THE INFORMATION PROCESSING COMPONENT
OF
JOB DESIGN
VOLUME TWO (TWO VOLUMES)

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CHAPTER 6:

THE PRODUCTION SYSTEM SIMULATION GAME.
Introduction

In order to examine some of the further implications of the general theory of job and organisational design set out in Chapter 4 above, various experimental procedures were considered. It appeared extremely unlikely that any company would permit the degree of interference in its operations that an adequate test of the theory would require. The design of a suitable laboratory experiment was therefore considered.

Dr. J. O. Evans, Lecturer in Production Management in the Department of Business Studies and Supervisor of this research project, had decided to use a production system simulation game as a teaching device on three courses for which he was responsible. It seemed that with a suitable design, such a game could be used both as a teaching device and as a research experiment. The descriptions of the game design and of the results obtained from this experiment are lengthy and detailed. They are, therefore, contained in full in Appendix II below. The materials used in running the game are described in Appendix III. The objective of this Chapter is to examine the hypotheses that the experiment attempts to test in the light of the results obtained. Brief descriptions only of the experiment design and results are given in this Chapter.

This experiment attempts to measure and compare the performance of groups working under two different types of organisational design - a conventional, hierarchical design and an autonomous group design. These are termed the "standard" design and the "experimental" design respectively.
The Standard Design

The game simulates the work of a six-person job shop manufacturing paper table mats to customer requirements, and it runs for 40 minutes. The "company" is called Tablemat Limited.

The table mats are made from computer printout (for the surfaces of the mats) and scrap A4 duplicating paper (for the bases). Surfaces may be given one of four simple patterns with felt-tip pen, and surfaces and bases are stapled together to make the finished mats. Job Cards showing the range of mats that each group had to manufacture are given in Appendix III, Section 2 (p. 726). The organisation chart for the standard design is shown in Figure 6.1. The respective duties of each position are detailed in Job Descriptions, given in Appendix II, Section 2 (p. 609).

[Diagram of organization chart]

Figure 6.1: Organization chart of Tablemat Ltd.
<table>
<thead>
<tr>
<th>TASKS INVOLVED</th>
<th>PERFORMED BY</th>
<th>CORRESPONDING PAPERWORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Quote</strong> delivery time for incoming order.</td>
<td>Controller</td>
<td>LOAD PLANNING CHART, JOB PROGRESS SHEET</td>
</tr>
<tr>
<td>2. <strong>Obtain</strong> material for first activity from Stores.</td>
<td>Storeman/Progressor</td>
<td>STOCK WITHDRAWAL SHEET</td>
</tr>
<tr>
<td>3. <strong>Deliver</strong> material to first activity.</td>
<td>Storeman/Progressor</td>
<td>---</td>
</tr>
<tr>
<td>4. <strong>Cut out</strong> surfaces as required.</td>
<td>Surface Operator</td>
<td>OPERATOR WORK RECORD</td>
</tr>
<tr>
<td>5. <strong>Deliver</strong> job materials to second activity.</td>
<td>Storeman/Progressor</td>
<td>JOB MOVEMENT CARD</td>
</tr>
<tr>
<td>6. <strong>Draw</strong> patterns as required.</td>
<td>Pattern Operator</td>
<td>OPERATOR WORK RECORD</td>
</tr>
<tr>
<td>7. <strong>Obtain</strong> material for next activity.</td>
<td>Storeman/Progressor</td>
<td>STOCK WITHDRAWAL SHEET</td>
</tr>
<tr>
<td>8. <strong>Deliver</strong> job materials to third activity.</td>
<td>Storeman/Progressor</td>
<td>JOB MOVEMENT CARD</td>
</tr>
<tr>
<td>9. <strong>Cut out</strong> bases as required and staple to surfaces.</td>
<td>Base Operator</td>
<td>OPERATOR WORK RECORD</td>
</tr>
<tr>
<td>10. <strong>Job complete</strong> - deliver to Umpire and inform Controller</td>
<td>Storeman/Progressor</td>
<td>JOB MOVEMENT CARD, JOB PROGRESS SHEET</td>
</tr>
</tbody>
</table>

Figure 6.2: Tablemat Ltd., order processing sequence for Job 00, standard design.

(See Appendix III, Section 2 for Job 00 specification.)
Figure 6.2 describes the processing of a typical order showing the tasks that are involved, who performs each task, and the paperwork that has to be completed at each stage. Details of the products, the equipment used and factory layout are given in Appendix II, Section 1 (p.606). Specimens of the forms used and descriptions of how they are used are given in Appendix III, Section 3 (p.739).

In the terms of the model of information processing and control developed in Chapter 3 above, the game illustrates the exercise of control at the routine control level only. To allow participants (in either version of the game) to exercise planning level control would have had at least two undesirable consequences. First, participants might have redesigned the production process, detracting from the realism of the game and its value as a teaching device. Second, alterations in the procedures used would have prevented valid comparisons between the two types of groups in terms of their respective performance levels. The routine control operations in the standard design are analysed in Appendix III, Section 7 (p.766).

The Experimental Design

This version of the game attempts to simulate an autonomous work group and was designed to test a number of hypotheses derived from Chapter 4 above. The main hypotheses concern the "learning" effects of particular forms of work organisation.

The experimental design uses the same production processes and equipment as the standard design, but the organisation and paperwork are different. Experimental groups use no job titles and have no individual job descriptions. Each participant is instead given a "Group Working - Description". A specimen of this is given in
Appendix II, Section 3 (p. 621). Group members are required to allocate tasks amongst themselves, and this allocation can be altered at any time during the game.

The paperwork for the experimental version of the game is designed for use by the whole group, rather than individual forms being allocated to specific persons. Specimens of these forms and descriptions of how they are used are given in Appendix III, Section 4 (p. 751). Figure 6.3 shows how these forms are used in the production process.

<table>
<thead>
<tr>
<th>Tasks Involved</th>
<th>Corresponding Paperwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Quote delivery time for incoming order.</td>
<td>JOB QUOTATION SHEET, LOAD PLANNING CHARTS</td>
</tr>
<tr>
<td>2. Obtain material for first activity from Stores.</td>
<td>STOCK WITHDRAWAL SHEET</td>
</tr>
<tr>
<td>3. Deliver material to first activity.</td>
<td>ACTIVITY WORK RECORD</td>
</tr>
<tr>
<td>4. Cut out surfaces as required.</td>
<td></td>
</tr>
<tr>
<td>5. Deliver job materials to next activity.</td>
<td>ACTIVITY WORK RECORD</td>
</tr>
<tr>
<td>6. Draw patterns as required.</td>
<td>ACTIVITY WORK RECORD</td>
</tr>
<tr>
<td>7. Obtain material for next activity.</td>
<td>STOCK WITHDRAWAL SHEET</td>
</tr>
<tr>
<td>8. Deliver job materials to next activity.</td>
<td></td>
</tr>
<tr>
<td>9. Cut out bases as required and staple to surfaces.</td>
<td>ACTIVITY WORK RECORD</td>
</tr>
<tr>
<td>10. Job complete – deliver to Umpire.</td>
<td>JOB QUOTATION SHEET</td>
</tr>
</tbody>
</table>

Figure 6.3: Tablemat Ltd., order processing sequence for Job 00, experimental design.

(see Appendix III, Section 2 for Job 00 specification.)
The Participants

The game was used with three production management classes at the University of Edinburgh:

1. Industrial Management (an assorted group of about 80 Science Faculty students. This is an optional course covering a range of business studies subjects. Most of these students are 3rd or 4th year undergraduates).

2. Business Studies Honours (a group of honours students in the Business Studies Department taking Production Management as a final paper. This was run as a six-man standard group).

3. Diploma in Business Studies (a class of about 30 postgraduate and post-experience students, including a number of foreigners).

All these courses were conducted by Dr. J.O. Evans and the game, which was run at the beginning of each course, took three main phases: introduction, running, tutorial feedback and discussion. The game was run in total with the following number of groups of each type:

- 6-man standard groups (40 mins) 6
- 6-man standard groups (23 mins) 2
- 6-man experimental groups (40 mins) 5
- 5-man experimental groups (40 mins) 2
- 6-man experimental group (26 mins) 1

making a total of 94 participants.

Details of the procedure for running each game are given in Appendix II, Section 4 (p.625).
The Hypotheses to be Tested

This experiment is exploratory in nature, but a number of tentative hypotheses were drawn up. These have been split into two groups, Group A comprising those hypotheses relying on quantitative data, Group B relying on qualitative and subjective observational data. In the statement of these hypotheses which follows, the standard groups are described as comprising "managers" (ie Controllers, Foremen and Storeman/Progressors) and "operators" (ie Surface, Pattern and Base Operators).

Group A Hypotheses:

1. Experimental groups will perform better than standard groups on the following measures:
   1(a) accuracy of job quotations and delivery performance;
   1(b) output;
   1(c) material usage;
   1(d) product quality;
   1(e) labour utilisation.

   As all members of the experimental groups have access to information regarding the success of previous job quotations and delivery performance (information held only by the Controller in the standard version) experimental groups will be able to improve their overall delivery performance. The only restriction on the number of group members who can participate in the actual mat-making process is the fixed amount of equipment provided for each activity; acting as a group, therefore, they will be able to optimise labour utilisation, improve output and product quality and, since the workers have a direct responsibility for the materials they use, reduce the amount of wastage or scrap.
2. Experimental groups will rate their perceived enjoyment of the game:
   2(a) higher, overall, than standard groups;
   2(b) higher than standard group operators;
   2(c) the same as standard group managers.

   The operator jobs in the standard version are rather boring and are totally lacking in responsibility for the production process as a whole. The standard version managers, and the experimental groups, have much more interesting and challenging tasks to perform.

3. Experimental groups will rate their perceived learning from the game:
   3(a) higher, overall, than standard groups;
   3(b) higher than standard group operators;
   3(c) the same as standard group managers.

   The explanation of hypothesis 2 is relevant here also. Participants in experimental groups are all in a better position to appreciate the problems involved in running the "factory" than are the standard version operators.

4. There will be a positive correlation between enjoyment and learning for all participants.

   This hypothesis is based on the naive assumption that the more a person enjoys a particular situation, the more he or she is likely to learn from it.

5. Experimental groups will be more consistent in their perceived performance ratings.
Neither standard nor experimental groups will have any absolute criteria against which to assess their groups' performance; but as all members of the experimental groups have complete access to their own group's performance levels, their performance ratings will be more consistent within each group than the ratings of the standard groups.

Group B Hypotheses:
6. With respect to actual as opposed to perceived learning:
   6(a) in standard groups, learning will be higher amongst managers than amongst operators;
   6(b) in experimental groups, learning will be higher for all group members than for standard group operators;
   6(c) in experimental groups, learning will be the same as for standard group managers.

A measure of how much participants learned from either version of the game is required. The operational definition of "learning" that is adopted here is "awareness of the problems of production management". No conception of what is regarded as "high" or "low" levels of learning was specified in advance. It is also recognised that, as the two versions are organised in such different ways, the problems which will arise might be different in degree between experimental and standard groups, but no separate hypotheses are made in this respect.

7. Experimental groups will adopt a more "innovatory" approach to solving the game's problems than standard groups, e.g. they might improve materials handling procedures, work methods, information usage, and so on. Exactly what the experimental
groups will do is not predicted.

As experimental groups do not have specified procedures to adhere to but have to make up their own, they will soon reject and improve upon any solutions which turn out to be unsatisfactory.

8. Experimental groups, through lack of management hierarchy, will have fewer "communications" problems than standard groups. Again, precisely what would happen was not predicted.

As with hypothesis 7, the lack of specified procedures in the experimental version should produce this result.

9. Experimental groups will, at least initially, have problems with their information system which is difficult to learn to use effectively in a short space of time. This will cause them to allocate excessive time either to the problems of control or to ignore this aspect and concentrate on output.

The experimental groups have more productive capacity than standard groups which are restricted to having three operators. This increased capacity should be offset, however, by the increased information-processing load placed on all experimental group members.

The Results

The results of this experiment come from the following three sources:

1. The "Opinion Questionnaire"

In order to assess participants' reactions to the game, this short questionnaire was administered at the end of each run. There are four questions concerning, respectively, perceived enjoyment and
learning, the main production problems encountered in the game, and estimated team performance. The results obtained from this questionnaire are described in detail in Appendix II, Section 5 (p.632). A specimen of this questionnaire is given in Appendix III, Section 6 (p.765).

2. Group Performance Measures

Each group was assessed on a number of quantifiable performance measures such as output and quality. These results are described in detail in Appendix II, Section 6 (p.644).

3. The "Tutorial Feedback Questionnaire"

During a tutorial hour in the week after the game run, participants were asked to spend half an hour writing answers to the following two questions:

1. List all the production problems that you believe you personally encountered in the game, giving a brief description of each.

2. List any other problems you believe your team encountered, with brief explanations.

A content analysis of the replies to these questions placed participants' separate "problem statements" into the following five main categories and twenty six sub-categories or sections:

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The production process</td>
<td>(a) Production activities</td>
</tr>
<tr>
<td></td>
<td>(b) Quantity v. quality</td>
</tr>
<tr>
<td></td>
<td>(c) Knowledge of job requirements</td>
</tr>
<tr>
<td></td>
<td>(d) Pressure of work</td>
</tr>
<tr>
<td></td>
<td>(e) Quality of equipment</td>
</tr>
<tr>
<td></td>
<td>(f) Insufficient equipment</td>
</tr>
<tr>
<td>2. Production scheduling and</td>
<td>(a) Quoting due times</td>
</tr>
<tr>
<td>control</td>
<td>(b) Determining job priorities</td>
</tr>
</tbody>
</table>
The full results of this content analysis are presented in Appendix II, Section 7 (p.658).

Summary of Hypotheses and Results

The hypotheses described above and the corresponding results obtained are summarised in Figure 6.4. The hypotheses are divided into two groups, those which can be supported by quantitative evidence (Group A) and those which rely on interpretation of qualitative evidence for their support (Group B). The levels of statistical significance of the results relating to the Group A hypotheses are also indicated in Figure 6.4. There are nineteen hypotheses altogether; ten are considered to have been confirmed on the basis of the results obtained, five are partially confirmed, and four are rejected.

The one overriding objective of this experiment was to examine the effects upon those who participated of two different types of
<table>
<thead>
<tr>
<th>GROUP A HYPOTHESES</th>
<th>SIGNIFICANCE</th>
<th>RESULT</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. Experimental groups will perform better than standard groups on accuracy of</td>
<td>.01</td>
<td>confirmed</td>
<td>There was no significant difference between the two types of group concerning the number of quotes made, or the actual number of jobs delivered late.</td>
</tr>
<tr>
<td>job quotations and delivery performance;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no. of successful quotes (18) -</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no. of successful quotes (21) -</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>no. of jobs delivered (18) -</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>no. of jobs delivered (21) -</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall average lateness (18) -</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall average lateness (21) -</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>average lateness of jobs delivered late (18) -</td>
<td>.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>average lateness of jobs delivered late (21) -</td>
<td>.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1b. Experimental groups will perform better than standard groups on output;</td>
<td>.01</td>
<td>confirmed</td>
<td>Experimental groups made more mats than standard groups.</td>
</tr>
<tr>
<td>total number of mats produced -</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1c. Experimental groups will perform better than standard groups on material usage;</td>
<td>-</td>
<td>rejected</td>
<td>Standard groups made slightly better use of their base material than experimental groups, there was no difference concerning surface material, and standard groups recorded stock usage more accurately.</td>
</tr>
<tr>
<td>1d. Experimental groups will perform better than standard groups on product quality;</td>
<td>-</td>
<td>rejected</td>
<td>No significant difference.</td>
</tr>
<tr>
<td>1e. Experimental groups will perform better than standard groups on labour utilization;</td>
<td>.05</td>
<td>confirmed</td>
<td>Experimental groups on the whole also performed more consistently than standard groups.</td>
</tr>
<tr>
<td>no. of standard minutes worked -</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a. Experimental groups will rate their enjoyment of the game higher than standard</td>
<td>-</td>
<td>rejected</td>
<td>No significant difference.</td>
</tr>
<tr>
<td>groups -</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2b. Experimental groups will rate their enjoyment of the game higher than standard operators;</td>
<td>-</td>
<td>rejected</td>
<td>No significant difference.</td>
</tr>
<tr>
<td>managers -</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2c. Experimental groups will rate their enjoyment of the game the same as standard managers;</td>
<td>-</td>
<td>confirmed</td>
<td>This result is not particularly meaningful as there were no significant differences between the ratings of the three main groups of participants</td>
</tr>
</tbody>
</table>

* This Figure is in two parts and is continued overleaf.
The significance of this result is reduced because the replies of standard managers are also taken into account.

Thus comparing experimental with standard operators alone produces a more significant result.

No significant difference.

The significance of the results vary for the different groups of participants; the significance level shown here is that for participants as a whole.

There is some evidence to this effect.

Experimental groups do not appear to have encountered these problems.

Experimental groups relied more on informal methods of gathering and transmitting information.
group (or "factory") organisation. The "standard" groups operated a conventional production management structure while the "experimental" groups were designed to have their members perform both the production operations and the routine control operations together, as an "autonomous group". These hypotheses were drawn up with this overriding objective in view: they were drawn up by attempting to predict the effects of allowing each experimental group as a whole to carry out routine control, compared with the standard groups where routine control was performed by a conventional management hierarchy. The results will now be discussed under the following four headings:

1. Group organisation and performance; (hypothesis 1(a to e)).
2. Group organisation and attitudes to the game; (hypotheses 2, 3, 4 and 5).
3. Group organisation and learning; (hypothesis 6(a to c)).
4. Miscellaneous; (hypotheses 7, 8 and 9).

**Group Organisation and Performance**

On the whole, experimental groups did perform better than standard groups. The only exceptions to this finding concerned material usage and product quality where there was little or no difference between the performance of the two types of group. The experimental groups should have been able to perform better on all the performance measures because they were not limited to having only three direct production workers. They had an obvious manning advantage over the standard groups. But the five-man experimental groups also had a similar manning advantage and their performance was very poor indeed. So the superior performance of the six-man experimental groups was not solely due to extra manpower. They
appear to have been able to organise themselves well enough to be able to cope with the production and information processing tasks in a flexible manner. One potential barrier to the achievement of these results may have arisen from an attempt to impose any kind of rigid organisation in an experimental group thus reducing the inherent flexibility of their working arrangements. Some experimental group members did comment on the desirability of a more formally organised management structure, but in practice the experimental groups avoided this.

Group Organisation and Attitudes To the Game

All participants rated their enjoyment of the game about the same, and no significant differences were found between the different types of group, or within the standard groups between operators and managers. Most participants seem to have enjoyed the experience. A few standard operators indicated their frustration at the boredom of their particular jobs, but even this does not appear to have detracted from the standard operators' overall enjoyment of the game.

