Finished Cloth Inventory and Sales (Tables: 17, A44)

Due to the lower bounds on sales in period two, only the inventory policy of narrow TP (m = 7) is of interest. It is produced most in period three and almost not at all in period one. Thus 92 per cent of the sales in period one is carried over from period three. The main reason for this is the high rates of narrow printed cloths in period one.

Sales figures are the same as before. If we do not consider production for lower bounds, though levels of the goods always sold are a little lower. There is a large drop in production and sales of narrow cotton plan dyed goods (m = 4).

There is 3.300.000 m of piecework in this scenario.

vi) Objective Function Value

Despite the increase in production the objective function value has decreased by 461.000.000 TL (5.2 %) with respect to Scenario 3 and 1.116.400.000 TL (11.6 %) with respect to Scenario 2.

This is a direct result of having to produce loss profitable goods in order to maintain market share.

III.D.5. Scenario 5

In the analyses performed till now we saw that bottlenecks develop at the bleaching washing, and second dyeing units of the Finishing department.

Allocation of capacity among the units of the Finishing department is based either on 100 per cent utilization of certain machines or on the assumption that the given machine will be used for a particular operation for a fixed percentage of its total up-time. These percentages were determined by a study of the present situation of the firm and previous years' production plans and used as input to the model.

As we have seen in the Model Input section, the second dyeing process (j = 4) uses 85 per cent of a certain machine's capacity. Narrow cotton dyed goods are dyed or a machine which has excess capacity and is not considered in the model. The remaining 15 per cent of the aforementioned machine is used for washing.

Certain old type washing machines, called "Jiggers", four of which can be used for wide washing, were not taken into consideration when the capacity of the washing unit was being calculated. They have a total daily washing capacity of 12.000 m.

Changing the distribution of the machines in these units with the aim of easing the bottlenecks was considered. For this purpose, it was first assumed that the second dyeing process uses 100 per cent of the machine, instead of 85 per cent. Thus a certain increase of capacity for second dyeing is achieved, at the price of a decrease in wide washing capacity. This deficiency will be more than made up by the use of the four old machines mentioned above.

TABLE : 18

CAPACITY USAGE RATES OF THE SCENARIOS 3-4-5-6

	SCN.3			SCN.4			SCN.5			SCN.6		
UNIT	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
SPINNERS	100	100	100	100	99	100	100	100	100	100	100	100
TWISTERS	99	99	99	96	100	100	89	100	99	96	100	100
WEAV.HA:1	100	100	100	100	100	100	70	70	70	100	70	92
WE.HA:2-4	100	100	100	100	100	100	100	100	100	100	100	100
BLEACH.	100	100	100	100	90	100	100	100	100	100	98	100
PRINT.	0	8	0	52	59	67	1	1	0	52	55	65
1-DYE	26	34	34	24	34	34	25	36	34	25	42	35
2-DYE	100	100	100	100	100	100	100	100	100	100	100	100
WASH-1	70	92	90	69	92	90	79	100	95	78	99	95
WASH-2	46	67	59	68	100	100	51	68	63	73	100	100
WASH-3	71	89	86	71	91	96	63	80	78	64	88	88
DRYER	62	75	71	63	83	81	72	83	80	72	96	88
CH.FINISH	58	62	60	64	65	66	61	65	63	67	69	69
YARN-DYE	100	100	100	100	100	89	100	100	100	100	94	68
RAISING	0	100	100	0	100	100	0	100	100	0	100	100
WINDING	80	96	97	82	92	95	80	97	97	82	92	96

TABLE : 19 UNIT : TON

YARN TABLE OF THE SCENARIOS 3-4-5-6

	SCN.3			SCN.4			SCN.5			SCN.6		
	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION												
COT.	0	0	0	0	0	4	0	0	0	0	0	0
TP	112	82	61	1	62	46	78	64	61	0	80	61
TV	1060	1192	1228	1133	1127	1199	1074	1222	1228	1134	1125	1207
TOTAL	1073	1274	1289	1134	1189	1252	1152	1286	1289	1134	1206	1268
PURCHASING												
COT.	714	694	671	810	700	747	580	513	552	804	354	704
TP	0	0	0	0	0	0	0	0	0	5	239	0
TOTAL	714	694	671	810	700	747	580	513	552	809	592	704

TABLE : 20 UNIT : KM

GRAY CLOTH TABLE FOR SCENARIOS 3-4-5-6

	SCN.1			SCN.2			SCN.5			SCN.6		
	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION												
NC	2357	2357	2357	2789	2469	2456	1528	1706	1617	2755	1665	2364
WC	1038	1038	976	1038	903	1038	1038	739	906	1038	229	937
NTP	104	104	104	8	104	200	189	19	104	41	165	106
WTP	0	178	124	0	127	64	0	299	124	0	761	124
YDC	0	0	0	0	0	0	0	0	0	0	0	0
TV	1656	1796	1875	1616	1863	1942	1588	1863	1875	1616	1913	2122
YDTV	833	833	833	833	833	740	833	833	833	833	780	569
TOT	5987	6244	6199	6284	6299	6440	5177	5459	5459	6284	5513	6221
PW	0	484	0	0	1859	1502	0	253	0	0	1642	1373
PURCHASING												
NC	343	0	0	1202	0	0	0	0	0	305	0	0
WC	6656	0	224	6778	0	157	8351	0	1368	7820	0	1601
TOT	6990	0	224	7880	0	157	8351	0	1368	8125	0	1601

TABLE 21 UNIT : KM

CLOTH TABLE FOR SCENARIOS 3-4-5-6

	SCN.3			SCN.4			SCN.5			SCN.6		
TYPE	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
NCP	0	475	0	3000	3373	3573	32	248	0	3000	3160	3746
NCPD	2341	2237	2550	895	276	585	1397	1550	1686	0	0	0
WCPD	3319	3019	2994	3357	3003	2987	4247	3706	3858	4221	3226	3624
NTP	100	100	100	8	100	192	100	100	100	39	113	148
WTP	0	166	116	0	119	60	0	280	116	0	711	116
TV	2500	2519	2481	2500	2584	2416	2500	2553	2417	2500	2573	2421
TOT	8260	8517	8241	9760	9453	10113	8276	8468	8177	9760	9790	10054

TABLE : 22 UNIT : KM

SALES OF SCENARIOS 3-4-5-6

TYPE	SCN.3	SCN.4	SCN.5	SCN.6
NAR. C PRT	475	10 245	281	9 906
NAR. C PL-DY	7 127	1 756	4 633	0
WD. C PL-DY	9 333	9 346	11 811	11 071
NAR. TP	300	300	300	300
WD. TP	283	179	396	827
TV	7 500	7 500	7 500	7 500
TOT. EXP	16 760	18 352	16 776	18 321
TOT. DOM	7 783	7 679	7 896	8 327
PIECEWORK	475	3 295	248	2 956
TOTAL SALES	25 018	29 326	24 920	29 604
OB FN (10**6TL)	8 950	8 489	9 242	8 753

The above changes were made in the technology matrix and the resulting scenario was run with the data of Scenario 3.

i) Capacity Usage Rates (Table: 18)

Despite a 100 per cent utilization in the Spinning department, the Weaving looms are not all full, as in previous scenarios. The narrow loom hall is working at its lower bound of 70 per cent, which means that either all looms in that hall, are closed down 30 per cent of the time, or that various looms are shut down for varying periods. The fact that the other three halls are working at 100 per cent utilization means that there is a drop in narrow gray cloth. The reason for this may be a drop in sales of narrow finished cloths, or production of narrow cloth from purchased gray cloth.

In the first two periods the printing unit has a utilization of only 1 per cent all utilization in the second period being piecework. The only explanation for production of printed cloth in the first period is that the machines processing plain dyed cloths are full but the narrow cloth produced due to the 70 per cent lower bound also has to be processed somewhere.

In other units, utilizations are the same as in Scenario 3.

ii) Finished Cloth Production (Tables: 21, A51)

The first thing we note in this scenario is that the products with highest profit margin, types 7, 14, and 15 are produced at the same level as in Scenario 3. Despite their high profitability these goods are restricted to these levels

of production by various other constraints of the model.

Only Epengle group (m = 13) is the only member of the TV group to be produced, despite the fact that in Scenario 3 production of TV was distributed between 12 and 13, and allocation of all weaving capacity to 13 did not maximize the objective function. In this scenario type 12 product is not produced as in other scenarios and all capacity is allocated to type 13 product.

In the cotton group, wide plain dyed (m = 5) good production has greatly increased, and narrow plain dyed (m = 4) good has dropped by the amount the production of type 5 increased.

The increase in the capacity of second dyeing process is filled with wide cotton, as the TV goods are already at their sales upper bounds for each period. The wide cloth on the second dyeing unit has to pass through the bleaching unit and the alternative for this unit is narrow cotton which has a lower profit margin. Thus there is a drop in narrow cotton production almost equal in amount to the increase in wide cotton production.

Wide TP and piecework production is again present, with slight changes in period two.

There is a slight decrease in total production with respect to Scenario 3.

iii) Gray Cloth Production, Purchasing and Inventory (Tables: 20, A52)

There are no changes in production and inventory policies for wide products, while production of narrow gray

cloth has decreased as expected. This drop has greatly reduced average daily production.

There are extensive changes in the purchasing program. Narrow cloth purchases are stopped and all purchases are of wide cloth, the amount of which has sharply increased.

iv) Yarn Production, Purchasing and Inventory (Tables: 19, A53)

There are no changes in the types of yarn produced but considerable changes in amounts. The increase in production of type 13 cloth and the drop in production of type 12 cloth results in a corresponding increase in production of type 5 yarn and a drop in production of type 8 yarn. As there is no change in production of type 14 cloth, production of type 7 yarn remains constant.

Since capacity is used to the full in period two, same type 6 yarn is produced in period one and stored.

Purchases of type 9 yarn have gone down in period two, and purchases of type 10 yarn all year round, due to increases in gray cloth purchases.

v) Finished Cloth Inventory and Sales (Tables: 22, A54)

There are no changes in the finished cloth inventory policy.

Due to the fact that, there is very little finished cloth inventory, the sales structure is very similar to the production program.

The difference from Scenario 3 is that the excess wide cotton produced in period one is sold in that period and a balanced sales program is followed all year round.

vi) Objective Function Value

Despite the slight decrease in total production the objective function has increased due to the increase in production of high profit margin goods. This increase in the objective function value is about 3.3 per cent with respect to Scenario 3. There is no penalty cost in the model for machines left idle. Thus the question of whether the 3.3 per cent increase in the objective function value is worth leaving certain machines idle is left to the decision-maker to resolve. This model does not seek the answer to this question.

III.D.6. Scenario 6

The changes made in the Scenario 5 are retained here also, and data for the Scenario 4 is used. As the reader will remember. Scenario 4 introduces lower bounds on sales of various product types.

i) Capacity Usage Rates (Table: 18)

When we compare this scenario with Scenario 5, we see that Spinning department utilization remains the same while narrow-loom idle time drops.

Utilization of narrow-looms increases proportionally with narrow cloth lower bounds. Utilization of the bleaching and printing units have incerased for the same reason. The increase in the printing unit is the same as the increase between Scenarios 3 and 4. This resemblance is also evident with the washing units.

When we consider Scenarios 4 and 6 together, we see that the decrease in narrow loom utilization between scenarios 3 and 5 is present, though in a slightly lower amount. Utilization of wide washing and bleaching units have increased with respect to Scenario 4.

ii) Production, Purchasing and Inventory (Tables: 19, 20, 21, A61, A62, A63)

Surveying the types of product, we see there is no change from Scenario 4. The only major difference from Scenario 4 is the drop to zero of production of narrow cotton plain dyed goods (m = 4). This is replaced, as in Scenario 5, by an increase in production of wide cotton plain dyed goods (m = 5).

There is no significant change in production of TV for the domestic market. There is some piecework but slightly less than before. On the other hand, for the first time there is a significant increase in wide TP (m = 9) production. This is due to allocation of excesse capacity.

Average daily finishing production is 98.700 m. 33.000 m of which are printed and 25.000 m of which are TV.

Total production is more or less the same as that in Scenario 4. There is an 18.8 per cent increase with respect to Scenario 5.

When we examine production and inventory figures for gray cloth, we find a situation very similar to Scenario 4. Production of narrow cotton gray cloth has gone down.

Purchases of narrow cloth have gone down and those of wide cloth gone up.

There is no change in the yarn production levels.

Increase in production of wide TP (m = 9) goods has led to an increase in production of the yarn (i = 6) needed for this type of cloth, and for the first time TP yarn (i = 13) this cloth needs has been purchased. Also type 12 yarn is purchased in this scenario.

iii) Finished Cloth Inventory and Sales (Tables: 22, A64)

Finished cloths inventories are very low.

There has been no change in sales levels, except for an increase in sales of wide cotton goods parallel to the increase in their production, and a drop in sales of type 6 in period three with a corresponding increase in sales of type 5. The reason for this is production of type 6 for inventory. The model prefers to purchase type 5 and process it using excess capacity.

A balanced sales program has been followed throughout the year, and sales upper bounds are reached all year round for domestic sales and in the last two periods for exports.

iv) Objective Function Value

Production has increased 0.9 per cent with respect to Scenario 4, leading to an increase in the objective function of 3.1 per cent. This increase is due to the replacement of type 4 cloth by type 5 cloth which has a high profit margin.

Introduction of lower bounds on sales has led to a drop of 5.3 per cent in objective function value with respect to Scenario 5.

III.D.7. Scenario 7

As was stated at the beginning of Scenario 5, one of the main bottlenecks in the Finishing department is the bleaching unit where there is a machine which has no alternative. Here increases in production can only be achieved by reducing production times. Narrow printed cloth passes through this unit at a speed of 80 m/min and narrow dyed cloth at a speed of 40 m/min. In this scenario the model was run assuming that narrow dyed cloths could pass through this unit at a speed of 80 m/min as well. The factory's technical research staff are currently studying this problem and increases of speed from 40 m/min to 60 m/min have been successfully achieved.

The data of Scenario 3 was adapted to accomodate this change and run as Scenario 7.

i) Capacity Usage Rates (Table: 23)

There is no change in the utilization of main units from Scenario 3.

The bleaching unit is no longer a bottleneck, the production of the Finishing department being restricted by the second dyeing and washing units. The increase in painting unit indicates an increase in piecework.

ii) Production, Purchasing and Inventory (Tables: 24, 25, 26, A71, A72, A73)

As expected, the product-mix here is the same as in Scenario 3, with slight changes in TV production leading to a small drop in total production. Distribution of TV production over the year is the same as in Scenario 3 and an optimum mix

TABLE : 23

CAPACITY USAGE RATES OF THE SCENARIOS 3-4-7-8

UNIT	SCN.3 T=1	SCN.3 T=2	SCN.3 T=3	SCN.4 T=1	SCN.4 T=2	SCN.4 T=3	SCN.7 T=1	SCN.7 T=2	SCN.7 T=3	SCN.8 T=1	SCN.8 T=2	SCN.8 T=3
SPINNERS	100	100	100	100	99	100	100	100	100	100	99	100
TWISTERS	99	99	99	96	100	100	96	100	99	96	100	100
WEAV.HA:1	100	100	100	100	100	100	100	100	100	100	100	100
WE.HA:2-4	100	100	100	100	100	100	100	100	100	100	100	100
BLEACH.	100	100	100	100	90	100	95	87	87	100	84	96
PRINT.	0	8	0	52	59	67	0	37	3	52	59	67
1-DYE	26	34	34	24	34	34	26	34	34	24	34	36
2-DYE	100	100	100	100	100	100	100	100	100	100	100	100
WASH-1	70	92	90	69	92	90	68	92	92	69	92	90
WASH-2	46	67	59	68	100	100	69	93	63	68	100	100
WASH-3	71	89	86	71	91	96	100	100	100	83	87	99
DRYER	62	75	71	63	83	81	67	87	76	65	82	82
CH.FINISH	58	62	60	64	65	66	65	64	64	67	64	67
YARN-DYE	100	100	100	100	100	89	100	100	100	100	100	89
RAISING	0	100	100	0	100	100	0	100	100	0	100	100
WINDING	80	96	97	82	92	95	80	96	96	82	92	95

TABLE : 24 UNIT : TON

YARN TABLE OF THE SCENARIOS 3-4-7-8

	SCN.3			SCN.4			SCN.7			SCN.8		
	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION												
COT.	0	0	0	0	0	4	0	0	0	0	0	4
TP	112	82	61	1	62	46	21	88	88	1	62	49
TV	1060	1192	1228	1133	1127	1199	1062	1183	1107	1133	1127	1199
TOTAL	1073	1274	1289	1134	1189	1252	1084	1270	1195	1134	1189	1252
PURCHASING												
COT.	714	694	671	810	700	747	701	705	700	810	700	747
TP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	714	694	671	810	700	747	701	705	700	810	700	747

TABLE : 25 UNIT : KM

GRAY CLOTH TABLE FOR SCENARIOS 3-4-7-8

	SCN.1			SCN.2			SCN.7			SCN.8		
	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION												
NC	2357	2357	2357	2789	2469	2456	2276	2437	2357	2789	2469	2456
WC	1038	1038	976	1038	903	1038	1038	970	994	1038	903	1038
NTP	104	104	104	8	104	200	181	27	104	8	104	200
WTP	0	178	124	0	127	64	0	215	192	0	127	64
YDC	0	0	0	0	0	0	0	0	0	0	0	0
TV	1656	1796	1875	1616	1863	1942	1646	1776	1776	1616	1863	1942
YDTV	833	833	833	833	833	740	833	833	833	833	833	740
TOT	5987	6244	6199	6284	6299	6440	5975	6257	6255	6284	6299	6440
PW	0	484	0	0	1859	1502	0	2195	177	0	1859	1502
PURCHASING												
NC	343	0	0	1202	0	0	2620	0	0	2141	0	0
WC	6656	0	224	6778	0	157	6649	0	176	6678	0	153
TOT	6990	0	224	7880	0	157	9270	0	176	8819	0	153

TABLE : 26 UNIT : KM

CLOTH TABLE FOR SCENARIOS 3-4-7-8

	SCN.3			SCN.4			SCN.7			SCN.8		
TYPE	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3	T=1	T=2	T=3
NCP	0	475	0	3000	3373	3573	0	2152	173	3000	3372	3873
NCPD	2341	2237	2550	895	276	585	4546	1396	3374	1798	0	861
WCPD	3319	3019	2994	3357	3003	2987	3328	3004	3026	3357	3003	2987
NTP	100	100	100	8	100	192	100	100	100	8	100	192
WTP	0	166	116	0	119	60	0	201	179	0	116	60
TV	2500	2519	2481	2500	2584	2416	2377	2500	2500	2500	2584	2416
TOT	8260	8517	8241	9760	9453	10113	10353	9353	9353	10663	9178	10388

TABLE : 27 UNIT : KM

SALES OF SCENARIOS 3-4-7-8

TYPE	SCN.3	SCN.4	SCN.7	SCN.8
NAR. C PRT	475	10 245	2 325	10 245
NAR. C PL-DY	7 127	1 756	9 317	2 653
WD. C PL-DY	9 333	9 346	9 358	9 346
NAR. TP	300	300	300	300
WD. TP	283	179	380	179
TV	7 500	7 500	7 377	7 500
TOT. EXP	16 760	18 352	18 975	19 255
TOT. DOM	7 783	7 679	7 757	7 679
PIECEWORK	475	3 295	2 325	3 295
TOTAL SALES	25 018	29 326	29 058	30 229
OB FN (10**6TL)	8 950	8 489	9 123	8 545

of types 12 and 13 have been found in period one.

Production increases due to the reduced production times is noted on narrow-dyed production. The increase in production of these goods results in a 16.1 per cent increase in total production with respect to Scenario 3 and an average daily production of 96.900 m. The only printed goods included in this figure are piecework.

There are no changes in gray cloth production, purchasing, and inventory policies except for an increase in purchasing of narrow-cotton gray cloth.

There are no changes in yarn production and purchasing programs, and no yarn inventory is held.

iii) Finished Cloth Inventory and Sales (Tables: 27, A74)

In this scenario for the first time there is no finished-cloth inventory, as all product is sold in the period it is produced. The balanced production program results in a balanced sales program. Both domestic sales and exports are at their upper bounds in periods two and three. The highest export figure in period one, until now is achieved: 7.975.500 m.

iv) Objective Function Value

The 16.1 per cent increase in production with respect to Scenario 3 results in 1.9 per cent increase in objective function value. Reducing production times in bleaching increases production but is unable to increase profit in the same proportion.

III.D.8. Scenario 8

In this scenario production times of narrow plain dyed cloth in the bleaching unit have been reduced as in Scenario 7 and the model was run with the data of Scenario 4.

i) Capacity Usage Rates (Table: 23)

The capacity utilizations of the two scenarios (Scenario 4 and 8) are very similar except for slight increases in production at various units in the Finishing department, due to the increase in production of the bleaching unit.

ii) Production, Purchasing and Inventory (Tables: 24, 25, 26, A81, A82, A83)

The only change in production is a slight increase in production of type 4 narrow dyed cloth. The fact that there is an increase only in type 4 cloth's production means that the various other products having lower bounds on production or high profit margins are assigned capacity first, and type 4 is assigned the excess capacity.

The increase in total production is only of one product and is 3.1 per cent.

Production and inventory policies for gray cloth and yarn have not changed, and the extra production's requirements, are met by purchasing gray cloth as in the previous scenario.

iii) Finished Cloth Inventory and Sales (Tables: 27, A84)

There are no changes in finished cloth inventory or sales.

The increase in production has not resulted in a drop in domestic sales this time, and domestic sales are at upper bound in all three periods. The highest figure for exports till now, 8.255.200 m, is reached, this being 98 % of the upper bound of period one.

iv) Objective Function Value

The increase in production leads to an increase in the objective function value of only 0.66 per cent. It should be borne in mind that this is achieved at the expense of drops in quality due to the reduced processing times in the bleaching unit, which may lead to a loss.

