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THE COLLEGE OF AERONAUTICS

CRANFIELD

DEPARTMENT OF PRODUCTION AND INDUSTRIAL ADMINISTRATION

The synthesis of a production information system

First Year Project

Summer 1965

1. Summary

This report outlines a proposed information flow system, capable of giving Management the information necessary to effectively control the Production Organisation of Barretts shoe factory in Northampton.

The report specifies the functions of each member of the system and assigns responsibilities to these functions and defines the information required to perform them.

The system was designed using the philosophy and techniques of Systems Design.

2. Table of Contents

3. Acknowledgements

The members of the group wish to express their gratitude for the guidance and advice provided by Mr. W.T. Singleton. Thanks are also due to Mrs. S. Mills for her help and patience in preparing the weekly minutes and this final report.

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5. Introduction

The purpose of this report was two-fold:-

1) To suggest to the management of Barretts a method by which they would have information regarding the state of production daily or, if required at any given instant. This information would be presented in the form of a production report which would enable better control to be exercised over production with an even greater efficiency than that possible at present.

2) To provide course members with the opportunity to use Systems Design techniques in solving a specific problem.

Systems Design is the philosophy of considering a problem, as the relationship of man to machine and the necessary communications between them so that a 'system' could work properly. The examination of functions required to be performed inaa system and the consideration of whether they should be done by man or machine gives the basis for Systems Design. Further consideration of the specific nature of these functions, in the form of a Task Description, gives additional information as to how the function should be performed and the information necessary for that task to be carried out. This approach has been used on the problem under consideration.

6. Procedure

The procedure followed was the normal system design procedure, consisting of the following stages.

1. Definition of the system objectives.
2. Separation of functions.
3. Allocation of functions.
4. Preparation of task descriptions.
5. Design of interfunctional linkage.
6. Interface design.

Stage 6 was not done because of the shortage of time. Validation studies were not possible also because of the shortage of time, and the particular circumstances of the project.

1. Definition of System Objectives

Before designing any system it is necessary to define, as precisely as possible, the job which the system is to be designed to do. This task is usually done by the agency which has requested the design, but it is always necessary to examine their request critically in order to make sure that they have in fact asked for what they want.

2. Separation of functions

All except the simplest system involve more than one function. It is necessary to disentangle these functions from one another. Once the have been disentangled it is possible to begin considering the sub-systems necessary to perform them.

If one considers the case of driving a wood-screw the component functions can be defined as guidance, forward motion or pressure, and circular motion or pressure.

3. Allocation of functions

Once the functions have been separated it is necessary to examine who or what will perform them. This may be done by considering which of existing sub-system could best perform them, and if existing sub-systems are inadequate new ones can be designed.

Continuing with the wood-screw analogy, guidance would be best provided by a combined visual and kinesthetic feedback syste, forward pressure or motion by the shoulder muscles and body-weight, and circular motion or pressure by the muscles of the forearm and upper arm.

4. Preparation of task description

It is now possible to draw up a description of the task to be performed

by each sub-system. This can be done in a number of ways. For this project a preliminary task analysis was prepared in the form of the decisions taken by each manager. The task description was concluded with a summary of the information required by each manager on which he could base his decisions.

5. Design of inter-functional linkage

This stage was considered as providing a definition of the relationship between each sub-system and the others in the total system. The relationships used were information channels. It was therefore a matter of taking each item of information required by each manager and tracing it back through the data-processing sub-systems to the prime source.

6. Interface design

This stage, would have involved the design of the information transmission mechanisms. The mechanisms involved depend on the type and quantity of information to be transmitted and time delay which is acceptable for the transmission.

These six stages of the system design process are not necessarily, in fact are rarely, sequential. A certain amount of iteration is necessary as present decisions affect previous ones and modifications are required.

7. Results

The systems approach used by the group is essentially a step by step process of arriving at a logical end result.

The results of the project are set out in a form corresponding to the standard system design approach used at Cranfield, and each Section will show the group's thinking at each stage of this process.

(i) Definition of objectives

The initial objectives of the project group were set out in its Preliminary Statement. In this, the objective of the group was stated to be the redesign of the production information flow system 'to keep members of the (Barrett's) Management hierarchy informed as to the current state of production' in the factory.