Experimental group participants rated the extent to which they thought they had learned from this game significantly higher than the standard group participants as a whole. Compared with standard operators, the perceived learning ratings of experimental group participants are again significantly higher. There is, on the other hand, no significant difference between the perceived learning ratings of standard managers and experimental group participants. These were precisely the results predicted. The job design theory outlined in Chapter 4 above suggests that learning is related to degree of involvement in routine control operations. Experimental
group participants and standard group managers were heavily involved in routine control in their respective groups, but standard operators were not involved in routine control at all.

Two other hypotheses fall under this heading:
(a) that there would be a correlation between enjoyment and learning ratings; and
(b) that experimental group performance ratings would be more consistent than those of standard groups.

For both of these hypotheses the results obtained lie in the direction predicted but are not particularly significant. These hypotheses are thus listed in Figure 6.4 as having been partially confirmed.

**Group Organisation and Learning**

"Learning" is here given the operational definition: "becoming aware of the problems of production management". The central hypotheses of this experiment thus concern the extent to which different groups of participants in the experiment "learn" more than or less than other groups. Questions regarding whether or not group organisation made any difference to what was learned in the course of the game are to be answered from the content of the replies to the Tutorial Feedback Questionnaire (detailed in Appendix II, Section 7, p.658).

Hypothesis 6a predicted that standard operators would "learn" less from the game than standard managers. Figure 6.5 summarises the main points of difference in the content of their respective replies to the Tutorial Feedback Questionnaire.

It would appear from Figure 6.5 that standard managers did indeed become more aware of the problems of production management
Main Differences in Replies* of
Standard Operators compared with Standard Managers

<table>
<thead>
<tr>
<th>Emphasis on:</th>
<th>Emphasis on:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The production activities</td>
<td>Quoting due times</td>
</tr>
<tr>
<td>Quality of equipment</td>
<td>Determining job priorities</td>
</tr>
<tr>
<td>Insufficient equipment</td>
<td>Tracing jobs</td>
</tr>
<tr>
<td>Line balancing</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6.5: Replies to the Tutorial Feedback Questionnaire:
standard operators compared with standard managers.

*Replies placed in Category 5 - Miscellaneous - have been omitted from this and subsequent similar Figures.

in the course of this simulation game than did standard operators. The replies of the latter concentrate, not unnaturally, upon the nature of the production tasks which they were asked to perform and the equipment which they had to use. Through the variability in their own respective work loads the standard operators did become aware of the line balancing problem, i.e., the problem of ensuring a maximum utilisation of manpower by arranging a steady flow of work through each activity in the production system. Standard managers, however, seem to have become aware of other fundamental production management problems such as quoting delivery times for orders, determining the relative priorities of orders and tracing particular jobs once they are in the production system. Hypothesis 6a, which predicted that standard managers would "learn" more from the game than standard operators, is confirmed on the grounds of the evidence in Figure 6.5.

Hypothesis 6b predicted that experimental group participants
would "learn" more than standard group operators in the course of the game. The differences between their respective replies to the Tutorial Feedback Questionnaire are summarised in Figure 6.6.

| Main Differences in Replies of Standard Operators compared with Experimentals |
|---|---|
| Emphasis on: | Emphasis on: |
| Line balancing | Quoting due times |
| Communications | Insufficient equipment |
| Information | Organisation |
| | Task allocation |

**Figure 6.6: Replies to the Tutorial Feedback Questionnaire:**
standard operators compared with experimental group participants.

The problems encountered by experimental group participants in the course of the game are certainly concerned with some of the problems of production management. But rather than becoming more aware of production management problems than standard operators, experimental group participants encountered different types of problems altogether. The experimental group participants did not meet with the communications and information problems that faced the standard operators. The latter on the other hand did not encounter problems of group organisation and task allocation. The experimental game design appears to have circumvented the traditional management problems of communications and access to information and focussed attention instead upon the more fundamental problems of that design, problems that each group had to solve for itself. These problems concerned the organisation of the group as a whole to operate the
production system and to control it, and the ways in which specific tasks were to be allocated to group members. It is significant that the communication and information problems did not arise, or were not considered important, in the experimental groups. The one conventional production management problem met by the experimental groups concerned the quotation of delivery times. Hypothesis 6b, which predicted that experimental group participants would "learn" more from the game than standard operators, does not find strong support from the results summarised in Figure 6.6. This hypothesis is therefore only partially confirmed.

Hypothesis 6c predicted that experimental group participants would "learn" the same kinds of things from the game as standard managers. The differences between their respective replies to the Tutorial Feedback Questionnaire are summarised in Figure 6.7.

<table>
<thead>
<tr>
<th>Main Differences in Replies of</th>
<th>Standard Managers</th>
<th>compared with</th>
<th>Experimentals</th>
</tr>
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<tbody>
<tr>
<td>Emphasis on:</td>
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<tr>
<td>Job progressing</td>
<td></td>
<td></td>
<td>Emphasis on:</td>
</tr>
<tr>
<td>Tracing jobs</td>
<td></td>
<td></td>
<td>Quoting due times</td>
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<tr>
<td>Difficulty filling in paper</td>
<td></td>
<td></td>
<td>Organisation</td>
</tr>
<tr>
<td>work</td>
<td></td>
<td></td>
<td>Time spent filling in paperwork</td>
</tr>
</tbody>
</table>

Figure 6.7: Replies to the Tutorial Feedback Questionnaire; standard managers compared with experimental group participants.

Standard managers and experimental group participants both became aware of a number of production management problems in the
course of the simulation game. There are also similarities in their replies; both mention problems of determining job priorities and line balancing (these are not shown on Figure 6.7). This much was predicted. What was not predicted was that the experimental design would overcome certain problems and focus attention on others. As with the standard operators, discussed above, the standard managers faced few problems concerning group organisation and task allocation. But experimental group participants did not encounter problems in progressing or tracing jobs in the production system. The combined results relating to hypotheses 6b and 6c show that the two different designs of the simulation game did not make participants aware of the same problems to different degrees, as predicted, but made participants aware of different problems altogether. In particular, the experimental design appears to circumvent some of the more usual production management problems. Hypothesis 6c, which predicted that standard managers and experimental group participants would "learn" the same kinds of things from the game, does not find strong support in the results obtained. This hypothesis, therefore, is only partially confirmed.

It has been established, then, that the two designs of the simulation game illustrated different problems rather than different degrees of the same problems. The different emphases in each of the designs are summarised in Figure 6.8 which compares the replies of experimental group participants with the replies of standard group participants as a whole.
Main differences in Replies of

<table>
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<tr>
<th>Standard compared with</th>
<th>Emphasis on:</th>
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<tr>
<td>Job progressing</td>
<td>Quoting due times</td>
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<tr>
<td>Tracing jobs</td>
<td>Insufficient equipment</td>
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<tr>
<td>Communication</td>
<td>Organisation</td>
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<tr>
<td>Information</td>
<td>Task allocation</td>
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<tr>
<td>Knowledge of job</td>
<td>Time spent filling in</td>
<td></td>
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<tr>
<td>requirements</td>
<td>paperwork</td>
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</tbody>
</table>

Figure 6.8: Replies to the Tutorial Feedback Questionnaire; standard compared with experimental group participants as a whole.

Miscellaneous

Hypothesis 7 predicted that the experimental groups would adopt a more innovatory approach to solving problems that arose during the game than standard groups. No specific predictions were made as to how this innovatory behaviour would manifest itself, and it proved difficult to assess whether or not this happened during the short duration of the game. One firm indication that this did happen is given in the replies of experimental group participants in Section 4b, Task allocation, of the content analysis of the Tutorial Feedback Questionnaire. Participants volunteered not only problems in this category but solutions as well (see p.697, below). A second indication of the "innovatory" behaviour of experimental group participants lies in their partial rejection of the formal information system (the paperwork) that they were asked to use. As one participant stated, "...we all could shout at each other and so find out what we wanted to know" (see p.701, below). This was perhaps the best strategy to maximise performance over a 40 minute game, and the
experimental group participants were almost unanimous in their realisation of this. Hypothesis 7 thus finds some support from the results obtained, and is partially confirmed on this basis.

Hypothesis 8 predicted that, in the absence of a hierarchical management structure, experimental groups would have fewer communication problems than standard groups. Results that concern this hypothesis have already been discussed at length above. Hypothesis 8 is, therefore, confirmed.

Hypothesis 9 predicted that experimental groups would have problems in operating their information system. They had to operate this system as a group and had to discover for themselves the best way of doing this. The content of replies to the Tutorial Feedback Questionnaire falling into sections 4a and 4b (organisation and task allocation respectively), coming from experimental group participants confirms this hypothesis. Experimental groups opted for an oral information system in place of the written one, enabling them to work faster, increase output and improve delivery performance.

What Generalisations Can be Made From These Results?

These results indicate the different effects of two different types of group organisation upon groups of six students in a laboratory setting. To what extent, therefore, can these results be applied to real industrial or commercial settings? The answer to this question is, naturally, speculative. It is suggested in Appendix II, Section 8 (p.719) that the simulation game, as far as it goes, appears to be a fairly realistic representation of a production system. But, however realistic, no simulation game can hope to represent more than a fraction of the complexity of the live situation. In attempting to generalise from the results of this
experiment, therefore, the limitations of the experimental method and design used must be borne in mind.

With regard to the performance of the two types of group, evidence was reviewed in Chapter 2 above that indicates the potential performance advantages of autonomous group working. The results obtained here, therefore, are in line with that existing evidence. With regard to the extent to which participants in the two game designs "learned" (about problems of production management), the predicted results were only partially confirmed. The experimental group design presented participants with problems different from those faced by the standard group participants. The original hypotheses suggested that participants in both game designs would face the same problems, but to different degrees; this was not the case.

An autonomous group can be defined here as a group of (production) operators who together perform all the routine control operations that relate to their (production) activities. Does autonomous group working of this kind overcome some of the traditional problems of production management such as progressing and tracing orders in the production system, communication and access to appropriate information? The results obtained here suggest that this is indeed the case (see Figure 6.8 above). The autonomous group (ie experimental) design focuses participants' attention upon the areas that this research has undertaken to investigate— the problems of organising work and allocating tasks to work-group members. Does autonomous group working of this type, therefore, concentrate the attentions of those involved upon the way in which their work is to be organised, the way in which their jobs are to be designed? Again, the results obtained here suggest that this is the case. From this,
it follows that each group should tend over time to develop the methods of organisation and of working that suit the group members best. There is also considerable inherent flexibility in the way in which groups can approach these problems and develop solutions to them.

The reactions of participants in the experimental design to the formal information system that they were asked to use may indicate a potential source of problems for small worker co-operatives that are organised along these lines. In the short run, the most effective organisational strategy would seem to involve dispensing with a formal information system and relying upon human memory for information storage and speech for communication. In the long run this approach is likely to be disastrous. Problems that develop gradually over time may not be detected quickly enough to allow effective remedies to be applied. A formal information system is indispensable. Small worker co-operatives that attempt to operate as autonomous groups, in the absence of managerial expertise, are likely to be highly prone to this type of problem.

Speculation beyond the results of an experiment like the one described here is fraught with uncertainty. But it is hoped that these results have indicated some potentially fruitful lines for future research concerning the nature and effects of autonomous group working.
CHAPTER 7:

THEORY, RESEARCH AND CONCLUSIONS;

A SUMMARY.
The Aims of This Chapter

This Chapter seeks to fulfil two purposes. First, to bring together in a brief summary the main theoretical arguments of this thesis and to describe the research carried out. Second, to assess the implications arising from the conclusions that have been reached in this research.

The Importance of Job Design.

This thesis is concerned with the content of jobs and with the processes whereby job content is determined and changed. The generic name given to this area of study is "job design". This area of study is grounded in two basic presumptions:

1. that the design of jobs is not rigidly determined by technical, organisational or human variables but that there is some freedom of choice in determining job content;
2. that job content can be manipulated to satisfy simultaneously criteria concerning technical efficiency, organisational effectiveness and the well-being of the job holder.

Research devoted to examining the effects of manipulating job content has suggested that a wide range of benefits may be produced for both organisations and individuals. Some of these benefits are listed in Chapter 1, and a number of specific applications of job design techniques and their results are detailed in Chapter 2. It is perhaps not surprising, therefore, that this area of study has
attracted the interest of management, unions, government and research workers in Britain. The design of jobs affects a cross section of problems, ranging from the physical and psychological state of the individual worker to the state of the nation's economy. Despite the promise of job design, however, applications are not widespread. Difficulties in applying the techniques of job design, some of which are explained in Chapter 1, appear to arise mainly from managerial apathy and from theoretical inadequacies.

This thesis is, therefore, presented in the conviction that job design is an important area of study, in the knowledge that applications of the technique are few, and in the belief that current theories of job design are unsatisfactory. The main objectives of this thesis are to examine the problems of current job design theories, and to derive and evaluate an alternative approach that attempts to deal with these problems.

Features of Current Theories of Job Design.

Much of the literature concerning the development of job design objectives and techniques is examined in Chapter 2. Academic interest in this area of study has a history of over 50 years, and this is, therefore, not a new subject. A number of comments may be made concerning the current "state of the art":

1. A vast quantity of theoretical and practical effort has been devoted to this topic over the past half century. Chapter 2 considers all the major contributions, but is far from comprehensive in its coverage of indirect contributions from closely related areas of study.
2. A number of techniques for designing jobs now exist. There are two basic approaches. The "job restructuring" approach takes the individual job as the basic unit of analysis and includes the techniques of job enlargement, job enrichment and the expectancy theory technique of job design. The "work organisation" approach takes the work group as the basic unit of analysis and includes the techniques of job rotation, socio-technical system design, project type organisation and "organisational design". The differences between these practical job design techniques reflect a variety of theoretical foundations.

3. Job design theories are derived from combinations of four theoretical components:
   (a) a theory of human motivation and/or human nature;
   (b) a model of the situation at which the theory directs proposals for change;
   (c) a statement of desirable job characteristics; and
   (d) a method of changing the design of jobs to incorporate the desirable characteristics.

Only one job design theory - socio-technical system design - incorporates all four components. It seems difficult to maintain, however, that any one of these components is unnecessary in an adequate theory of job design.

4. There is substantial agreement amongst current job design theories over their objectives in terms of desirable job characteristics. This agreement reflects the broadly similar theories of motivation (based principally on Maslow, 1943, 1970) that have been adopted.
5. There is little agreement amongst current job design theories over the methods by which job content should be manipulated in order to bring about the desired changes. This disagreement reflects a lack of systematic conceptualisation of the job or organisational setting to be changed. Only two job design theories - socio-technical system design and project type organisation - provide an analytical framework on which to base job design changes. Other theories rely on the ingenuity of those in charge of the project to work appropriate changes in the directions required.

Practical Problems of Job Design.

The theoretical inadequacies of current job design theories are illustrated by the practical problems that face the implementation of job design projects. Five such problems are identified and discussed in Chapter 2. These are:

1. difficulty in assessing the impact of particular changes on the jobs of other members of the organisation;
2. difficulty in making generalised statements of desirable job characteristics operational;
3. difficulty in transferring knowledge of successful types of change from one organisational or technological setting to another;
4. difficulty in implementing changes that cater for individual differences;
5. difficulty in assessing the durability of the effects of a given change.
The overriding problem of job design theories thus lies in the difficulty of translating prescription into action.

How This Research Attempts to Solve These Problems.

The major problem of current job design theories lies not with prescription but with method. This thesis argues that a theory adequate for the design of jobs requires the four theoretical components outlined above and that for two of those components—a model of the situation to be changed and a method for implementing change—no satisfactory formulations currently exist. It is further argued, towards the end of Chapter 2, that a model of the situation that is to be changed should have three characteristics:

(a) it should take the organisation as a whole as the basic unit of analysis;
(b) it should express the totality of tasks, managerial and non-managerial, that must be performed if the organisation is to be effective;
(c) it should be a general model, not bound to one type of technological or organisational setting.

The first problem tackled in this thesis concerns the derivation of such a model. The next stage is to develop a method, based on that model, for arriving at appropriate job design changes. These two stages are described in detail in Chapters 3 and 4 respectively.

The Derivation of an Appropriate Model

The more powerful job design techniques, in terms of ability to
impart to jobs the characteristics deemed to be desirable, are those that pass beyond job rotation and horizontal job enlargement and involve the transfer of managerial tasks to those who traditionally perform only non-managerial tasks. Before reallocating managerial tasks to workers, these tasks and who is performing them should first be identified.

Management can be conceptualised as the organisational function concerned with information processing and control. One logical starting point for an examination of information processing and control in organisations lies in the field of cybernetics - the science of communication and control in both living and inanimate systems. Several analyses of the management function, and of the production control function in particular, have adopted this approach, and these are examined in detail in Chapter 3. The models examined have one fundamental characteristic in common - the use of the cybernetic concept of the feedback control loop as the model-building unit. These models suggest that it is both necessary and sufficient to regard the management function of an organisation as a three tier hierarchy of control of control. One schema for analysing worker participation in management (Chamberlain, 1948) also points to this formulation.

The three levels of the management function are here termed and defined as:

1. primary decision making; determining the task or tasks of the enterprise and the financial resources to be used in achieving these tasks;

2. planning; determining how the task of the enterprise is to be achieved with the resources available;
3. Routine control; the day-to-day monitoring and adjustment of the operating systems (Miller and Rice, 1967) of the enterprise.

These three levels of control constitute a basic model of the management function; they possess the following configurational properties:

(a) each level is a "controller", operating in the manner of a feedback control loop;
(b) each level makes decisions and issues directions that constrain the freedom of the level below;
(c) each level operates continuously, although the three levels work to different time scales.

There remain two other components of the management function which the model incorporates; co-ordination between control operations of different operating systems, and the organisation's exchange of information with its environment. Both of these functions are conceptualised as forming additional inputs to and outputs from each of the three levels of control.

The Derivation of an Appropriate Method.

The model of organisational information processing and control can be used to provide a framework for organisational analysis which can in turn be used to identify desirable job design changes. A ten-stage method of organisational analysis is described in Chapter 4.

The ten stages are:

Stage 1: Identify the operating systems of the enterprise and their current work methods.
Stage 2: Identify the control factors of each operating system.

Stage 3: Analyse how the routine control operations for each control factor are carried out.

Stage 4: Analyse how the planning operations for each control factor are carried out.

Stage 5: Analyse how primary decisions are made.

Stage 6: Analyse how co-ordination between the routine control functions of each of the operating systems is carried out.

Stage 7: Analyse how co-ordination between the planning functions of each of the operating systems is carried out.

Stage 8: Analyse how information concerning the organisation's environment is collected and used as input to the control operations.

Stage 9: Analyse how information concerning the organisation is transmitted to the organisation's environment.

Stage 10: Produce job and organisational design proposals.

The procedure of the analysis at each stage is based upon the components of the model. The analysis provides two types of information. First, any information processing or control tasks that are not being carried out will be identified. Second, in providing a comprehensive breakdown of all the managerial and non-managerial tasks performed in an organisation the analysis can be used to generate proposals for job and organisational design change.

The model of organisational information processing and control, and the ten stage method of organisational analysis constitute two of the four basic components of a job design theory. The nature of the
job and organisational design proposals produced through this method are determined by the other two components of the theory.