III.E. RESULTS AND CONCLUSIONS REGARDING MPP MODEL

According to the cost and sales data given as input, narrow TP (m = 7), wide cotton plain dyed (m = 5,6) and Epengle of TV group (m = 13) emerge as the most profitable products, while type 14 and 15 of TV group and narrow cotton plain dyed (m = 4) appear as the next most profitable product groups.

The firm's 1984 Production Plan(6) figures and the figures for the first four scenarios are listed together by type of product in Table 28. From here we see that planned production of the most profitable export goods are well below that recommended by the model, while the figures for TV

products are approximately equal.

Total production and sales figures planned for the products included in the model and domestic, export and piece-work figures are given in Table 29.

As is seen in the first three scenarios, unless lower bounds are given, the model does not produce any printed goods. The reason is that printed goods are less profitable than dyed goods and in some cases are sold at a loss (note that "tax rebates" on exports are not considered in the model). While these results may not justify not producing any printed goods at all, the model seems to indicate that reducing printed goods to a minimum and placing extra emphasis on the production of plain dyed goods is remunerative. The firm's Market share and the fact that it has sold large amounts of printed goods in the past should also be considered.

When the present state of the market is taken into account and lower bounds added in Scenario 4, there is no change in production of wide cotton plain dyed goods, even though printed goods production remains at lower bound. Also, as can be seen in Table 29, the total production rises sharply.

When we compare the figures of the firm's 1984 Production Plan and Scenario 4 in Table 28, despite many similarities we notice that the scenarios figures are larger. 97 % of the product types included in the 1984 Production Plan are included in the 17 product groups of the model. To achieve the higher production recommended by the model, the firm must increase its market share and thus its sales. The present state of the finishing department permits a total production of 29.000.000 m/year under the given assumptions, while average production has been around 25.000.000 m/year to date. There is no reason why, sales permitting, production

TABLE : 28 UNIT : KM

COMPARISON OF THE FIRM'S PROGRAM AND SCENARIOS

M	PROGRAM	SCN.1	SCN.2	SCN.3	SCN.4
1+3	8170	---	---	---	6950
2	382	---	---	---	---
4	2239	1380	340	7127	1756
5	1300	6131	6153	6552	6509
6	571	2965	2965	2781	2937
7	542	6803	6803	300	300
8+9	734	---	---	283	179
10	---	---	---	---	---
11	377	---	---	---	200
12	1683	---	---	926	1140
13	1458	4396	4454	2147	2023
14	1377	1195	1116	2000	1800
15	1904	1618	1618	2427	2337
16+17	2850	---	2036	475	3295

TABLE : 29 UNIT : KM

COMPARISON OF THE FIRM'S SALES PROGRAM AND SCENARIOS

	PROG.	SCN.1	SCN.2	SCN.3	SCN.4	SCN.5	SCN.6	SCN.7	SCN.8
TOTAL	23587	24489	25486	25018	29326	24920	29604	29058	30229
DOM.	7533	7209	7188	7783	7679	7896	8327	7757	7677
EXP.	13204	17280	16262	16760	18352	16776	18321	18975	19255
PW.	2850	----	2036	475	3295	248	2956	2325	3295

should not increase. The assumptions above mentioned are that each working day is 24 hours and the working year is 300 rays. The first assumption may be objected to on grounds of down-time, maintenance, etc. But even if we take the working day as 22.5 hours, we reach an annual production figure of 27.000.000 m/year which is eight per cent more than the current production.

Despite the fact that the model does not maximize production, when we put lower bounds on sales as in Scenario 4, production automatically rises. Piece work are processed in periods two and three, when market upper bounds are reached, even though they are not very profitable.

In scenarios without sales lower bounds production is low, approaching the current figure of 25.000.000 m/year, as can be seen in Table 29. But when we analyse the total production in terms of types produced, we see that there are considerable differences from the plan; notably that this 25.000.000 m/year contains no printed goods at all.

The model results in terms of product types can be summarized as follows: Minimize printed goods, increase production of plain dyed goods, especially wide dyed goods and try to sell as much as possible of narrow TP (as long as the data remains valid).

When we examine domestic TV sales, we see that the model has them at upper bound throughout. Despite the fact that only 7.200.000 m of TV are sold in Scenario 1, in all other scenarios which reflect the current situation the upper bound of 7.500.000 m is reached.

When we study the products to be sold on the domestic market we see that the model prefers type 13 Epengle, whereas

at present type 12 Serj is produced and sold at a higher level. Thus a switch from Serj to Epengle would seem to be profitable. The reason for this is the situation in the spinning department. As there are bottlenecks at the spinning and winding units the model prefers single yarn, which has a shorter production time, to double folded yarn, which leads to the preference of Epengle.

Apart from the two types, raised and yarn-dyed TV are also produced for the domestic market. Production of these profitable product lines is restricted by the capacity of the special units involved in their construction. The whole capacity of the yarn-dyeing unit is allocated to TV and no yarn-dyed cotton goods are produced. The firm's production policy is to minimize production of yarn-dyed cotton goods and no production is scheduled for 1984.

The capacity utilizations indicate that in the event of an investment in the Finishing department, the bleaching, second dyeing and wide washing units, which constitute the major bottlenecks, should be considered first, due account being taken of the current product-mix.

Expansion of capacity in the second dyeing unit should be coordinated with the expansion of other related capacities and the firm's market share. The changes in machine allocations in Scenarios 5 and 6 bring same interesting results to light. In these scenarios the production of wide plan dyed goods increases sharply and a decrease is noted in production of narrow plan dyed goods due to the bottleneck at the bleaching unit. The drop in production of narrow cloth leaves the narrow weaving hall, one of the firm's main production units, idle. Supposing that the firm can increase its sales of wide cotton goods and if the other necessary unit's capacities are not expanded, the narrow looms may have to be

left idle or sold. Not selling the looms leaves the decision-maker face to face with the alternative of either keeping the machines idle and incurring the opportunity cost this involves, or increasing sales of wide cotton goods.

As is clearly seen above, increasing the capacity of only the second dyeing or wide washing units will not give the desired results unless the capacity of the bleaching unit is expanded as well. An increase in the productivity of the bleaching unit will enable both the currently produced narrow goods and the increased volume of wide goods to be processed.

Another set of interesting results emerges from the increase of productivity of the bleaching unit experimented with in the last scenarios. As narrow goods are not very profitable, the model produces these only to satisfy sales lower bounds or to fill excess capacity left over from more profitable goods. Thus, the reduction of processing time of these goods in the bleaching unit does not lead to a now product-mix, but merely to an increase in their production. As speeding up the bleaching process may lead to quality problems, the decision-maker here has to trade off increases in production against drops in quality level.

The capacity utilizations in the spinning department repeatedly indicate the presence of a bottleneck at the winding unit. This unit should be considered for capacity expansion first.

The model also brings to light the problem of purchases. The model suggests different purchasing policies for yarn and gray-cloth. Gray-cloth purchases for the year are made in the first period; a policy which carries with it a certain risk and uncertainty, especially since in the textile industry product demands change rapidly. This risk

can be minimized by the Export and Sales department's keeping close track of market trends and cooperating with the purchasing department in preparing yearly purchasing policies.

Due to the fact that data collection for the model began in July 1983, some of the values used may differ from 1984 values.

This difference is greatest in foreign currency exchange rates. However, as exports and domestic sales are considered seperately, this will not effect results of the model to a great degree. As long as the upper bounds for the profitable TV products sold on the domestic market remain constant, changes in exchange rates will reflect on export levels proportionately and there will be no change in the product-mix.

III.E.1. Summary of the Results of the Scenario Analysis

The following trends emerge from the scenario analysis:

a) The firm should shift emphasis from printed to plain dyed products and should investigate market possibilities for these goods.

b) Sales of wide cotton goods are higher than those of narrow goods.

c) Sales on the domestic market are constantly at upper bound. Consequently, efforts should be made to raise these.

d) New products such as the narrow TP type should be promoted and sales potential investigated.

e) The whole production system should be taken into account in the event of a capacity increasing investment being made.

f) The yarn and gray cloth purchases which are necessitated by differences in capacity of the Spinning, Weaving, and Finishing departments should be made as early as possible to minimize problems occurring during the year.

IV. SCHEDULING IN THE FINISHING DEPARTMENT

IV.A. STATEMENT OF THE PROBLEM

As was seen in the section on production methods in the textile industry, the production processes of yarn and gray cloth consist of a series of distinct steps, each of which is performed on a different machine and in a definite order. The production of finished cloth, however, is not such a well-defined process. The cloth may need several different processes according to the various desired qualities of the finished product, such as construction, dyed or printed, brightness, schrinkage, etc. Different types of finished cloth may be obtained from the same gray cloth by subjecting it to different combinations of the various finishing processes.

Apart from the qualities of the finished cloth, the speed and heat of the machines used, types of dyes used and types of chemicals employed in the chemical finishing process may also vary. The machines in the Finishing department are multipurpose, in contrast to the single-purpose machines in the other departments. One machine can fulfill several different functions e.g. a stenter can be used for chemical finishing, and for fore-fixing or thermofixing; or a dyeing machine can also be used for washing or bleaching.

The factory under study words on a customer order basis. Under the current planning system, the incoming orders are divided into groups and production plans are drawn up for horizons of two weeks, one week, or daily according to the characteristics of the orders. The machines are loaded daily according to the production plans and each days production is checked the next day, allowing revision of the production plan when necessary.

Several programs are prepared, based on the construction of the gray cloth involved in the production of the finished cloth.

Production schedules for TV and TP products have a horizon of two weeks. Orders for these types of products are taken twice a month and are grouped into "lots" according to the types of dyes they require. This is due to technological constraints. Loading the dyeing machines without taking dye colours and types into consideration creates serious problems. The various dyes are composed of different chemicals, which are fixed differently on the various cloths. Dyeing a dark-coloured order before a light-coloured one necessitates very thorough washing of the machine's rollers, which greatly increases set up time. The same problem occurs when the type of dye changes, which requires that the machine's dye tank be emptied and cleaned, with the same adverse result on setup time.

Due to the above reasons, the present system described below has been established and all agreements with customers are made on the basis of this system.

Each month is divided into two equal periods. Orders are gathered and seperated into lots according to colour and dye type. Dyeing operations are performed from lightest

towards darkest colour, i.e, first the white orders and last the dark blue and black orders. Thus, setup times on the dyeing machines are minimized. The customer is told the earliest data he can expect his order, based on the dye it requires.

As the gray cloth and yarn needed for TV cloths are produced on-house, the Spinning and Weaving departments are informed of the requirements and all three departments coordinate their production plans.

Cotton gray cloths are both produced and purchased. TV goods can only be dyed, whereas cotton goods can be dyed, printed or both (dyed and then printed).

Orders for dyed cotton goods are collected weekly, and urgent orders are processed first. There is no given method used for assignment of non-urgent cotton orders.

The schedule for printed goads is drawn up on a daily basis a week in advance. Other products such as yarn dyed goods and piecework for other firms is processed as the gray cloth and machine workload situations permit.

As emerges clearly from the above discussion, the Finishing department consists of a pool of machines, several of which have multitask capabilities and there exists a list of orders, each requiring a different sequence of operations, to be assigned to these machines. Thus the problem of scheduling in the Finishing department leaves us face to face with a classical "n-jobs, m-machines" problem.

As the n-jobs, m-machines problem(5) can not be solved optimally for large searcleproblems by analytic methods, a heuristic approach was employed, care being taken to preserve

characteristics of the current system. Due to lack of data, a stochastic approach was not used and a deterministic model was established.

IV.B. SCHEDULING MODEL

The model constructed for the scheduling problem stated above has the following objectives;

i) Generation of alternative schedules
ii) Determination of realistic delivery times, especially when orders exceed capacity
iii) Determination in advance which machines are to be left idle in slack periods
iv) Determination of most suitable times for preventive maintenance.

After collection of available data and discussion with the concerned persons, the model given in figure 5 emerged.

The model input, which consists of the order list, initial state of the system, machine data and process data, will be explained later.

The model assumes that there are no shortages of gray cloths, dye and other chemicals.

An algorithmic statement of the heuristic method employed is given below.

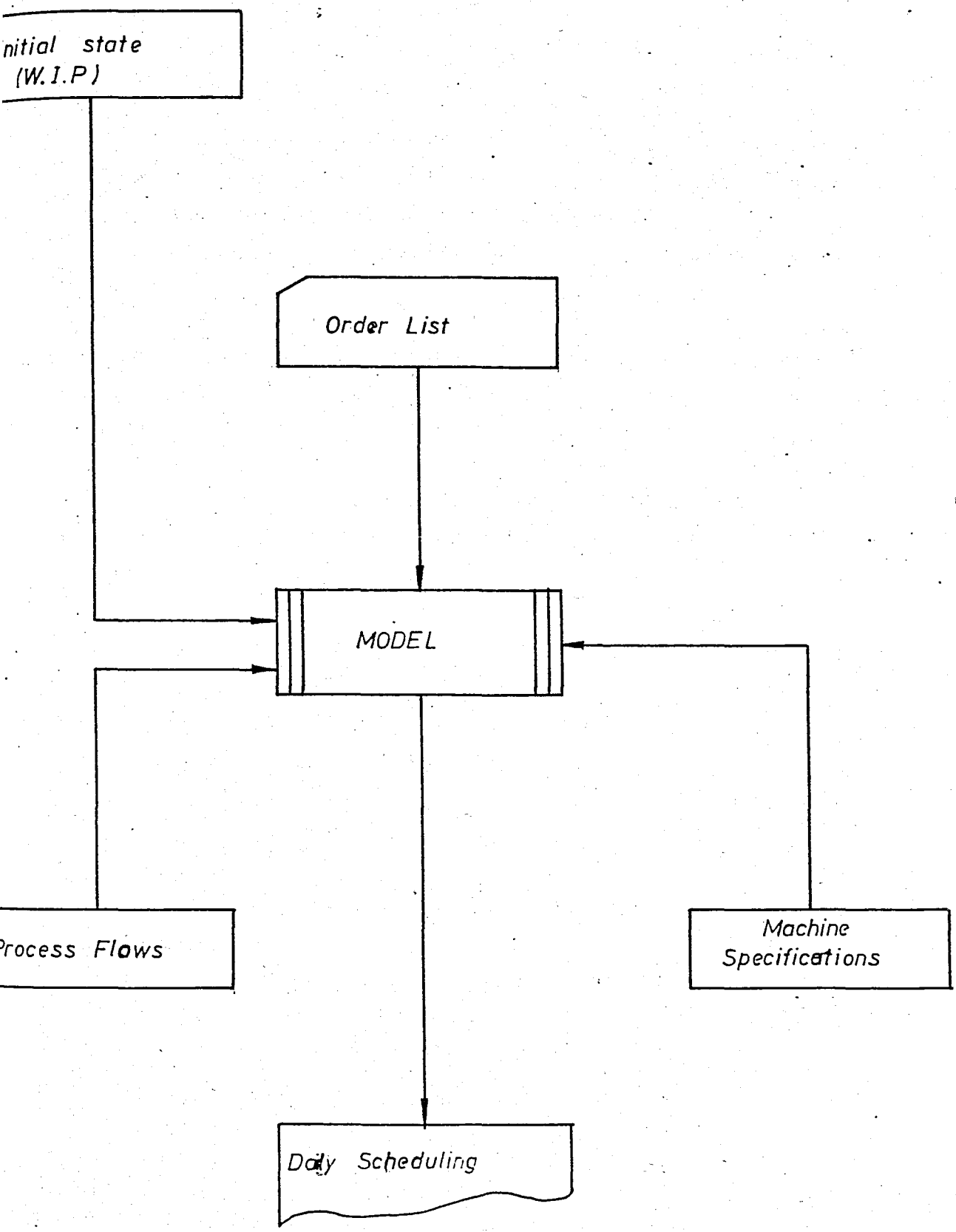

Figure 5 : Structure of the Scheduling model

IV.B.1. ALGORITHM

Step 0 : Initialization

The order list, initial state of system, machine data and process data are read from the relevant files and machine queue and order process pointers are initialized. As all machines are free on monday morning, here this assumption is made.

Orders are then taken one by one from the order list and the first operation to be processed on that order and the machines the operation can be processed on are determined.

As each order can be placed in the queue of only one machine, the choice between alternative machines is made by means of the following heuristic:

i) If the queue of any one of the alternative machines is empty, assign order to that queue.

ii) If there is no empty queue, calculate the total time required to process all the orders in the queue and place the order in the queue having the shortest time.

Machine queue pointers are updated after each assignment.

If all orders have been placed in queues, go to Step 1.

Step 1 : Initial loading of machines

Machines are taken one by one and loaded according to the principles below:

i) Urgeney check:

If there is an urgent order in the queue, load it at once.

ii) Lot check:

Applicable to TV orders only. Orders with lot numbers between 1 and 11 are assigned in ascending order of lot number, i.e., for example an order with lot number 2 can not be assigned to a machine before completion of assignments of all orders with lot number 1 in that machine's queue. No urgency check is performed for these orders.

iii) Special machine check:

Certain machines are special in that they cannot work if a certain other machine is working. Assignment of jobs to these machines is done by the following heuristic:

The total time needed to process all the orders in the queue of each of the special, i.e., mutually exclusive machines, is calculated and the machine with highest time in queue is assigned work, the others being left empty.

iv) Special process check:

It is necessary for certain products to wait for a given length of time between two operations. These waiting times are defined as "special processes" and treated as "dummy" machines with infinite capacities.

A job assigned to a machine is removed from the queue. Process pointers are updated and process time is calculated for each machine.

Step 2 : Job completion and queue update

Process time for each machine is checked, the minimum determined and the system clock brought to this value.

If system clock is greater than the given simulation time (deadline), stop and print a report.

Otherwise, first of all the system time and the times the orders on the special processes have been waiting are compared and orders that have completed this process are placed in the queue of their next process. After all jobs on special processes have been checked, next process of the order just finished on the winning (minimum process time) machine is determined.

If the order has no further process, print a message and go to Step 3. Otherwise, the next process is checked for special processes, alternative machines on which it can be performed are determined and the order is placed in a machine queue using the heuristic stated in Step 0, with the only difference that if one of the alternative machines is free the order is assigned to it directly. Proceed to Step 3.

Step 3 : Assignment of job to vacant machine

The machine vacated in Step 2 is first checked to see whether it is a special machine or not. If it is, the heuristic described in Step 1 is used to decide whether it is to work or not. If it is not a special machine, then as in Step 1, lot and urgency checks are performed. If there is no urgent order in the machine queue, the order to be processed next on the machine is chosen by means of the SPT(5) dispatching rule from among the orders in the queue satisfying lot conditions. The order selected is deleted from the queue and

process pointer is updated. The new process time of the machine is calculated. Go to Step 2.

IV.C. MODEL INPUT

As has been described above, there are basically four inputs: The order list, process flows, machine speeds and initial state. These are described in detail below.

IV.C.1. Preperation of the Order List

Under the current system, orders are taken by the Sales or Export departments and forwarded to the Planning department on the form given in Figure 6.

The following items of information are used by the model.

1) Order no
2) Gray cloth code
3) Pattern/colour code and variety
4) Amount
5) Note

These can be explained as follows.

1) Order no: A number given to the order by the Sales or Export department.

2) Gray cloth code: This is a 5-digit code used throughout the firm. The first digit denotes the construction (TV, TP or cotton), the second whether the yarn is dyed or not the third the breath and weight and the last two digits are used to identify different cloths with similar construction. For example,

Figure :6 , ORDER FORM

SİPARİŞ FORMU

SIRA NO._____

Product name Mamul adı : _____ Delivery Termin tarihi : | | | | | | |

Customer name Müşteri adı : _____ Order date Sipariş tarihi : | | | | | | |

Customer no. Müşteri no. : | | | | | | | | | | Gray cloth Hambez adı : _____

Package type Ambalaj Şekli : _____

Sipariş No. Order no.	MAMUL KODU			Ölçü Birimi	MİKTAR	NOT
	Hambez Kodu	Desen - Renk	Vary.			
	Gray cl. no	Dye type	Vr.		Amount	Notes
Yekûn	Total					

Siparişi Veren : Sales dept. pers. name

Code : 1 1 4 6 6

TV white yarn 1 m ≧ 400 gr

Code : 3 3 1 0 1

Cotton dyed yarn narrow , 1 m ≦ 200 gr

3) Pattern/Colour code and variety: This is a 5-digit code used by the firm. If, first digit = 0 , and
50 > variety > 0 ⇒ printed
Variety = 0 ⇒ dyed
if variety >50 ⇒ both dyed and printed.

The third digit indicates dye colour, ranging from very light (0) to dark (9).

4) The amount is the length desired in meters. Minimum order amount is assumed to be 2000 meters.

5) Notes: Special details such as brightness, shrinkage etc. are given.

The order forms are gathered at the planning unit for the Finishing department and seperated into lots. As was previously explained, this is done only for TV and TP goods. The critical information at this stage is the gray cloth code and the pattern/colour code. There are 495 different dyes currently in use and the lots are composed according to dye types. The employees performing this operation in the present system have the dye codes in memory and so perform this operation quickly.

A computer program (UI/LLS/SPROG)(Appd.B) was writen so as to enable even a person who knows nothing about the dye codes to perform this operation. This program takes the order file and uses the dye file to seperate it into lots.

The operation of seperating the order list into lots can be done by hand or on computer. The seperated list is stored on hard-disk for future use.

IV.C.2. Process Flows

The sequence of operations cloths follow in the Finishing department vary according to the following:

1) Construction
2) Dyed/Printed
3) Dye type
4) Raised or not
5) Yarn-dyed or not.