A visit to the factory however, convinced the members of the group that this objective was not feasible for the following reasons:-

(a) It was found that there was no parent system to which the particular production sub-system of communications could be related. At the most the parent system existed only in a set of tentative management proposals.

(b) The production system of the factory was in the initial stages of re-organisation and there seemed little point in studying the existing system which would soon be scrapped. Even if the group did decide to study the existing system it seemed likely that the management would consider the time spent wasted.

It was therefore decided to redefine the objective as being 'the specification of an appropriate management hierarchy and to design an information system which would keep this hierarchy informed of the current state of production'.

(ii) Allocation and separation of functions

These steps have been combined because it was felt that allocation of functions had in this context, little meaning since this sub-system is being 100% run by humans. A pure systems approach at this stage would attempt to synthesis logically the management structure of the organisation and in the course of so doing, specify the communication channels necessary. However, considering the magnitude of the task and the limited time available it became obvious that this is too large an undertaking. Consequently an organisation chart was drawn up that reflected the experience of members of the group in industry and was therefore, based mainly on existing standard industrial procedures (see exhibit 2). The main area of interest in this chart is the line management concerned directly with production.

(iii) Task description

Each member of the production line management shown in Exhibit 2 was examined and the following three questions asked:-

1. What are his responsibilities.

2. Given his responsibilities, what decisions does he have to make.

3. What information is needed to make these decisions. A list showing the results gained from this procedure is shown in Exhibit 3.

(iv) Information flow

The most important item in the above analysis is the decisions which have to be made by each individual. The quality of the decision is influenced, to a great degree, by the quality of information received. To list the information required by each individual is not enough. It is necessary to specify the information source and destination, and also suggest the form in which this information could best be put. The results of this analysis are shown in exhibit 4 and the inter-relationship in exhibit 5.

It is emphasised here that this analysis concentrates only on the production function. A foreman, for example, will require much more information, from sources outside production, than is shown in Exhibit 4.

(v) Interface design

The concern of interface design is to design standard forms and job cards. The standard forms specified in Exhibit 4 are:-

1. Production schedule form.

2. Standard job card.

3. Quality control report.

4. Warehouse foreman's report.

A detailed design of these was not attempted due to lack of time.

8. Discussion

1. The value of this analysis is limited. It would be foolish to pretend that the recommendations are anything more than a first approach to a general system.

2. The analysis has not taken into account the personalities, qualifications and experience of those whose responsibility it will be to install and control the new system.

3. Attention must be given to the problem of introducing the new system and evaluating it when it is in operation:

   (i) putting it into operation - the new system could be run in parallel to the existing system or started cold.

   (ii) responsibility for starting the scheme should be carefully delegated.

   (iii) provision should be made during the introduction for consultation at all levels.

   (iv) evaluation of the system should take place at regular intervals and future plans could be modified by experience.

4. Someone in senior management will have to make a close examination of both the jobs involved in the new system and the personnel available to fill each position, in order to ascertain whether they have the necessary capacities and abilities to perform the jobs efficiently. Should they decide that the present personnel cannot meet the demands made by the job, senior management will have to define the criteria which they will use to select outsiders.