A General Theory of Job and Organisational Design.

The theory of job and organisational design developed in this thesis adopts the views of current theories concerning human motivation and desirable job characteristics with slight modification. The job design objective of providing continuous learning, however, appears to be particularly important since it relates to the satisfaction of higher order human needs. In considering how the method of organisational analysis can be used to render this (and other) objectives operational, it is noted that cybernetic models using the feedback control loop as a basic building block are now popular in (cognitive) psychological explanations of (a) skill performance, (b) learning, and (c) human behaviour as a whole. These cybernetic models are examined in Chapter 4 since they provide insight as to how several desirable job characteristics, particularly the provision of continuous learning, can be made operational.

Purposive human behaviour can be regarded as being made up of a series of "plans" (Miller, Galanter and Pribram, 1960). Each plan can be broken down into a series of sub-plans, sub-sub-plans, and so on, each of which contributes to the performance of the overall plan. Learning to carry out a plan at any level is feedback dependent; once the plan can be performed properly, feedback or knowledge of performance results will still be required in order to maintain performance, but learning will have ceased. The provision of feedback is not sufficient to provide continuous learning. Continuous learning may only occur where the method of performing a
lower order plan can be altered by the performer in order to improve performance of the overall, higher order plan within which it is nested.

The tasks that must be performed by an organisation in the pursuit of its overall objective (plan) of survival can be regarded as possessing a hierarchical nature identical to the plans that make up individual human behaviour. The problem of job and organisational design then becomes the problem of assigning parts of the overall plan to members of the organisation. It is argued in Chapter 4 that carrying out the operating activities of the organisation, or carrying out the routine control operations, does not provide continuous learning. Tasks at both of these levels are constrained by decisions taken at the planning level. The routine control level, for example, has little or no opportunity to experiment with novel corrective action (without usurping the planning function's prerogatives) and thus has little or no opportunity for continuous learning. If jobs are to provide continuous learning, planning level operations must be included in their content. It is argued in Chapter 4 that this objective is best achieved with groups rather than with individual members of the organisation.

The general theory of job and organisational design postulated in Chapter 4 incorporates these four theoretical components:

1. A theory of motivation based on the current status of Maslow's need hierarchy theory (Lawler, 1973);
2. A model of organisational information processing and control;
3. A statement of desirable job characteristics based on current theories but emphasising the importance of "continuous learning";
4. A ten stage method of organisational analysis that can be used to render desirable job characteristics operational.
Applying the Method of Organisational Analysis.

The ten stage method of organisational analysis was used to analyse the production control operations of three manufacturing units. Two of these studies are described in detail in Chapter 5 and the third is described briefly in Appendix IV. The advantages and disadvantages of the method are also discussed in Chapter 5. The principal drawback to this assessment is that in this research it was not possible to implement all ten stages of the analysis.

These studies indicate that the method can be used:

(a) to systematically identify the range of job and organisational design choices open to an organisation;
(b) to produce operational definitions of statements of desirable job characteristics; and
(c) to assess the impact of specific changes on other jobs in the organisation.

There was little scope in any of the units analysed for radical job or organisational design change. But a means of implementing job design changes gradually is suggested. A primary objective is to establish composite, autonomous groups of workers who carry out all the operating and routine control tasks within their operating system. This could be achieved over a period by gradually allowing workers to perform more of the routine control operations while gradually withdrawing supervisory assistance. A secondary objective would be to extend the activities of the group in a similar manner to the planning operations. Once this stage is reached, it is a small step to participation in primary decision making also. Those holding "managerial" positions take on the operations of co-ordination,
between operating systems and between the enterprise and its environment. Although the analysis and prescriptions presented here are based on production control systems, the method can be applied to any type of organisation of any size.

Reallocation of control operations in this manner has a number of other consequences:

1. workers who carry out planning, routine control and operating activities "design" the patterning of activities in their group and thus design their own jobs;

2. the design of jobs within the work group is adaptable to the needs of individual members;

3. the "job design" change is not a single time-bound intervention by a project team, but a basis for continuing organisational change should circumstances require it;

4. a system for recording relevant information in a format that can be used for collective information processing and control is required;

5. there will be a limit to the size of the group that can effectively make such collective decisions. (Trist et al, 1963 report that autonomous groups with 41 members can operate effectively.)

This method of identifying job and organisational design changes thus attempts to overcome the practical problems of job design listed above.

These applications of the method of organisational analysis also revealed two characteristics of production control systems which affect the implementation of job and organisational design changes.
First, in the manufacturing units analysed, up to four levels of management could be involved in carrying out the routine control operations. Second, routine control problems tend to "escalate" through the management hierarchy as individuals faced with problems decline to deal with them and pass them on to superiors. The changing role of the first line supervisor has for some time been recognised as a stumbling block for the implementation of job design techniques. This research indicates that the problem may be more fundamental. Apparently straightforward job design changes may affect positions in an organisation well beyond that of the immediate supervisor. There are clearly difficulties in "de-escalating" control (i.e. having control operations carried out at lower organisational levels), the main reason for suggesting here that such changes should be conducted gradually.

A Laboratory Experiment Comparing Conventional with Autonomous Work Groups.

In order to test some of the hypotheses generated by the general theory of job and organisational design, a production system simulation game was developed and was used with over 100 students on production management courses run by the University of Edinburgh Department of Business Studies. A further objective of the simulation game was, therefore, to assist in the teaching of production management. The game has two designs (standard and experimental) both of which simulate a 6-man factory making table mats (from scrap paper) to customer order. The standard or conventional design operates with a conventional management hierarchy and each group member is given a job description that details his or her particular tasks. Each group
has three operators and three managers. The experimental design operates as an autonomous group and group members are not allocated in advance to specific tasks; the group itself must decide how to allocate the work that has to be done. The paperwork used in the two designs is also different. The forms used in the experimental design attempt to make collective information processing and decision making easier. Both designs simulate only the operating and routine control functions of their respective "factories".

Both designs of the game and the manner in which they were run are described in detail in Appendix II. The results obtained from this experiment come from three sources:

1. The Opinion Questionnaire, administered to participants immediately after each run;
2. The Performance Results of each group;
3. The Tutorial Feedback Questionnaire, which asked participants to write essays on the production problems encountered in the course of the game.

The extent to which these results support the hypotheses which the experiment sets out to test is discussed in Chapter 6. Out of 19 hypotheses, 10 are taken to be confirmed by these results, 5 are partially confirmed, and 4 are rejected. Only the most important findings are mentioned here.

Experimental groups performed better than standard groups on most measures. They were able, in the absence of specified task allocations, to organise themselves well enough to cope with the production and information processing tasks. Participants in experimental groups rated the amount which they thought they had
learned from the game significantly higher than standard group operators, but the same as standard group managers. These results were as predicted.

The central hypotheses of this experiment concern the extent to which participants "learn" about production management. The operational definition of learning used here is - "becoming aware of the problems of production management". Content analysis of replies to the Tutorial Feedback Questionnaire provide the bulk of the evidence relating to these hypotheses. The following results were obtained:

1. operators in standard groups "learned" less than their managers;
2. experimental group participants on the whole appear to have "learned" more than standard group operators, but they became aware of different types of problems in the game.

It was predicted that standard and experimental group participants would face the same production management problems, but to different degrees. This did not happen. The lack of hierarchical structure and job descriptions in the experimental design appears to have overcome a number of traditional production management problems, such as those concerning:

- communication
- availability of information
- job progressing
- tracing jobs
- line balancing
These problems occur frequently in the replies of standard group participants but not in the replies of experimental group participants.

The experimental design, in overcoming some conventional production management problems, focused attention on problems of organising work and allocating tasks to group members. These problems occur frequently in the replies of experimental group participants but not in the replies of standard group participants.

A further noteworthy feature of the experimental groups is that they preferred to operate a verbal information system and made little use of most of the paperwork that was designed for them. As groups of 6 people, working for 40 minutes, this was perhaps the most effective strategy. This may point to a potential problem for small workers' co-operatives where a similar informal information system may be seen to operate quite satisfactorily. This may be suitable in the short term where the identification of immediate operating problems may not require any formal information recording and monitoring system, but in the long run this approach is potentially disastrous.

In assessing these generalisations from the results of this experiment, it should be remembered that the results are derived largely from the subjective content analysis of essays written by students who participated for 40 minutes in a simulation game. On the other hand, the simulation appears to have been comparatively realistic, and was certainly a success as a teaching device.

Implications of the Conclusions Drawn From This Research.

The general theory of job and organisational design developed in this thesis has been only partially evaluated. But it may be worthwhile
to assess the implications of the results that have been obtained. There appear to be two main considerations, concerning the nature of job design and the pace of organisational change respectively.

First, the extent to which individuals can be provided with opportunities for continuous learning in organisations appears to be related to degree of involvement in the information processing and control tasks of the organisation. In order to provide jobs that possess this characteristic, it is necessary to alter the design of the organisation structure itself. It is necessary either to "de-escalate" or "de-verticalise" (Wild, 1975) information processing and control tasks. Existing job design theories will be unable to fulfil their objectives unless radical organisational design changes are also accepted.

Second, the organisational changes advocated in this thesis are radical and could not be achieved quickly. The research reported here suggests that comparatively minor alterations to the content of the jobs of operators could affect several levels of the management hierarchy. This type of change of organisation structure is difficult to achieve and perhaps impossible to achieve quickly.

It is clear that organisations in our society have not begun to exploit the range of organisational design options that appear to be available. The objective should perhaps not be to design jobs with desirable characteristics, but rather to create opportunities within organisations for members to consciously design, adapt and elaborate patterns of organisation that they find appropriate for themselves.
APPENDIX I:

TWO CASE STUDIES IN THE ANALYSIS OF INFORMATION PROCESSING AND CONTROL IN "COMMON OWNERSHIP" COMPANIES.
THE INDUSTRIAL COMMON OWNERSHIP MOVEMENT

Introduction

This research project has been partly concerned with an examination of conventional forms of work organisation. The Industrial Common Ownership Movement (ICOM) is one of a number of bodies in this country whose aim is to promote companies with what might be considered more unorthodox methods of organisation. The two case studies which follow were originally intended to stand in comparison with the previous case studies of Ferranti and Wilkie and Paul.

The Movement exists to promote companies which are owned and controlled by their employees. At an ICOM Conference in December 1974, representatives of three member firms were asked to consider a closer study of their organisations in pursuit of this research project. All agreed at that time that this would be possible, and formal requests were subsequently sent to these companies in February 1975. Visits to the two companies which replied were then arranged.

Background and Objectives*

The organisation was founded in 1958 by Ernest Bader under the name "Society for Democratic Integration in Industry" (DEMINTRY). This name was changed to the current one in 1971. ICOM is comprised of practitioner firms and individual members, the former complying with the requirement of being a common ownership. There are currently (October 1975) thirteen practitioner firms, 35 associate

*The information in this section is taken mainly from the booklet "This is ICOM" available from Industrial Common Ownership Movement, 8 Sussex Street, London, S.W.1. (Price 10p).
member firms and about 300 individual members. Since 1972 there has been a paid, part-time Organising Secretary who also works for the Home Office as a consultant on Community Development Projects.

The main objective of ICOM is described as being

"To achieve democratic control of their own work by people at work."

A common ownership firm is defined as

"... one that is wholly owned and controlled by those working in it."

Practitioner firms, in fact, fulfill those requirements in a variety of ways and ICOM does not advocate any particular methods as superior. The name of the Movement is thus perhaps misleading in that it gives prominence to only one of the two characteristics being advocated; the importance of the relationship between ownership and control is stressed, however, as an indispensable facet of common ownership. Thus -

"We stand for worker control, but a responsible form of control that is based on ownership."

Another characteristic of ICOM firms is the emphasis placed on social objectives. These firms are run in the interests of their employees (as opposed to shareholders) but many have wide social objectives of relevance to the local community. This is illustrated in both the Case Studies.

ICOM itself is therefore concerned with three main tasks. First, it attempts to publicise its views, persuade firms to become common ownership, and persuade individuals and Members of Parliament in particular to adopt the views advocated. Second, through the Movement, contact is maintained between member firms and mutual assistance is facilitated. Third, and probably most important, the Movement seeks to introduce a new Companies act "...which will
establish common ownership as the statutory basis for all companies." A more realistic short-term objective is to promote legislation that will provide assistance to firms organising themselves in this way and the connection with Community Development Projects is regarded as useful in this context. Earlier this year, an "Industrial Officer for Common Ownerships" was appointed to work in West Cumbria. Although based in Whitehaven he will work to some extent with the Community Development Project in Cleator Moor, his task being to establish as many common ownerships in the area as possible.

The Movement rejects such measures as having worker directors, worker shareholdings, "profit-sharing" and "capital-sharing" schemes as inadequate bases on which to build satisfactory relationships between man and work. The "cachet" of ICOM is a fist holding a tool which is a spanner at the top and a pen at the bottom.

**Industrial Common Ownership Finance Ltd.**

In 1974, ICOM established a trust fund, Industrial Common Ownership Finance (ICOF) which can offer financial assistance to existing and potential common ownership firms. Naturally, a common ownership is unable to raise capital by issuing shares in the usual manner, and loan capital is thus of particular significance. ICOF is a non profit making revolving loan fund and the first loans made to ICOF came from existing common ownership companies.

The ICOF trustees who administer the fund are concerned with the economic viability of any enterprise they intend to finance, but since the main objective is to promote common ownership, loans may be granted in situations that an orthodox source of finance
would reject. The advertising literature of ICOF* lists three criteria on which loan applications are assessed:

"1. the motivation, integrity and business experience of the individual applicants,
2. the trading record of the enterprise or in the case of a new enterprise the commercial viability of the product or service proposed,
3. the number of jobs created."

During the year ending May 31st, 1975, loans totalling £29,400 were made to eight projects, three being established firms and five being new enterprises.

*Available from the Secretary, Brian Bridge, 42 Aberdeen Park, London, N.11.5.
Introduction

Landsman's (Co-Ownership) is an ICOM company situated near Huntingdon, manufacturing and hiring mobile site offices and other special-purpose trailers; it is the subject of the first case-study below. In recognition of the fact that the company had reached its tenth year as a common ownership, a weekend conference was held at the Grafham Water Residential Centre, not far from Landsman's factory. The conference was attended by the Organising Secretary of ICOM, the Chairman of ICOM, about 12 of Landsman's "co-owners", 25 representatives from other ICOM practitioner firms and prospective member firms, seven "individual" members of ICOM, a local marketing consultant and management trainer and the Warden of the centre who is a sociologist.

The purpose of the conference was to discuss the problems of common ownership using the experience of Landsman's as a starting point. The basic format for much of the conference consisted of one or two speakers from Landsman's illustrating some aspect of the company, followed by general criticism and discussion of some of the points raised. For example, Landsman's Managing Director began the conference by describing the firm's history and this initiated discussion of the ways in which common ownership enterprises start up. Following this, the Foreman Driver (also Chairman of the Works Committee) presented an account of his impressions of working for Landsman's for the past ten years. His initial scepticism of the organisation has been transformed into ardent enthusiasm and the resultant discussion concerned general problems of recruitment and "conversion" to common ownership ideology.
The Discussion

Several subjects of particular relevance to common ownership companies were discussed and among these were the following:

Size:

The size of a common ownership firm appears to be crucial with respect to the arrangements made to operate "democratic control". Landsman's, according to the Managing Director, is now having "communications" problems which are attributed in part to the size of the company - less than 40 "co-owners". Scott Bader, the largest firm in ICOM with 400 employees, has a two-tier representative structure which involves employees at all levels in the control of the company. Some argued that this latter type of arrangement is not effective since a large proportion of employees are not directly involved with the system. There are ICOM practitioner firms, like Sunderlandia and Rowen Cnllwyn, where a general meeting of all employees is the controlling body, but both these companies are small and it is apparent that total involvement in decision-making becomes more impractical as the size of the firm increases.

Inception:

Common ownership firms have been established in a number of ways, and the method used may be important with respect to organisation and future success. Some companies, like Landsman's and Scott Bader, have been transformed from conventional enterprises into common ownerships at the instigation of their initial owners. Others have commenced from crisis situations such as factory closure or mass redundancy. This has happened, for example, at Triumph Meriden (now operating with Government support) and at Fakenham Enterprises. This latter firm has 20 female employees who staged a sit-in when
their leather goods factory was closed in 1972. Despite financial assistance and advice from other ICOM companies, the future of this firm was for some time in doubt, but they now appear to have overcome most of their problems. Their problems stem not only from a depressed market for their products but also from a lack of managerial skills in the workforce. The factory is now run by one of the company's original chargehands.

There have been exceptions but there is validity in the argument that workers who take over their factories when declared redundant lack the managerial skills necessary to continue successfully. The role of an organisation such as ICOM could be crucial in such cases and the lack of assistance other than financial given to Fakenham Enterprises, when faced with this situation in 1972, was criticised.

In complete contrast, the original owners of Landsman's relinquished financial and to some extent managerial control of their company gradually. The Managing Director (who with his wife represents the original ownership) feels that this method is more satisfactory and also believes that the style of management in operation before the transition was a contributory factor in making that change smoothly.

Recruitment:

The source of recruitment for common ownership firms raises problems. Those who have worked in conventional industry for some time are not always immediately willing to accept the responsibilities involved in working for a more democratic organisation. The problem is apparently not one of "induction" so much as "indoctrination". This may take time and the process may not always be as effective as
with Landsman's Foreman Driver, mentioned above.

(The account of the "factory simulation game" run with schoolchildren, given in Appendix A1, illustrates another aspect of this problem. While able to operate the "hierarchical" version extremely well, these 14-15 year old boys were reluctant to take part in group decision making in the "democratic" version.)

Remuneration:

Voting power at Landsman's Annual General Meeting is determined by shareholding which is determined by gross earnings and duration of employment with the company. This aspect suffered criticism from some who suggested that "one man, one vote" was a more equitable principle with which to distribute such decision-making rights. The popular counter argument was that those who had been with a company longer should have a larger say in how it should be run.

Another aspect of the question of remuneration which was discussed was wage differentials. There were some present who clung to the belief that higher ability, qualification and responsibility necessitated, per se, higher remuneration. The majority view was that equal payment for all types of work is the only just solution. The principle argument in favour of the supporters of wage differentials, however, was that higher wages must be offered in order to obtain more highly qualified manpower. A large proportion of potential recruits are doubtless discouraged by the offer of wages substantially lower than those obtainable elsewhere. One of the participants in this argument was a qualified architect who had left an extremely well paid job to join Sunderlandia, an ICOM building firm in Sunderland, being prepared to accept a drop in income to work in an organisation more acceptable to his beliefs. He could,
however, be regarded as exceptional.

Social Objectives:

The extent to which pursuit of objectives other than financial ones should be carried out raises problems. ICOM firms differ in the type and extent of these social objectives. Rowen Onllwyn employs disabled miners in an area of high unemployment. Landsman’s operates a Welfare Fund which is used to provide an annual staff party, and which has also been used to purchase a television for an old people's home, and hold a party for disabled children. To survive these companies must make a profit like any other, or receive subsidies from the government or charitable sources. The fulfillment of social objectives in themselves brings in no money.