According to the characteristics above, the cloth passes through different processes. The cloth may also be subjected to a number of processes such as brightness, shrinkage reduction, etc., after leaving the chemical finishing unit. Processes after chemical finishing have not been considered in this study, as they are of no great importance in the scheduling of the department.

The processes which the various products will undergo have been established and noted. When we study the operations lists as a whole we see that several groups reoccur frequently. These we combine and call a process. After these combinations have been done, a total of 86 processes remain. Which machines the processes can be performed on and the average speeds of the machines are also found.

The fact that certain machines process only narrow cloth leads to an increase in the number of processes and the total number of operations. Another reason for the increase in the number of operations is the high variety of dye types. There are six different dyeing processes for TV and TP and three for cotton.

Despite the fact that some processes appear identical, they have all been taken as seperate in the process file so as not to change the process flows.

Another computer program (UI/LLS/PROSES), (Appd.B) takes the order list which has been partitioned into lots and finds the processes it has to undergo. It writes these sequences of processes into the process file and also writes a report if the user so desires.

The matris which contains the information on which process can be performed on which machine and at what speed is performed by the third program (LLS/HIZPRG)(Appd.B). The rows of this matrix are the processes, the columns are the machines and the entries are the operation speeds. Zero elements mean that that process cannot be done on that machine.

IV.C.3. Initial State

Under the present system production is checked daily from the production slips of the machines. Also the machine queues are checked and recorded daily. The daily state of affairs is thus easily accessible.

The model is planned to be run on a weekly basis, as on monday mornings the machines are cleaned they are not loaded at once. The initial state of the system obtained from the forms mentioned above can easily be added by hand to the

order and process files. Incomplete orders are inserted as if they were new but with completed processes deleted from their process entries and different lotnumbers they are deleted from their previous lots. There is no assignment to machines here. The model treats the next process of these orders as if it were later. This operation can be performed easily using the above mentioned forms.

IV.C.4. Machine Specifications

There are approximately 100 machines in the Finishing department, some of which are single and some multi-purpose. These machines are grouped in six main groups: Bleaching, Dyeing, Printing, Chemical-finishing, Yarn-dyeing and Quality Control. The machines in the Quality Control and Yarn-dyeing departments are not considered in this study, which leaves us with over 50 machines in the other four departments to take into account. Some of these are the special machines used after the cloth has left the chemical finishing machine. These machines are very infrequently used and do not affect the result of the scheduling and so are not considered in this study.

Another reason for the high number of machines is the raising machines in the raising unit and the old Jigger washing machines. There are eight raising machines in the Finishing department. A product to be raised passes through at least four, or multiples of four, machines. For this reason four machines have been treated as a single machine.

The Jiggers are old washing machines which can process at most 1000-2000 metres per shift, there are eight of these machines.

In this study the 43 machines studied are treated as 37 machine groups and scheduling is done accordingly. The machines and their functions are given in Table 30.

The 18 main machines at main production points (1, 3, 4, 5, 7(8-9), 10, 11, 12, 22, 23, 27, 28, 29, 30, 31, 32, 33, 34) are kept under control by the finishing planning unit by means of daily reports and problems are discussed at daily meetings. Preventive maintenance of these machines is carried out regularly by the maintenance department.

From the reports above, data for down time of the above machines for two years has been collected and a statistical analysis performed. Also data for the past 13 months have been studied.

The down-time has been grouped into five groups according to reason and percentages of total working time calculated.

Total working time is taken as total work time assigned to that machine that month.

The five groups of down-times are;

i) Total down-time
ii) Cleaning time
iii) Preparation time
iv) Preventive maintenance time
v) Idle time (no work to do)

All other reasons are classified as 'other'. Results of the statistical analysis are given in Table 31.The results yield the following information.

TABLE: 30 MACHINE SPECIFICATIONS

NO	NAME	PROCESSES	NOTES
1	E.YAKMA	C BURNING	
2	Y.YAKMA	TV/TP BURNING	
3	PIS-BEY	SCOURING-BLEACHING	
4	MERSERIZE	MERCERIZING	NARROW CLOTHS 2 BANDS
5	EGALIZE	EQUALIZING	
6	K.KURUTMA	DRYING	ONLY NARROW CLOTHS
7	PAD STEAM	2ND-DYE DEVELOPING	2 PARTS SIMULTANEOUS
8	PAD ST. 1	WASHING,DYEING	ONLY FOULARD
9	PAD ST. 2	WASHING,DEVELOPING	ONLY BATHES
10	AH1	POLYESTER DYEING	
11	AH2	POLYESTER DYEING	
12	FLEISSNER	THERMO-FIXING	
13	DAR SIKMA	REACTIVE DYEING	ONLY NARROW CLOTHS
4-19	G.JIGGER	WASHING,DEVELOPING, SEMI-SCOURING	OLD TYPE PROCESSING
0-21	D.JIGGER	WASHING,DEVELOPING, SEMI-SCOURING	OLD TYPE PROCESSING
22	RD3	PRINTING	
23	RD4	PRINTING	NARROW CLOTHS 2 BANDS
24	HT BUHAR	STEAMING	
25	NOTR BUHAR	STEAMING	
26	WB6	WASHING	ONLY NARROW-PRINTED
27	WB10	WASHING	ONLY NARROW
28	GOLLER	WASHING	
29	GERGEF 1	CHEMICAL FINISHING, FORE-FIXING, EMULSIONING	
30	GERGEF 2	CH. FINISHING, DRYING, EMULSIONING, UVITEXING	
31	GERGEF 3	CH. FINISHING, DRYING	
32	GERGEF 4	CH. FINISHING, DRYING	ONLY NARROW CLOTHS
33	GERGEF 5	FORE-FIXING, THERMO-FIXING	
34	GERGEF 6	CH. FINISHING, DRYING, FORE-FIXING, EMULSIONING	
35	HAAS KUR.	DRYING	
6-37	SARDON	RAISING	

TABLE : 31

PERCENTAGE DOWN-TIMES OF THE MACHINES

NO	NAME	TOTAL 25 MO	TOTAL 12 MO	CLEAN 25 MO	CLEAN 12 MO	PREPA. 25 MO	PREPA. 12 MO	P.MAIN 25 MO	P.MAIN 12 MO	NO ORD 25 MO	NO ORD 12 MO	OTHER 25 MO	OTHER 12 MO
1	E.YAK	38	35	5.5	5.2	1.1	1.1	1.2	0.4	6.3	8.2	23.7	20.0
3	PI-BE	25	21	0.6	0.6	3.2	3.4	5.0	4.2	1.0	1.1	15.3	11.8
4	MERSE	32	28	0.5	0.4	2.8	3.0	2.6	2.0	5.2	7.3	21.1	15.6
5	EGALI	28	26	4.1	3.5	1.1	1.2	0.9	0.7	6.3	6.5	16.0	13.9
7-9	P.STE	34	31	4.5	4.0	8.8	12.	2.5	2.2	1.4	1.2	17.1	11.5
10	AH1	31	27	6.3	5.5	0.7	0.3	1.3	1.7	6.8	8.9	15.9	11.1
11	AH2	27	20	5.6	6.0	1.2	1.0	1.1	1.2	2.6	3.0	16.0	8.9
12	FLEIS	18	13	2.5	2.7	2.2	2.3	1.1	0.9	5.8	3.3	6.5	3.7
22	RD3	35	28	6.3	4.1	9.8	8.0	1.5	1.1	3.8	4.0	13.2	10.4
23	RD4	42	41	9.3	7.9	5.3	4.7	1.4	1.2	6.7	7.9	19.1	18.6
27	WB10	26	26	0.9	0.9	-	-	2.5	2.1	2.5	3.1	20.3	20.0
28	GOLLER	33	32	1.4	1.4	-	-	2.0	1.9	1.5	1.5	28.3	27.2
29	G1	22	20	3.9	4.1	1.4	1.4	0.2	0.4	0.7	0.5	16.1	14.0
30	G2	23	22	3.6	4.2	1.8	1.2	0.5	0.5	0.6	0.6	16.7	15.3
31	G3	16	14	3.3	3.0	1.2	1.4	0.3	0.2	0.7	0.5	10.5	8.6
32	G4	19	16	3.7	3.2	1.1	1.0	0.2	0.1	1.7	0.9	12.6	10.4
33	G5	23	18	4.0	3.9	2.1	2.1	0.5	0.6	6.4	3.6	10.4	7.3
34	G6	20	18	3.7	3.8	1.4	1.2	0.3	0.1	1.5	1.6	12.6	11.5

1) As can be seen from the Table 31, there is a general drop in down-time for all machines. This drop is greatest for the AH2(10) and RDIII(22), 7 %, and secondly for the Gergef 5(33) and Fleissner(12), 5 %.

2) The drop in down-time by units is as below:

Bleaching	3.25 %
Dyeing	4.75 %
Printing	2.25 %
Chemical finishing	2.5 %

The total drop for the whole is 3.2 %.

3) When we analyse the components of total down time. We see the greatest drop is in 'other'(6) delays. This drop differs in magnitude but is present in all machines.

4) There is generally very little variance in the cleaning(2) and preparation(3) down-times. Standardization of cleaning times would greatly facilitate production planning for the department. Although preparation times vary according to the product being processed, a stable figure is expected over a two year period.

5) As expected, preventive maintenance(4) down-times vary very little.

6) Idle times(5) have increased in the last year except on the bottleneck machines. This is due to an increase in productivity which results in more starving of stations.

7) The total down-times(1) have high variance, while the cleaning(2), preperation(3), and maintenance(4) times have low variance. Reduction of this high variance may lead to increased production.

8) When we consider, the downward tendency in down-time, we can say that the Finishing department works 20 hours out of 24, the other four hours being "unavoidable" down-time.

In the light of the above results this study takes a day to be 20 hours, and a shift as 400 minutes.

Certain machines work continuously as one, while parts of certain others can function independently. This is the case for Pad-steam (7 or 8-9) which is included as "special machine" in the model.

Also, bleaching machine(3) is in fact two different machines, which are treated as one by the model.

IV.D. APPLICATION OF THE MODEL

The Scheduling Model was run on the computer to see whether or not the aimed objectives would be reached and the impacts of the assumptions on the model.

The model was tested with the actual data of the first two weeks of April 1984. Data on orders for 12 days for TV-TP, 6 days for Cotton, and the actual amount of WIP on the morning of April 2 nd 1984 were incorporated within the model. The actual amount of cloth in the factory was 417000 m, while new orders for TV-TP and Cotton were 322000 and 754000 meters respectively.

When the model was run for three days with the above data, it was seen that, all TV s went through burning unit, which is the first process and were distributed within the Finishing department. However, as seen in the Macro Production Planning (MPP) model, TV weaving is done within the company

with an average capacity of 30000 m/day. Thus, 30000 m of TV cloth come to the Finishing department daily. The model did not give a reasonable solution for this point had not been taken into consideration since one assumption was that there was no scarcity of gray cloth.

A daily amount of 30000 m TV processing was easily taken into consideration, because the model was being run on a daily basis. Thus the program was run again for the same data with 35000 m of TV/day.

Before running the model for the second day an additional 30000 m, of TV was added to the burning machines pool.

The main objective of the model is to create alternative programs. As can be seen from the algorithm, priority and SPT rules(5) were applied. The model was again run for two days with the same data, the only difference being the application of the LPT (Longest Processing Time) rule instead of the SPT rule.

The results obtained by applying two different rules are demonstrated in Table 32 and 33. If desired, detailed analyses of the results may be done.

When running the model other objectives were also studied. Some machines were shut down, or one machine which can make multi-processing was run like a single-process machine. The special machine (No: 7, 8, 9) were also examined carefully.

Realistic solutions were obtained both by using the SPT and LPT rules, and the validity of the model was confirmed by a comparison with the actual operation.

TABLE : 32

COMPARISON OF THE SPT AND LPT RESULTS 1

	SPT		LPT	
	1.D	2.D	1.D	2.D
NUMBER OF ORDERS COMPLETED :	37	24	25	14
TOTAL AMOUNT COMPLETED (KM) :	157.5	102	142	97.5
COMPLETED LAST WEEK'S ORDERS :	34	18	25	10
COMP. LAST WEEK'S ORD. AMO. (KM) :	152	80	142	86.5

TABLE : 33

COMPARISON OF THE SPT AND LPT RESULTS 2
(TOTAL IDLE TIMES AND PERCENTAGES)

MACHINE NO	S P T				L P T			
	1.D	PER.	2.D	PER.	1.D	PER.	2.D	PER.
1	0	0	0	0	0	0	0	0
2	605	50	967	81	605	50	967	81
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	285	24	379	32	280	23
6	876	73	784	65	984	82	891	74
7-9	0	0	0	0	0	0	0	0
10	55	5	233	19	0	0	450	38
11	50	4	553	46	0	0	900	75
12	100	8	175	15	150	13	375	31
13	871	73	1085	90	957	80	1059	88
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	67	6	0	0	0	0
18	0	0	0	0	0	0	38	3
19	29	2	0	0	325	27	0	0
22	440	37	720	60	540	45	760	63
23	807	67	987	82	780	65	950	79
24	0	0	0	0	0	0	88	7
25	0	0	9	1	30	3	0	0
27	70	6	0	0	0	0	179	15
28	320	27	76	6	320	27	143	12
29	0	0	0	0	178	15	115	10
30	0	0	0	0	0	0	0	0
31	0	0	0	0	7	1	0	0
32	0	0	0	0	148	12	0	0
33	0	0	0	0	84	7	0	0
34	0	0	0	0	0	0	0	0
35	40	3	0	0	100	8	0	0
36	600	50	1113	93	600	50	600	50
37	600	50	1200	100	600	50	1200	100

IV.E. EXTENSION OF THE MODEL

Scheduling model was built and operationalized in order to solve some existing problems of the firm's Finishing department. These problems are stated as objectives of the model. To create alternative schedules, which is one of the most important of the objectives, SPT and LPT priority dispatching rules were used, and the model was run with these heuristics.

The current model can be considered as a first attempt for modelling the scheduling process in the Finishing department and it can easily be developed in order to solve for some other objectives. Data structure of the model is very convenient for updating. It is also very easy to interfere in the model at any stage of the solution procedure. Besides SPT and LPT other scheduling rules, such as Least Work Remaining (LWKR), Total Work (TWK), Fewest Operations Remaining (FOPR) or Work In Next QURUC (WINQ)(5), can be adapted on the model for different and more generally used objectives (for example, minimize WIP stock levels, minimize total machine idle times, etc.).

For the problems of the Finishing department the most appropriate priority dispatching rule can be found by running the model several times with the same data but applying different heuristic rules.

The model, which is deterministic, can be changed to a stochastic one by collecting and analyzing necessary and sufficient data. Probability distributions of the machines up and down times should be found in order to work with the stochastic model.

Finally, as it was mentioned above, the scheduling model is a first attempt and can be changed to accomodate different objectives and is ready to be used for future problems, too.

APPENDIX A
RESULTS OF THE SCENARIO ANALYSIS

Scenario 1

TABLE : A11 UNIT : KM

C L O T H; T A B L E

	M	INVENTORY T=1	T=2	T=3	T=1	T=2	T=3
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
C	4	---	1380	---	---	---	---
C	5	3492	2639	---	3492	---	---
C	6	---	369	2596	---	369	---
TP	7	2268	1372	3164	2268	3640	---
TP	8	---	---	---	---	---	---
TP	9	---	---	---	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	---	---	---	---	---
TV	12	---	---	---	---	---	---
TV	13	1140	1176	2079	---	---	---
TV	14	264	712	220	264	---	---
TV	15	809	809	---	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	---	---	---	---	---
TOTAL		7973	8457	8060	6024	4008	---

TABLE : A12 UNIT : KM

G R A Y C L O T H T A B L E

		D	INVENTORY T=1	T=2	T=3	T=1	T=2	T=3
PROD.	C	1	---	---	---	---	---	---
	C	2	---	---	---	---	---	---
	C	3	---	---	---	---	---	---
	C	4	1038	1038	1038	1038	1688	---
	TP	5	2358	2358	2358	---	932	---
	TP	6	---	---	---	---	---	---
	TP	7	---	---	---	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	---	---	---	---	---	---
	TV	10	1387	1045	2183	190	---	---
	TV	11	277	747	231	---	---	---
	YDTV	12	833	833	---	---	---	---
TOTAL			5894	6022	5811			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	---	---	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	1435	---	---	1435	---	---
	C	17	6438	---	---	2771	---	---
TOTAL			13767	6022	5811	5434	2620	---

TABLE : A13 UNIT : TON

Y A R N T A B L E

		INVENTORY					
	i	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
TP	4	73	66	147	---	66	---
TV	5	255	192	402	---	---	---
TP	6	---	---	---	---	---	---
TV	7	132	355	110	---	---	---
TV	8	728	636	585	---	---	---
TOTAL		1188	1249	1243			
PURCHASING							
C	9	334	334	334	---	---	---
C	10	---	---	---	---	---	---
C	11	---	---	---	---	---	---
TP	12	205	278	66	---	---	---
TP	13	---	---	---	---	---	---
TOTAL		539	612	400			
TOTAL		1727	1862	1643	---	66	---

TABLE : A14 UNIT : KM

S A L E S

	M	T=1	T=2	T=3
EXP	1	---	---	---
EXP	2	---	---	---
EXP	3	---	---	---
EXP	4	---	1380	---
EXP	5	---	6131	---
EXP	6	---	---	2965
EXP	7	---	---	6803
EXP	8	---	---	---
	9	---	---	---
EXP	10	---	---	---
DOM	11	---	---	---
DOM	12	---	---	---
DOM	13	1140	1176	2079
DOM	14	---	975	220
DOM	15	809	809	---
PW	16	---	---	---
PW	17	---	---	---
TOTAL		1949	10472	12068

OBJECTIVE FUNCTION = 9 670 200 000 TL

TABLE : A15

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	100	100
TWISTERS	85	90	69
WEAVING HALL 1	100	100	100
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	100	100	100
PRINTING UNIT	--	--	--
FIRST DYEING UNIT	49	48	74
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	100	100	100
WASHING GROUP 2	65	65	65
WASHING GROUP 3	71	84	78
DRYING UNIT	76	74	74
CHEMICAL FINISHING	57	61	55
YARN DYEING UNIT	100	100	--
RAISING UNIT	26	71	22
WINDING UNIT	82	90	78

Scenario 2

TABLE : A21 UNIT : KM

C L O T H T A B L E

	M	T=1	T=2	T=3	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
C	4	159	181	---	---	---	---
C	5	3333	2820	---	---	---	---
C	6	---	491	2474	---	---	---
TP	7	2268	2268	2268	498	1758	---
TP	8	---	---	---	---	---	---
TP	9	---	---	---	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	---	---	---	---	---
TV	12	---	---	---	---	---	---
TV	13	1379	1321	1754	---	78	---
TV	14	184	264	668	184	---	---
TV	15	809	809	---	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	---	2036	---	---	---
TOTAL		8132	8154	9200	682	1836	---

TABLE : A22 UNIT : KM

G R A Y C L O T H T A B L E

		D				INVENTORY		
			T=1	T=2	T=3	T=1	T=2	T=3
PROD.	C	1	---	---	---	---	---	---
	C	2	---	---	---	---	---	---
	C	3	---	---	---	---	---	---
	C	4	1038	1038	1038	1038	1560	---
	TP	5	2358	2358	2358	---	---	---
	TP	6	---	---	---	---	---	---
	TP	7	---	---	---	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	---	---	---	---	---	---
	TV	10	1448	1387	1842	---	---	---
	TV	11	194	277	702	---	---	---
	YDTV	12	833	833	---	---	---	---
TOTAL			5871	5893	5939			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	---	2036	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	354	---	---	188	---	---
	C	17	6461	---	---	2961	---	---
TOTAL			12685	5893	5939	4187	1560	---

TABLE : A23 UNIT : TON

Y A R N T A B L E

	i	INVENTORY T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
TP	4	74	73	139	---	73	---
TV	5	266	255	339	---	---	---
TP	6	---	---	---	---	---	---
TV	7	92	131	333	---	---	---
TV	8	744	728	494	---	---	---
TOTAL		1175	1188	1305			
PURCHASING							
C	9	334	334	334	---	---	---
C	10	---	---	---	---	---	---
C	11	---	---	---	---	---	---
TP	12	204	278	66	---	---	---
TP	13	---	---	---	---	---	---
TOTAL		538	612	400			
TOTAL		1713	1800	1705	---	73	---

TABLE : A24 UNIT : KM

S A L E S

	M	T=1	T=2	T=3
EXP	1	---	---	---
EXP	2	---	---	---
EXP	3	---	---	---
EXP	4	159	181	---
EXP	5	3333	2820	---
EXP	6	---	491	2474
EXP	7	1770	1008	4026
EXP	8	---	---	---
	9	---	---	---
EXP	10	---	---	---
DOM	11	---	---	---
DOM	12	---	---	---
DOM	13	1379	1243	1832
DOM	14	---	448	668
DOM	15	809	809	---
PW	16	---	---	---
PW	17	---	---	2036
TOTAL		7450	7000	11036

OBJECTIVE FUNCTION = 9 605 500'000 TL

TABLE : A25

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	100	100
TWISTERS	84	85	74
WEAVING HALL 1	100	100	100
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	100	100	100
PRINTING UNIT	--	--	35
FIRST DYEING UNIT	52	52	67
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	98	100	100
WASHING GROUP 2	64	65	97
WASHING GROUP 3	73	74	99
DRYING UNIT	75	75	87
CHEMICAL FINISHING	57	58	60
YARN DYEING UNIT	100	100	--
RAISING UNIT	18	26	67
WINDING UNIT	81	82	85