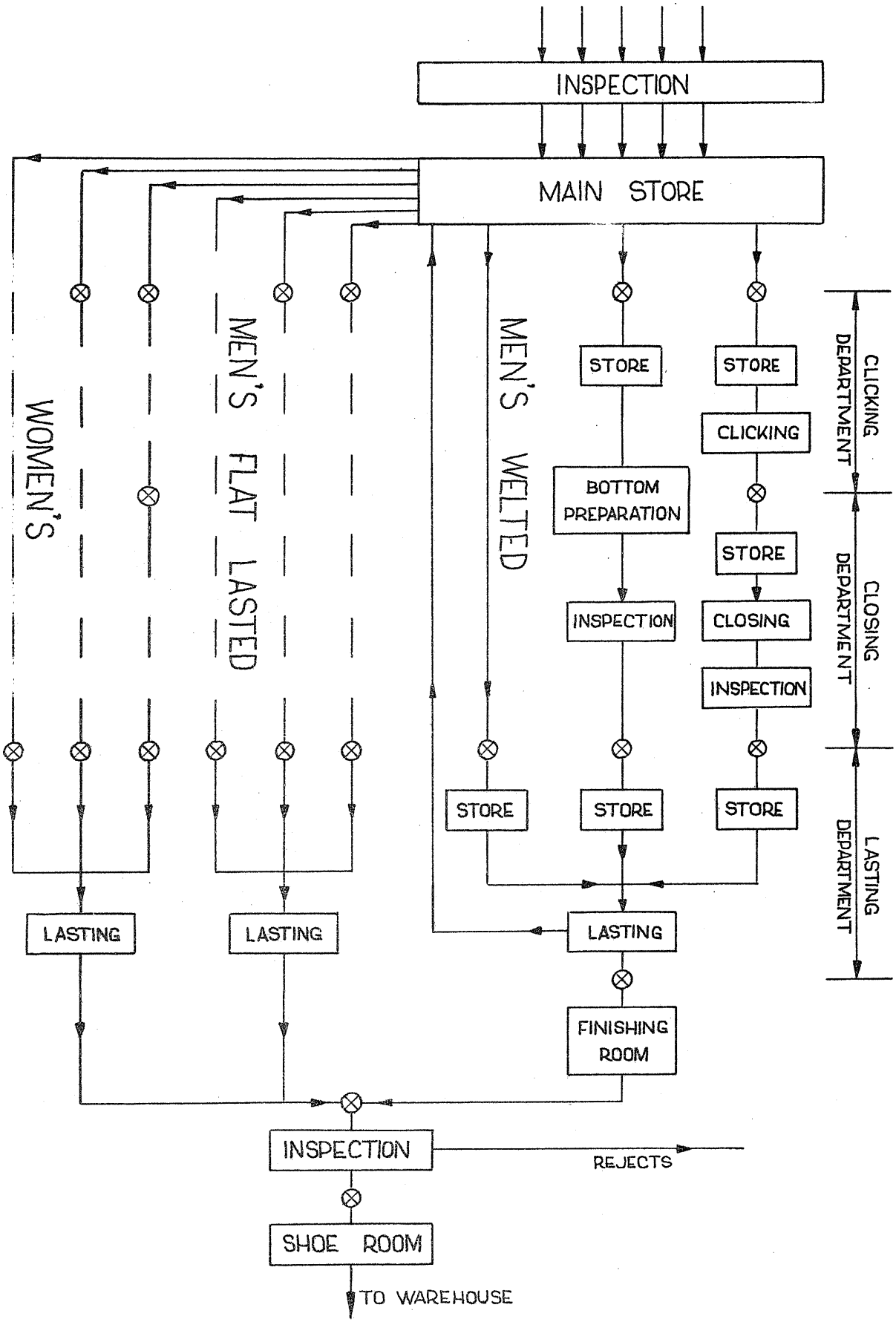

EXHIBIT 1

SCHEMATIC OF PRODUCTION PROCESS.