Conclusions

The problems discussed all emphasise the conflict between the theory and the practice of common ownership and worker control. The fundamental problem of these enterprises is that they are operating in an environment which is hostile to their ideals and objectives. They will continue to face difficulties in integrating themselves into an environment which they are attempting to change. This highlights the importance of the interim legislation, which ICOM is attempting to promote, to provide temporary support for such ventures where necessary and desirable, to assist marginal companies not merely to continue providing employment, but to fulfill and extend their social objectives as well.
Impressions

This has been a rather personal view of that particular conference. Other participants may not agree with the emphasis placed on the points mentioned. Continuing, however, on this personal level, three further comments on the conduct of the conference may be relevant.

First, the Movement and its ideals are not regarded as political in any way by its members. ICOM holds allegiance to no political party, political discussion did not occur during the conference. The views advocated may be labelled "socialist" but those who hold them do not see themselves as "socialists". This is not to deny that Labour M.P.'s may be more sympathetic than any others; but when it comes to canvassing, all M.P.'s find ICOM literature in their mail.

Second, the depth of commitment to ideals held is very high. Those "practitioners" at the conference are not given to platitudes about "worker control" or "participation". They are concerned to see that this is done, and are deeply concerned about how it is done. And this is sometimes carried out in the face of great difficulties and at much personal sacrifice, particularly in the smaller companies.

Another indication of this degree of commitment is the extent to which criticism is attended to, either from other firms or from outsiders. Each firm in the Movement operates somewhat differently and naturally each has a tendency to advocate its particular solutions. But these differences were discussed openly in an atmosphere of mutual respect, without malice, their relative advantages and disadvantages listed frankly. This readiness to listen to the views of others was highlighted in the talk given by a guest speaker -
a management consultant - towards the end of the conference. Much of his criticism was light hearted (naturally so when faced with a room full of 50 people with basically unified beliefs) but some was sincere. He regarded ICOM companies as "inward looking" and, in many ways, as commercially immature. He claimed that a lack of acceptance of the harsh facts of business would lead to ruin. The approach suggested was therefore a more "hard-headed" one. He was not heckled or shouted down. In fact, at first after he had finished, criticism was slow to come. This situation was soon rectified and the general consensus appeared to be that his comments although exaggerated in emphasis were to some extent valid.

The third point again concerns the nature of the conference participants. The representatives from ICOM companies were not all Managing Directors or Production Managers. They included welders, joiners, electricians, drivers, secretaries, and participation in discussion was not determined by job title.
Introduction

Landsman's (Co-Ownership) Ltd. is a small company, situated near Huntingdon, manufacturing industrial mobile units such as site offices, mess rooms, toilets, laboratories and exhibition trailers. Standard models are offered but the flexibility of the production process permits a wide range of custom made units to be manufactured. Output is currently about 250 units per year. The company also operates a hire fleet consisting of 180 of its own products, serving the entire country. Turnover is currently around £250,000 per annum.

There are two premises, about four miles apart, housing the four main departments; the factory, servicing and repairs, hiring and transport. At present there are 36 employees who are generally referred to as "co-owners".

History

The company was started in 1949 with one man, now the Managing Director, towing caravans with a Landrover. Growth of the towing activities and diversification into actual manufacture and hiring increased the size of the company and by 1964, there were 25 employees. A partial profit sharing scheme was in operation at this time and the company, although there were some problems, was managing to survive.

In 1964, the owners (now the Managing Director and his wife,
who is part time Company Secretary) decided to sell the company to a new limited company. After an independent valuation the owners, who became employees of the new company, received payment with a block of "A" shares. These are non-transferable, redeemable over a period and carry a fixed dividend. Each of these "A" shares carries half a vote. The original owners thus initially retained control of the company. The objective, however, was to relinquish this control gradually.

At the end of each financial year, the total surplus is assessed. This is divided amongst all co-owners in proportion to gross earnings over the preceding year. The Board of Directors decides what proportion of this bonus is paid in cash and what proportion will be issued as shares. The current division is 60 per cent shares, 40 per cent cash. These "B" (bonus) shares accumulated in such a way that the original owners lost control of the firm after five years, as intended. The "A" share vote is now one seventh of the total. For the first three years, the bonus was about 15 per cent of gross wages. This rose to 40 per cent in the fourth year and only fell below 30 per cent for the first time in 1974 (when it was 26 per cent).

Other results cited by the company as evidence of continuing success are that wages have kept pace with the national average; and those who have been with the firm since 1964 each have about £3,000 invested in it in the form of "B" shares. Around 90 per cent of co-owners attend and vote at Annual General Meetings and the company has never had a strike.

Landsman's, the company, attitudes to work and future plans are mainly the creation of the Managing Director. The company's
Figure A1.1: Landsman's (Co-ownership), organization chart.
outlook is summed up in his words:

"Unlike the conventional firm, we are not concerned with growth for its own sake - the normal pressures for it don't operate on us. Our aim is to be efficient, to see that everyone gets paid the true and fair value for their labour, to ensure that we give good value to our customers, to be free of any outside control, and to be happy in our work."

Although Landsman's has now begun diversification into house repairs, there are no plans to expand the labour force by more than two or three employees.

Organisation

The company's organisation chart is shown in Figure AI.1. Overall control of the company lies with two bodies - the Board of Directors and the Works Committee (neither are shown on the chart).

The Board of Directors has six members, three of whom are co-owners, and three outsiders. They are all elected by the co-owners in the normal manner, at the Annual General Meeting. Voting power is determined by number of shares held. The three co-owner-directors are the Managing Director, the Chairman of the Works Committee and a representative of the shop floor. Provision was made in the articles of association for outside directors who would provide not only managerial expertise but an independent view of the company and its operations. Those elected are generally enthusiasts for the common ownership idea. They are treated as advisors and each receives a nominal £7.5 per annum for attending meetings. They hold no shares in the company, represent no external interests, and do not receive any of the annual bonus. As in a conventional firm, the Board of Directors hires and fires, and advises management. But in Landsman's, the crucial distinction
is seen to be that those who are managed elect the Board.

The Works Committee also has six members, this number having
been set by the Board of Directors. They are elected from within
the company, on the basis of one man one vote. Membership rotates,
two members (who may be re-elected) resigning each year. The
Chairman of the Works Committee, at present the Foreman Driver, is
ex officio a Director. This body controls the Welfare Fund, acts
as a court of appeal over dismissals which it may veto if it believes
a mistake has been made, and has general, but informal, powers of
recommendation. The Committee meets every six weeks. In general,
it informs, advises and sometimes pressurises the Board on a number
of matters. Its function has developed through time and these powers
are now fairly well established. The following quotation from the
Works Committee Chairman's Report for 1974 illustrates the scope of
its activities;

"During the year the Committee has been responsible for
increasing the "B" share dividend from 7 per cent to
8 per cent. The tool money allowance has been
increased from 25p. to 40p. and a voucher system
implemented for a trial period of one year.

The Committee also gained a moderate subsidy
towards the cost of petrol for those workers who
have to travel daily over a distance in excess of
two miles to get to work, and following a consensus
of opinion the pay day was changed from Friday to
Thursday to help the wives with their shopping
problems."

Other matters with which it has dealt in the recent past have
been overtime, sick pay, tea breaks, foreman's pay and a guaranteed
week. The Managing Director in his report to the 1970 Annual
General Meeting commented on the success of the Works Committee
stating that it had provided "...a steady stream of suggestions as
to the better running of the company which have certainly assisted
our increased productivity."
Its main values appear to lie in its production of useful ideas, and in the way in which it facilitates communication with the shop floor. Some of its recommendations are rejected as impractical but the majority are acted upon. A number of problems arising on the shop floor are presented to the Managing Director through the Works Committee, not through the Factory Manager. The Managing Director attends the beginning of each meeting, which is always held during working hours, at which he presents a short progress report, answers any questions (there are usually several) then leaves the meeting to continue with its proceedings.

Financial Policy

Landsman's borrows money from banks, finance houses and private individuals (debenture holders), but none of this finance carries any rights to control or share of profits.

The trading surplus is divided amongst all co-owners at the end of each financial year in proportion to their gross earnings over the past year. Nothing goes to a general reserve, the Board determining the amount of reinvestment in deciding what proportion of the bonus to distribute as shares. These are termed "B" shares and carry one vote each. It is these "B" shares which give the co-owner the voting power to elect directors. The number of votes held is thus determined by the duration of the co-owner's employment. The proportion issued as shares is currently around 60 per cent.

The other 40 per cent is distributed as cash and it is treated as a bonus wage payment, all the tax paid coming out of this portion. On paper, therefore, the company makes no profit.

The "B" shares also carry a fixed dividend which started at
6 per cent and has now been increased by successive A.G.M.'s to 8 per cent maintaining an approximate parity with outside rates.

Each co-owner must maintain a ten-year holding of shares. Thus, after the tenth year he has the option of cashing the shares he was issued in his first year. On death or retirement, his shares are immediately cashed in full. If employment is terminated for any other reason, voting rights cease, the fixed interest dividend is still paid, and the shares can be cashed between three and five years later.

This structure has its disadvantages. For example, if two or three co-owners were to leave or die (say in a car crash) simultaneously, their dependants would be entitled to claim, in cash, their shareholdings in the firm. The financial embarrassment created by borrowing money for this purpose at rates higher than those paid in dividends could prove to be serious. The company has never had to face such a situation.

Wages and Salaries

Wage or salary differentials are decided by the Board in consultation with the Works Committee. The company's relative wage differential is approximately 2.5 (i.e. the Managing Director is paid about two and a half times as much as the lowest paid co-owner, excluding apprentices).

The Board of Directors reviews wages automatically every six months. Consideration is given to national increases, scales of similar local firms, the union rates for the type of work, and the state of the firm's finances. They then decide on the highest percentage increase they think the firm can afford, and this figure
applies to everyone. When a new person is hired, care is taken not to mention the annual bonus as an incentive to work for the firm; the basic wage itself must be adequate.

Working Conditions

Regulations governing conditions of work and terms of employment have evolved through decisions made by the Board of Directors and the Works Committee.

Basic pay is calculated on a 40 hour week for men and a 38 hour week for women. Overtime rates, based on an eight hour day, five day week, are time and a quarter, time and a half being paid over 50 hours. Anyone taking time off for legitimate reasons during normal working hours still receives overtime rates for extra hours worked, but this may be reduced to the flat rate if the system is being abused.

In the event of a work shortage, working hours may be reduced but pay is not reduced below the \(42\frac{1}{2}\) hours a week level, for not longer than four consecutive weeks. There can be no redundancies during this period. If redundancies become inevitable, the "last in first out" principle is applied. The Board must sanction all such dismissals and "B" shares belonging to anyone made redundant are redeemed within six months.

Standard arrangements have been made for sick pay and holidays. Each co-owner is entitled to four weeks holiday a year, with pay at their average weekly rate.

On retirement, a co-owner may be offered continuing full-time employment if he so wishes, but he will then be at the top of the list should redundancies become necessary.
On the death of a co-owner's close relative, up to three days' absence with pay is allowed.

For those employed in the hiring and transport section, the Board of Directors established a "Drivers' Charter" in 1971 which gives the following benefits to those driving vehicles owned or hired by the company, being used primarily on company business:
First, the right to free counsel from the firm's solicitor for any motoring offence;
Second, full payment of parking fines or fines incurred for technical offences (and, at the Managing Director's discretion, for fines incurred for speeding or careless driving).
Third, payment of basic wages in any such circumstances.
Fourth, in the event of the co-owner's driving licence being revoked, the Managing Director may offer alternative work until it is restored.

With regard to work methods, Landsman's co-owners rejected the production or assembly line method. Such an approach may have increased output and perhaps profits, but they decided that two men should work on and complete each unit, and this method is operating satisfactorily. This decision has also given the factory a degree of flexibility which larger production lines manufacturing standard models may not have. Each unit can be tailored to customers' requirements and the maintenance of Landsman's market share may be attributed in part at least to this facility.

The Welfare Fund

As mentioned in the introduction, common ownership firms generally incorporate social as well as economic objectives.
Landsman's operates a Welfare Fund, although it is only during the past two years that this money has been spent outside the company. The Fund amounts to about £850 per annum raised by a weekly levy of 47p. on each of the 35 co-owners. The Fund is used to finance an annual staff party but there is a suggestion board on which co-owners can register their ideas as to how the money could be utilised. A colour television was purchased for an old people's home, and the Fund has provided a party for handicapped children. This expenditure does not pass without argument. Several people suggested that fishing licences and a small boat be purchased for the use of co-owners in their leisure hours, but the non-fishermen in the company prevented this. The Fund is also used to give small interest free loans to co-owners.

The co-owners themselves apparently regard their charitable activities as worthwhile, and the Managing Director views the changes in the use of the fund as indication of the company's increasing maturity, and as another indication of the company's success.

Products: Construction

Landsman's manufactures a wide range of mobile trailers such as site offices, mess rooms and toilets. Most of these are produced as standard models, but at present approximately half the units being made are "specials" built to particular customers' requirements. These are usually exhibition trailers or dental laboratories. Any unit may be fitted with wheels, stilts or skids depending on where and how it is to be used.

The present Managing Director is contemplating partial retirement at the end of this year and his function has been
temporarily divided with a Managing Director Designate handling the hiring and repairs section. Construction is at present the responsibility of the Managing Director; the seventeen operators in the factory are supervised by a Foreman and a Factory Manager (see Figure AI.1). There are three machinists, a part-time electrician, a cabinetmaker, storeman, ten general operators who work in pairs, and an apprentice. With the exception of the machinists and the electrician, division of labour is highly flexible. Only two operators are union members and there are never any demarcation problems. The cabinetmaker, for example, while working primarily on that task, may assist other operators where necessary, or if he has no other work to do. On occasion, in the absence of the electrician, the Factory Manager may undertake some wiring work.

The manufacturing process:

Orders are received either by the Managing Director or the Salesman. The Managing Director quotes a price and approximate delivery time to the customer. Few orders are requested for a specific date and these are given priority. The scheduling of the work load for the factory is done by the Factory Manager who maintains a large "load chart" on his office wall. The Managing Director has a copy of this chart enabling him to estimate delivery times.

Working drawings for all standard models are kept in the Factory Manager's office. When a "special" unit is required, the Managing Director prepares an initial design based on the customer's requirements. Where necessary this is ratified by the customer. The Factory Manager translates this design into working drawings
for use on the shop floor. The basic construction of each unit is performed by a two man team whose first task on being allocated a job is to collect the appropriate chassis (purchased from another company) from the yard outside and anchor it in place on the factory floor. Each team tends to work in the same area, replacing the unit they have just completed with the chassis for the next. This arrangement is quite flexible, however, and depends on the number and size of units under construction at any one time.

The chassis is first checked to ensure that it is "true", i.e. that it is perfectly rectangular and that the axle, if required, is in the right place. It will have been the task of the machinists to prepare the "underfloor runners" for the chassis and the team next collect and fit these. The electrical wiring must be done at this stage before the chassis becomes inaccessible. All units require road lights and some may need supplementary wiring for other fitments. This work is done by the part-time electrician. The team then lay the floor for the unit and this becomes a convenient work bench for the rest of the build-up. The framework for the shell is then erected using pre-machined square cross-sectioned beams. The next stage is usually to put on the roof.

The sequence in which the interior and exterior surfaces are constructed depends on the unit being made. Sometimes one may have to be done first, sometimes it may not matter. The exterior is usually of aluminium sheeting, interior surfaces are satin-faced hardboard. A number of units require special interior fitments for cockers, sinks, benches, beds, cupboards, display racks and so on. The construction and fitting of these is the task of the cabinetmaker. The operators themselves handle plumbing, which is never complex.
These operators fulfill the requirement of being "good carpenters". Only three are trained coachbuilders, a skill difficult to obtain locally, but the supply of carpenters is adequate. Average output is around six units per week, this depends on the size of the units being made.

Services: Hiring, Towing, Repairs

The company operates a hire fleet of around 180 of its own units, and it is divided into two parts - the contract and local authority work fleet, and the show toilet fleet. The former are principally for use on construction sites, and the latter are used at outdoor events such as agricultural shows, gymkhanas and dog shows. These units may be sent anywhere in the country. They are kept in a yard about four miles from the factory where there is also a workshop to effect repairs and maintenance. House repairs as yet form an insignificant proportion of the company's activities; in 1974-75, this contributed less than 4 per cent to the total profit figure.

In preparation for taking over almost all of the present Managing Director's duties, the Managing Director Designate (MDD) presently looks after the hiring activities, towing and repairs (see Figure AI.1). Enquiries and applications for hiring come directly to the MDD who checks availability of units and schedules drivers to do the towing. Before a unit is sent out, the MDD performs a cursory inspection to ensure that all items requested are there. The Drivers, who each have their "own" vehicle, work alone and are responsible for transporting the unit to its required destination, positioning and anchoring it, and for returning the unit to the factory, or moving
When a unit is returned from hire, the Workshop Foreman and the MDD examine it to determine what repairs and maintenance should be carried out. The MDD must also decide upon the extent of customer liability for any damage or loss incurred as a result of the hire. This generally requires an accurate costing of materials and time consumed, and is normally carried out after the repair is made. Once the returned unit has been inspected a Worksheet is made out by the MDD, with the assistance of the Workshop Foreman, listing for the operator who will work on that unit what is to be done before it is hired out again. Once repairs and maintenance work are complete, the cleaner performs her functions and the unit is then ready for its next assignment. Although the MDD performs a visual check on each unit before it leaves the yard, he does not check any electrical, gas or plumbing installation work done. The operators themselves are expected to ensure that these are in working order.

As in the main factory, the operators here are not trained electricians, carpenters, or plumbers, but since the work is not complex, they are expected to handle all these facets of unit maintenance and repair. The Workshop Foreman, for example, was formerly a welder.

The organisation chart given is not capable of reflecting the flexibility of the working of the company as a whole, and this is particularly true of this section. In summer there are normally four drivers, including the Foreman, constantly occupied. There is not so much towing work through the winter, the temporary drivers taken on for the summer leave, reducing the pool to two who are
expected when available to assist with any of the jobs in the workshop. This includes the Foreman Driver.

When possible, the company is prepared to hire out drivers on towing contracts for other concerns. The workshop also performs repairs on other vehicles, for example on caravans from a local site, but neither of these activities is significant in terms of overall work load.

Control

The analysis here, and in the next Case Study, is based on the model developed in Chapter 3, above.

ROUTINE CONTROL

This is carried out in a manner similar to that of the companies examined in Chapter 5, and only a few examples need be given here in illustration. The control factors Task Allocation, Methods of Work and Product Quality are selected for particular attention since it is these areas of control which are most frequently granted to Operators in job redesign projects, and which one might expect to find in the present circumstances. One significant difference is that, being a smaller company, lines of communication are shorter, there being only four hierarchical levels.