Scenario 3

TABLE : A31 UNIT : KM

C L O T H T A B L E

	M	T=1	T=2	T=3	INVENTORY T=1	T=2	T=3
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
C	4	2341	2237	2550	---	---	---
C	5	3319	3019	213	---	856	---
C	6	---	---	2781	---	---	---
TP	7	100	100	100	---	---	---
TP	8	---	---	---	---	---	---
TP	9	---	166	116	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	---	---	---	---	---
TV	12	926	---	---	---	---	---
TV	13	651	710	786	---	19	---
TV	14	---	1000	1000	---	---	---
TV	15	809	809	695	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	475	---	---	---	---
TOTAL		8260	8517	8241	---	875	---

TABLE : A32 UNIT : KM

G R A Y C L O T H T A B L E

		D				INVENTORY		
			T=1	T=2	T=3	T=1	T=2	T=3
PROD.	C	1	---	---	---	---	---	---
	C	2	2357	2357	2357	265	295	---
	C	3	---	---	---	---	---	---
	C	4	1038	976	906	1038	2014	---
	TP	5	104	104	104	---	---	---
	TP	6	---	---	---	---	---	---
	TP	7	---	178	124	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	972	---	---	---	---	---
	TV	10	683	746	825	---	---	---
	TV	11	---	1050	1050	---	---	---
	YDTV	12	833	833	833	---	---	118
TOTAL			5987	6244	6199			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	484	---	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	343	---	---	---	---	---
	C	17	6656	---	224	3170	---	---
TOTAL			12977	6728	6423	4473	2309	118

TABLE : A32

UNIT : TON

Y A R N T A B L E

	i	T=1	T=2	T=3	INVENTORY T=1	T=2	T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
TP	4	12	12	12	---	---	---
TV	5	126	137	152	---	---	---
TP	6	---	70	49	---	---	---
TV	7	---	499	499	---	---	---
TV	8	935	556	577	---	---	---
TOTAL		1073	1274	1289			
PURCHASING							
C	9	334	314	292	---	---	---
C	10	379	379	379	---	---	---
C	11	---	---	---	---	---	---
TP	12	---	---	---	---	---	---
TP	13	---	---	---	---	---	---
TOTAL		714	694	671			
TOTAL		1786	1968	1960	---	---	---

TABLE : A34 UNIT : KM

S A L E S

	M	T=1	T=2	T=3
EXP	1	---	---	---
EXP	2	---	---	---
EXP	3	---	---	---
EXP	4	2341	2237	2550
EXP	5	3319	2163	1070
EXP	6	---	---	2781
EXP	7	100	100	100
EXP	8	---	---	---
	9	---	166	116
EXP	10	---	---	---
DOM	11	---	---	---
DOM	12	926	---	---
DOM	13	651	691	805
DOM	14	---	1000	1000
DOM	15	809	809	695
PW	16	---	---	---
PW	17	---	475	---
TOTAL		8260	7641	9116

OBJECTIVE FUNCTION = 8 950 110 000 TL

TABLE : A35

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	100	100
TWISTERS	99	99	99
WEAVING HALL 1	100	100	100
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	100	100	100
PRINTING UNIT	--	8	--
FIRST DYEING UNIT	26	34	34
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	70	92	90
WASHING GROUP 2	46	67	59
WASHING GROUP 3	71	89	86
DRYING UNIT	62	75	71
CHEMICAL FINISHING	58	62	60
YARN DYEING UNIT	100	100	100
RAISING UNIT	--	100	100
WINDING UNIT	80	96	97

Scenario 4

TABLE : A41 UNIT : KM

C L O T H T A B L E

					INVENTORY		
	M	T=1	T=2	T=3	T=1	T=2	T=3
C	1	1000	450	800	---	---	---
C	2	---	---	---	---	---	---
C	3	2000	1100	1600	---	---	---
C	4	895	276	585	---	---	---
C	5	3357	3003	150	---	428	---
C	6	---	---	2837	---	---	---
TP	7	8	100	192	---	---	92
TP	8	---	---	---	---	---	---
TP	9	---	119	60	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	184	16	---	84	---
TV	12	380	380	380	---	---	---
TV	13	1159	395	469	---	19	---
TV	14	---	816	984	---	---	---
TV	15	961	809	567	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	1823	1473	---	---	---
TOTAL		9760	9453	10113	---	512	92

TABLE : A42 UNIT : KM

G R A Y C L O T H T A B L E

		D	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3			
PROD.	C	1	1020	459	816	---	---	---
	C	2	1769	2010	1640	---	601	---
	C	3	---	---	---	---	---	---
	C	4	1038	903	1038	1038	1941	---
	TP	5	8	104	200	---	---	---
	TP	6	---	---	---	---	---	---
	TP	7	---	127	64	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	399	592	416	---	---	---
	TV	10	1217	414	493	---	---	---
	TV	11	---	857	1033	---	---	---
	YDTV	12	833	833	740	---	---	156
TOTAL			6284	6299	6440			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	1859	1502	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	1202	---	---	---	---	---
	C	17	6678	---	157	3153	---	---
TOTAL			14164	8158	8099	4191	2542	156

TABLE : A43 UNIT : TON

Y:A R:N T A:B L E

	I	PRODUCTION T=1	PRODUCTION T=2	PRODUCTION T=3	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	4	---	---	---
C	3	---	---	---	---	---	---
TP	4	1	12	24	---	---	---
TV	5	224	76	91	---	---	---
TP	6	---	50	25	---	---	---
TV	7	---	407	491	---	---	---
TV	8	909	643	618	64	---	---
TOTAL		1134	1189	1252			
PURCHASING							
C	9	410	325	395	---	---	---
C	10	400	375	352	---	---	---
C	11	---	---	---	---	---	---
TP	12	---	---	---	---	---	---
TP	13	---	---	---	---	---	---
TOTAL		810	700	747			
TOTAL		1943	1889	1998	---	---	---

TABLE : A44 UNIT : KM

S A L E S

	M	T=1	T=2	T=3	
EXP	1	1000	450	800	LL
EXP	2	---	---	---	
EXP	3	2000	1100	1600	LL
EXP	4	895	276	585	
EXP	5	3357	2574	578	
EXP	6	---	---	2837	
EXP	7	100	100	100	UL
EXP	8	---	---	---	
	9	---	119	60	
EXP	10	---	---	---	
DOM	11	---	100	100	LL
DOM	12	380	380	380	LL
DOM	13	1159	395	469	
DOM	14	---	816	984	
DOM	15	961	809	567	
PW	16	---	---	---	
PW	17	---	1823	1473	
TOTAL		9852	8941	10533	

OBJECTIVE FUNCTION = 8 489 100 000 TL

TABLE : A45

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	99	100
TWISTERS	96	100	100
WEAVING HALL 1	100	100	100
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	100	90	100
PRINTING UNIT	52	59	67
FIRST DYEING UNIT	24	34	36
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	69	92	90
WASHING GROUP 2	68	100	100
WASHING GROUP 3	71	91	96
DRYING UNIT	63	83	81
CHEMICAL FINISHING	64	65	66
YARN DYEING UNIT	100	100	89
RAISING UNIT	--	100	100
WINDING UNIT	82	92	95

Scenario 5

TABLE : A51 UNIT : KM

C L O T H T A B L E

	M				INVENTORY		
		T=1	T=2	T=3	T=1	T=2	T=3
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	32	---	---	---	---	---
C	4	1397	1550	1686	---	---	---
C	5	4247	3706	1303	---	856	---
C	6	---	---	2555	---	---	---
TP	7	100	100	100	---	---	---
TP	8	---	---	---	---	---	---
TP	9	---	280	116	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	---	---	---	---	---
TV	12	---	---	---	---	---	---
TV	13	1513	774	786	---	83	---
TV	14	---	1000	1000	---	---	---
TV	15	987	809	631	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	248	---	---	---	---
TOTAL		8276	8468	8177	---	940	---

TABLE : A52 UNIT : KM

G R A Y C L O T H T A B L E

		D	INVENTORY T=1	T=2	T=3	T=1	T=2	T=3
PROD.	C	1	---	---	---	---	---	---
	C	2	1528	1706	1617	42	136	---
	C	3	---	---	---	---	---	---
	C	4	1038	739	906	1038	1777	---
	TP	5	189	191	104	85	---	---
	TP	6	---	---	---	---	---	---
	TP	7	---	299	124	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	---	---	---	---	---	---
	TV	10	1588	813	825	---	---	---
	TV	11	---	1050	1050	---	---	---
	YDTV	12	833	833	833	---	---	184
TOTAL			5176	5459	5459			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	253	---	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	---	---	---	---	---	---
	C	17	8351	---	---	1368	---	---
TOTAL			13527	5713	6828	5057	1913	184

TABLE : A53 UNIT : TON

Y A R N T A B L E

					INVENTORY		
	I	T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
TP	4	22	2	12	---	---	---
TV	5	292	150	152	---	---	---
TP	6	55	62	49	55	---	---
TV	7	---	499	499	---	---	---
TV	8	782	574	577	---	---	---
TOTAL		1152	1286	1289			
PURCHASING							
C	9	334	238	292	---	---	---
C	10	246	275	260	---	---	---
C	11	---	---	---	---	---	---
TP	12	---	---	---	---	---	---
TP	13	---	---	---	---	---	---
TOTAL		580	513	552			
TOTAL		1732	1799	1841	55	---	---

TABLE : A54 UNIT : KM

S A L E S

	M	T=1	T=2	T=3
EXP	1	---	---	---
EXP	2	---	---	---
EXP	3	32	---	---
EXP	4	1397	1550	1686
EXP	5	4247	2850	2159
EXP	6	---	---	2555
EXP	7	100	100	100
EXP	8	---	---	---
	9	---	280	116
EXP	10	---	---	---
DOM	11	---	---	---
DOM	12	---	---	---
DOM	13	1513	691	869
DOM	14	---	1000	1000
DOM	15	987	809	631
PW	16	---	---	---
PW	17	---	248	---
TOTAL		8276	8299	8346

OBJECTIVE FUNCTION = 9 242 280 000 TL

TABLE : A55

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	100	100
TWISTERS	89	100	99
WEAVING HALL 1	70	70	70
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	100	100	100
PRINTING UNIT	1	1	--
FIRST DYEING UNIT	25	36	34
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	79	100	95
WASHING GROUP 2	51	68	63
WASHING GROUP 3	63	80	78
DRYING UNIT	72	83	80
CHEMICAL FINISHING	61	65	63
YARN DYEING UNIT	100	100	100
RAISING UNIT	--	100	100
WINDING UNIT	80	97	97

Scenario 6

TABLE : A61 UNIT : KM

C L O T H T A B L E

	M	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3	T=1	T=2	T=3
C	1	1000	450	800	---	---	---
C	2	---	---	---	---	---	---
C	3	2000	1100	1600	---	---	---
C	4	---	---	---	---	---	---
C	5	4221	3226	1525	---	376	---
C	6	---	---	2099	---	---	---
TP	7	39	113	148	---	13	61
TP	8	---	---	---	---	---	---
TP	9	---	711	116	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	179	21	---	79	---
TV	12	380	380	380	---	---	---
TV	13	1159	442	641	---	---	---
TV	14	---	821	979	---	---	---
TV	15	961	757	400	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	1610	1346	---	---	---
TOTAL		9760	9790	10054	---	469	61

TABLE : A62 UNIT : KM

G R A Y C L O T H T A B L E

		D	T=1	T=2	T=3	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3
PROD.	C	1	1020	459	816	---	---	---
	C	2	1735	1206	1548	---	84	---
	C	3	---	---	---	---	---	---
	C	4	1038	229	937	1038	1267	---
	TP	5	41	165	106	---	47	---
	TP	6	---	---	---	---	---	---
	TP	7	---	761	124	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	399	587	421	---	---	---
	TV	10	1217	464	673	---	---	---
	TV	11	---	862	1028	---	---	---
	YDTV	12	833	780	568	---	---	156
TOTAL			6283	5513	6221			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	1642	1373	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	305	---	---	---	---	---
	C	17	7820	---	1601	3388	---	---
TOTAL			14407	7155	9196	4426	1398	156

TABLE : A63 UNIT : TON

Y A R N T A B L E

	i				INVENTORY		
		T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	4	---	---	---
C	3	---	---	---	---	---	---
TP	4	---	19	13	---	---	---
TV	5	224	85	124	---	---	---
TP	6	---	61	49	---	---	---
TV	7	---	409	488	---	---	---
TV	8	910	631	594	66	---	---
TOTAL		1134	1206	1268			
PURCHASING							
C	9	410	108	362	---	---	---
C	10	395	246	341	---	---	---
C	11	---	---	---	---	---	---
TP	12	5	---	---	---	---	---
TP	13	---	239	---	---	---	---
TOTAL		810	700	747			
TOTAL		1943	1798	1971	66	---	---

TABLE : A64 UNIT : KM

S A L E S

	M	T=1	T=2	T=3	
EXP	1	1000	450	800	LL
EXP	2	---	---	---	
EXP	3	2000	1100	1600	LL
EXP	4	---	---	---	
EXP	5	4221	2850	1902	
EXP	6	---	---	2099	
EXP	7	100	100	100	UL
EXP	8	---	---	---	
	9	---	711	116	
EXP	10	---	---	---	
DOM	11	---	100	100	LL
DOM	12	380	380	380	LL
DOM	13	1159	442	641	
DOM	14	---	821	979	
DOM	15	961	757	400	
PW	16	---	---	---	
PW	17	---	1610	1346	
TOTAL		9821	9321	10462	

OBJECTIVE FUNCTION = 8 752 960 000 TL

TABLE : A65

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	100	100
TWISTERS	96	100	100
WEAVING HALL 1	100	70	92
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	100	98	100
PRINTING UNIT	52	55	65
FIRST DYEING UNIT	25	42	35
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	78	99	95
WASHING GROUP 2	73	100	100
WASHING GROUP 3	64	88	88
DRYING UNIT	72	96	88
CHEMICAL FINISHING	67	69	69
YARN DYEING UNIT	100	94	68
RAISING UNIT	--	100	100
WINDING UNIT	82	92	96

Scenario 7

TABLE : A71 UNIT : KM

C L O T H T A B L E

	M	INVENTORY T=1	T=2	T=3	T=1	T=2	T=3
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
C	4	4548	1396	3374	---	---	---
C	5	3328	3004	167	---	---	---
C	6	---	---	2859	---	---	---
TP	7	100	100	100	---	---	---
TP	8	---	---	---	---	---	---
TP	9	---	201	179	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	---	---	---	---	---
TV	12	798	---	---	---	---	---
TV	13	770	691	691	---	---	---
TV	14	---	1000	1000	---	---	---
TV	15	809	809	809	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	2152	1733	---	---	---
TOTAL		10353	9352	9353	---	---	---

TABLE : A72

UNIT : KM

G R A Y C L O T H T A B L E

		D	T=1	T=2	T=3	INVENTORY T=1	T=2	T=3
PROD.	C	1	---	---	---	---	---	---
	C	2	2276	2437	2357	168	1153	---
	C	3	---	---	---	---	---	---
	C	4	1038	970	994	1038	2007	---
	TP	5	181	27	104	77	---	---
	TP	6	---	---	---	---	---	---
	TP	7	---	215	192	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	838	---	---	---	---	---
	TV	10	808	725	725	---	---	---
	TV	11	---	1050	1050	---	---	---
	YDTV	12	833	833	833	---	---	---
TOTAL			5974	6257	6255			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	2195	177	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	2621	---	---	---	---	---
	C	17	6649	---	176	3155	---	---
TOTAL			15244	8452	6608	4437	3160	---

TABLE : A73 UNIT : TON

Y A R N T A B L E

	i				INVENTORY		
		T=1	T=2	T=3	T=1	T=2	T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	---	---	---	---
C	3	---	---	---	---	---	---
TP	4	21	3	12	---	---	---
TV	5	149	133	133	---	---	---
TP	6	---	84	75	---	---	---
TV	7	---	499	499	---	---	---
TV	8	916	550	550	---	---	---
TOTAL		1084	1270	1195			
PURCHASING							
C	9	334	312	320	---	---	---
C	10	367	392	379	---	---	---
C	11	---	---	---	---	---	---
TP	12	---	---	---	---	---	---
TP	13	---	---	---	---	---	---
TOTAL		701	704	699			
TOTAL		1784	1975	1894	---	---	---

TABLE : A74 UNIT : KM

S A L E S

	M	T=1	T=2	T=3
EXP	1	---	---	---
EXP	2	---	---	---
EXP	3	---	---	---
EXP	4	4548	1396	3374
EXP	5	3328	3004	1673
EXP	6	---	---	2859
EXP	7	100	100	100
EXP	8	---	---	---
	9	---	201	179
EXP	10	---	---	---
DOM	11	---	---	---
DOM	12	798	---	---
DOM	13	770	691	691
DOM	14	---	1000	1000
DOM	15	809	809	809
PW	16	---	---	---
PW	17	---	2152	1733
TOTAL		10353	9352	9353

OBJECTIVE FUNCTION = 9 123 060 000 TL

TABLE : A75

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	100	100
TWISTERS	96	100	99
WEAVING HALL 1	100	100	100
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	95	87	87
PRINTING UNIT	--	37	3
FIRST DYEING UNIT	26	34	34
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	68	92	92
WASHING GROUP 2	69	93	63
WASHING GROUP 3	100	100	100
DRYING UNIT	67	87	76
CHEMICAL FINISHING	65	64	64
YARN DYEING UNIT	100	100	100
RAISING UNIT	--	100	100
WINDING UNIT	80	96	96

Scenario 8

TABLE : A81 UNIT : KM

C L O T H T A B L E

	M	T=1	T=2	T=3	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3
C	1	1000	450	800	---	---	---
C	2	---	---	---	---	---	---
C	3	2000	1100	1600	---	---	---
C	4	1798	---	861	---	---	---
C	5	3357	3003	150	---	153	---
C	6	---	---	2837	---	---	---
TP	7	8	100	192	---	---	92
TP	8	---	---	---	---	---	---
TP	9	---	119	60	---	---	---
C	10	---	---	---	---	---	---
TV	11	---	184	16	---	84	---
TV	12	380	380	380	---	---	---
TV	13	1159	395	469	---	---	---
TV	14	---	816	984	---	---	---
TV	15	961	809	567	---	---	---
PW	16	---	---	---	---	---	---
PW	17	---	1823	1473	---	---	---
TOTAL		10663	9178	10388	---	236	92

TABLE : A82 UNIT : KM

G R A Y C L O T H T A B L E

		D	PRODUCTION T=1	PRODUCTION T=2	PRODUCTION T=3	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3
PROD.	C	1	1020	459	816	---	---	---
	C	2	1769	2010	1640	---	888	---
	C	3	---	---	---	---	---	---
	C	4	1038	903	1038	1038	1941	---
	TP	5	8	104	200	---	---	---
	TP	6	---	---	---	---	---	---
	TP	7	---	127	64	---	---	---
	YDC	8	---	---	---	---	---	---
	TV	9	399	592	416	---	---	---
	TV	10	1217	414	493	---	---	---
	TV	11	---	857	1033	---	---	---
	YDTV	12	833	833	740	---	---	156
TOTAL			6284	6299	6440			
PIECEWORK								
	C	13	---	---	---	---	---	---
	C	14	---	1859	1502	---	---	---
PURCHASING								
	C	15	---	---	---	---	---	---
	C	16	2141	---	---	---	---	---
	C	17	6678	---	153	315	---	---
TOTAL:			15103	8158	8095	1353	2828	156

TABLE : A83 UNIT : TON

Y A R N T A B L E

	I	T=1	T=2	T=3	INVENTORY T=1	INVENTORY T=2	INVENTORY T=3
PRODUCTION							
C	1	---	---	---	---	---	---
C	2	---	---	4	---	---	---
C	3	---	---	---	---	---	---
TP	4	1	12	24	---	---	---
TV	5	224	76	91	---	---	---
TP	6	---	50	25	---	---	---
TV	7	---	407	491	---	---	---
TV	8	909	643	618	64	---	---
TOTAL		1134	1189	1252			
PURCHASING							
C	9	410	325	395	---	---	---
C	10	400	375	352	---	---	---
C	11	---	---	---	---	---	---
TP	12	---	---	---	---	---	---
TP	13	---	---	---	---	---	---
TOTAL		810	700	747			
TOTAL		1943	1889	1998	---	---	---

TABLE : A84 UNIT : KM

S A L E S

	M	T=1	T=2	T=3	
EXP	1	1000	450	800	LL
EXP	2	---	---	---	
EXP	3	2000	1100	1600	LL
EXP	4	1798	---	861	
EXP	5	3357	2850	302	
EXP	6	---	---	2837	
EXP	7	100	100	100	UL
EXP	8	---	---	---	
	9	---	119	60	
EXP	10	---	---	---	
DOM	11	---	100	100	LL
DOM	12	380	380	380	LL
DOM	13	1159	395	469	
DOM	14	---	816	984	
DOM	15	961	809	567	
PW	16	---	---	---	
PW	17	---	1823	1473	
TOTAL		10755	8941	10533	

OBJECTIVE FUNCTION = 8 544 900 000 TL

TABLE : A85

CAPACITY USAGE RATES

	T=1	T=2	T=3
RING SPINNERS	100	99	100
TWISTERS	96	100	100
WEAVING HALL 1	100	100	100
WEAVING HALL 2	100	100	100
WEAVING HALL 3	100	100	100
WEAVING HALL 4	100	100	100
BLEACHING UNIT	100	84	96
PRINTING UNIT	52	59	67
FIRST DYEING UNIT	24	34	36
SECOND DYEING UNIT	100	100	100
WASHING GROUP 1	69	92	90
WASHING GROUP 2	68	100	100
WASHING GROUP 3	83	87	99
DRYING UNIT	65	82	82
CHEMICAL FINISHING	67	64	67
YARN DYEING UNIT	100	100	89
RAISING UNIT	--	100	100
WINDING UNIT	82	92	95