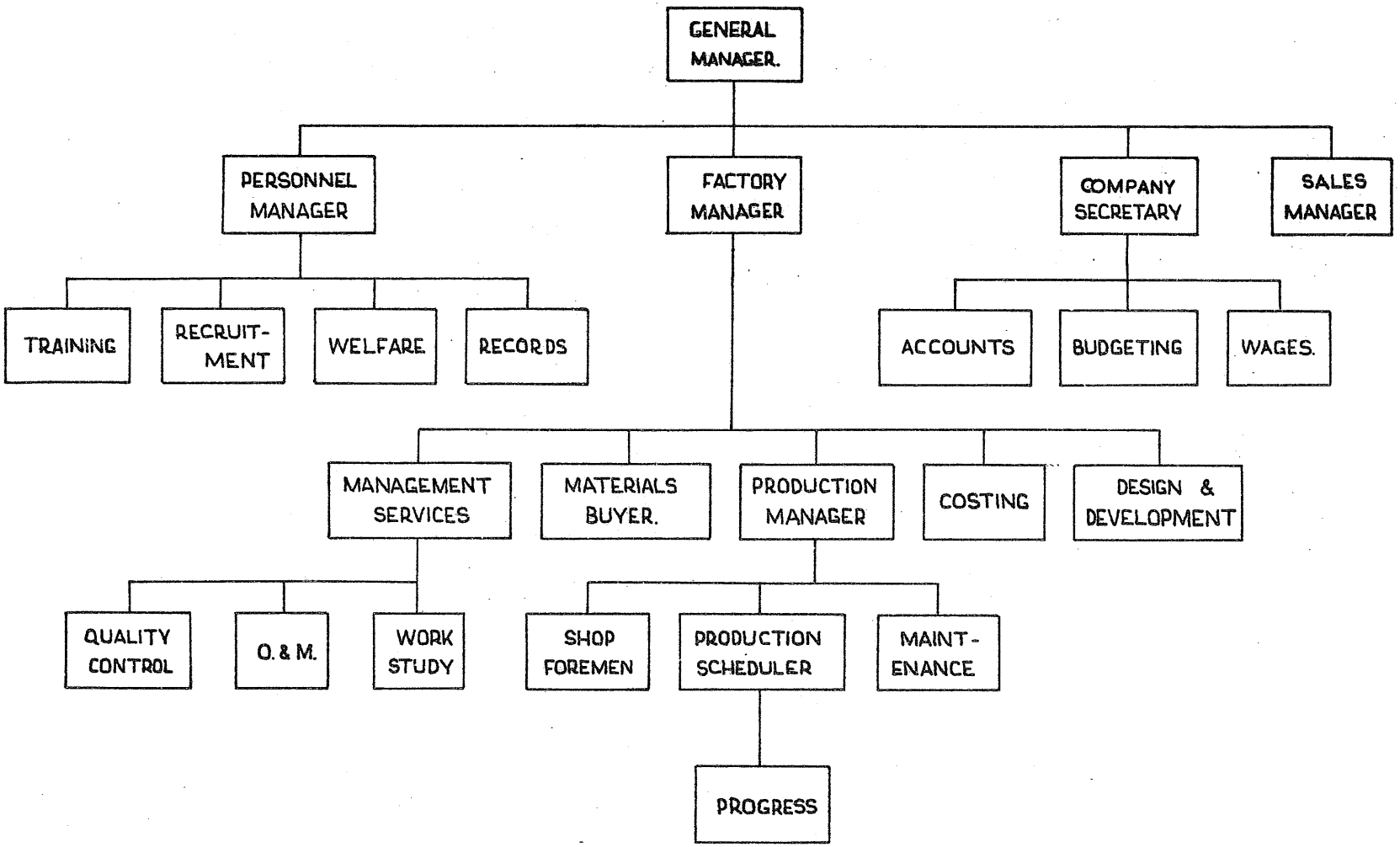

EXHIBIT 2

CHART OF PROPOSED ORGANIZATION.

Exhibit 3. Task description list

1. General Manager

Responsibilities

1. Leadership
2. Formulation of company policy
3. The co-ordination of the top management to assess the achievement of the optimum profit potential.
4. Training of managers.

Decisions

1. Whether or not to change the product mix of the Company.
2. Appointment of top managers.
3. Investigation of reasons for exceeding budgets.

Information

1. Actual versus budgeted performance
2. Market requirements
3. Production utilisation

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2. Factory Manager

1. Overall efficiency of the production operations.
2. Hiring and firing of personnel.
3. Initiating innovation in the factory.

Decisions

1. Whether to buy new plant.
2. Whether to expand or contract labour force.
3. Whether to use the services of the specialist sections.

Information: Production only

1. Are the expected production performances being achieved? If not which orders are behind time?
2. The percentage loading of each department. The utilisation of the resources of each production department.
3. The profitability of each department under his control.

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3. Production Manager

Responsibilities:

1. Co-ordination of workshops.
2. Control of foreman's activities.
3. Maintenance of manufacturing system.
4. Co-ordination of planning and maintenance functions.
5. Allocation of rush-orders.

Decisions

1. Whether to interfere with junior management or not.
2. What to do in cases of malfunctioning (e.g. breakdowns, jobs behind time) in the manufacturing system.

Information:

1. Expected and actual performances. (Output, W.I.P., Quality).
2. a. Scheduled and actual position of batches in the production system.
   b. Scheduled and actual expected completion date of batches.