Construction

The Factory Manager does all the production scheduling from load sheets which are kept in his office; he decides on the sequencing of jobs and on priorities when they arise. (Order Throughput Time).
The Foreman allocates Operators to their two-man teams - they are not self-selecting. The Foreman also allocates jobs as they come up to particular teams. (Task Allocation).

The build-up sequence is often flexible and it is the Foreman who directs this: for example, it may happen that if two teams perform the same sequence they will both require the same piece of machinery at the same time. The Foreman attempts to avoid this by redirecting the build-up sequence of one team. He may consult the Factory Manager if this materially disrupts the production schedule. (Methods of Work).

Inspection of Operators' work is cursory; the Foreman monitors quality in an informal manner by his presence on the shop floor, and the Factory Manager checks each unit briefly before it leaves the works to ensure that there is nothing obviously lacking. In general, however, the Operators are expected to inspect the quality of their own and each other's work. (Product Quality).

**Hiring, Towing, Repairs**

The entire hiring and towing operation is directed and scheduled by the Managing Director Designate. He selects drivers for particular jobs and it is his responsibility to optimise manpower usage and minimise mileage through careful selection. This task may become complex when a number of units and drivers are operating in the same area, shunting trailers between sites, and between the yard and sites. (Task Allocation, Methods of Work).

With regard to repairs, it is the Managing Director Designate and the Workshop Foreman who decide what maintenance (repair or preventative) is to be carried out on returned trailers and how it
is to be done. They inspect a trailer together and make out a Worksheet listing the requirements. (Methods of Work).

The Workshop Foreman allocates this work to Operators after being informed of any priorities by the Managing Director Designate. (Task Allocation).

Inspection of repair work is again cursory, the Operators being expected to check their own work. But before a trailer leaves the yard, it is given a brief inspection by the Managing Director Designate, mainly to make sure that everything the customer requires by way of extras has been supplied. (Product Quality).

**PLANNING AND PRIMARY DECISIONS**

Both these areas of control are the domain of the Board of Directors. If a new product or service is being considered, it is the Board which makes the final decision. (The company has recently begun to undertake house repairs.) A decision to adopt some new construction method for the factory would also lie with the Board. But it is in these areas of control that the Works Committee has influence. It would certainly be consulted and its opinions would certainly be taken into account in either of the examples just given and in any similar cases. The opinion of the Works Committee would carry considerable weight. The fact that the Chairman of the Works Committee is, ex officio, a Director, gives little indication in itself of the direction in which his influence may be placed; but the Works Committee is a body of six people which meets formally only once every six weeks to consider these questions. Unlike the management, dealing with such matters is not part of their normal
daily activities, and the powers which they do have in this area are informal ones which the Board can override.
Differences

1. Objectives:

As a small firm with no plans for expansion or growth, Landsman's is no different from many similar small firms, content to remain at a size they find satisfactory. But the size of the firm has a direct effect on communications and on the functioning of arrangements designed to achieve "democratic control". The Works Committee comprises a fifth of all those eligible for election; it would be unusual, for example, in a company with a thousand employees to find a Works Committee of two hundred. The small company thus facilitates more direct employee involvement in its running.

The company attempts to achieve some social objectives through the Welfare Fund. This should be distinguished from the example of companies which offer support to educational institutions, local authorities or charities, partly in expectation of some mutual benefit or prestige. (For examples, see Rubner 1965). The expenditure which Landsman's makes outside its normal activities is not designed to attract more custom.

2. Ownership and Distribution of Incomes:

All shares in Landsman's are held by its employees. The management and workforce are not responsible to external shareholders in any way. For the individual, the longer one stays with the company the greater one's shareholding and the greater the amount received as dividend each year. For the workforce as a whole,
annual earnings are higher than those of comparable firms in this industry due to the way in which profits are distributed - partly in shares and partly as bonus wage payment. The profit recorded in the annual accounts is thus nil, and no tax is paid on this.

A key aspect of this type of ownership is the power which the workforce have over the management. Voting power at the Annual General Meeting is determined by shareholding and a unified workforce could easily remove or severely pressurise the existing directorship if it so desired. This situation has never arisen at Landsman's, and it seems unlikely that it will, to judge from the "climate" of the company at present.

3. The Works Committee:

A comparatively high proportion of Landsman's workforce has the opportunity to significantly affect the running of the company through the Works Committee. This body has only two formal powers, management of the Welfare Fund, and a veto on dismissals by management. This latter ability is necessary in keeping with the principle of management being responsible to the workforce. With respect to the running of the company, however, the Works Committee has the power of recommendation, and although many of its recommendations are accepted, this is not obligatory. The scope of matters dealt with is wide and the impact of the Works Committee is certainly substantial, but not dramatic. The size of the company should be noted when considering the success of this body. A similar six-man committee in a larger company may not be capable of truly representing those who elect it, and of exerting comparable influence.
Similarities

1. Management Structure:

Although the organisation chart given does not illustrate the degree of flexibility and overlap between jobs in the company, it does illustrate a conventional management hierarchy, and this is the company's intention. There are at most four levels in this hierarchy (Operator, Foreman, Factory Manager, Managing Director) which are reinforced by wage and status differentials. That these wage differentials are small has already been noted. The fact that the Works Committee often transmits knowledge of problems arising on the shop floor to the Managing Director, rather than those problems coming directly to the attention of the Factory Manager is an indication that status differentials inhibiting normal communication through this hierarchy are in operation. The vast majority of conventional enterprises have this type of problem also, to judge from the quantity of literature produced on the subject. Landsman's management structure, therefore, is not significantly different from that of a conventional company.

2. Job Design:

The shop floor Operators are here employed on craft work. There is no fragmentation of tasks and demarcation problems do not arise. But the split between manual and intellectual work is maintained.

In comparison with most orthodox companies, therefore, the content of jobs in Landsman's is much the same. It is possible to argue that craft work of the type carried out here does not require
"job enrichment" of any kind. But this has a bearing on the control proceedings, particularly the extent to which workers have control over their work situation.

3. Control:

The meaning of the term "democratic control" when applied to Landsman's takes on a comparatively limited aspect in relation to some other ICOM companies using the same term to apply to quite different circumstances. The characteristics of "democratic control" in this company stem more from its size than from its nature as a co-ownership.

CONCLUSIONS

The differences between Landsman's and the companies examined in Chapter 5 are small, the similarities great and more fundamental. Workers at Landsman's are not exploited financially as some might argue of workers in orthodox organisations. The arrangements made to avoid this give the workforce power over their management and a significant say in the manner in which the company is run. The management structure and job content at all levels in the organisation is, however, similar to that of a conventional enterprise. The workforce have no control over the day-to-day operations of the company and the Works Committee, while powerful, has no formal ability to direct the management of the company on any matter other than dismissal.

The definition given to the term "democratic control" must therefore be a relatively limited one in comparison to some ICOM
companies which are controlled, for example, by a general meeting of all employees.

There are certainly other ICOM companies which operate in a manner similar to Landsman's. These companies appear to have adopted common ownership arrangements in full, but only to have adopted partial "workers' control" arrangements. Other companies in ICOM utilise both to the fullest extent. The distinction is crucial because the structure of Landsman's approximates to that of conventional enterprise; the structure of firms like Sunderlandia is radically different. It is therefore apparent that, as an agent of change in our society, the Industrial Common Ownership Movement incorporates at least two points of view as to the direction this change should take - a better form of capitalism, or a form of socialism. The incompatibility of these views is detrimental to the Movement's influence, whichever it decides finally to adopt.

The Case Study which follows is an example of a company which had adopted common ownership (although of a form vastly different to that of Landsman's) and direct workers' control, and further comment upon the variety of practices within the Industrial Common Ownership Movement will be taken up at the end of that section.
CASE STUDY 2: ROWEN ONLLWYN LTD.

(July 1975)

Introduction

Approximately 16 kilometres north of Neath in South Wales, in the Dulais Valley, Rowen Onllwyn operates from two small factories; the metalwork division is at Seven Sisters and about two kilometres further up the valley is the woodwork division at Onllwyn. Both factory buildings were once pithead baths and have been obtained from the National Coal Board at a nominal rent. The company's range of products currently includes outdoor seating and litter bins, metal fencing, and aids for the disabled. There are 10 full time employees and one part time.

Rowen Onllwyn (the name comes from Robert OWEN) is the operating company of Rowen Community (South Wales) Ltd, which acts as a holding company and has charitable status because of its aims which are stated in the Memorandum as follows:

"The object for which the community is established is the training and employment of persons who by reason of physical or mental injuries received in the course of their proper employment are temporarily or permanently incapable of or handicapped in obtaining normal employment with a preference for persons of such description being former employees and mineworkers of the National Coal Board in South Wales,....."

At present, three of the ten employees are ex-miners who suffer from various back and chest complaints.

Since only employees of the operating company, Rowen Onllwyn, can be members of Rowen Community, and since Rowen Community is the holding company (at the moment it only holds one share in Rowen Onllwyn but up to 1000 are available for issue), the firm qualifies
as a common ownership and is a practitioner firm of ICOM.

History*

Rowen Onllwyn has had a particularly troubled history. The firm was established in 1965 with the assistance of Rowen Engineering Ltd. (Glasgow), the South Wales National Union of Mineworkers, the Society of Friends and other benefactors. Rowen Engineering had been founded in Glasgow in 1963 as a self governing enterprise, manufacturing storage heaters. The following extract from the minutes of a general meeting held in Glasgow in June 1966 has been copied into the front of the minute book at Onllwyn and provides an insight, if a somewhat lengthy one, into the ideology of the participants in these ventures:

Factory for Peace: Aims

1. A factory started by donations which is experimenting with industrial democracy, the employees collectively deciding their own wages, profits and all policy matters. The factory intends to experiment with creative working patterns to avoid industrial boredom, etc., and otherwise be concerned with the welfare of the employees.

2. The factory will make no goods directly for war purposes and part of its profits will be used to further the cause of peace possibly by employing peace workers to disseminate own ideas, etc....

3. The factory will assist with the setting up of further factories and other co-operative enterprises, in other parts of Britain, particularly those in unemployment areas.

*The history of Rowen Onllwyn over its first four years of operation, up to 1969, has been described by Roger Hadley (1970), and a large proportion of this account of that period is drawn from his paper.
4. The factory intends to do something about world poverty, by training those in under-developed countries in our various crafts and, by use of our profits, with assistance from "Oxfam", "War on Want" etc., to set up industry in such under-developed countries.

5. The factory intends to be the centre of a community group who will be concerned with social work in the surrounding area. Eventually in conjunction with trained social workers, local authorities, local groups etc., the factory will promote a Peace Action Centre with War on Want groups, classes, youth clubs, adventure playground etc. The concern will also be for integrating children, and old age pensioners, with the rest of the community.

6. The factory, although being assisted by and intending to work with many religious groups, political groups, trade unions etc., has no allegiance to any particular group and is willing to work with all to promote the above objects.

In accordance with the third of these wide-ranging objectives, voluntary agents conducted a search for other suitable ventures. One of these agents, a lecturer in social studies in South Wales, approached and stimulated the interest of the South Wales National Union of Mineworkers whose Secretary supplied invaluable advice and assistance. It was at his suggestion that the factory be located in the Dulais valley, where there had been a large number of pit closures and where a work force could be found among many unemployed, disabled miners. The National Coal Board x-ray returns for 1969-73 claim that 10.2 per cent of all miners have traces of pneumoconiosis on their chests, and that 3.3 per cent have enough to warrant compensation. But South Wales is the worst area in the country, where 23.8 per cent of miners have some form of the disease, 8.2 per cent justifying compensation. (New Society, 1975, Vol. 33, No. 670, p.292.) Surface jobs in the collieries are a common source of employment for disabled miners, but when pits close, alternative work is scarce for those who have no skills outside
mining and who are suffering from some form of disablement. The NUM were also instrumental in obtaining factory buildings from the NCB, and in raising a large part of the firm's initial working capital. Even before an official appeal was launched £1400 had been received from miners' lodges throughout South Wales.

An official appeal was launched in May 1965, and when the first factory manager started work that August, in disused NCB office buildings at Onllwyn, it had reached £3,400, and was eventually to raise nearly £10,000. Rowen Onllwyn operated in complete freedom, but remained legally a part of Rowen Engineering and was to adopt a similar organisation structure. But a product had not yet been chosen, and there were three major constraints on the decision. First, the idea of manufacturing storage heaters was dropped as sales from the Glasgow factory were not satisfactory; second, it was not possible to estimate the final total which the appeal would raise; and third, the workforce, unskilled and disabled, were restricted in the types of tasks which they could perform.

After examining a number of possible products, and even manufacturing (unsuccessfully) jewellery suggested by students from the Swansea College of Art, the factory manager and two disabled miners finally commenced work in October 1965, salvaging scrap metal and machinery from closed pits. This work was often hard, particularly in winter, and the profits from the loads obtained fluctuated dramatically. After ten months of this, it was clear that a more satisfactory product would have to be found if the firm was to survive.

By this time, sales of the storage heaters from Glasgow had
improved significantly and it was proposed that manufacture of these commence in Onllwyn at the end of 1966. A skilled metal worker and another two miners were employed and machinery was obtained on hire purchase. The work force had to be trained from scratch by the factory manager and the metal worker who was now foreman. The Ministry of Technology also assisted by occasionally providing training experts. Hadley (1970) claims that in addition to giving these men new skills, they apparently obtained a "new self confidence" which they lacked on joining the company. This was regarded as an indication of the factory's rehabilitative value.

Orders started arriving in 1967 through the joint sales organisation of the two companies. As sales increased, the work force was expanded to ten and it was proposed that operations be transferred to larger premises in the disused pithead baths at Seven Sisters.

Internal conflict created by this proposal, which was eventually carried out, led to the resignation of the foreman, and a new foreman (the current General Manager) was recruited from Rowen Engineering in Glasgow. He joined the firm just before the move to Seven Sisters in June 1968. At this stage, production was switched to a larger storage heater, and the company began to show a profit.

The flow of orders during 1968 was steady, but this apparently satisfactory progress was interrupted by a series of crises which all but ruined the company. The Rowen Community Newsletter of January 1970 summarises these events:

"Towards the end of 1968, when we were manufacturing night storage heaters, no less than four of our customers went bankrupt while still owing us a total
of £2830. This put us in a difficult position as we were very short of working capital, but when another company with which we were dealing were made bankrupt when two of their directors absconded leaving the company with debts totalling £57,000 of which £4,700 was owing to us, our financial position was impossible."

The newsletter also records the decision of the General Meeting (of all employees) held to decide what action should be taken:

"At this time there were ten employed in Rowen Onllwyn and at an emergency factory meeting we decided to pay off all but two in the hope of saving the company.

This was a very difficult decision for us to make as most of us would find it difficult to find alternative employment."

So, one week before Christmas 1968, all but two of the workers resigned, leaving the manager and one of the workers elected by the others as having the widest range of skills thus giving the firm the best chance of survival. For the next nine months these two men completed work on heaters which had been started, and through sales of these gradually managed to pay off the creditors.

But now the large electrical companies had entered the market for storage heaters at prices lower than those which Rowen could offer and once again the firm had to search for a suitable product. The tide of fortune turned when the furniture firm for which Rowen's manager used to work was taken over and part of the business, making outdoor furniture, was sold to two of the section's former managers. They now had machinery and customers, but neither premises nor work force. Rowen decided to manufacture their designs which would be sold through their sales organisation, Orchard Seating Ltd. based in Wallingford. Additional premises were available in the old pithead baths at Onllwyn which is now the woodwork division, and Rowen's manager had previous experience and
skill in wood machining. Some of the machinery used to produce storage heaters could be used to make the metal frames for the seating and the problem of capital was solved by a gift of £2,300 from Scott Bader, another ICOM practitioner firm which also provided a loan of £11,000 and some financial advice.

Production began again in 1970. The foreman and one of the original disabled miners were brought back but the rest of the staff were new and included a 16 year old welding apprentice, a disabled miner with woodworking experience, and an office manager. An external designer and consultant offered his services free of charge for six months.

No further disasters have struck the company and since 1970 the labour force has increased to 11, other products have been successfully put into production, and Rowen's financial position is a little more secure.

A range of metal fencing is now available, intended for sale mainly to local authorities. Standard designs are available but the factory is capable and willing to produce custom-made orders. A full time sales representative has been employed since November 1974 dealing mainly with this line.

Over the past two years, the company has been working with a young designer who, disabled herself, designs aids for the disabled. Two of her designs are now in production: an aluminium walking frame (which comes in three sizes), and a "bin chair" (which comes in two sizes) for handicapped children. Both of these products were shown on BBC's "Tomorrow's World" programme in June 1975. Two further aids for the disabled are under consideration but are still at the prototype stage: an electrical wheelchair hoist, and a
thermostatically controlled bath plug, the essential component of which is a bimetal strip.

Rowen Onllwyn has made profits over the last two financial years of £800 and £1,400 respectively, but this money had to be used to purchase stocks of materials, particularly for the walking frame and bin chair. Turnover for 1974-75 was £65,000 and the breakeven point for 1975-76 is in the region of £80,000. Actual and estimated breakdown of turnover for last year and for the current year is shown in Figure AI .2.

<table>
<thead>
<tr>
<th></th>
<th>1974-75</th>
<th>1975-76</th>
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</thead>
<tbody>
<tr>
<td>Seating</td>
<td>65-70%</td>
<td>50%</td>
</tr>
<tr>
<td>Fencing</td>
<td>15-20%</td>
<td>50%</td>
</tr>
<tr>
<td>Aids for disabled</td>
<td>15%</td>
<td></td>
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</tbody>
</table>

**Figure AI .2: Rowen Onllwyn, breakdown of turnover for 1974-75 and estimated breakdown of turnover for 1975-76**

There is also the possibility that since the employment of a salesman, sales of seating not involving Orchard Seating may become significant. But the predicted general trend is for the aids for the disabled to account for an increasing proportion of turnover.

These products are sold direct to customers and a few walking frames have been sold to the United States.

**Organisation**

As explained above, the company has a curious two-tier structure which exists on paper but is difficult to detect in practice. Rowen Community (South Wales) Ltd., a registered charity, is a holding company and at present, Rowen Onllwyn is the only operating company. (It is hoped that one day there may be more.)
The Community is controlled by two supervisory bodies, the General Meeting, and an Advisory Council. Since only employees of the operating company can be members of the Community, the General Meeting is simply a General Meeting of all employees.

The Articles of Association make provision for an Advisory Council composed of twelve representatives appointed by local welfare associations. The powers of the Advisory Council are described in the Articles as:

"a) Veto over
1) any action by the members of the company to sell the company for personal gain;
2) the manufacture of products for military purposes;
3) any action to disband the Advisory Council without that body's approval.

b) It may at any time inspect the company records, processes, premises etc..."

When the Advisory Council was originally formed, the bodies represented on it lent their names and influence to the venture. But with no real control over the affairs of the company, its members have lost interest, and there has been no council meeting for the past two years.