APPENDIX B
COMPUTER PROGRAMS

UI/LLS/SIPROG
Program for Order List preparation

```
LE: U1/LLS/SIPROG RCDLGTH/BLCK: 90/20 EOFP: 346 DATE: 09/13/84 THURSDAY

LE  6=OUT,UNIT=PRINTER                                                  000
LE  3=LL/SIPLIS,UNIT=DISK,RECORD=90,BLOCKING=20                         000
LE  4=LL/SIPOUT,UNIT=DISK,RECORD=90,BLOCKING=20                         000
LE  2=U1/BYF/PBOYA,UNIT=DISK,RECORD=90,BLOCKING=20                      000
    IMPLICIT INTEGER (A-Z)                                              000
    DIMENSION TVBEY(20), TVSIY(30),TVANT(30),TVTER(30),TVD1(50)         000
    DIMENSION TVD2(50),TVDR1(50),TVDR2(50),TVDI1(50),TVDI2(50)          000
    DIMENSION TVDK(50),TVIB(20),PIB(20),TP(20),FAS(30),PBEY(20)         000
    DIMENSION PDB(150),PBAS(150),PZBB(50),SIPBOY(19),KODLOT(19)         000
    DIMENSION BOYA(8),B1(50),B2(150),B3(100),B4(100),B5(100)            000
    DATA (KODLOT(I),I=1,19) /'TBEY','TANT','TTER','TDR1','TVD1',        000
   *'TDI1','TVD2','TDR2','TDI2','TVDK','TSIY','TP','TVIB','PIB',       000
   *'PBEY','PBAS','PDB','PZBB','FAS'/                                   000
    DATA (BOYA(I),I=1,8) /'ANTR','DISP','DIRE','DIIN','DIKU',           000
   *'REAK','KUKR','   X'/                                               000
    DATA (B1(I),I=1,50) /50*0/                                          000
    DATA (B2(I),I=1,150) /150*0/                                        000
    DATA (B3(I),I=1,100) /100*0/                                        000
    DATA (B4(I),I=1,100) /100*0/                                        000
    DATA (B5(I),I=1,100) /100*0/                                        000
     BOS=0                                                              000
     DO 666 J=1,19                                                      000
     SIPBOY(J)=0                                                        000
666  CONTINUE                                                           000
     LZ1=0                                                              000
     LZ2=0                                                              000
     LZ3=0                                                              000
     LZ4=0                                                              000
     LZ5=0                                                              000
***************SİPARİŞLERİ OKUMAYA BAŞLA***************                 000
                                                                        000
     DO 100 I=1,5000                                                    000
     READ (3,11,END=999) SIPNO,KD1,KD2,DES,UCR,VR,MIKT,ZBOY,AC,TUY,     000
   *ACIL,TERM                                                           000
 11 FORMAT (I5,I2,I3,I5,I1,I2,I6,I5,3I1,I6)                             000
************                                                            000
************ TV GRUBUNU AYIR ****************                         000
************                                                            000
    IF (KD1.NE.11) GO TO 40                                             000
************ TV BEYAZ ************************                        000
    IF (DES.NE.10001) GO TO 21                                          000
    SIPBOY(1)=SIPBOY(1)+1                                               000
    TVBEY(SIPBOY(1))=SIPNO                                              000
    GO TO 100                                                           000
************ TV SIYAH ************************                        000
 21 IF (DES.NE.77999) GO TO 22                                          000
    SIPBOY(11)=SIPBOY(11)+1                                             000
    TVSIY(SIPBOY(11))=SIPNO                                             000
    LZ5=LZ5+1                                                           000
    B5(LZ5)=SIPNO                                                       000
    GO TO 100                                                           000
*************                                                           000
************* BOYA CİNSİNİ BUL ****************                       000
*************                                                           000
 22 DO 20 J=1,1000                                                      000
    READ (2,12,END=888) K1,BOY,KOD                                      000
 12 FORMAT(I2,I5,32X,I1)                                                000
    IF ( K1.EQ.KD1.AND.BOY.EQ.DES) GO TO 234                            000
    GO TO 20                                                            000
234 DESKD=KOD                                                           000
    GO TO 23                                                            000
 20 CONTINUE                                                            000
```

```
 13 FORMAT (///,10X,' BU SİPARİŞİN: BOYA NOSU DOSYADA YOK ',///,10X,
    *' SIP.NO : ',I5,5X,' MAM.KOD : ',I2,I3,5X,' BOYA NO :',I5,5X,
    *'MIKTAR (M) :',2X,I6,//,10X,'DUZELTIP GIRINIZ , STOP !!')
    GO TO 1001
    BOS=BOS+1
    GO TO 10
*************** TV ANTHROZOL LISTESI ********************
 23 IF(DESKD.NE.1) GO TO 24
    SIPBOY(2)=SIPBOY(2)+1
    TVANT(SIPBOY(2))=SIPNO
    LZ1=LZ1+1
    B1(LZ1)=SIPNO
    GO TO 10
 24 IF(DESKD.NE.2) GO TO 27
    IF(AC.NE.1) GO TO 25
******** TV TERINDOZOL LISTESI YUKARDA BULUNDU ************
    SIPBOY(3)=SIPBOY(3)+1
    TVTER(SIPBOY(3))=SIPNO
    LZ2=LZ2+1
    B2(LZ2)=SIPNO
    GO TO 10
************ TV DISPERS ORTA RENKLER ********************
 25 IF (UCR.GE.7) GO TO 26
    SIPBOY(5)=SIPBOY(5)+1
    TVD1(SIPBOY(5))=SIPNO
    LZ2=LZ2+1
    B2(LZ2)=SIPNO
    GO TO 10
**********TV DISPERS KOYU RENKLER ********************
 26 SIPBOY(7)=SIPBOY(7)+1
    TVD2(SIPBOY(7))=SIPNO
    LZ2=LZ2+1
    B2(LZ2)=SIPNO
    GO TO 10
 27 IF (DESKD.NE.3) GO TO 29
********** TV DISPERS-REAKTIF ORTA RENKLER *************
    IF (UCR.GE.7) GO TO 28
    SIPBOY(4)=SIPBOY(4)+1
    TVDR1(SIPBOY(4))=SIPNO
    LZ3=LZ3+1
    B3(LZ3)=SIPNO
    GO TO 10
************ TV DISPERS-REAKTIF KOYU RENKLER ************
 28 SIPBOY(8)=SIPBOY(8)+1
    TVDR2(SIPBOY(8))=SIPNO
    LZ3=LZ3+1
    B3(LZ3)=SIPNO
    GO TO 10
 29 IF (DESKD.NE.4) GO TO 32
************ TV DISPERS-INDANTHREN ORTA RENKLER ************
    IF (UCR.GE.7) GO TO 31
    SIPBOY(6)=SIPBOY(6)+1
    TVDI1(SIPBOY(6))=SIPNO
    LZ4=LZ4+1
    B4(LZ4)=SIPNO
    GO TO 10
************ TV DISPERS-INDANTHREN KOYU RENKLER *********
 31 SIPBOY(9)=SIPBOY(9)+1
    TVDI2(SIPBOY(9))=SIPNO
    LZ4=LZ4+1
    B4(LZ4)=SIPNO
    GO TO 10
 32 IF (DESKD.NE.5) GO TO 33
************ TV DISPERS-KUKURT ***************************
    SIPBOY(10)=SIPBOY(10)+1
```

```
      LZ5=LZ5+1
      B5(LZ5)=SIPNO
      GO TO 10
   33 WRITE (6,14) SIPNO,DES,DESKD
   14 FORMAT(///,10X,' BU SIPARISIN DESEN KODU HATALI  SIP : ',I5,5X,
     *' BOYA, KOD ',I5,5X,I1,//)
      BOS=BOS+1
      GO TO 10
************** TV IPLIĞI BOYALILAR **********************
   40 IF (KD1.NE.13) GO TO 41
      SIPBOY(13)=SIPBOY(13)+1
      TVIB(SIPBOY(13))=SIPNO
      GO TO 100
************ PAMUK IPLIĞI BOYALILAR *****************
   41 IF (KD1.NE.33) GO TO 42
      SIPBOY(14)=SIPBOY(14)+1
      PIB(SIPBOY(14))=SIPNO
      GO TO 100
************TERİLEN PAMUKLULAR **********************
   42 IF(KD1.NE.21) GO TO 43
      SIPBOY(12)=SIPBOY(12)+1
      TP(SIPBOY(12))=SIPNO
      GO TO 100
************ FASON LISTESI ***************************
   43 IF (KD1.NE.01) GO TO 44
      SIPBOY(19)=SIPBOY(19)+1
      FAS(SIPBOY(19))=SIPNO
      GO TO 100
**************** PAMUKLULAR ***************************
   44 IF (KD1.EQ.31.OR.KD1.EQ.03) GO TO 505
      GO TO 50
************ PAMUK BEYAZLAR ***************************
  505 IF (DES.NE.10001) GO TO 45
      SIPBOY(15)=SIPBOY(15)+1
      PBEY(SIPBOY(15))=SIPNO
      GO TO 100
************** PAMUK DÜZ BOYALILAR *******************
   45 IF (VR.NE.0) GO TO 46
      SIPBOY(17)=SIPBOY(17)+1
      PDB(SIPBOY(17))=SIPNO
      GO TO 100
**************** PAMUK BASKILILAR ********************
   46 IF(VR.NE.0.AND.VR.GE.50) GO TO 47
      SIPBOY(16)=SIPBOY(16)+1
      PBAS(SIPBOY(16))=SIPNO
      GO TO 100
************** PAMUK ZEMİNİ BOYALI BASKILILAR **********
   47 SIPBOY(18)=SIPBOY(18)+1
      PZBB(SIPBOY(18))=SIPNO
      GO TO 100
   50 WRITE (6,15) SIPNO,KD1,KD2
   15 FORMAT(///,10X,' HATALI MAMUL KOD  SIP. NO : ',I5,5X,I2,I3,//)
      BOS=BOS+1
      GO TO 100
   10 REWIND 2
  100 CONTINUE
**************** SIPARIS LISTESI OKUNDU VE ARRAYLERE YAZILDI*******
***************
***************
  999 REWIND 3
      TOPSIP=BOS
      DO 665 J=1,19
      TOPSIP=TOPSIP+SIPBOY(J)
  665 CONTINUE
      DO 88 II=1,19
```

```
      WRITE(6,16) II,KODLOT(II)                                          0019
16    FORMAT(1X,I2,4X,A4,' LOTU ')                                       0019
      WRITE(4,16) II,KODLOT(II)                                          0019
      WRITE (6,17)                                                       0019
17    FORMAT(10X,' SIP. NO ',5X,' MAMUL KOD ',5X,' DES/BOYA ',5X,        0019
     *' VAR ',5X,'MIKTAR',5X,'ZEMIN RENGI',5X,'BOYA KODU',//,120('-'),/) 0019
      MM=SIPBOY(II)                                                      0019
      DO 60 M=1,MM                                                       0019
      DO 70 N=1,TOPSIP                                                   0019
      READ(3,11) SIPNO,KD1,KD2,DES,UCR,VR,MIKT,ZBOY,AC,TUY,ACIL,TERM     0020
**********************                                                   0020
      IF(KD1.EQ.01.OR.KD1.EQ.02) GO TO 7776                              0020
      IF(KD1.EQ.13.OR.KD1.EQ.33) GO TO 7776                              0020
      IF(DES.EQ.10001) GO TO 7776                                        0020
      IF(KD1.EQ.11) GO TO 700                                            0020
      DO 2000 NJ=1,1000                                                  0020
      READ(2,12,END=2888) BK1,BBOY,BKOD                                  0020
      IF(KD1.EQ.03.OR.KD1.EQ.31) GO TO 7778                              0020
      GO TO 7779                                                         0020
78    KD1OR=KD1                                                          0020
      KD1=31                                                             0021
      IF(VR.NE.00) GO TO 7776                                            0021
79    IF(BK1.EQ.KD1.AND.BBOY.EQ.DES) GO TO 2234                          0021
      GO TO 2000                                                         0021
34    DKOD=BKOD                                                          0021
      IF(KD1.EQ.31) KD1=KD1OR                                            0021
      GO TO 2008                                                         0021
00    CONTINUE                                                           0021
88    WRITE(6,13) SIPNO,KD1,KD2,DES,MIKT                                 0021
      GO TO 1001                                                         0021
08    REWIND 2                                                           0021
      GO TO 777                                                          0021
76    DKOD=8                                                             0021
      IF(KD1.EQ.31) KD1=KD1OR                                            0021
      GO TO 777                                                          0022
**********************                                                   0022
00    DO 701 MI=1,LZ1                                                    0022
      IF ( SIPNO.NE.B1(MI)) GO TO 701                                    0022
      DKOD=1                                                             0022
      GO TO 777                                                          0022
01    CONTINUE                                                           0022
      DO 702 MI=1,LZ2                                                    0022
      IF ( SIPNO.NE.B2(MI)) GO TO 702                                    0022
      DKOD=2                                                             0022
      GO TO 777                                                          0023
02    CONTINUE                                                           0023
      DO 703 MI=1,LZ3                                                    0023
      IF ( SIPNO.NE.B3(MI)) GO TO 703                                    0023
      DKOD=3                                                             0023
      GO TO 777                                                          0023
03    CONTINUE                                                           0023
      DO 704 MI=1,LZ4                                                    0023
      IF ( SIPNO.NE.B4(MI)) GO TO 704                                    0023
      DKOD=4                                                             0023
      GO TO 777                                                          0024
04    CONTINUE                                                           0024
      DKOD=5                                                             0024
**************************************************                       0024
77    IF(II.NE.1) GO TO 101                                              0024
      IF(TVBEY(M).NE.SIPNO) GO TO 70                                     0024
      GO TO 501                                                          0024
                                                                         0024
01    IF(II.NE.2) GO TO 102                                              0024
      IF (TVANT(M).NE.SIPNO) GO TO 70                                    0024
      GO TO 501                                                          0025
```

```
102 IF(II.NE.3) GO TO 103
    IF(TVTER(M).NE.SIPNO) GO TO 70
    GO TO 501

103 IF(II.NE.4) GO TO 104
    IF(TVDR1(M).NE.SIPNO) GO TO 70
    GO TO 501

104 IF(II.NE.5) GO TO 105
    IF(TVD1(M).NE.SIPNO) GO TO 70
    GO TO 501

105 IF(II.NE.6) GO TO 106
    IF(TVDI1(M).NE.SIPNO) GO TO 70
    GO TO 501

106 IF(II.NE.7) GO TO 107
    IF(TVD2(M).NE.SIPNO) GO TO 70
    GO TO 501

107 IF(II.NE.8) GO TO 108
    IF(TVDR2(M).NE.SIPNO) GO TO 70
    GO TO 501

108 IF(II.NE.9) GO TO 109
    IF(TVDI2(M).NE.SIPNO) GO TO 70
    GO TO 501

109 IF(II.NE.10) GO TO 110
    IF(TVDK(M).NE.SIPNO) GO TO 70
    GO TO 501

110 IF(II.NE.11) GO TO 111
    IF(TVSIY(M).NE.SIPNO) GO TO 70
    GO TO 501

111 IF(II.NE.12) GO TO 112
    IF(TP(M).NE.SIPNO) GO TO 70
    GO TO 501

112 IF(II.NE.13) GO TO 113
    IF(TVIB(M).NE.SIPNO) GO TO 70
    GO TO 501

113 IF(II.NE.14) GO TO 114
    IF(PIB(M).NE.SIPNO) GO TO 70
    GO TO 501

114 IF(II.NE.15) GO TO 115
    IF(PBEY(M).NE.SIPNO) GO TO 70
    GO TO 501

115 IF(II.NE.16) GO TO 116
    IF(PBAS(M).NE.SIPNO) GO TO 70
    GO TO 501

116 IF(II.NE.17) GO TO 117
    IF(PDB(M).NE.SIPNO) GO TO 70
    GO TO 501

117 IF(II.NE.18) GO TO 118
    IF(PZBB(M).NE.SIPNO) GO TO 70
    GO TO 501
118 IF(FAS(M).NE.SIPNO) GO TO 70
*****************************************************
```

```
                                                                      OC
 501 WRITE(6,18) SIPNO,KD1,KD2,DES,VR,MIKT,ZBOY,BOYA(DKOD)            OC
  18 FORMAT(12X,I5,T28,I2,I3,T44,I5,T57,I2,T65,I6,T80,I5,T94,A4)      OC
     WRITE(4,1100) SIPNO,KD1,KD2,DES,UCR,VR,MIKT,ZBOY,AC,TUY,ACIL,TERM,OC
    *DKOD                                                             OC
1100 FORMAT(I5,I2,I3,I5,I1,I2,I6,I5,3I1,I6,I1)                        OC
     REWIND 3                                                         OC
     GO TO 60                                                         OC
  70 CONTINUE                                                         OC
  60 CONTINUE                                                         OC
     WRITE (6,19)                                                     OC
  19 FORMAT(/,120('-'),8(/))                                          OC
     WRITE(4,210)                                                     OC
 210 FORMAT(50X,'LOT SONU')                                           OC
     GO TO 88                                                         OC
  87 WRITE(6,211) II,KODLOT(II)                                       OC
 211 FORMAT(//,5X,I2,4X,A4,'  LOTUNDA SİPARİŞ YOK ',//)               OC
  88 CONTINUE                                                         OC
1001 STOP                                                             OC
     END                                                              OC
```