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4. Production Scheduller

Responsibilities

1. Allocation of priorities to each order.
2. Allocation of work to each department.
3. The smooth flow of work through the factory.
4. Inventories of raw materials and production components

Decisions:

1. The loading by quantity and style of all departments concerned in manufacture.
2. Allocation of priorities to each order.
3. The setting of operation completion targets for groups of each operation.
4. The monitoring of work flow through factory so that if necessary adjustments can be made to the sequencing of orders and their precise effects can be known.

Information

1. The delivery dates and quantities required of all orders.
2. The availability of machines, lasts, materials and labour.
3. The duration of each operation.
4. Policy concerning - a) sub contracting
   b) overtime
   c) machine purchases
   d) buying out.

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5. Progress

Responsibilities

To obtain information on production flow.

Decisions:

Is the information obtained important to act on (i.e. pass on).

Information:

1. Present position of each batch, the lasts and patterns in the production line, with respect to the focal point.
2. Planned position.

Exhibit 4. Flow and coding of information

1. Production Scheduller

	Input Information	Content and Structure
From 1)	Production Manager	Policy concerning a) sub contracting b) overtime c) machine purchases d) buying out. This information will be non-standard and normal written communication will suffice.
2)	Sales Dept.	Orders: This should be in the form of a standard order card containing the following standard items:- a) sales dept. code no. for order b) name of customer c) specification of style, class, and detailed manufacture of shoes d) No. of pairs of each size. Item c) above will be difficult to reduce to a standard form since there is a large variety of possible types of shoe. In addition there should be some means of detaching the relevant portions of the specification, to be sent to the foreman concerned with those operations specified.
3)	Work Study Dept.	Estimates of the manufacturing time required to produce one type of shoe. These estimates will form a permanent record. The form of communication will be non-standard.
4)	Foreman	Notice of breakdown in machines and temporary shortage of labour. This form is non-standard and can be written or verbal.

	Output Information	Content and Structure
To 1)	Production Manager Progress Foreman	Standard Schedule card. This card should contain: a) Code number devised by Production Scheduller for each batch. b) No. of pairs in each batch. c) Input date of batch into each department. d) Output date of batch from each department. e) The number of batches listed should correspond approximately to one weeks work. The schedule should be separated into portions corresponding to each department before being sent to the foreman.

		Output Information	Content and Structure
To	2)	Stores	Estimate of amount of major materials and lasts required in the next week.
	3)	Foremen	Standard Job Card, containing specification of shoes as given by the Sales Dept., the information being separated into departmental units for the foremen. This should be sent with the appropriate portion of the Production Schedule.

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2. Progress

		Input Information	Content and Structure
From	1)	Production Scheduller	Complete Production Schedule.
	2)	Foreman	Present position of each batch. Progress will visit each department and observe a wall chart there, or have the information conveyed electronically or otherwise to a wall display in his office. It is important to keep the method simple and uncomplicated. The easiest method is for the foreman to mark off on the Production Schedule which batches have been received and which batches have been completed.

		Output Information	
To	1)	Production Manager	Marked up complete Production Schedule indicating which batches have been completed by each department, which batches are behind time, and re-estimated finishing date.

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3. Foremen

		Input Information	Content and Structure
From	1)	Production Scheduller	Part of Production Schedule. Part of Standard Job card.
	2)	Quality Control Dept.	Standard form containing the following: a) Name of Inspector b) Code number of batch. c) Number of defectives in batch d) Reason for rejection.

		Output Information	Content and Structure
To	1)	Progress	Marked up version of Production Schedule showing batches received and batches completed, to which progress has access.
	2)	Production Manager from Shoe room only.	Standard form showing total number of shoes sent out per week and which orders have been completed.

4. Production Manager

		Input Information	Content and Structure
From	1)	Production Scheduller	Complete Production Schedule.
	2)	Quality Control Dept.	Total proportion of defects.
	3)	Warehouse foreman	No. of pairs shipped and amount of finished goods carried.
	4)	Progress	Marked up Production Schedule.
		Output Information	
To	1)	Production Scheduller	Policy
	2)	Factory Manager	Report containing a) No. of order behind schedule. b) Actual No. of shoes processed by each department per week.