Ultimate control of the Community, therefore, lies in the General Meeting of all employees which controls Rowen Onllwyn. This duality of function is illustrated in the following quotation from the Articles of Association of Rowen Onllwyn regarding employment and dismissal:

"All officers and employees (including Directors, Managers and Executives) shall be appointed, employed, discharged or removed only after approval by a Special Resolution of the Rowen Community (South Wales) Limited."
The Articles make provision for a two-tier representative arrangement comprising Department Committees and a General Council, the latter being composed of members elected by Department Committees and by the Directors. These provisions foresaw a much larger company, where control by General Meeting would be impractical, but since the company intends to remain small, it appears that these provisions will never be invoked.

The organisation chart is given in Figure AI.3, more as a point of reference than as an accurate reflection of reality, as later discussion will illustrate.

Figure AI.3: Rowen Onllwyn, organization chart.
The "factory manager" at Onllwyn and one of the operators at Seven Sisters are Directors. They are elected by the Community and hold office for one year when they are eligible for re-election. They perform few functions as Directors, only signing their names to documents to conform with legal requirements. Neither do they receive any remuneration, although they are reimbursed for expenses incurred carrying out company business.

There is no Board of Directors. All members of the company are entitled to attend and vote at General Meetings which are held every two weeks. These General Meetings literally control all aspects of the organisation from the most trivial to the most important. Meetings are held during working hours and the Minute Book records almost 100 per cent attendance. It is most unusual for more than one person to be absent. Hadley (1970) gives the following description:

"All major decisions such as changes in production, wage rates, and the recruitment of new workers, are taken by meetings of all members. The meetings usually take place in tea breaks or over lunch. The Chairmanship is rotated amongst the members, a different person holding the office each month." (p8).

Finance

The company's capital is all in the form of loans. Some have no burden of interest, the interest rate on one major loan, from Scott Bader, is tied to the minimum lending rate (the bank rate). Each Rowen employee holds one share in the company, costing one pound which is purchased at the end of three months' employment. Should an employee leave the company his share is immediately bought back. Rowen Community currently holds one such share. Possession of a share entitles the holder to a vote at General
Meetings, but this right can be granted before then at the consent of the other members, depending on the individual concerned.

Working Conditions

Wage rates, as with all other terms and conditions of employment at Rowen’s, are determined at General Meetings. Factory hours are 8.00 a.m. to 4.30 p.m.; there is a basic wage for all employees over 18, the Foreman and Manager (Oxllwyn) receive basic plus 10 per cent and the General Manager’s wage is negotiable. The workers felt that the position of General Manager involved more work and responsibility and thus merited higher pay. The current overall relative differential is, however, only 1.6.

One of the operators at Seven Sisters is a fully trained welder and receives the same pay as the Foreman. The Sales Representative receives the same basic wage as the others plus £5 a week for expenses. There is no overtime pay, time off is allowed in lieu.

It was at one time considered to give a wage increment for each dependent child, but this suggestion was dropped as it appeared that some members would benefit disproportionately to others.

Sick pay is allowed for up to three days without a certificate, and for up to six weeks with a certificate.

Holidays with full pay are granted after one year’s employment. Rowen employees can use the pension scheme operated by Scott Bader. It is contributory and transferrable and each employee must request to be included; at present only the Foreman and Manager are members.

Hadley (1970) concluded that:

"It could hardly be claimed, therefore, that the workers at Rowen have been self-indulgent in the conditions"
They may, however, be indulgent in breaking these regulations in special cases, where a strict interpretation would lead to unusual hardship. For example, one employee who has been with the company only two months was given full holiday pay without which he and his family would have been in some difficulty.

Production Process

Production is divided between the two factories: the metalwork division at Seven Sisters makes the metal framework for the seating, fencing, litter bins, and the walking frame. The woodwork division at Callwyn makes the wooden slats for the seats and bins, and the bin chair which has just gone into production.

Metalwork Division, Seven Sisters:

Orders for seating and litter bins come mainly through Orchard Seating, although the Sales Representative has obtained orders independently. Regardless of source, Rowen receives a commission from Orchard Seating on all completed orders. Orders for fencing are obtained through the Sales Representative, and the aids for the disabled are displayed when possible at exhibitions, and are sold direct to customers.

The designs for the seating belong to Orchard Seating, but the fencing designs have been done mainly by the General Manager who trained as a sheet metal worker in Glasgow.

The company will consider making any product in wood or steel, and recent "specials" have included a cradle for oil drums, seating for a swimming pool, and pedestrian guard rails.
There is no formalised production scheduling procedure in the Seven Sisters factory. The General Manager informs the Foreman and the others of what orders are required. At present, orders begin almost as soon as they are received, but the factory has been loaded up to one month in advance. The General Manager is responsible for costing and quoting approximate delivery times.

At Seven Sisters the metal framework for the seating and litter bins is made by a fairly simple production process. The frames are welded together from sheet metal which has been cut to size, drilled and pressed to the required shape. A similar process is necessary for the fencing. If required, painting or red oxide coating is carried out here, but normally the seat frames are sent to a firm in Monmouth, Plastic Coatings Ltd., where a weatherproof finish is applied. (This firm collects the frames from Seven Sisters, takes them for coating and delivers them when ready to the Woodwork Division at Onllwyn, thus giving Rowen free transport of their frames between the two factories.)

Some local authority orders also require site work - erection and painting - but this is unusual.

The walking frame is constructed from aluminium tube which is given its shape on a wooden former and is then welded together. The frame also is sent for coating and is delivered back to Onllwyn for despatch.

Woodwork Division, Onllwyn:

The actual seats, and the finish on the litter bins, are made from African Teak (Iroko) which is bolted to the completed frames. Production of the "bin chair" is also just commencing at Onllwyn.
Here, a Works Order is made out for each job indicating product specifications and order quantity, customer and due date if applicable. These are kept clipped to their respective product "progress boards" in a small general purpose room off the main floor. Work is carried out on the various different products in rotation, except when an order with an early due date demands priority. When there are no orders, they produce for stock.

Making the seating slats is also a relatively simple process: the wood cut to the required length, drilled, sanded to give it its smooth edges, and dipped in "Cuprinol", a protective coating. Timber is now bought, cut to approximately the length required, and with machined edges. Originally, the wood was simply machined from the log, but the heavy work involved in this proved too much for the men. It is cheaper to purchase pre-machined slats, given the labour saving which this allows.

Packaging and despatch of most orders is done at Onllwyn. The seating is usually sent broken down, as assembly requires only a spanner. Transport may be by various modes: commercial carriers are frequently used, but a local firm with a lorry gives assistance on occasion and if a number of orders can be delivered on one round trip, a large van is hired and somebody from the factory (this may be the General Manager) does the deliveries.

Control

In his account of the company, Hadley claims that:

"Rowen provides an interesting example of the modifying effect of the system of ownership and control on the organisation of work."
He was referring to the lack of task fragmentation and demarcation found in "conventional" companies.

"At Rowen, in contrast, it has been taken for granted that a man should learn all he can learn about as many work processes as possible." (Hadley, 1970).

Description of the control of the company is, therefore, affected by the fact that the manager here is a "co-ordinator", not a "boss"; Hadley quoted the General Manager at the time describing his job as being to

"...represent the company to the outsider and bring together all the relevant information, details and statistics necessary for the management committees to make their decisions." (Hadley, 1970).

The following account of the control of the company thus differs markedly not only from the three conventional units described, but also from Landsman's which, as discussed above, approximates more to the conventional approach. The reason for not dividing some of the analyses of control factors into the four stages of measurement, comparison, decide, and take action, will become apparent as the description proceeds. The following applies to both factories, except where indicated.

**ROUTINE CONTROL**

**Factor: Hours of Work**

If an employee is late or absent on a particular day, no action is taken. There are no time clocks or time sheets to record number of hours worked. Normal factory hours are 8.00 a.m. to 4.30 p.m. The situation is described by the Manager at Onllwyn, who said:
"It's just give and take. If timber comes in at half past four, we just unload it; if you want to go to the dentist, you go to the dentist."

This attitude is not, however, one of total laissez-faire. Two of the men in the woodwork division had been consistently taking advantage of this arrangement; and after they had taken time off to go to a football match while the entire factory was working overtime to complete an important order, they were dismissed following the decision of a General Meeting of all employees.

**Factor: Quality of Material Used**

No formal quality check is made on incoming raw materials. The workers detect and set aside defective items as they are encountered in the course of the production process. Wherever possible, these materials are automatically returned to the suppliers for credit, and are generally despatched from Onllwyn.

**Factor: Recruitment and Selection**

Due to the nature of the local community, potential recruits are generally known to someone in the factory. The Foreman and Manager (Onllwyn) usually make the final decision, but this will depend on the individual concerned.

**Factor: Output Measurement**

The General Manager records monthly production figures based on records of goods despatched.
Comparison

The General Manager compares these figures with the number of man-hours worked per month. Originally, timings were taken for work on standard items and these provide a rough indication of the factory's productivity. If the General Manager feels that output is low, he will raise the issue at the next General Meeting.

Decide Action

The General Meeting discusses and decides what action to take, based on the General Manager's opinion and recommendation.

Take Action

The employees themselves carry out any action decided upon by the General Meeting. This may be, for example, to work overtime, or to take shorter tea-breaks.

Factor: Order Throughput Time

The Secretary at Seven Sisters keeps a record of when orders were received and when they were despatched. There is no record of man-hours spent on each job. If an order is running late, everyone is told about it, usually by the General Manager, and everyone is responsible for doing what they can to improve the situation.

Factor: Operator Efficiency, Seven Sisters

The comparison of production figures with man-hours per month (Factor: Output, above) provides a check on the efficiency of the factory in general. It is not part of the Foreman's job to supervise the work of the other employees. If a particular employee is not performing satisfactorily, the other employees
will tell him. Employees can only be dismissed by the decision of a General Meeting of all employees.

Factor: Operator Efficiency, Onllwyn

The only difference between the two factories is that here, the employees perform a "batch check" on their work, usually about twice a year. They time themselves over a particular production target, say on sanding 100 slats, or packing 50 seats. Each worker does this check himself and additional checks may be run for new products, a recent example being litter bins. This information is also used by the General Manager for costing purposes.

Factor: Machine Maintenance

When machinery breaks down, the employees, including the General Manager, attempt to repair it themselves. If this cannot be done, the General Manager is responsible for contacting some company which can effect the repair.

Factor: Methods of work

The tasks involved and the sequence in which they must be performed are almost completely determined by the technology of the production process. An exception is in packaging goods for despatch; although the one operator at Onllwyn, a disabled miner, has only been with the company for two months, he devised a quicker and easier method of packing the slats which is just as effective as the previous slower way. Thus, given the constraints of the production technology, no additional constraints are placed upon the workers as to the manner in which tasks are performed.
Factor: Product Quality

The men inspect the quality of their own work and discuss any problems with each other. The closest approximation to a formal inspection occurs when the products are being finally packed for despatch. Faulty items are often detected at this stage, faulty metal-work being returned to Seven Sisters. Any problems arising from this procedure are generally resolved by the Foreman and the Manager (Onllwyn).

Sometimes workers are transferred for a short period from Seven Sisters to assist with the work at Onllwyn. Their work is given a thorough inspection, shared by the two employees there. (See Factor: Scrap Quantities, below).

Factor: Scrap Quantity

The quantities of scrap produced in both factories is said to be insignificant and no attempt is made to record the actual amounts. The Manager (Onllwyn), for example, estimates that normally two per cent of slats are finally rejected, including those originally received spoiled from the timber merchant. (When the woodwork division is overloaded and metalworkers come to their assistance, the rejection rate rises to an estimated 10 per cent.)

When costing, the General Manager makes a 15 per cent scrap allowance which he feels is more than adequate.

Factor: Task Allocation Within Divisions

The employees, including the Foreman and Manager (Onllwyn) arrange this amongst themselves in their respective factories.
Job rotation is also affected by mutual agreement.

Factor: Task Allocation Between Divisions

Operators move frequently from Seven Sisters to the woodwork division, but only rarely in the opposite direction. When the employees at Onllwyn realise that they are overloaded, the Manager telephones either the Foreman or General Manager at Seven Sisters and asks if assistance can be granted. Again, the operators themselves decide who is to go, depending on their own work load at the time.

Factor: Material Costs

This factor is currently dealt with exclusively by the General Manager, who is responsible for re-ordering raw materials and for selecting suppliers.

Factor: Labour Costs

The Secretary maintains a file, which is open to all, of expenditure on wages. Alterations to wage rates are made only at General Meetings, based on information concerning the financial position compiled by the firm's accountants and the General Manager. This is, therefore, a Planning decision.

Factor: Other Costs

Again, the General Manager is responsible for monitoring overheads, and should any item of expenditure reach an unsatisfactory level, the General Meeting will be informed and appropriate action decided there.
Factor: Layout

The workers themselves determine the optimum positioning of machinery and tools.

Factor: Raw Materials Stocks

The Foreman and Manager inform the General Manager of materials shortages. The latter is responsible for contacting and selecting suppliers and obtaining the required material. There is no storeman and the workers do not make records of material usage.

Note: It is the General Manager's intention to increase the involvement of the Foreman and operators in production control decisions such as ordering material supplies, and production scheduling when necessary. He believes, however, that this process will take some time, as the men are reluctant to accept such responsibilities immediately. The margins of error which can be allowed are still small. Production does not continue at a steady rate thus preventing the establishment of a regular materials re-order pattern. Storage space is limited, but a more serious drawback to purchasing in bulk and obtaining discounts is a financial one. Decisions in these areas are left at present, therefore, in the hands of the General Manager.

PLANNING AND PRIMARY DECISIONS

All planning decisions and primary decisions are made by General Meetings of all employees which are held once every two weeks.
Examples of Planning Decisions:

A General Meeting may determine

a) factory layout;
b) basic wage rates, and extras;
c) the General Manager's salary;
d) factory working hours;
e) the amount of overtime worked;
f) changes in work methods where possible;
g) distribution of workers between and within factories.

Examples of Primary Decisions:

A General Meeting may determine

a) whether or not to begin manufacture of a new product.
   It was recently decided to manufacture the walking frame for home and export markets. The decision made in 1968 to switch production to a different type of storage heater created a conflict which resulted in the resignation of the foreman.

b) whether or not to relocate the factory. Production was moved from Onllwyn to Seven Sisters in 1968 (additional premises were later obtained in Onllwyn) and the controversy surrounding this decision was a contributory factor to the resignation of the foreman, mentioned above.

c) whether or not to expand or contract the labour force. The events of December 1968, when all but two of the employees voluntarily resigned, have already been described. At a General Meeting in November 1974, it was decided to employ a full time sales representative.
It is now well established that ownership and control in conventional private industry are the province of separate groups of people. Company ownership lies with the shareholders, but it is the management body that controls the company. Although the management are employees of the company, the degree of shareholder control to which they are subjected is very limited. Shareholders have become one of a number of interest groups that management has to consider in directing the operations of the company. Management now generally recognises a number of other areas of responsibility - to consumers, to society as a whole, and to employees. These various groupings may thus frequently compete for the outcome of the management decision making process that is most favourable to their several interests.

In common ownership companies, the owners are by definition the employees of the company as a whole. But control of the common ownership company is not necessarily carried out by the employees as a whole, although this is one possible arrangement. Control of Landsman's (Case Study 1 of this Appendix) is carried out by a conventional managerial hierarchy at the routine control, planning and primary decision making levels. The rest of the workforce may obtain a say in the company's control through the Works Committee and the Annual General Meeting. Control of Rowen Onllwyn (Case Study 2 of this Appendix) is conducted by a general meeting of all employees. So to use the term "workers' control" to apply to the arrangements in both of these companies is grossly misleading.

Where workers have a significant stake in the ownership of the company in which they work, this may strengthen the legitimacy of any
claim they may make to a stake in the control of the company as well. Worker ownership thus facilitates workers' control. In these circumstances, two of the interest groups that the conventional company must cater for - shareholders and employees - have become one group. While this may make workers' control easier to achieve, it is clearly not inevitable that it will be achieved. The separation of ownership and control that is a feature of conventional enterprise can arise in the common ownership company as well. Landsman's is but one example.

The literature of the Industrial Common Ownership Movement appears to use the terms ownership and control synonymously, as if assuming that worker ownership inevitably means worker control. The ownership and control arrangements of Landsman's demonstrate that this assumption is false. Worker ownership may create a basis for changing the traditional relationships between management and workers and for progressing towards complete worker control (as, for example, in Rowen Onllwyn). But this is only a beginning.

The terms that we use at present to describe different forms of organising work do not seem adequate to the task. Phrases like "worker participation", "industrial democracy", "workers control" and even "job enrichment" are each used with a multitude of different meanings by different writers. In order to study the new forms of work organisation that are developing in our society, we must develop a vocabulary that can cope with the complexity and variety of these phenomena. Eskimos, it is claimed, use about thirty different names for "snow" because it is important for them to be able to make such fine distinctions in coping with the environment in which they live. It seems that we should attempt to achieve a similar level of sophistication in our discussions of work organisation.
APPENDIX II:

PRODUCTION SYSTEM SIMULATION GAME

DESIGN, RUNNING PROCEDURE AND

RESULTS.
APPENDIX II - CONTENTS

This Appendix is divided into the following eight Sections:

Section 1: Products, Equipment and Layout.
Section 2: Standard Design; Job Descriptions.
Section 3: Experimental Design; Group Working - Description.
Section 4: The Procedure for Running the Games.
Section 5: The Opinion Questionnaire Results.
Section 6: Group Performance Measures - Results.
Section 7: The Tutorial Feedback Questionnaire Results:
    Introduction
    Content Analysis: Procedure
    Content Analysis: Results
    Discussion
Section 8: Evaluation of This Simulation Game as a Teaching Device.
Appendix II, Section 1: Products, Equipment and Layout.

Product Specifications:

The products manufactured in this simulation game are table mats which can have the following characteristics:

Sizes

<table>
<thead>
<tr>
<th>Sizes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8 cm x 8 cm</td>
<td></td>
</tr>
<tr>
<td>15 &quot; x 15 &quot;</td>
<td></td>
</tr>
<tr>
<td>15 &quot; x 20 &quot;</td>
<td></td>
</tr>
<tr>
<td>15 &quot; x 18 &quot;</td>
<td></td>
</tr>
<tr>
<td>20 &quot; x 20 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Patterns

<table>
<thead>
<tr>
<th>Patterns</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Blank</td>
<td></td>
</tr>
<tr>
<td>Diagonal</td>
<td></td>
</tr>
<tr>
<td>Hatched</td>
<td></td>
</tr>
<tr>
<td>Diamond</td>
<td></td>
</tr>
<tr>
<td>Jack</td>
<td></td>
</tr>
</tbody>
</table>

Shapes

A mat may have its corners removed, producing an octagonal rather than a square or rectangular shape.

Combinations

Mats need not have both surface and base, and there are some orders in the game for mats made with either surface or base material only. There are, therefore, three possible combinations of materials:

- surface only,
- base only,
- surface and base.

These combinations, together with the Pattern specification,
determine the routing which an order will take through the factory; thus with 5 sizes, 5 patterns, 2 shapes and 3 combinations, 150 different mats can be made. (See Appendix III, Section 2, p. for the complete set of orders actually used in the games.)