UI/LLS/PROSES

Program for Process Flows

```
: U1/LLS/PROSES RCDLGTH/BLCK: 90/20 EOFP: 458 DATE: 09/13/84 THURSDAY

:  6=OUT,UNIT=PRINTER                                                    000
:  4=U1/LLD/SIPSON,UNIT=DISK,RECORD=90,BLOCKING=20                       000
:  3=U1/LLD/PROSES,UNIT=DISK,RECORD=90,BLOCKING=20                       000
                                                                         000
                                                                         000
   IMPLICIT INTEGER (A - Z)                                              000
                                                                         000
                                                                         000
   DIMENSION TVBTZ(8),TVBTY(11),DTPB(8),GTPB(8),TVTZAH(4),TVTZH(4),      000
  *TVTYAH(7),TVTYH(7),GTPH(4),DTPH(5),TERBY(5),ANTBY(5),DRBY(8),         000
  *DBY(5),DIBY(5),DKBY(5),TVITZ(5),TVITY(9),PITZ(4),PITY(4),DPB(6),      000
  *GPB(6),DPBS(10),GPBS(9),DPDH(6),GPDH(6),DPRBY(5),GPRBY(5),           000
  *DPABY(4),GPABY(4),DPKBY(3),GPKBY(3),DPZBR(9),GPZBR(9),DPZBA(8),      000
  *GPZBA(8)                                                              000
                                                                         000
                                                                         000
   DIMENSION P01(8),P02(11),P03(8),P04(8),P05(4),P06(4),P07(7),          000
  *P08(7),P09(4),P10(5),P11(5),P12(5),P13(8),P14(5),P15(5),P16(5),       000
  *P17(5),P18(9),P19(4),P20(4),P21(6),P22(6),P23(10),P24(9),             000
  *P25(6),P26(6),P27(5),P28(5),P29(4),P30(4),P31(3),P32(3),P33(9),       000
  *P34(9),P35(8),P36(8)                                                  000
                                                                         000
                                                                         000
   DATA (TVBTZ(I),I=1,8) /'YAKM','YKAS','KURT','UVIT','FORF','YIKA',     000
  *'KURT','APRE'/                                                        000
   DATA(TVBTY(I),I=1,11) /'YIKA','KURT','EMUS','SARD','YKAS','KURT',     000
  *'UVIT','FORF','YIKA','KURT','APRE'/                                   000
   DATA(DTPB(I),I=1,8) /'YAKM','YIKR','UVIT','FORF','MERS','PIBY',       000
  *'KURT','APRE'/                                                        000
   DATA(GTPB(I),I=1,8) /'YAKM','YIKR','UVIT','FORF','MERS','PIBY',       000
  *'KURT','APRE'/                                                        000
   DATA(TVTZAH(I),I=1,4) /'YAKM','YKAS','KURT','FORF'/                   000
   DATA(TVTZH(I),I=1,4) /'YAKM','YIKA','KURT','FORF'/                    000
   DATA (TVTYAH(I),I=1,7) /'YIKA','KURT','EMUS','SARD','YKAS',           000
  *'KURT','FORF'/                                                        000
   DATA (TVTYH(I),I=1,7) /'YIKA','KURT','EMUS','SARD','YIKA',            000
  *'KURT','FORF'/                                                        000
   DATA (GTPH(I),I=1,4) /'YAKM','MERS','PIBY','KFOF'/                    000
   DATA (DTPH(I),I=1,5) /'YAKM','8BEK','MERS','PIBY','KFOF'/             000
   DATA (TERBY(I),I=1,5) /'BOYA','THRF','INKS','KURT','APRE'/            000
   DATA (ANTBY(I),I=1,5) /'BOYA','INKS','KURT','THRF','APRE'/            000
   DATA (DRBY(I),I=1,8) /'BOYA','THRF','AKTR','REBO','12BK',             000
  *'REYI','KURT','APRE'/                                                 000
   DATA (DBY(I),I=1,5) /'BOYA','THRF','RDYI','KURT','APRE'/              000
   DATA (DIBY(I),I=1,5) /'BOYA','THRF','INKS','KURT','APRE'/             000
   DATA (DKBY(I),I=1,5) /'BOYA','THRF','INKS','KURT','APRE'/             000
   DATA (TVITZ(I),I=1,5) /'YAKM','YIKA','KURT','FORF','APRE'/            000
   DATA (TVITY(I),I=1,9) /'YAKM','YIKA','KURT','EMUS','SARD',            000
  *'YIKA','KURT','FORF','APRE'/                                          000
   DATA (PITZ(I),I=1,4) /'YAKM','8BEK','YIKR','APRE'/                    000
   DATA (PITY(I),I=1,4) /'YAKM','YIKR','SARD','APRE'/                    000
   DATA (DPB(I),I=1,6) /'YAKM','8BEK','MERS','PIBY','KURT','APRE'/       000
   DATA (GPB(I),I=1,6) /'YAKM','8BEK','MERS','PIBY','KURT','APRE'/       000
   DATA (DPBS(I),I=1,10) /'YAKM','8BEK','MERS','PIBY','KURT',            000
  *'EGAL','BASK','BUHR','YIKR','APRE'/                                   000
   DATA (GPBS(I),I=1,9) /'YAKM','8BEK','MERS','PIBY','KREG',             000
  *'BASK','BUHR','YIKR','APRE'/                                          000
   DATA (DPDH(I),I=1,6) /'YAKM','8BEK','MERS','PIBY','KURT','AKTR'/      000
   DATA (GPDH(I),I=1,6) /'YAKM','8BEK','MERS','PIBY','KURT','AKTR'/      000
   DATA (DPRBY(I),I=1,5) /'BOYA','12BK','YIKA','KURT','APRE'/            000
   DATA (GPRBY(I),I=1,5) /'BOYA','12BK','YIKA','KURT','APRE'/            000
   DATA (DPABY(I),I=1,4) /'BOYA','INKS','KURT','APRE'/                   000
```

```
      DATA (DPKBY(I),I=1,3) /'BOIN','KURT','APRE'/                      0000
      DATA (GPKBY(I),I=1,3) /'BOIN','KURT','APRE'/                      0000
      DATA (DPZBR(I),I=1,9) /'BOYA','12BK','YIKA','KURT','EGAL','ZBAS',  0000
     *'BUHR','YIKR','APRE'/                                             0000
      DATA (GPZBR(I),I=1,9) /'BOYA','12BK','YIKA','KURT','EGAL','ZBAS',  0000
     *'BUHR','YIKR','APRE'/                                             0000
      DATA (DPZBA(I),I=1,8) /'BOYA','INKS','KURT','EGAL','ZBAS','BUHR',  0000
     *'YIKR','APRE'/                                                    0000
      DATA (GPZBA(I),I=1,8) /'BOYA','INKS','KURT','EGAL','ZBAS','BUHR',  0000
     *'YIKR','APRE'/                                                    0000
C*****************************************************************     0000
C*****************************************************************     0000
      DATA (P01(I),I=1,8) /01,02,03,27,04,28,25,26/                     0000
      DATA (P02(I),I=1,11) /05,06,07,08,02,03,27,04,28,25,26/           0000
      DATA (P03(I),I=1,8) /29,33,34,38,36,31,40,42/                     0000
      DATA (P04(I),I=1,8) /29,33,34,35,30,31,39,41/                     0000
      DATA (P05(I),I=1,4) /01,02,03,04/                                 0000
      DATA (P06(I),I=1,4) /01,82,03,04/                                 0000
      DATA (P07(I),I=1,7) /05,06,07,08,02,03,04/                        0000
      DATA (P08(I),I=1,7) /05,06,07,08,82,03,04/                        0000
      DATA (P09(I),I=1,4) /29,30,31,32/                                 0000
      DATA (P10(I),I=1,5) /29,84,36,31,37/                              0000
      DATA (P11(I),I=1,5) /09,10,11,25,26/                              0000
      DATA (P12(I),I=1,5) /12,13,25,14,26/                              0000
      DATA (P13(I),I=1,8) /15,10,16,17,85,18,25,26/                     0000
      DATA (P14(I),I=1,5) /19,10,20,25,26/                              0000
      DATA (P15(I),I=1,5) /21,10,22,25,26/                              0000
      DATA (P16(I),I=1,5) /23,81,24,25,26/                              0000
      DATA (P17(I),I=1,5) /01,82,03,04,26/                              0000
      DATA (P18(I),I=1,9) /01,05,06,07,08,82,25,04,26/                  0000
      DATA (P19(I),I=1,4) /43,84,44,46/                                 0000
      DATA (P20(I),I=1,4) /43,44,45,46/                                 0000
      DATA (P21(I),I=1,6) /43,84,48,49,51,53/                           0000
      DATA (P22(I),I=1,6) /43,84,47,49,50,52/                           0000
      DATA (P23(I),I=1,10) /43,84,48,54,83,56,58,60,62,64/              0000
      DATA (P24(I),I=1,9) /43,84,47,54,55,57,59,61,63/                  0000
      DATA (P25(I),I=1,6) /43,84,48,65,67,68/                           0001
      DATA (P26(I),I=1,6) /43,84,47,65,66,68/                           0001
      DATA (P27(I),I=1,5) /70,85,72,80,64/                              0001
      DATA (P28(I),I=1,5) /69,85,71,79,63/                              0001
      DATA (P29(I),I=1,4) /74,76,80,64/                                 0001
      DATA (P30(I),I=1,4) /73,75,79,63/                                 0001
      DATA (P31(I),I=1,3) /78,80,64/                                    0001
      DATA (P32(I),I=1,3) /77,79,63/                                    0001
      DATA (P33(I),I=1,9) /70,85,72,67,56,86,60,62,64/                  0001
      DATA (P34(I),I=1,9) /69,85,71,66,56,86,59,61,63/                  0001
      DATA (P35(I),I=1,8) /74,76,67,56,86,60,62,64/                     0001
      DATA (P36(I),I=1,8) /73,75,66,56,86,59,61,63/                     0001
C*****************************************************************     0001
C*****************************************************************     0001
                                                                        0001
                                                                        0001
                                                                        0001
      WRITE(6,99)                                                       0001
   99 FORMAT(1H1,1X,'SIP.NO  MAM.KOD ',10X,' P R O S E S  S I R A S I ',0001
     */,125('-'),//)                                                    0001
  100 READ(4,10) LN                                                     0001
   10 FORMAT(I3)                                                        0001
      IF(LN.GT.18) GO TO 1120                                           0001
  900 READ(4,11)  LN,SIPNO,KD1,KD2,DES,VR,ZBOY,AC,TUY,DKOD              0001
   11 FORMAT(I3,I5,I2,I3,I5,1X,I2,6X,I5,2I1,7X,I1)                      0001
      IF(SIPNO.EQ.00000) GO TO 100                                      0001
      IF(LN.GT.18) GO TO 1120                                           0001
       LOTLARA GORE PROSES SIRALARINI BUL                               0001
                                                                        0001
```

```
    TV BEYAZ ICIN
    IF(LN.EQ.1) GO TO 101
    GO TO 150
101 IF(TUY.EQ.0) GO TO 102
    WRITE(6,12) SIPNO,KD1,KD2,(TVBTY(I),I=1,11)
    WRITE(3,82) SIPNO,KD1,KD2,(PO2(I),I=1,11)
 12 FORMAT (2X,I5,2X,I2,I3,5X,15(A4,2X))
 82 FORMAT (1X,I5,1X,I2,I3,1X,15(I2,1X))
    GO TO 900
102 WRITE(6,12) SIPNO,KD1,KD2,(TVBTZ(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(PO1(I),I=1,8)
    GO TO 900

     TV ANTHROZOL ICIN

150 IF(LN.EQ.2) GO TO 151
    GO TO 200
151 IF(TUY.EQ.0) GO TO 152
    WRITE(6,12) SIPNO,KD1,KD2,(TVTYAH(I),I=1,7),(ANTBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO7(I),I=1,7),(P12(I),I=1,5)
    GO TO 900
152 WRITE(6,12) SIPNO,KD1,KD2,(TVTZAH(I),I=1,4),(ANTBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO5(I),I=1,4),(P12(I),I=1,5)
    GO TO 900

      TV TERINDOZOL LOTU

200 IF(LN.EQ.3) GO TO 201
    GO TO 220
201 IF(TUY.EQ.0) GO TO 202
    WRITE(6,12) SIPNO,KD1,KD2,(TVTYAH(I),I=1,7),(TERBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO7(I),I=1,7),(P11(I),I=1,5)
    GO TO 900
202 WRITE(6,12) SIPNO,KD1,KD2,(TVTZAH(I),I=1,4),(TERBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO5(I),I=1,4),(P11(I),I=1,5)
    GO TO 900

      TV DISPERS/REAKTIF ACIK LOTU

220 IF(LN.EQ.4) GO TO 221
    GO TO 240
221 IF(AC.EQ.0) GO TO 222
    IF(TUY.EQ.0) GO TO 223
    WRITE(6,12) SIPNO,KD1,KD2,(TVTYAH(I),I=1,7),(DRBY(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(PO7(I),I=1,7),(P13(I),I=1,8)
    GO TO 900
223 WRITE(6,12) SIPNO,KD1,KD2,(TVTZAH(I),I=1,4),(DRBY(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(PO5(I),I=1,4),(P13(I),I=1,8)
    GO TO 900
222 IF(TUY.EQ.0) GO TO 224
    WRITE(6,12) SIPNO,KD1,KD2,(TVTYH(I),I=1,7),(DRBY(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(PO8(I),I=1,7),(P13(I),I=1,8)
    GO TO 900
224 WRITE(6,12) SIPNO,KD1,KD2,(TVTZH(I),I=1,4),(DRBY(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(PO6(I),I=1,4),(P13(I),I=1,8)
    GO TO 900

     TV DISPERS ACIK LOTU

240 IF(LN.EQ.5) GO TO 241
    GO TO 260
241 IF(AC.EQ.0) GO TO 242
    IF(TUY.EQ.0) GO TO 243
    WRITE(6,12) SIPNO,KD1,KD2,(TVTYAH(I),I=1,7),(DBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO7(I),I=1,7),(P14(I),I=1,5)
```

```
      GO TO 900                                                          000
243   WRITE(6,12) SIPNO,KD1,KD2,(TVTZAH(I),I=1,4),(DBY(I),I=1,5)         000
      WRITE(3,82) SIPNO,KD1,KD2,(P05(I),I=1,4),(P14(I),I=1,5)            000
      GO TO 900                                                          000
242   IF(TUY.EQ.0) GO TO 244                                             000
      WRITE(6,12) SIPNO,KD1,KD2,(TVTYH(I),I=1,7),(DBY(I),I=1,5)          000
      WRITE(3,82) SIPNO,KD1,KD2,(P08(I),I=1,7),(P14(I),I=1,5)            000
      GO TO 900                                                          000
244   WRITE(6,12) SIPNO,KD1,KD2,(TVTZH(I),I=1,4),(DBY(I),I=1,5)          000
      WRITE(3,82) SIPNO,KD1,KD2,(P06(I),I=1,4),(P14(I),I=1,5)            000
      GO TO 900                                                          000
                                                                         000
       TV DISPERS/INDANTHREN ACIK LOTU                                   000
                                                                         000
260   IF(LN.EQ.6) GO TO 261                                              000
      GO TO 280                                                          000
261   IF(AC.EQ.0) GO TO 262                                              000
      IF(TUY.EQ.0) GO TO 263                                             000
      WRITE(6,12) SIPNO,KD1,KD2,(TVTYAH(I),I=1,7),(DIBY(I),I=1,5)        000
      WRITE(3,82) SIPNO,KD1,KD2,(P07(I),I=1,7),(P15(I),I=1,5)            000
      GO TO 900                                                          000
263   WRITE(6,12) SIPNO,KD1,KD2,(TVTZAH(I),I=1,4),(DIBY(I),I=1,5)        000
      WRITE(3,82) SIPNO,KD1,KD2,(P05(I),I=1,4),(P15(I),I=1,5)            000
      GO TO 900                                                          000
262   IF(TUY.EQ.0) GO TO 264                                             000
      WRITE(6,12) SIPNO,KD1,KD2,(TVTYH(I),I=1,7),(DIBY(I),I=1,5)         000
      WRITE(3,82) SIPNO,KD1,KD2,(P08(I),I=1,7),(P15(I),I=1,5)            000
      GO TO 900                                                          000
264   WRITE(6,12) SIPNO,KD1,KD2,(TVTZH(I),I=1,4),(DIBY(I),I=1,5)         000
      WRITE(3,82) SIPNO,KD1,KD2,(P06(I),I=1,4),(P15(I),I=1,5)            000
      GO TO 900                                                          000
                                                                         000
          TV DISPERS ORTA LOTU                                           000
                                                                         000
280   IF(LN.EQ.7) GO TO 281                                              000
      GO TO 300                                                          000
281   IF(TUY.EQ.0) GO TO 282                                             000
      WRITE(6,12) SIPNO,KD1,KD2,(TVTYH(I),I=1,7),(DBY(I),I=1,5)          000
      WRITE(3,82) SIPNO,KD1,KD2,(P08(I),I=1,7),(P14(I),I=1,5)            000
      GO TO 900                                                          000
282   WRITE(6,12) SIPNO,KD1,KD2,(TVTZH(I),I=1,4),(DBY(I),I=1,5)          000
      WRITE(3,82) SIPNO,KD1,KD2,(P06(I),I=1,4),(P14(I),I=1,5)            000
      GO TO 900                                                          000
                                                                         000
         TV DISPERS/REAKTIF ORTA LOTU                                    000
                                                                         000
300   IF(LN.EQ.8) GO TO 301                                              000
      GO TO 320                                                          000
301   IF(TUY.EQ.0) GO TO 302                                             000
      WRITE(6,12) SIPNO,KD1,KD2,(TVTYH(I),I=1,7),(DRBY(I),I=1,8)         000
      WRITE(3,82) SIPNO,KD1,KD2,(P08(I),I=1,7),(P13(I),I=1,8)            000
      GO TO 900                                                          000
302   WRITE(6,12) SIPNO,KD1,KD2,(TVTZH(I),I=1,4),(DRBY(I),I=1,8)         000
      WRITE(3,82) SIPNO,KD1,KD2,(P06(I),I=1,4),(P13(I),I=1,8)            000
      GO TO 900                                                          000
                                                                         000
           TV DISPERS/INDANTHREN ORTA RENKLER                            000
                                                                         000
320   IF(LN.EQ.9) GO TO 321                                              000
      GO TO 340                                                          000
321   IF(TUY.EQ.0) GO TO 322                                             000
      WRITE(6,12) SIPNO,KD1,KD2,(TVTYH(I),I=1,7),(DIBY(I),I=1,5)         000
      WRITE(3,82) SIPNO,KD1,KD2,(P08(I),I=1,7),(P15(I),I=1,5)            000
      GO TO 900                                                          000
322   WRITE(6,12) SIPNO,KD1,KD2,(TVTZH(I),I=1,4),(DIBY(I),I=1,5)         000
      WRITE(3,82) SIPNO,KD1,KD2,(P06(I),I=1,4),(P15(I),I=1,5)            000
```

```
      GO TO 900

         TV  DISPERS/KUKURT LOTU

340   IF(LN.EQ.10.OR.LN.EQ.11) GO TO 341
      GO TO 360
341   IF(TUY.EQ.0) GO TO 342
      WRITE(6,12) SIPNO,KD1,KD2,(TVTYH(I),I=1,7),(DKBY(I),I=1,5)
      WRITE(3,82) SIPNO,KD1,KD2,(P08(I),I=1,7),(P16(I),I=1,5)
      GO TO 900
342   WRITE(6,12) SIPNO,KD1,KD2,(TVTZH(I),I=1,4),(DKBY(I),I=1,5)
      WRITE(3,82) SIPNO,KD1,KD2,(P06(I),I=1,4),(P16(I),I=1,5)
      GO TO 900

         TP LOTU DAHA SONRA YAZILACAK

         TV IPLIĞI BOYALI LOTU

360   IF(LN.EQ.13) GO TO 361
      GO TO 380
361   IF(TUY.EQ.0) GO TO 362
      WRITE(6,12) SIPNO,KD1,KD2,(TVITY(I),I=1,9)
      WRITE(3,82) SIPNO,KD1,KD2,(P18(I),I=1,9)
      GO TO 900
362   WRITE(6,12) SIPNO,KD1,KD2,(TVITZ(I),I=1,5)
      WRITE(3,82) SIPNO,KD1,KD2,(P17(I),I=1,5)
      GO TO 900

         PAMUK IPLIĞI BOYALILAR LOTU

380   IF(LN.EQ.14) GO TO 381
      GO TO 400
381   IF(TUY.EQ.0) GO TO 382
      WRITE(6,12) SIPNO,KD1,KD2,(PITY(I),I=1,4)
      WRITE(3,82) SIPNO,KD1,KD2,(P20(I),I=1,4)
      GO TO 900
382   WRITE(6,12) SIPNO,KD1,KD2,(PITZ(I),I=1,4)
      WRITE(3,82) SIPNO,KD1,KD2,(P19(I),I=1,4)
      GO TO 900

        PAMUK BEYAZ LOTU

400   IF(LN.EQ.15) GO TO 401
      GO TO 420
401   IF(KD2.LT.200) GO TO 402
      WRITE(6,12) SIPNO,KD1,KD2,(GPB(I),I=1,6)
      WRITE(3,82) SIPNO,KD1,KD2,(P22(I),I=1,6)
      GO TO 900
402   WRITE(6,12) SIPNO,KD1,KD2,(DPB(I),I=1,6)
      WRITE(3,82) SIPNO,KD1,KD2,(P21(I),I=1,6)
      GO TO 900

         PAMUK BASKILI LOTU

420   IF(LN.EQ.16) GO TO 421
      GO TO 440
421   IF(KD2.LT.200) GO TO 424
      WRITE(6,12) SIPNO,KD1,KD2,(GPBS(I),I=1,9)
      WRITE(3,82) SIPNO,KD1,KD2,(P24(I),I=1,9)
      GO TO 900
424   WRITE(6,12) SIPNO,KD1,KD2,(DPBS(I),I=1,10)
      WRITE(3,82) SIPNO,KD1,KD2,(P23(I),I=1,10)
      GO TO 900

        PAMUK DUZBOYA LOTU
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```
440 IF(LN.EQ.17) GO TO 441
    GO TO 480
441 IF(KD2.LT.200) GO TO 442
    IF(DKOD.EQ.1) GO TO 447
    GO TO 448
447 WRITE(6,12) SIPNO,KD1,KD2,(GPDH(I),I=1,6),(GPABY(I),I=1,4)
    WRITE(3,82) SIPNO,KD1,KD2,(P26(I),I=1,6),(P30(I),I=1,4)
    GO TO 900
448 IF(DKOD.EQ.7) GO TO 449
    WRITE(6,12) SIPNO,KD1,KD2,(GPDH(I),I=1,6),(GPRBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(P26(I),I=1,6),(P28(I),I=1,5)
    GO TO 900
449 WRITE(6,12) SIPNO,KD1,KD2,(GPDH(I),I=1,6),(GPKBY(I),I=1,3)
    WRITE(3,82) SIPNO,KD1,KD2,(P26(I),I=1,6),(P32(I),I=1,3)
    GO TO 900


442 IF(DKOD.EQ.1) GO TO 454
    GO TO 455
454 WRITE(6,12) SIPNO,KD1,KD2,(DPDH(I),I=1,6),(DPABY(I),I=1,4)
    WRITE(3,82) SIPNO,KD1,KD2,(P25(I),I=1,6),(P29(I),I=1,4)
    GO TO 900
455 IF(DKOD.EQ.7) GO TO 456
    WRITE(6,12) SIPNO,KD1,KD2,(DPDH(I),I=1,6),(DPRBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(P25(I),I=1,6),(P27(I),I=1,5)
    GO TO 900
456 WRITE(6,12) SIPNO,KD1,KD2,(DPDH(I),I=1,6),(DPKBY(I),I=1,3)
    WRITE(3,82) SIPNO,KD1,KD2,(P25(I),I=1,6),(P31(I),I=1,3)
    GO TO 900

      PAMUK ZEMIN BOYALI BASKILI LOTU

480 IF(LN.EQ.18) GO TO 481
    GO TO 520
481 IF(KD2.LT.200) GO TO 482
    IF(DKOD.EQ.1) GO TO 485
    WRITE(6,12) SIPNO,KD1,KD2,(GPDH(I),I=1,6),(GPZBR(I),I=1,9)
    WRITE(3,82) SIPNO,KD1,KD2,(P26(I),I=1,6),(P34(I),I=1,9)
    GO TO 900
485 WRITE(6,12) SIPNO,KD1,KD2,(GPDH(I),I=1,6),(GPZBA(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(P26(I),I=1,6),(P36(I),I=1,8)
    GO TO 900
482 IF(DKOD.EQ.1) GO TO 488
    WRITE(6,12) SIPNO,KD1,KD2,(DPDH(I),I=1,6),(DPZBR(I),I=1,9)
    WRITE(3,82) SIPNO,KD1,KD2,(P25(I),I=1,6),(P33(I),I=1,9)
    GO TO 900
488 WRITE(6,12) SIPNO,KD1,KD2,(DPDH(I),I=1,6),(DPZBA(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(P25(I),I=1,6),(P35(I),I=1,8)
    GO TO 900

      TP LOTU

520 IF(LN.EQ.12) GO TO 521
    WRITE (6,13) LN
 13 FORMAT(////,10X,'LOT NO = ',I3,////)
    GO TO 1120
521 IF(DES.EQ.10001) GO TO 522
    GO TO 540
522 IF(KD2.LT.200) GO TO 523
    WRITE(6,12) SIPNO,KD1,KD2,(GTPB(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(P04(I),I=1,8)
    GO TO 900
523 WRITE(6,12) SIPNO,KD1,KD2,(DTPB(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(P03(I),I=1,8)
    GO TO 900
```