5. Factory Manager

		Input Information	Content and Structure
From	1)	Production Manager	See above.
	2)	Accounting Dept.	Relevant cost data.
		Output Information	
To	1)	General Manager	General statement of situation. Investment requests, etc.

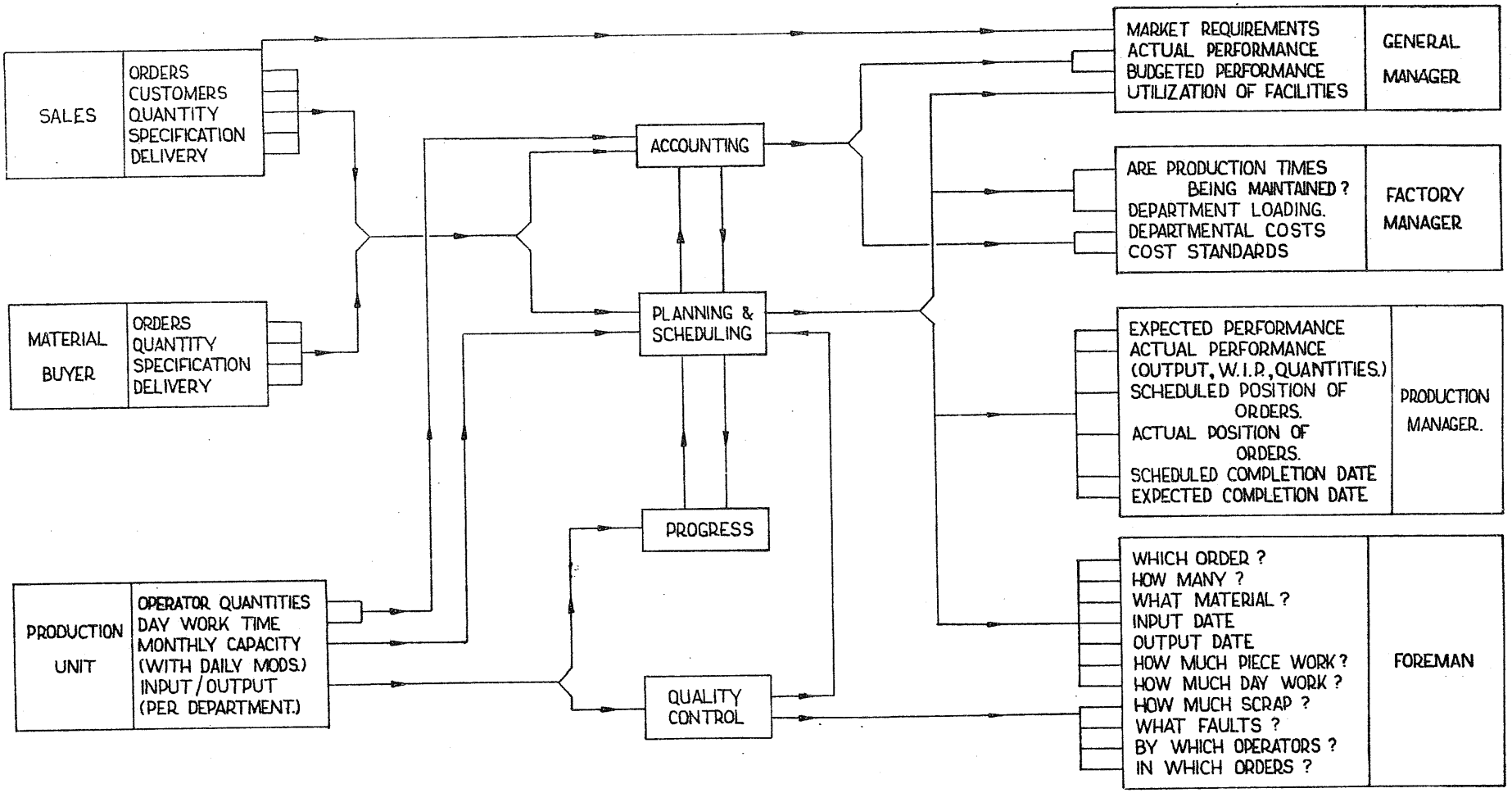

EXHIBIT 5

INFORMATION FLOW CHART.