Equipment:

Both versions of the game use the same equipment. This equipment is issued to the standard group participants in the following way:

Controller: pencil, sharpener, rubber.
Foreman: pencil.
Storeman/Progressor: pencil.
Surface Operator: scissors, 3 fold-back clips, foot rule, pencil.
Pattern Operator: felt tip pen, foot rule, paper towel.
Base Operator: scissors, 3 fold-back clips, foot rule, pencil, stapler.

Layout:

As the games were run in a number of different rooms, it was not possible to standardise the factory layout. Two basic layouts were used, illustrated here with standard design job titles. Experimental group members could personally move from position to position, but were not permitted to change the locations of the production activities or the stores area.
Basic Layouts Used for the Games

Umpire  Controller

Surface

Base

Stores

Pattern

Umpire  Controller

Stores

Surface

Base

Pattern
Appendix II, Section 2: Standard Design; Job Descriptions.

Each of the six members of the standard design groups is issued with one of the following six Job Descriptions:

Job Description - Controller
Job Description - Foreman
Job Description - Storeman/Progressor
Job Description - Surface Operator
Job Description - Base Operator
Job Description - Pattern Operator
JOB DESCRIPTION - CONTROLLER

Job Objectives

To quote for jobs and to plan and control the load on the works so that:

1. all operators have work at all times; and
2. all jobs are delivered by the quoted time.

Quoting for Job and Issuing it to Works

When a job is offered, quote a due time (a planned delivery time) or decline to quote. If you do not quote within two minutes, or if your quoted due time is too large, the job will be withdrawn. The LOAD PLANNING CHART and the JOB CARD may help you give a realistic quote.

If successful, add the job to the LOAD PLANNING CHART and the JOB PROGRESS SHEET, using the details given on the JOB CARD.

Call the Storeman/Progressor to remove the JOB CARD.

Scheduling Departments

As often as you think necessary, call the Foreman and update his JOB PRIORITY LIST for the different activities. You should list job numbers to indicate the order in which jobs should be done for each activity. You may alter your previous list or simply add new job numbers to it. The LOAD PLANNING CHART should assist you in deciding on the priority listing. Frequent updating is recommended.

Updating Works Information

As often as you think necessary, call the Storeman/Progressor and, from his JOB MOVEMENT CARD, update your JOB PROGRESS CARD. Frequent updating is recommended.

As a consequence of this information, you may wish to reorganise your LOAD PLANNING CHART and to adjust the current JOB PRIORITY LIST.

Moving Operators

The Foreman or the Storeman/Progressor may recommend the transfer of an operator (or operators), or you may consider it necessary anyway. Should you decide to move an operator (or operators), complete and sign the Foreman's OPERATOR TRANSFER SHEET which instructs the Foreman to make the change.

If /
If it is the Storeman/Proressor who has made the request, consult the Foreman before making your decision.

As a consequence of any change, you may wish to reorganise your LOAD PLANNING CHART and adjust the current JOB PRIORITY LIST.

Arbitration

In the event of any dispute between personnel, your decision is final.

Problems

If you have any problems concerning the Game rules, ask the Umpire.
Job Objectives

To ensure that all operators have sufficient work and do their work efficiently.

Controller's Call

This takes priority over all other activities. You may complete your current activity before going to him, but must start no other.

Giving Work to Operators

Whenever the Controller wishes he will call you to update your JOB PRIORITY LIST.

When an Operator completes his current job, instruct him as to which job he is to begin, selecting from the jobs available the job with the highest priority on the JOB PRIORITY LIST.

If none of the available jobs is on the JOB PRIORITY LIST, instruct him to begin the job that you consider the best.

If no job is available, check to see if one will be available soon. If not, consult the Controller. You may suggest that the Operator be moved elsewhere.

Controlling Operator Performance

Ensure that the Operator has filled in his OPERATOR WORK RECORD correctly when he has finished a job. Do this before giving him the next job.

By looking at the OPERATOR WORK RECORDS and either the Controller's JOB PROGRESS SHEET or JOB CARDS (the latter two for standard times) you will be able to fill in your PERFORMANCE ANALYSIS SHEET. Try to keep these up to date.

You may find from this that an Operator is consistently failing to achieve standard performance. You may also notice from the EXCESS MATERIAL REQUISITION that an Operator is making mistakes. Consequently, you may wish to encourage him to improve, or to swap him with another Operator in the hope that he will be better at another activity. If you wish to make a transfer, ask the Controller.

The Storeman/Progressor may ask the Controller to move an Operator. The Controller will ask for your opinion before making a decision.

If /
If no work is available, check that no job has been completed at another activity and is available for this activity. If one such is available, ask the Storeman/Propressor to transfer it. If not, consult the Controller; you may wish to suggest that the idle Operator be transferred elsewhere.

If the Controller decides to move an Operator (or Operators) he will complete your OPERATOR TRANSFER SHEET. Using this, instruct the Operator (or Operators) concerned to move as required.

**Excess Material Requisition**

If an Operator makes an error in his work and consequently requires fresh material, he will call you. Fill in the EXCESS MATERIAL REQUISITION and give it to the Storeman/Propressor - he will return it to you as soon as he has delivered the required materials.

If the error has been made in such a way that the excess material must pass through another activity (e.g. if a mistake in Patterning means that some mats are scrapped so that Surfaces must be cut) then give the Storeman/Propressor all job material (including scrap) and the JOB CARD.

Ensure that the Operator is not likely to make the same error again.

**Problems**

If you have any problems about the Game rules, ask the Controller.
Job Description

Job Objectives

To issue material as economically as possible and ensure the minimum amount of material is wasted.

To ensure that the jobs move through the works as smoothly as possible and to keep the Controller informed about the movement of jobs.

Controller's Call

This takes priority over all other activities. You may complete your current activity but should start no other.

Progressing Jobs and Issuing Material

Only one job (material and JOB CARD) can be carried at a time.

From time to time, the Controller will call you to give you a JOB CARD. Take this and draw the necessary material (specified on the JOB CARD) from the Stores, filling in the STOCK WITHDRAWAL SHEET. Specify the number of complete sheets issued.

Take the material and the JOB CARD to the first activity specified on the JOB CARD and leave it at that activity with any other waiting unstarted jobs.

When you have time, transfer any job that you see has been completed at an activity to the next activity specified, leaving it with any other waiting unstarted jobs. If material is required for that activity, collect that from the Stores, filling in the number of complete sheets drawn on the STOCK WITHDRAWAL SHEET on the way.

If no activity is specified (i.e. if the job is finished), deliver it to the Umpire.

Record each transfer on your JOB MOVEMENT CARD, writing either both activities (if transferring from one to another) or the activity and "DELIVERED" (if transferring from the activity to the Umpire).

If the Foreman asks you to move a particular job, this transfer takes priority over other possible transfers. You may, however, complete your current activity.

Excess Material Requisition

The Foreman may call you to give you the EXCESS MATERIAL REQUISITION.
REQUISITION. This call takes priority over other activities (apart from the Controller's call) though you may conclude your current activity first.

Take the EXCESS MATERIAL REQUISITION to the Stores and draw sufficient material, filling in the STOCK WITHDRAWAL SHEET (specifying the number of complete sheets drawn). Return this material to the activity given and the EXCESS MATERIAL REQUISITION to the Foreman.

The Foreman may in addition give you the JOB CARD and material for the job; (he will do this when the job must be taken to another activity). Take these, together with the fresh material drawn from stock, to the activity specified. Fill in the JOB MOVEMENT CARD.

Stock Control and Scrap

It is sometimes possible that the scrap material left after cutting certain jobs can be used for other jobs. This saves issuing as much stock as is indicated on the JOB CARD. Therefore, collect all scrap from the activities and return it to the Stores. Throw into the bin anything that you consider unusable (either because it is too small or because it is torn or marked), but keep the rest. Scrap should be collected from activities as often as possible. It is recommended that it should be removed from an activity at the same time as the job, and taken to the Stores while moving the job.

When drawing stock, by referring to the JOB CARD or the EXCESS MATERIAL REQUISITION, use whatever scrap you can rather than complete sheets of material. In completing the STOCK WITHDRAWAL SHEET, fill in only the number of complete sheets drawn, even if it is zero.

Operator Transfer

If you consider that an Operator is making too many mistakes leading to the drawing of excess material and that he should be moved from his present activity, tell the Controller.

Problems

If you have any problems about the Game rules, ask the Controller.
Job Objectives

To work efficiently.

Starting and Finishing a Job

Do not start any job unless told to by the Foreman.

When you start a job and when you finish it fill in your OPERATOR WORK RECORD.

Transfer to another Activity

Do not move to another activity unless told to do so by the Foreman.

When told by the Foreman to move, take your OPERATOR WORK RECORD, but do not take any equipment (e.g. your ruler).

Performance

If you make a mistake so that a mat (or mats) is out of tolerance, call the Foreman.

If the Foreman tells you that you are not performing well enough, explain your difficulties.

Method of Work (Cutting)

Draw the mat outline for the job at the correct size and shape (given on the JOB CARD) on one sheet of paper. It may be possible to draw more than one mat on the sheet. It is possible to tell how many mats you should get from one sheet by dividing the number of sheets by the number of mats required.

No punched holes should appear on a completed mat and the outline must be drawn to ensure this.

If there is more than one sheet, use bulldog clips to clamp all the sheets together with the marked sheet on top, marked surface uppermost.

Cut along the outline, rearranging the bulldog clips as necessary.

After cutting out the mats, it may be necessary to trim them. It is important to keep within tolerance (± 2mm.), however, or it may be necessary to cut out a fresh mat or mats.
Method of Work (Corner Cutting)

Draw the outline to be cut, given on the JOB CARD, on one mat.

Clamp the mats together using bulldog clips, marked mat on top, markings uppermost.

Cut along the outline.

Trim the mats as necessary. It is important to keep within tolerance, however.

Problems

If you have a problem about the Game rules, ask the Foreman.
JOB DESCRIPTION – BASE OPERATOR

Job Objectives

To work efficiently.

Starting and Finishing a Job

Do not start any job unless told to do so by the Foreman.

When you start a job and when you finish it fill in your OPERATOR WORK RECORD.

Transfer to another Activity

Do not move to another activity unless told to do so by the Foreman.

When told by the Foreman to move, take your OPERATOR WORK RECORD, but do not take any equipment (e.g. your ruler).

Performance

If you make a mistake so that a mat (or mats) is out of tolerance, call the Foreman.

If the Foreman tells you that you are not performing well enough, explain your difficulties.

Method of Work (Cutting)

Draw the mat outline for the job at the correct size and shape (given on the JOB CARD) on one sheet of paper. It may be possible to draw more than one mat on the sheet. It is possible to tell how many mats you should get from one sheet by dividing the number of sheets by the number of mats required.

If there is more than one sheet, use bulldog clips to clamp all the sheets together with the marked sheet on top, marked surface uppermost.

Cut along the outline, rearranging the bulldog clips as necessary.

After cutting out the mats it may be necessary to trim them. It is important to keep within tolerance (± 2 mm.) however, or it may be necessary to cut out a fresh mat or mats.

Method /
Method of Work (Stapling)

Take the surface and base and staple them together, positioning the staples as shown on the JOB CARD. If the surface has a pattern, ensure that it is uppermost.

It may be necessary to trim to match surface and base. Beware, however, of going out of tolerance (± 2 mm.) because a mistake may make it necessary to produce a fresh mat.

Repeat for all pairs of surface and base.

Problems

If you have a problem about the Game rules, ask the Foreman.
Job Objectives

To work efficiently.

Starting and Finishing a Job

Do not start any job unless told to by the Foreman.

When you start a job and when you finish it fill in your OPERATOR WORK RECORD.

Transfer to another Activity

Do not move to another activity unless told to do so by the Foreman.

When told by the Foreman to move, take your OPERATOR WORK RECORD, but do not take any equipment (e.g. your ruler).

Performance

If you make a mistake so that a mat (or mats) is out of tolerance, call the Foreman.

If the Foreman tells you that you are not performing well enough, explain your difficulties.

Method of Work

Copy the pattern shown on the JOB CARD onto each sheet using the felt tip pen. Be as neat and as accurate as possible (tolerance: ±2 mm.) as a mistake may make it necessary to cut out a fresh mat or mats.

Problems

If you have a problem about the Game rules, ask the Foreman.
Appendix II, Section 3: Experimental Design; Group Working - Description.

Each experimental design group member is given a copy of this Group Working - Description.

GROUP WORKING - DESCRIPTION

The Group's Objectives
To make the most efficient use of the group's members.
To ensure that all jobs are delivered by the quoted time.
To use material as economically as possible.

Quoting for Jobs

When the Umpire offers a job, the group must quote a due time (a planned delivery time) or decline to quote. If the group does not quote within two minutes, or if the quoted due time is too large, the job will be withdrawn.

To simplify the calculation of the due time, a JOB QUOTATION SHEET is used - the Umpire will explain how to use this before you start.

If the quote is successful and you receive the job, enter it on the LOAD PLANNING CHART for each activity.

Task Allocation

The various tasks involved in maintaining production and keeping correct records can be allocated to group members in any way that you, as a group, decide is best.

The suggested initial allocation (see below) is only a recommended allocation to help you get to know the game. You can alter this task allocation as often as you like and at any time during the game.

Note: Group members may move around freely, but the EQUIPMENT FOR EACH ACTIVITY CANNOT BE MOVED TO ANOTHER ACTIVITY.

Starting and Finishing Jobs

If you are working at a specific activity, you must plan your own work load using the LOAD PLANNING CHART. If you move to
another Activity, the LOAD PLANNING CHART there will again help you decide which jobs to tackle first.

There may, of course, be more than one person at an Activity, and in this case you must decide on your work load together.

When you have finished working on a job, remember to fill in the ACTIVITY WORK RECORD. If two group members work on the same job each member's work must be filled in on this form.

Obtaining Materials

Your group must make its own arrangements for withdrawing material from stores for each job. The person or persons responsible must fill in the STOCK WITHDRAWAL SHEET each time material is taken out. No more than the amount indicated on the JOB CARD can be withdrawn.

If something goes wrong with a job and more material is required, the EXCESS MATERIAL REQUISITION must be filled in.

Both these forms will be situated permanently in the Stores area.

Scrap Usage

It is sometimes possible that the scrap material left after cutting certain jobs can be used for other jobs. The group members at each activity are responsible for the best use of the scrap material produced.

Methods of Work

Each Activity will be provided with a "Methods Sheet" which gives suggestions as to the best way of performing these tasks. Group members are free to experiment with other methods which may be quicker, or produce better quality tablemats.

Moving Jobs from Activity to Activity

The group must decide on the best way of doing this. (You may have the person who finishes the job move it, or have one person just moving jobs around, and so on.) Only one job can be carried by this person at a time.

Delivery

The group must decide how completed jobs are to be delivered to the Umpire. Only one job can be delivered by a person at a time. Remember to fill in the JOB QUOTATION SHEET on each delivery.

Problems

If problems arise in the course of the game, the group as a whole must determine the best solution. If a problem arises with
the game rules, and if the group is unable to supply a satisfactory solution, it may ask the Umpire.

**SUGGESTED INITIAL ALLOCATION**

To start the game, it is suggested that the group be organised as follows:

1 member at Pattern Activity  
2 members at Surface Activity  
2 members at Base Activity  
1 member obtaining material and moving jobs around.

Improvements on this may become apparent as the game proceeds, e.g. the last member mentioned above may find himself under- or over-worked.

To explain how the mats are to be made, a "METHODS SHEET" is taped to the bench for each activity, explaining how that activity is to be carried out:

**METHODS SHEET - SURFACE**

**Cutting:** Draw the mat outline for the job at the correct size and shape (given on the JOB CARD) on one sheet of paper. It may be possible to draw more than one mat on the sheet. It is possible to tell how many mats you should get from one sheet by dividing the number of sheets by the number of mats required.

No punched holes should appear on a completed mat and the outline must be drawn to ensure this.

If there is more than one sheet, use bulldog clips to clamp all the sheets together with the marked sheet on top, marked surface uppermost. Cut along the outline, rearranging the bulldog clips as necessary. After cutting out the mats, it may be necessary to trim them. It is important to keep within tolerance (+ or - 2 mm.), however, or it may be necessary to cut out a fresh mat or mats.

**Corner Cutting:** Draw the outline to be cut, given on the JOB CARD, on one mat.

Clamp the mats together using bulldog clips, marked mat on top, markings uppermost.

Cut along the outline.

Trim the mats as necessary. It is important to keep within tolerance, however.
METHODS SHEET - PATTERN

Copy the pattern shown on the JOB CARD on to each mat using the felt tip pen. Patterning is a rather messy activity and paper is provided to keep the ruler clean.

Be as neat and as accurate as possible (tolerance: ± 2 mm.) as a mistake may make it necessary to cut out a fresh mat or mats.

METHODS SHEET - BASE

Cutting: Draw the mat outline for the job at the correct size and shape (given on the JOB CARD) on one sheet of paper. It may be possible to draw more than one mat on the sheet. It is possible to tell how many mats you should get from one sheet by dividing the number of sheets by the number of mats required.

If there is more than one sheet, use bulldog clips to clamp all the sheets together with the marked sheet on top, marked surface uppermost.

Cut along the outline, rearranging the bulldog clips as necessary.

After cutting out the mats it may be necessary to trim them. It is important to keep within tolerance (± 2 mm.) however, or it may be necessary to cut out a fresh mat or mats.

Stapling: Take the surface and base and staple them together, positioning the staples as shown on the JOB CARD. If the surface has a pattern, make sure that it is uppermost.

It may be necessary to trim to match surface and base. Beware, however, of going out of tolerance (± 2 mm.) because a mistake may make it necessary to produce a fresh mat.

Repeat for all pairs of surface and base.

At the end of the "Group Working - Description", there is a section entitled "Suggested Initial Allocation" which was included once the induction and training problems were realised. This allocation was not, of course, obligatory and groups reacted to it in different ways.
Appendix II, Section 4: The Procedure for Running the Games.

The running of these games took place in three phases - introduction, running, and feedback.

Phase 1: Introduction

During the week previous to the running of the game, Dr. Evans gave each class an introductory lecture on production management, during which the game was presented and described as an approximate simulation of an actual factory. Job Descriptions were distributed at random during this lecture, normally to only half the class, the others being given the Group Working - Description at the next lecture. There were usually three days between this introductory lecture and the first game running.

The Honours class with which this game was run was given the introduction on a Tuesday, and the game was run on the Friday of the same week. The Industrial Management class was given the introduction on a Monday, the standard game was run with half the class that Wednesday. While the standard game was running, the other half of the class were introduced to the experimental design, and this was run on the Friday of that same week. The Diploma class had the introduction on a Tuesday, half of the class played the standard version on the Friday, the rest playing the experimental version the
following Tuesday. All groups were run between December 1974 and February 1975.