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540 IF(KD2.LT.200) GO TO 560
    IF(DKOD.EQ.1) GO TO 541
    GO TO 542
541 WRITE(6,12) SIPNO,KD1,KD2,(GTPH(I),I=1,4),(ANTBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO9(I),I=1,4),(P12(I),I=1,5)
    GO TO 900
542 IF(DKOD.EQ.2) GO TO 543
    GO TO 544
543 WRITE(6,12) SIPNO,KD1,KD2,(GTPH(I),I=1,4),(DBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO9(I),I=1,4),(P14(I),I=1,5)
    GO TO 900
544 IF(DKOD.EQ.3) GO TO 545
    GO TO 546
545 WRITE(6,12) SIPNO,KD1,KD2,(GTPH(I),I=1,4),(DRBY(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(PO9(I),I=1,4),(P13(I),I=1,8)
    GO TO 900
546 IF(DKOD.EQ.4) GO TO 547
    GO TO 548
547 WRITE(6,12) SIPNO,KD1,KD2,(GTPH(I),I=1,4),(DIBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO9(I),I=1,4),(P15(I),I=1,5)
    GO TO 900
548 IF(DKOD.EQ.5) GO TO 549
666 WRITE(6,14) DKOD
 14 FORMAT(////,10X,'BOYA KODU = ',I1,5X,'LISTEDE YOK ',////)
    GO TO 900
549 WRITE(6,12) SIPNO,KD1,KD2,(GTPH(I),I=1,4),(DKBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(PO9(I),I=1,4),(P16(I),I=1,5)
    GO TO 900


560 IF(DKOD.EQ.1) GO TO 561
    GO TO 562
561 WRITE(6,12) SIPNO,KD1,KD2,(DTPH(I),I=1,5),(ANTBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(P10(I),I=1,5),(P12(I),I=1,5)
    GO TO 900
562 IF(DKOD.EQ.2) GO TO 563
    GO TO 564
563 WRITE(6,12) SIPNO,KD1,KD2,(DTPH(I),I=1,5),(DBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(P10(I),I=1,5),(P14(I),I=1,5)
    GO TO 900
564 IF(DKOD.EQ.3) GO TO 565
    GO TO 566
565 WRITE(6,12) SIPNO,KD1,KD2,(DTPH(I),I=1,5),(DRBY(I),I=1,8)
    WRITE(3,82) SIPNO,KD1,KD2,(P10(I),I=1,5),(P13(I),I=1,8)
    GO TO 900
566 IF(DKOD.EQ.4) GO TO 567
    GO TO 568
567 WRITE(6,12) SIPNO,KD1,KD2,(DTPH(I),I=1,5),(DIBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(P10(I),I=1,5),(P15(I),I=1,5)
    GO TO 900
568 IF(DKOD.EQ.5) GO TO 569
    GO TO 666
569 WRITE(6,12) SIPNO,KD1,KD2,(DTPH(I),I=1,5),(DKBY(I),I=1,5)
    WRITE(3,82) SIPNO,KD1,KD2,(P10(I),I=1,5),(P16(I),I=1,5)
    GO TO 900

      LOTLAR BITTI VE PROSESLER YAZILDI
      FILE = 3    LL/PROSES

120 WRITE(6,15)
 15 FORMAT(////,10X,'LOT NO 18 DEN BUYUK, STOP ...',////)
    WRITE(6,16)
 16 FORMAT(//,10X,' PROSES YAZIMLARI BITMISTIR ',/)
    STOP
    END
```

UI/LLS/HIZPRG
Machine/Process Matrix Generator

```
ILE: U1/LLS/HIZPRG RCDLGTH/BLCK: 90/20 EOFP: 79 DATE: 09/13/84 THURSDAY

ILE  4=U1/LLD/HIZ,UNIT=DISK,RECORD=125,BLOCKING=25                              00
                                                                                00
                                                                                00
                                                                                00
      IMPLICIT INTEGER ( A - Z )                                                00
      DIMENSION A(90,37)                                                        00
                                                                                00
                                                                                00
      DATA (A(I,1),I=1,90) /42*0,100,47*0/                                      00
      DATA (A(I,2),I=1,90) /120,27*0,120,61*0/                                  00
      DATA (A(I,3),I=1,90) /30*0,60,17*0,60,4*0,80,10*0,60,25*0/                00
      DATA (A(I,4),I=1,90) /29*0,40,5*0,80,10*0,40,80,42*0/                     00
      DATA (A(I,5),I=1,90) /15*0,70,39*0,70,11*0,70,22*0/                       00
      DATA (A(I,6),I=1,90) /50*0,120,31*0,120,7*0/                              00
      DATA (A(I,7),I=1,90) /12*0,60,8*0,60,0,60,50*0,4*60,12*0/                 00
      DATA (A(I,8),I=1,90) /16*0,70,51*0,2*70,20*0/                             00
      DATA (A(I,9),I=1,90) /4*0,50,5*0,50,6*0,50,0,50,50*0,2*70,9*0,50,         00
     *8*0/                                                                      00
      DATA (A(I,10),I=1,90) /8*0,20,2*0,20,2*0,20,3*0,20,0,20,                  00
     *0,20,49*0,2*20,16*0/                                                      00
      DATA (A(I,11),I=1,90) /8*0,20,2*0,20,2*0,20,3*0,20,0,20,                  00
     *0,20,49*0,2*20,16*0/                                                      00
      DATA (A(I,12),I=1,90) /9*0,16,80*0/                                       00
      DATA (A(I,13),I=1,90) /69*0,70,20*0/                                      00
      DATA (A(I,14),I=1,90) /0,3,2*0,3,5*0,8,6*0,3,0,3,0,8,0,                   00
     *8,46*0,3,5*0,3,13*0/                                                      00
      DATA (A(I,15),I=1,90) /0,3,2*0,3,5*0,8,6*0,3,0,3,0,8,0,                   00
     *8,46*0,3,5*0,3,13*0/                                                      00
      DATA (A(I,16),I=1,90) /0,3,2*0,3,5*0,8,6*0,3,0,3,0,8,0,                   00
     *8,46*0,3,5*0,3,13*0/                                                      00
      DATA (A(I,17),I=1,90) /0,3,2*0,3,5*0,8,6*0,3,0,3,0,8,0,                   00
     *8,46*0,3,5*0,3,13*0/                                                      00
      DATA (A(I,18),I=1,90) /0,3,2*0,3,5*0,8,6*0,3,0,3,0,8,0,                   00
     *8,46*0,3,5*0,3,13*0/                                                      00
      DATA (A(I,19),I=1,90) /0,3,2*0,3,5*0,8,6*0,3,0,3,0,8,0,                   00
     *8,46*0,3,5*0,3,13*0/                                                      00
      DATA (A(I,20),I=1,90) /71*0,3,5*0,3,12*0/                                 00
      DATA (A(I,21),I=1,90) /71*0,3,5*0,3,12*0/                                 00
      DATA (A(I,22),I=1,90) /56*0,2*50,27*0,50,4*0/                             00
      DATA (A(I,23),I=1,90) /56*0,50,100,32*0/                                  00
      DATA (A(I,24),I=1,90) /58*0,12,25,30*0/                                   00
      DATA (A(I,25),I=1,90) /58*0,12,25,30*0/                                   00
      DATA (A(I,26),I=1,90) /90*0/                                              00
      DATA (A(I,27),I=1,90) /61*0,40,9*0,40,18*0/                               00
      DATA (A(I,28),I=1,90) /4*0,50,22*0,50,4*0,50,10*0,50,16*0,2*50,           00
     *19*0,50,8*0/                                                              00
      DATA (A(I,29),I=1,90) /3*0,23,2*0,27,18*0,23,27,6*0,27,56*0/              00
      DATA (A(I,30),I=1,90) /2*0,37,2*0,37,41,17*0,37,2*41,6*0,41,4*0,          00
     *2*37,2*41,3*0,41,3*0,37,0,41,2*0,37,7*0,2*41,0,2*37,11*0,2*37,10*00       0
     */                                                                         00
      DATA (A(I,31),I=1,90) /2*0,19,2*0,19,18*0,19,28,12*0,2*19,2*28,           00
     *3*0,28,3*0,19,0,2*28,0,23,7*0,2*28,0,2*19,11*0,2*19,10*0/                 00
      DATA (A(I,32),I=1,90) /39*0,75,0,82,8*0,75,0,82,2*0,75,7*0,82,            00
     *2*0,75,12*0,75,10*0/                                                      00
      DATA (A(I,33),I=1,90) /3*0,32,5*0,16,3*0,16,20*0,32,2*0,32,42*0,          00
     *16,9*0/                                                                   00
      DATA (A(I,34),I=1,90) /2*0,38,32,0,38,37,17*0,38,0,37,4*0,32,0,           00
     *37,32,0,2*32,2*38,9*0,38,4*0,38,10*0,2*38,11*0,38,11*0/                   00
      DATA (A(I,35),I=1,90) /2*0,23,2*0,23,18*0,23,13*0,23,10*0,23,             00
     *15*0,2*23,11*0,2*23,10*0/                                                 00
      DATA (A(I,36),I=1,90) /7*0,5,36*0,5,45*0/                                 00
      DATA (A(I,37),I=1,90) /7*0,5,36*0,5,45*0/                                 00
```

```
                                                                      000
                                                                      000
                                                                      000
                                                                      000
                                                                      000
                                                                      000
                                                                      000
                                                                      000
   DO 10 I=1,90                                                       000
   WRITE(4,11) (A(I,J),J=1,37)                                        000
11 FORMAT(5X,37I3)                                                    000
                                                                      000
10 CONTINUE                                                           000
                                                                      000
                                                                      000
   STOP                                                               000
   END                                                                000
```

UI/LLS/SPT
Scheduling Model (SPT) Program List

```
E: U1/LLS/SPT RCDLGTH/BLCK: 90/20 EOFP: 647 DATE: 09/13/84 THURSDAY     TI

E   2=U1/LLD/SIPIKI,UNIT=DISK,RECORD=90,BLOCKING=20                      000C
E   3=U1/LLD/PROIKI,UNIT=DISK,RECORD=90,BLOCKING=20                      000C
E   4=U1/LLD/HIZ,UNIT=DISK,RECORD=125,BLOCKING=25                        000C
E   6=OUT,UNIT=PRINTER                                                   000C
E   8=U1/LLD/SONIKI,UNIT=DISK,RECORD=200,BLOCKING=25                     000C
                                                                        000C
                                                                        000C
    IMPLICIT INTEGER (A - Z)                                            000C
    REAL TIM,SUR,HIZ,METRAJ,ZMN,MIN,TIME                                000C
    REAL LAST,CLOCK,TIME38,TIME39,ZAMAN,FARK                            000C
                                                                        000C
    DIMENSION LOTNO(300),SIPNO(300),METRAJ(300),ACIL(300)               000C
    DIMENSION PROSES(300,15),NPROS(300),HIZ(90,37),NNSAY(39)            000C
    DIMENSION MK(10),SP(10),MHAVUZ(39,200),ZMN(200),MAK(10),TIME(37)    000C
    DIMENSION NMAK(37),SNO(300),MHAVTR(200,39),TIME38(150),TIME39(150)  000C
    DIMENSION AL(10),AK(10)                                             000C
                                                                        000C
    WRITE(6,8774)                                                       000C
74  FORMAT(5X,' STEP 0 BASLANGICI ',//,100('*'))                        000C
    DO 21 I=1,500                                                       000C
    SIPSAY=I-1                                                          000C
    READ(2,1,END=99) LOTNO(I),SIPNO(I),METRAJ(I),ACIL(I)                000C
 1  FORMAT(I3,I5,13X,F6.0,7X,I1,7X)                                     000C
    READ(3,2) (PROSES(I,J),J=1,15)                                      000C
 2  FORMAT(13X,15(I2,1X))                                               000C
    NPROS(I)=1                                                          000C
21  CONTINUE                                                            000C
99  DO 22 J=1,90                                                        000C
    READ(4,3) (HIZ(J,K),K=1,37)                                         000C
 3  FORMAT(5X,37F3.0)                                                   000C
22  CONTINUE                                                            000C
    DO 23 J=1,37                                                        000C
    NNSAY(J)=1                                                          000C
23  CONTINUE                                                            000C
                                                                        000C
    DO 2212 IHI=14,19                                                   000C
    HIZ(11,IHI)=0.                                                      000C
    HIZ(22,IHI)=0.                                                      000C
    HIZ(24,IHI)=0.                                                      000C
    HIZ(77,IHI)=0.                                                      000C
12  CONTINUE                                                            000C
    DO 2213 IG=20,21                                                    000C
    HIZ(72,IG)=0.                                                       000C
    HIZ(78,IG)=0.                                                       000C
13  CONTINUE                                                            000C
                                                                        000C
    DO 24 KK=1,SIPSAY                                                   000C
    K=PROSES(KK,1)                                                      000C
    JQ=1                                                                000C
    DO 25 JJ=1,37                                                       000C
    IF(HIZ(K,JJ).EQ.0) GO TO 25                                         000C
    MK(JQ)=JJ                                                           000C
    SP(JQ)=HIZ(K,JJ)                                                    000C
    JQ=JQ+1                                                             000C
25  CONTINUE                                                            000C
    IF(JQ.NE.1) GO TO 92                                                000C
    WRITE(6,101) KK,SIPNO(KK),K                                         000C
01  FORMAT(5X,I3,' NCI SIRADAKI ',I5,' NOLU SİPARİSİN ',I2,' PROSESİ   COC
   1 İÇİN MAKİNA BULUNAMADI')                                           COC
    GO TO 24                                                            COC
92  IF(JQ.NE.2) GO TO 91                                                COC
    IZ=MK(1)                                                            COC
```

```
GO TO 76                                                                00006
DO 35 II=1,JQ-1                                                         00006
IZ=MK(II)                                                               00006
IF(NNSAY(IZ).EQ.1) GO TO 76                                             00006
CONTINUE                                                                00006
DO 26 KKK=1,JQ-1                                                        00006
TIM=0.                                                                  00006
IZ=MK(KKK)                                                              00007
DO 27 LKK=1,NNSAY(IZ)-1                                                 00007
SIP=MHAVUZ(IZ,LKK)                                                      00007
DO 28 I1=1,SIPSAY                                                       00007
JJ=I1                                                                   00007
IF(SIP.EQ.SIPNO(I1)) GO TO 77                                           00007
CONTINUE                                                                00007
PQ=PROSES(JJ,1)                                                         00007
SUR=HIZ(PQ,IZ)                                                          00007
TIM=TIM+METRAJ(KK)/SUR                                                  00007
CONTINUE                                                                00008
ZMN(KKK)=TIM                                                            00008
MAK(KKK)=IZ                                                             00008
CONTINUE                                                                00008
NK=MAK(1)                                                               00008
IT=1                                                                    00008
MIN=ZMN(1)                                                              00008
DO 29 I2=2,JQ-1                                                         00008
IF(ZMN(I2).GE.MIN) GO TO 29                                             00008
MIN=ZMN(I2)                                                             00008
IT=I2                                                                   00009
CONTINUE                                                                00009
NK=MAK(IT)                                                              00009
MHAVUZ(NK,NNSAY(NK))=SIPNO(KK)                                          00009
NNSAY(NK)=NNSAY(NK)+1                                                   00009
GO TO 24                                                                00009
MHAVUZ(IZ,NNSAY(IZ))=SIPNO(KK)                                          00009
NNSAY(IZ)=NNSAY(I7)+1                                                   00009
CONTINUE                                                                00009
WRITE(6,4482)                                                           00009
FORMAT(5X,'  MHAVUZ MATRISI DOKUMU  2OLIK ',//)                         00010
DO 80 I=1,37                                                            00010
WRITE(6,4481) (MHAVUZ(I,J),J=1,NNSAY(I)-1)                              00010
FORMAT(20I6,/)                                                          00010
CONTINUE                                                                00010
WRITE(6,84)                                                             00010
FORMAT(1X,110('*'),/)                                                   00010
WRITE(6,83)  (NNSAY(I),I=1,37)                                          00010
FORMAT (/,1X,' NNSAY VEKTORU ',//,(10X,10I5,),///)                      00010
                                                                        00010
S T E P 1                                                               00011
                                                                        00011
WRITE(6,1006)                                                           00011
FORMAT(1X,'  STEP 1  SONUCLARI ',/,1X,110('*'),/)                       00011
                                                                        00011
DO 400 I=1,37                                                           00011
TIME(I)=0.                                                              00011
NMAK(I)=0.                                                              00011
CONTINUE                                                                00011
                                                                        00011
IRR=0                                                                   00012
DO 621 I=1,37                                                           00012
DO 629 J3=1,NNSAY(I)-1                                                  00012
ZMN(J3)=0.                                                              00012
CONTINUE                                                                00012
IF(NNSAY(I).EQ.1) GO TO 450                                             00012
IF(I.NE.7) GO TO 674                                                    00012
Q=1                                                                     00012
DO 625 K=7,9                                                            00012
```

```
      ZMN(Q)=0.
      DO 622 J=1,NNSAY(K)-1
      SIP=MHAVUZ(K,J)
      DO 623 L=1,SIPSAY
      LL=L
      IF(SIP.EQ.SIPNO(L)) GO TO 673
   23 CONTINUE
   73 PROS=PROSES(LL,NPROS(LL))
      SUR=HIZ(PROS,K)
      ZMN(Q)=ZMN(Q)+METRAJ(LL)/SUR
   22 CONTINUE
      Q=Q+1
   25 CONTINUE
      IF(ZMN(1).GT.ZMN(2).AND.ZMN(1).GT.ZMN(3)) GO TO 674
      IRR=1
      GO TO 621
   74 IF(IRR.EQ.0.AND.I.EQ.8) GO TO 621
      IF(IRR.EQ.0.AND.I.EQ.9) GO TO 621
      LN=1
   81 IR=0
      DO 626 I1=1,NNSAY(I)-1
      SIP=MHAVUZ(I,I1)
      DO 627 J=1,SIPSAY
      JJ=J
      IF(SIPNO(J).EQ.SIP) GO TO 671
   27 CONTINUE
   71 LOT=LOTNO(JJ)
      IF(LOT.GE.1.AND.LOT.LE.11) GO TO 672
      IF(ACIL(JJ).EQ.0) GO TO 675
      NMAK(I)=SIP
      PQ=PROSES(JJ,NPROS(JJ))
      SUR=HIZ(PQ,I)
      TIME(I)=TIME(I)+METRAJ(JJ)/SUR
      MHAVUZ(I,I1)=0
      NPROS(JJ)=NPROS(JJ)+1
      GO TO 621
   72 IF(LOT.NE.LN) GO TO 680
      IR=1
   75 PQ=PROSES(JJ,NPROS(JJ))
      SUR=HIZ(PQ,I)
      ZMN(I1)=METRAJ(JJ)/SUR
      SNO(I1)=JJ
      GO TO 626
   80 ZMN(I1)=99999999.
   26 CONTINUE
      IF(IR.NE.0.OR.LOT.GT.11) GO TO 682
      LN=LN+1
      GO TO 681
   82 IT=1
      MIN=ZMN(1)
      IF(NNSAY(I).EQ.2) GO TO 888
      DO 630 I2=2,NNSAY(I)-1
      IF(ZMN(I2).GE.MIN) GO TO 630
      MIN=ZMN(I2)
      IT=I2
   30 CONTINUE
   88 NMAK(I)=MHAVUZ(I,IT)
      MHAVUZ(I,IT)=0
      KZ=SNO(IT)
      NPROS(KZ)=NPROS(KZ)+1
      TIME(I)=TIME(I)+MIN
      GO TO 621
   50 WRITE(6,1016) I
   16 FORMAT(5X,I5,' NOLU MAKINANIN KUYRUGU BOS ',/)
   21 CONTINUE
```

```
      WRITE(6,511) (TIME(I),I=1,37)
511   FORMAT(10X,' MAKINA ZAMANLARI VEKTORU ',///,(10X,10F10.1),//)
      WRITE(6,512) (NMAK(I),I=1,37)
512   FORMAT(10X,' MAKINA USTUNDEKI SIPARIS ',///,(10X,10I10),//)
      WRITE(6,513) (NNSAY(I),I=1,37)
513   FORMAT(10X,' MAKINA KUYRUGUNDAKI IS SAYISI ',///,(10X,10I10),//)
      WRITE(6,514) (NPROS(I),I=1,SIPSAY)
514   FORMAT (10X,' SIPARISLERIN ATANACAK ILK PROCESLERI ',///,(20I5))

      WRITE(6,8775)
775   FORMAT(5X,' STEP 2-3 BASLANGICI ',//,100('*'))
      DO 220 I=38,39
      DO 230 J=1,200
      MHAVUZ(I,J)=0
230   CONTINUE
      NNSAY(I)=1
220   CONTINUE
      DO 240 I=1,150
      TIME38(I)=0.
      TIME39(I)=0.
240   CONTINUE

S T E P 2-3  Y U K L E,M E   B A S L I Y O R

      LAST=1200.
      CLOCK=0.
981   IRR=0
      ITT=1
      MIN=TIME(1)
      DO 921 J=2,37
      IF(TIME(J).GE.MIN.OR.NMAK(J).EQ.0) GO TO 921
      ITT=J
      MIN=TIME(J)
921   CONTINUE
      CLOCK=TIME(ITT)
      WRITE(6,903) CLOCK,ITT
903   FORMAT(/,2X,' S:76  CLOCK = ',F8.1,37X,'BOSALAN MAK:',I4,/)

OZEL PROSES DURUMU KONTROLU VE ISLEMI
      DO 9101 KZ=38,39
      PI=0
      IF(NNSAY(KZ).EQ.1) GO TO 9101
      DO 9102 KY=1,NNSAY(KZ)-1
      IF(KZ.NE.38) GO TO 946
      ZAMAN=TIME38(KY)
      IF(ZAMAN.EQ.0.) GO TO 9102
      FARK=CLOCK-ZAMAN
      IF(FARK.GE.480.) GO TO 947
      GO TO 9102
946   ZAMAN=TIME39(KY)
      IF(ZAMAN.EQ.0.) GO TO 9102
      FARK=CLOCK-ZAMAN
      IF(FARK.LT.720.) GO TO 9102
947   SIP=MHAVUZ(KZ,KY)
      IF(KZ.EQ.38) TIME38(KY)=0.
      IF(KZ.EQ.39) TIME39(KY)=0.
      MHAVUZ(KZ,KY)=0
      PI=1
      DO 919 J=1,SIPSAY
      IS=J
      IF(SIPNO(J).EQ.SIP) GO TO 948
919   CONTINUE
948   NEXT=PROSES(IS,NPROS(IS))
      JK=IS
```

```
      GO TO 9135
102   CONTINUE
101   CONTINUE


      IF(CLOCK.GT.LAST) GO TO 9150
      SIP=NMAK(ITT)
      NMAK(ITT)=0
      DO 922 JJ=1,SIPSAY
      JK=JJ
      IF(SIPNO(JJ).EQ.SIP) GO TO 973
922   CONTINUE
973   NEXT=PROSES(JK,NPROS(JK))
      IF(NEXT.EQ.0) GO TO 9140

 OZEL PROSES DURUMU 8BEKLE VEYA 12BEKLE
      IF(NEXT.NE.84.AND.NEXT.NE.85) GO TO 9135
      II=38
      IF(NEXT.EQ.84) GO TO 998
      II=39
998   IF(NNSAY(II).NE.1) GO TO 8231
      MHAVUZ(II,1)=SIP
      NNSAY(II)=NNSAY(II)+1
      IF(NEXT.EQ.84) TIME38(1)=CLOCK
      IF(NEXT.EQ.85) TIME39(1)=CLOCK
      NPROS(JK)=NPROS(JK)+1
      WRITE(6,7924) JK,NPROS(JK)
924   FORMAT(/,2X,' SIP. NPROS : ', 2I7)
      WRITE(6,8232) II,SIP
232   FORMAT(2X,'S:139',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI')
      GO TO 980
231   DO 941 K=1,NNSAY(II)-1
      IF(MHAVUZ(II,K).NE.0) GO TO 941
      MHAVUZ(II,K)=SIP
      WRITE(6,8001) II,SIP
001   FORMAT(2X,'S:145',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI ')
      IF(NEXT.EQ.84) TIME38(K)=CLOCK
      IF(NEXT.EQ.85) TIME39(K)=CLOCK
      NPROS(JK)=NPROS(JK)+1
      WRITE(6,7924) JK,NPROS(JK)
      GO TO 980
941   CONTINUE
      MHAVUZ(II,NNSAY(II))=SIP
      WRITE(6,8002) II,SIP
002   FORMAT(2X,'S:153',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI ')
      IF(NEXT.EQ.84) TIME38(NNSAY(II))=CLOCK
      IF(NEXT.EQ.85) TIME39(NNSAY(II))=CLOCK
      NNSAY(II)=NNSAY(II)+1
      NPROS(JK)=NPROS(JK)+1
      WRITE(6,7924) JK,NPROS(JK)
      GO TO 980


 ALTERNATIF MAKINA TESBITI
135   IQ=1
      DO 923 J=1,37
      IF(HIZ(NEXT,J).EQ.0) GO TO 923
      SP(IQ)=HIZ(NEXT,J)
      MK(IQ)=J
      IQ=IQ+1
923   CONTINUE
      WRITE(6,7923) (MK(LI),LI=1,IQ-1)
923   FORMAT(/,5X,' ALTERNATIVE MAKINALAR ',10(1X,I4))


'EK BOS MAKINA VAR VE   7 8 9 DEGIL HEMEN YUKLE
```

```
   IZ=MK(1)                                                              000
   IF(NMAK(IZ).NE.0) GO TO 977                                           000
   IF(IZ.EQ.7.OR.IZ.EQ.8.OR.IZ.EQ.9) GO TO 9772                          000
   NMAK(IZ)=SIP                                                          000
   WRITE(6,904) IZ,SIP                                                   000
04 FORMAT(/,2X,'S:180',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')     000
   NPROS(JK)=NPROS(JK)+1                                                 000
   WRITE(6,7924) JK,NPROS(JK)                                            000
   TIME(IZ)=CLOCK+METRAJ(JK)/SP(1)                                       000
   IF(IZ.EQ.ITT) GO TO 981                                               000
   IF(PI.EQ.1) GO TO 981                                                 000
   GO TO 980                                                             000
                                                                         000
TEK BOS MAKINA VE 7,8 VEYA 9                                             000
72 IF(IZ.NE.7) GO TO 9773                                                000
   IF(NMAK(8).NE.0.OR.NMAK(9).NE.0) GO TO 977                            000
   NMAK(7)=SIP                                                           000
   WRITE(6,5001) IZ,SIP                                                  000
01 FORMAT(/,2X,'S:192',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')     000
   NPROS(JK)=NPROS(JK)+1                                                 000
   WRITE(6,7924) JK,NPROS(JK)                                            000
   TIME(IZ)=CLOCK+METRAJ(JK)/SP(1)                                       000
   IF(IZ.EQ.ITT) GO TO 981                                               000
   IF(PI.EQ.1) GO TO 981                                                 000
   GO TO 980                                                             000
73 IF(NMAK(7).NE.0) GO TO 977                                            000
   NMAK(IZ)=SIP                                                          000
   WRITE(6,5002) IZ,SIP                                                  000
02 FORMAT(/,2X,'S:201',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')     000
   NPROS(JK)=NPROS(JK)+1                                                 000
   WRITE(6,7924) JK,NPROS(JK)                                            000
   TIME(IZ)=CLOCK+METRAJ(JK)/SP(1)                                       000
   IF(IZ.EQ.ITT) GO TO 981                                               000
   IF(PI.EQ.1) GO TO 981                                                 000
   GO TO 980                                                             000
                                                                         000
 TEK MAKINA FAKAT CALISIYOR KUYRUGUNA YUKLEME YAP                        000
77 DO 999 JKK=1,NNSAY(IZ)-1                                              000
   IF(MHAVUZ(IZ,JKK).NE.0) GO TO 999                                     000
   MHAVUZ(IZ,JKK)=SIP                                                    000
   WRITE(6,8003) IZ,SIP                                                  000
03 FORMAT(2X,'S:213',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI ')          000
   IF(PI.EQ.1) GO TO 981                                                 000
   GO TO 980                                                             000
99 CONTINUE                                                              000
   MHAVUZ(IZ,NNSAY(IZ))=SIP                                              000
   WRITE(6,8004) IZ,SIP                                                  000
04 FORMAT(2X,'S:219',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI ')          000
   NNSAY(IZ)=NNSAY(IZ)+1                                                 000
   IF(PI.EQ.1) GO TO 981                                                 000
   GO TO 980                                                             000
76 C1=1                                                                  000
   DO 9241 MD=1,IQ-1                                                     000
   IZ=MK(MD)                                                             000
   IF(NMAK(IZ).NE.0) GO TO 9241                                          000
   AL(C1)=IZ                                                             000
   AK(C1)=MD                                                             000
   C1=C1+1                                                               000
41 CONTINUE                                                              000
   IF(C1.EQ.1) GO TO 9242                                                000
   IF(C1.NE.2) GO TO 9252                                                000
   IF(AL(1).EQ.7.OR.AL(1).EQ.8.OR.AL(1).EQ.9) GO TO 9254                 000
   IZ=AL(1)                                                              000
   GO TO 9243                                                            000
52 DO 9253 MD1=1,C1-1                                                    000
```

```
      IF(AL(MD1).EQ.7.OR.AL(MD1).EQ.8.OR.AL(MD1).EQ.9) GO TO 9253
      IZ=AL(MD1)
      GO TO 9243
253   CONTINUE
254   IZ=AL(1)
      MR=AK(1)
      IF(IZ.NE.7) GO TO 9255
      IF(NMAK(8).NE.0.OR.NMAK(9).NE.0) GO TO 977
      NMAK(7)=SIP
      WRITE(6,5521) IZ,SIP
521   FORMAT(/,2X,'S:247',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')
      NPROS(JK)=NPROS(JK)+1
      WRITE(6,7924) JK,NPROS(JK)
      TIME(IZ)=CLOCK+METRAJ(JK)/SP(MR)
      IF(IZ.EQ.ITT) GO TO 981
      IF(PI.EQ.1) GO TO 981
      GO TO 980
255   IF(NMAK(7).NE.0) GO TO 977
      NMAK(IZ)=SIP
      WRITE(6,5522) IZ,SIP
522   FORMAT(/,2X,'S:256',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')
      NPROS(JK)=NPROS(JK)+1
      WRITE(6,7924) JK,NPROS(JK)
      TIME(IZ)=CLOCK+METRAJ(JK)/SP(MR)
      IF(IZ.EQ.ITT) GO TO 981
      IF(PI.EQ.1) GO TO 981
      GO TO 980

242   DO 924 J=1,IQ-1
      IZ=MK(J)
      DO 925 JJ=1,NNSAY(IZ)-1
      IF(MHAVUZ(IZ,JJ).NE.0) GO TO 924
925   CONTINUE

 ALTERNATIF MAKINADAN BOS OLANA HEMEN YUKLE
      IF(NMAK(IZ).NE.0) GO TO 974
      IF(IZ.EQ.7.OR.IZ.EQ.8.OR.IZ.EQ.9) GO TO 974
243   NMAK(IZ)=SIP
      WRITE(6,905) IZ,SIP
905   FORMAT(/,2X,'S:274',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')
      NPROS(JK)=NPROS(JK)+1
      WRITE(6,7924) JK,NPROS(JK)
      SUR=HIZ(NEXT,IZ)
      TIME(IZ)=CLOCK+METRAJ(JK)/SUR
      IF(IZ.EQ.ITT) GO TO 981
      IF(PI.EQ.1) GO TO 981
      GO TO 980

  MAKINA CALISIYOR KUYRUK BOS KUYRUGA KOY
974   MHAVUZ(IZ,1)=SIP
      NNSAY(IZ)=2
      WRITE(6,8038) IZ,SIP
038   FORMAT(2X,'S:286',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI ')
      IF(PI.EQ.1) GO TO 931
      GO TO 980
924   CONTINUE

  KUYRUKTAN IS SECIMI
      DO 926 I=1,IQ-1
      ZMN(I)=0.
      IZ=MK(I)
      TIM=TIME(IZ)
      DO 927 J=1,NNSAY(IZ)-1
      IF(MHAVUZ(IZ,J).EQ.0) GO TO 927
      SIPP=MHAVUZ(IZ,J)
      DO 928 II=1,SIPSAY
```

```
      JM=II                                                              0004
      IF(SIPP.EQ.SIPNO(II)) GO TO 975                                    0004
   28 CONTINUE                                                           0004
   75 PQ=PROSES(JM,NPROS(JM))                                            0004
      SUR=HIZ(PQ,IZ)                                                     0004
      TIM=TIM+METRAJ(JM)/SUR                                             0004
   27 CONTINUE                                                           0004
      ZMN(I)=TIM                                                         0004
      MAK(I)=IZ                                                          0004
   26 CONTINUE                                                           0004
UYRUKTAN  MINIMUM BULUNMASI                                              0004
      IT=1                                                               0004
      MIN=ZMN(1)                                                         0004
      DO 929 J=2,IQ-1                                                    0004
      IF(ZMN(J).GE.MIN) GO TO 929                                        0004
      MIN=ZMN(J)                                                         0004
      IT=J                                                               0004
   29 CONTINUE                                                           0004
MINIMUMUN ILK BOS HAVUZ ELEMANINA KOYULMASI                              0004
      IA=MAK(IT)                                                         0004
      DO 930 J=1,NNSAY(IA)-1                                             0004
      IF(MHAVUZ(IA,J).NE.0) GO TO 930                                    0004
      MHAVUZ(IA,J)=SIP                                                   0004
      WRITE(6,8011) IA,SIP                                               0004
   11 FORMAT(2X,'S:324',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI ')       0004
      IF(PI.EQ.1) GO TO 981                                              0004
      GO TO 980                                                          0004
   30 CONTINUE                                                           0004
      MHAVUZ(IA,NNSAY(IA))=SIP                                           0004
      WRITE(6,8012) IA,SIP                                               0004
   12 FORMAT(2X,'S:330',I30,'. MAKINANIN HAVUZUNA ',I6,' ATANDI ')       0004
      NNSAY(IA)=NNSAY(IA)+1                                              0004
      IF(PI.EQ.1) GO TO 981                                              0004
                                                                         0004
OZEL MAKINA DURUMU MAK. NO= 7 VEYA 8 VEYA 9                              0004
   80 IF(ITT.NE.7.AND.ITT.NE.8.AND.ITT.NE.9) GO TO 982                   0004
      Q=1                                                                0004
      DO 931 K=7,9                                                       0004
      ZMN(Q)=0.                                                          0004
      DO 932 J=1,NNSAY(K)-1                                              0004
      IF(MHAVUZ(K,J).EQ.0) GO TO 932                                     0004
      SIP=MHAVUZ(K,J)                                                    0005
      DO 933 L=1,SIPSAY                                                  0005
      LL=L                                                               0005
      IF(SIP.EQ.SIPNO(L)) GO TO 983                                      0005
   33 CONTINUE                                                           0005
   83 PROS=PROSES(LL,NPROS(LL))                                          0005
      SUR=HIZ(PROS,K)                                                    0005
      ZMN(Q)=ZMN(Q)+METRAJ(LL)/SUR                                       0005
   32 CONTINUE                                                           0005
      Q=Q+1                                                              0005
   31 CONTINUE                                                           0005
      IF(ZMN(1).GT.ZMN(2).AND.ZMN(1).GT.ZMN(3)) GO TO 984                0005
      IRR=1                                                              0005
      WRITE(6,4521)                                                      0005
   21 FORMAT(10X,' 7 NIN ZAMANI 8 VEYA 9 DAN KISA , 7 YI CALISTIRMA')    0005
 IRR=1 DEMEKKI 7 KAYBETTI                                                0005
      IF(ITT.EQ.7) GO TO 2214                                            0005
      GO TO 982                                                          0005
   14 IOZ=0                                                              0005
      IF(NNSAY(8).EQ.1) GO TO 2215                                       0005
      ITT=8                                                              0005
      IOZ=1                                                              0005
      GO TO 982                                                          0005
   15 IOZ=0                                                              0005
      IF(NNSAY(9).EQ.1) GO TO 981                                        0005
```

```
      ITT=9                                                              00C
      GO TO 982                                                          00C
                                                                         00C
 7 KAZANDI                                                               00C
984   IF(NMAK(8).NE.0.OR.NMAK(9).NE.0) GO TO 981                         00C
      ITT=7                                                              00C
                                                                         00C
 LOT VE ACIL DURUM KONTROLU                                              00C
982   LN=1                                                               00C
991   IR=0                                                               00C
      DO 952 IZK=1,NNSAY(ITT)-1                                          00C
      IF(MHAVUZ(ITT,IZK).NE.0) GO TO 953                                 00C
952   CONTINUE                                                           00C
      WRITE(6,8852) ITT                                                  00C
352   FORMAT(/,10X,I4,' NOLU MAKINA BOS, KUYRUGU BOS ',/)                00C
      NNSAY(ITT)=1                                                       00C
      IF(IOZ.EQ.1) GO TO 2215                                            00C
      GO TO 981                                                          00C
953   DO 934 I=1,NNSAY(ITT)-1                                            00C
      IF(MHAVUZ(ITT,I).EQ.0) GO TO 988                                   00C
      SIP=MHAVUZ(ITT,I)                                                  00C
      DO 935 J=1,SIPSAY                                                  00C
      JKK=J                                                              00C
      IF(SIPNO(J).EQ.SIP) GO TO 985                                      00C
935   CONTINUE                                                           00C
985   LOT=LOTNO(JKK)                                                     00C
      IF(LOT.GE.1.AND.LOT.LE.11) GO TO 986                               00C
      IF(ACIL(JKK).EQ.0) GO TO 987                                       00C
      NMAK(ITT)=SIP                                                      00C
      WRITE(6,906) ITT,SIP                                               00C
906   FORMAT(/,2X,'S:384',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')  00C
      PQ=PROSES(JKK,NPROS(JKK))                                          00C
      SUR=HIZ(PQ,ITT)                                                    00C
      TIME(ITT)=CLOCK+METRAJ(JKK)/SUR                                    00C
      MHAVUZ(ITT,I)=0                                                    00C
      NPROS(JKK)=NPROS(JKK)+1                                            00C
      WRITE(6,7924) JKK,NPROS(JKK)                                       00C
      IF(IOZ.EQ.1) GO TO 2215                                            00C
      GO TO 981                                                          00C
986   IF(LOT.NE.LN) GO TO 988                                            00C
      IR=1                                                               00C
987   PQ=PROSES(JKK,NPROS(JKK))                                          00C
      SUR=HIZ(PQ,ITT)                                                    00C
      ZMN(I)=METRAJ(JKK)/SUR                                             00C
      SNO(I)=JKK                                                         00C
      GO TO 934                                                          00C
988   ZMN(I)=99999999.                                                   00C
934   CONTINUE                                                           00C
      IF(IR.NE.0.OR.LOT.GT.11) GO TO 990                                 00C
      LN=LN+1                                                            00C
      GO TO 991                                                          00C
                                                                         00C
      S P T  YAPILMASI                                                   00C
990   IT=1                                                               00C
      MIN=ZMN(1)                                                         00C
      IF(NNSAY(ITT).EQ.2) GO TO 992                                      00C
      DO 936 I2=2,NNSAY(ITT)-1                                           00C
      IF(ZMN(I2).GE.MIN) GO TO 936                                       00C
      MIN=ZMN(I2)                                                        00C
      IT=I2                                                              00C
936   CONTINUE                                                           00C
992   NMAK(ITT)=MHAVUZ(ITT,IT)                                           00C
      WRITE(6,907) ITT,MHAVUZ(ITT,IT)                                    00C
907   FORMAT(/,2X,'S:415',25X,'MAKINA',I4,' YE SIPARIS',I8,' YUKLENDI')  00C
      MHAVUZ(ITT,IT)=0                                                   00C
      KZ=SNO(IT)                                                         00C
```

```
      NPROS(KZ)=NPROS(KZ)+1                                              000
      WRITE(6,7924) KZ,NPROS(KZ)                                         000
      TIME(ITT)=CLOCK+MIN                                                000
      IF(IOZ.EQ.1) GO TO 2215                                            000
      GO TO 981                                                          000
                                                                         000
   40 WRITE(6,901) SIPNO(JK),CLOCK                                       000
   01 FORMAT(/,43X,I6,'NOLU SIPARIS',F11.1,'INCI DAKIKADA BITTI',/)      000
      GO TO 980                                                          000
   50 WRITE(6,902) CLOCK,LAST                                            000
   02 FORMAT(/,10X,'SAAT =',F6.1,'   SIM. TIME (',F6.1,') ASILDI',////)  000
                                                                         000
   RAPOR BAS  KAGIDA VE LL/S3SONU=8 NOLU DOSYAYA                         000
                                                                         000
      WRITE(6,82)                                                        000
   82 FORMAT(5X,'   MHAVUZ MATRISI DOKUMU   20 LIK ',//)                 000
   81 FORMAT(20I6,/)                                                     000
      DO 9500 I=1,39                                                     000
      WRITE(6,81) (MHAVUZ(I,KLM),KLM=1,NNSAY(I)-1)                       000
      DO 9600 J=1,200                                                    000
      MHAVTR(J,I)=MHAVUZ(I,J)                                            000
   00 CONTINUE                                                           000
   00 CONTINUE                                                           000
      WRITE(6,9511) (TIME(I),I=1,37)                                     000
   11 FORMAT(10X,' MAKINA ZAMANLARI VEKTORU ',///,(10X,10F10.1),//)      000
      WRITE(6,9512) (NMAK(I),I=1,37)                                     000
   12 FORMAT(10X,' MAKINA USTUNDEKI SIPARIS ',///,(10X,10I10),//)        000
      WRITE(6,9513) (NNSAY(I),I=1,39)                                    000
   13 FORMAT(10X,' MAKINA KUYRUGUNDAKI IS SAYISI ',///,(10X,10I10),//)   000
      WRITE(6,9514) (NPROS(I),I=1,SIPSAY)                                000
   14 FORMAT (10X,' SIPARISLERIN ATANACAK ILK PROCESLERI ',///,(20I5))    000
      DO 9700 I=1,200                                                    000
      WRITE(8,9517) (MHAVTR(I,J),J=1,39)                                 000
   00 CONTINUE                                                           000
   17 FORMAT(39I5)                                                       000
      WRITE(8,9518) (NPROS(I),I=1,SIPSAY)                                000
   18 FORMAT (50I4)                                                      000
      WRITE(8,9519) (NNSAY(I),I=1,39)                                    000
   19 FORMAT(39I3)                                                       000
      WRITE(8,9520) (NMAK(I),I=1,37)                                     000
   20 FORMAT(37I5)                                                       000
      WRITE(8,9521) (TIME(I),I=1,37)                                     000
   21 FORMAT(20F7.1)                                                     000
                                                                         000
                                                                         000
      WRITE(8,9522) (TIME38(I),I=1,NNSAY(38)-1)                          000
      WRITE(8,9522) (TIME39(I),I=1,NNSAY(39)-1)                          000
   22 FORMAT(15F10.1)                                                    000
      WRITE(8,9523) CLOCK                                                000
   23 FORMAT(F10.1)                                                      000
      WRITE(6,9524)                                                      000
   24 FORMAT(/,5X,' TIME38 VE TIME39 ARRAYLERI 10 LUK ',/,110('*'))      000
      WRITE(6,9525) (TIME38(I),I=1,NNSAY(38)-1)                          000
      WRITE(6,9525) (TIME39(I),I=1,NNSAY(39)-1)                          000
   25 FORMAT(/,(5X,10F10.1))                                             000
      STOP                                                               000
      END                                                                000
```

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