The postgraduate/staff group (experimental design) was run in one afternoon, the game following immediately after the explanation. It was principally from this group that Umpires were recruited for running the game with the larger classes, and their participation at this stage proved a valuable training for that task.

Phase 2: Running the Game

As several groups were normally run simultaneously, and as one Umpire was required for each group, an "Umpire Procedure" description was given to each of them in advance of the actual run to standardise the running of each group. The Umpires' instructions are given in Appendix III, Section 5, and illustrate the induction problems encountered in getting the game started with each group.

Timetable constraints dictated the length of the game, which was 40 minutes, to run during one lecture or tutorial hour. As participants entered the room allocated, they were assigned to groups according to their job-title, for the standard game, or at random for the experimental game. (The Postgraduate Diploma class was already divided into five groups for teaching purposes on that course.) For the standard game, therefore, the first person to enter the room with a Foreman's job description was assigned to Group 1 for that day, the second was assigned to Group 2, and so on. This allocation was therefore random since Job Descriptions had been issued at random during the introductory lecture.
The Standard Game:

Once all Groups in the room were ready to start, each Umpire commenced a "dummy job" with his group. This was designated JOB 00. The Umpire gave the JOB CARD to the Controller who called the Storeman/Progressor who obtained the materials from Stores and delivered them to the first activity (Surface). The Umpire followed the Job until it reached the Pattern operator, making sure that each stage was being carried out correctly and that all the paperwork was being correctly filled in. Once JOB 00 was moved to Pattern, the Umpire left the Foreman to monitor completion of the Job while he returned to the Controller to explain the procedure for job quotation and the use of the LOAD PLANNING CHART and JOB PROGRESS SHEET. At this point, the Controller was asked to calculate due times for jobs 01, 02, 03, thus giving him practice in the use of the relevant forms.

When JOB 00 was complete, the Umpire dealt with any further problems or questions, the "clock" was started, and the game began.

Jobs 01/1, 01/2, 02 and 03 were placed in each "factory", before the participants arrived, complete with necessary materials to represent work in progress. The start-up position was therefore:

<table>
<thead>
<tr>
<th>Job</th>
<th>at Activity</th>
<th>Work Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/1</td>
<td>Base</td>
<td>None</td>
</tr>
<tr>
<td>01/2</td>
<td>Base</td>
<td>None</td>
</tr>
<tr>
<td>02</td>
<td>Pattern</td>
<td>Surfaces Cut</td>
</tr>
<tr>
<td>03</td>
<td>Surface</td>
<td>None</td>
</tr>
</tbody>
</table>
The relevant paperwork had been completed in advance for these three Jobs and this assisted the Umpire in explaining the use of some of the forms.

As the clock was started at the beginning of the game, the Operators did not therefore have to wait for Jobs to reach them but had work in front of them with which to commence. As they did so, the Controller was asked to give a quote for Job 04. The "two-minute" rule was not enforced strictly for these initial quotes as the Controller learned what was involved. For the first three Jobs, any quote was accepted, but for Job 04, and for all the others, the Allowed Time (in this case 36) was enforced. The Umpire issued Jobs according to his ORDER ISSUE SHEET, recording the quotes given and the delivery times.

At the end of 40 minutes, the game was stopped, Operators being asked to leave whatever they were working on at the desk. All participants were then given an OPINION QUESTIONNAIRE to complete while the Umpire counted the quantities of stock remaining and entered this on the ORDER ISSUE SHEET. Knowing what had initially been given to each group, the actual amount of stock used could be calculated, checking the figures recorded by the Storeman/Progressor. The Umpire then collected all work in progress along with delivered Jobs.

The OPINION QUESTIONNAIRE was administered to obtain participants' immediate reactions to the game in terms of enjoyment and perceived learning. A specimen of this questionnaire is given in Appendix III, Section 6.

The Experimental Game:

The procedure for running the Experimental game was identical
to that for the standard game. These groups manufactured the same products with the same equipment and were not allowed to alter the basic "production technology" (e.g. they could not attempt job enlargement by having one person make a complete mat - unless that person moved from bench to bench, from activity to activity, in so doing.) The layout of these Groups was also similar but was partly determined by facilities available where the games were run.

The procedure followed by the Umpire is described in Appendix III, Section 5 and was similar to that for the standard game. The major difference here was that the Umpire had to explain to the entire group the procedure for quoting due times and the use of the JOB QUOTATION SHEET and LOAD PLANNING CHARTS. This was done before JOB 00 was run. Again, at the end of the game the stock was checked and the OPINION QUESTIONNAIRE administered.

Problems:

For both designs, induction was a major problem. The introductory lecture gave the background to production control procedures and what would be required in the game. The Job Descriptions appeared to be an inadequate method of teaching participants what was actually required of them. Knowledge of how to play the game, to operate the system, only really came during the running of the game. The "dummy job", JOB 00, was introduced after the first pilot run in an attempt to overcome this problem, but in some ways this too was inadequate. Several such jobs would be required to familiarise participants fully with the procedures involved, but this was not possible in the time
available. (Some groups, in fact, did spend too long on this stage and did not complete the entire 40 minutes of the game.) The results are consistent, however, in that all groups were run with one dummy job at the start. Confusion normally died down within the first five minutes, any gross errors still being made after that were corrected by the Umpire.

Phase 3: Feedback

During a tutorial hour in the week following game running, participants were asked to spend half an hour writing an answer to the following two questions:

1. List all the production problems that you believe you personally encountered in the game, giving a brief description of each.

2. List any other problems you believe your team encountered, with brief explanations.

These scripts were collected and the second half of the tutorial consisted of a discussion of the game and the aspects of production control which it illustrated. This served to clarify the objectives of the game for the students, and provided the tutor with some evidence as to how well the exercise had been received. The general impressions obtained from these discussions were:

(a) that most participants had enjoyed the exercise, although some who had been confined to the operator activities questioned its value as a teaching device;

(b) on the other hand, a number of participants indicated that they had not enjoyed the game but that they felt that they had learnt something from it; their reason for disliking the exercise was that it was "too much like hard work"; and
that the exercise had stimulated discussion and interest.

The groups were shown their actual performance levels and this initiated discussion of the problems they had encountered, the mistakes they had made, the solutions they had attempted, and the extent to which the exercise was relevant to real-life production management.

The exercise appeared, therefore, to have been a worthwhile teaching device. This matter is discussed in a little more detail below in Section 8 of this Appendix (p.719).
Appendix II, Section 5: The Opinion Questionnaire Results.

The following terminology has been adopted throughout the presentation of the results of this experiment in this and in the following two Sections of this Appendix:

- **standard managers** = standard group Controllers, Foremen, and Storeman/Progressors;
- **standard operators** = standard group Surface, Pattern and Base Operators;
- **experimentals** = experimental group members as a whole.

In order to assess the participants' immediate reaction to this game, this small questionnaire was administered at the end of each run. A specimen of this questionnaire is given in Appendix III, Section 6 (p.765). There are four questions concerning, respectively, perceived enjoyment and learning through the exercise, the foremost production problem that had been encountered during the game, and individual estimates of team performance. A total
of 91 replies to this questionnaire were received, including participants in the two 5-man groups, and the three groups which were unable to complete the 40 minute run due to a late start.

Enjoyment:

Question 1 asked participants to rate their enjoyment of the game on a five-point rating scale. Figure AII.1 gives the ratings of standard operators, standard managers, and experimentals respectively.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Operators</th>
<th>Managers</th>
<th>Total</th>
<th>Experimental</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very little</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>6</td>
<td>11</td>
<td>17</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Very much</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>24</td>
<td>47</td>
<td>44</td>
</tr>
</tbody>
</table>

Figure AII.1: Enjoyment ratings of all participants

Of all participants, 89 per cent gave a rating of 3 or above, and 60 per cent gave a rating of either 4 or 5. Using a median test (Siegel, 1956, p.111) the following comparisons may be made:
(a) Between standard managers and standard operators:

<table>
<thead>
<tr>
<th>Rating</th>
<th>above median</th>
<th>median and below</th>
</tr>
</thead>
<tbody>
<tr>
<td>managers</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>operators</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>21</td>
</tr>
</tbody>
</table>

chi-square = 0.5644, not significant.

(b) Between standard groups as a whole and experimentals:

<table>
<thead>
<tr>
<th>Rating</th>
<th>above median</th>
<th>median and below</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>experimental</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>36</td>
</tr>
</tbody>
</table>

chi-square = 1.0689, not significant

(c) Between standard operators and experimentals:

<table>
<thead>
<tr>
<th>Rating</th>
<th>above median</th>
<th>median and below</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard operators</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>experimentals</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>24</td>
</tr>
</tbody>
</table>

chi-square = 0.1663, not significant.
(d) Between standard managers and experimentals;

<table>
<thead>
<tr>
<th>Rating</th>
<th>above median</th>
<th>median and below</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>managers</td>
<td>12</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>experimentals</td>
<td>29</td>
<td>15</td>
<td>44</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>27</td>
<td>68</td>
</tr>
</tbody>
</table>

chi-square = 1.6410, not significant.

None of these results is significant, and it appears that all participants enjoyed the games equally.

Learning:

The participants were asked in question 2 to rate their perceived learning "about production" from the game, again on a 5-point rating scale. Figure A12 shows the ratings of each group of participants.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Standard Operators</th>
<th>Standard Managers</th>
<th>Total</th>
<th>Experimental</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very little 1</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>5</td>
<td>14</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>7</td>
<td>14</td>
<td>20</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>Very much</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>24</td>
<td>47</td>
<td>44</td>
<td>91</td>
</tr>
</tbody>
</table>

Figure A12: Perceived Learning Ratings.
Of all participants, 66 per cent gave a rating of 3 or above, but only 28.5 per cent gave a rating of 4 or 5. There are some interesting differences, however, between the groupings.

(a) Between standard managers and standard operators;

<table>
<thead>
<tr>
<th>Rating</th>
<th>above median</th>
<th>median</th>
<th>below median</th>
</tr>
</thead>
<tbody>
<tr>
<td>managers</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>operators</td>
<td>2</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>

chi-square = 7.6381, significant at the .05 level.

Standard managers therefore appear to have rated their perceived learning from the game significantly higher than standard operators.

(b) Between standard groups as a whole and experimentals;

<table>
<thead>
<tr>
<th>Rating</th>
<th>above median</th>
<th>median</th>
<th>below median</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard</td>
<td>12</td>
<td>14</td>
<td>21</td>
</tr>
<tr>
<td>experimental</td>
<td>14</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

chi-square = 5.0240, significant at the .10 level.

This difference is not particularly significant, replies of experimentals tending to cluster at the median whereas the largest number of standard group participant replies are below the median.
(ratings 1 and 2). There is, therefore, a slight overall tendency for the experimental groups to have rated their perceived learning from the game higher than standard group participants.

(c) Between standard operators and experimentals;

<table>
<thead>
<tr>
<th></th>
<th>Rating above median</th>
<th>median</th>
<th>below median</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard operators</td>
<td>2</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>experimentals</td>
<td>14</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>27</td>
<td>24</td>
</tr>
</tbody>
</table>

chi-square = 10.3556, significant at the .01 level.

Here the difference is notably significant, standard operators rating their learning from the game lower than experimentals.

(d) Between standard managers and experimentals;

<table>
<thead>
<tr>
<th></th>
<th>Rating above median</th>
<th>median</th>
<th>below median</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard managers</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>experimentals</td>
<td>14</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>27</td>
<td>17</td>
</tr>
</tbody>
</table>

chi-square = 0.6601, not significant.

In comparing standard groups as a whole with experimentals, the difference in perceived learning ratings was significant, but not particularly so. The ratings of standard managers and experimentals
are not significantly different, whereas those of standard operators and experimentals are. This supports the finding that standard managers and standard operators differed significantly on this rating, and explains the weak overall difference between standard and experimental groups.

Enjoyment and Learning:

In order to examine the relationship between enjoyment and perceived learning in this experiment, the following product moment correlation coefficients (Yeomans, 1968a, p.186) were calculated:

1. for experimentals,
   \[ r = 0.27^4, \text{significant (t-test) at the .10 level.} \]

2. for standard groups as a whole,
   \[ r = 0.313, \text{significant at the .10 level.} \]

3. for standard operators,
   \[ r = 0.399, \text{significant at the .05 level.} \]

4. for standard managers,
   \[ r = 0.339, \text{significant at the .01 level.} \]

5. for all participants,
   \[ r = 0.276, \text{significant at the .01 level.} \]

Given the nature of this data, however, (which has ordinal, not
interval scaling), a non-parametric test has more validity here
(i.e. making no assumptions with regard to normality or homo-
scedasticity of distributions, as does the t-test). The measure
adopted is the contingency coefficient, C, "... a measure of the
extent of association or relation between two sets of attributes."
(Siegel, 1956, p.196), which is significant when chi-square is
significant. This appears to be the best available measure, but
information is lost in combining categories for the purposes of
calculation, and in two cases, the calculation has been carried out
in spite of the fact that some expected frequencies fall below 5
(See Yeomans, 1968b, p.285).
1. for experimentals,
   \[ C = .18, \text{ not significant.} \]
2. for standard groups as a whole,
   \[ C = .327, \text{ significant at the .10 level.} \]
3. for standard operators,
   \[ C = .4179, \text{ significant at the .05 level.} \]
4. for standard managers,
   \[ C = 0. \]
5. for all participants,
   \[ C = .3088, \text{ significant at the .05 level.} \]

There does, therefore, seem to have been an overall tendency for
those who enjoyed the game more to rate their perceived learning from it higher. This relationship is strongest for standard operators in comparison with experimentals and standard managers.

Production Problems:

Question 3 asked participants to state, from their experience with the game, what they thought to be the most important feature of a production system. Although 87 participants answered this question, some listed two or three separate features, and where necessary, these have been included in separate categories, giving a total of 105 statements. (For example, "Form filling and organisation" is counted in categories 7 and 1 respectively.) The answers were generally one word or short phrase statements which were sorted without difficulty into nine main categories shown in Figure AII.3. Inclusion in the largest, "Group Organisation", was dependent on a key word analysis.
<table>
<thead>
<tr>
<th>Category</th>
<th>Standard</th>
<th>Experimental</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Managers</td>
<td>Operators</td>
<td></td>
</tr>
<tr>
<td>1. Group organisation</td>
<td>9</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>(key words: organisation,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>coordination, cooperation,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>teamwork.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Task Allocations</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>3. Communications</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>4. Control (key word: control)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>5. Information/Feedback</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6. Scheduling/Work Flow</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>7. Paperwork</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>8. Job Requirements</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>9. Quoting due times</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10. Others</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Totals</td>
<td>29</td>
<td>26</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td>105</td>
</tr>
</tbody>
</table>

Figure All. 3: Content analysis of question 3 of the Opinion Questionnaire.

The range of content in these replies reflects the similar wide spread of content found in the tutorial feedback questionnaire replies, detailed below. There are no significant differences, however, between the replies of standard and experimental groups. Problems of organisation and production scheduling were seen as most important in both cases.
Performance:

The last question on the opinion questionnaire asked participants to give a rating of their team's performance, again on a 5-point rating scale. Figure AII.4 gives the ratings of the various groups.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Standard Operators</th>
<th>Standard Managers</th>
<th>Total</th>
<th>Experimental</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poor</td>
<td>2 4 6</td>
<td>2 3 6</td>
<td>12</td>
<td>2 4</td>
<td>11</td>
</tr>
<tr>
<td>Very good</td>
<td>4 6 9</td>
<td>4 6 3</td>
<td>15</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Totals</td>
<td>22 23 45</td>
<td>45</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure AII.4: Performance ratings of all participants.

There does not appear to be any overall difference between standard and experimental groups in their performance ratings. There is some indication, however, that experimental group participants were more consistent in their ratings than standard group participants. Taking the range of the performance ratings of each group gives the following result:

<table>
<thead>
<tr>
<th>Range</th>
<th>Standard groups</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>3 or 4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

p = 0.069 (The Fisher Exact Probability Test, Siegel, 1956, p.96).
Thus verging on a 7 per cent level of significance, experimental groups were somewhat more consistent in their performance ratings than standard groups.

No correlations were found between participants' performance ratings and the performance measures examined below, i.e. the groups' estimated performance does not appear to be meaningfully related to their actual performance. None of the participants (in common with the researchers) knew what standard they would be expected to achieve, and other than the calculations which they could perform for themselves during the game, they were given no immediate feedback on performance from the Umpires.
Appendix II, Section 6: Group Performance Measures - Results.

A summary of these results is given in Figure AII.5. Notes explaining the calculation of some of these results are appended to that Figure. Performance measures were calculated only for those groups which completed the full 40 minute run of the game. This includes six standard groups and five experimental groups. The results of the two five person experimental groups will also be discussed.

Three of the jobs offered to groups in the game consisted of two parts (Jobs 01/1 and 2, 05/1 and 2, and 10/1 and 2). The results are therefore examined in two ways; First, as though the groups were offered 18 jobs, and second, as though they were offered 21 jobs.

Most of these data have been treated in the following manner. In order to assess the performance differences between standard and experimental groups, an F test (Yeomans, 1968b, p.101) is first
Figure AII.5: Summary of performance measures for all groups.*

<table>
<thead>
<tr>
<th>GROUP</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time run (in minutes)</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>No. of quotes given</td>
<td>14(3)</td>
<td>15(3)</td>
<td>16(3)</td>
<td>15(3)</td>
<td>14(3)</td>
<td>17(3)</td>
<td>15(2)</td>
<td>18(3)</td>
<td>15(3)</td>
<td>18(3)</td>
<td>15(3)</td>
<td>17(2)</td>
<td>17(2)</td>
</tr>
<tr>
<td>No. of successful quotes</td>
<td>13(3)</td>
<td>12(3)</td>
<td>14(3)</td>
<td>11(3)</td>
<td>12(3)</td>
<td>14(3)</td>
<td>13(2)</td>
<td>15(3)</td>
<td>13(2)</td>
<td>12(3)</td>
<td>11(3)</td>
<td>12(3)</td>
<td>7(1)</td>
</tr>
<tr>
<td>No. of Jobs delivered</td>
<td>10(3)</td>
<td>9(3)</td>
<td>10(3)</td>
<td>6(3)</td>
<td>6(3)</td>
<td>12(3)</td>
<td>13(2)</td>
<td>17(2)</td>
<td>18(3)</td>
<td>15(3)</td>
<td>18(3)</td>
<td>17(2)</td>
<td>17(2)</td>
</tr>
<tr>
<td>No. of Jobs delivered late</td>
<td>9(2)</td>
<td>3(1½)</td>
<td>0(0)</td>
<td>5(1½)</td>
<td>5(½)</td>
<td>6(½)</td>
<td>1(½)</td>
<td>5(1)</td>
<td>4(0)</td>
<td>1(½)</td>
<td>6(½)</td>
<td>2(1)</td>
<td>1(½)</td>
</tr>
<tr>
<td>Overall average lateness</td>
<td>1.9 (1.81)</td>
<td>-1.3 (-.83)</td>
<td>-5.7 (-5.38)</td>
<td>8.3 (1.86)</td>
<td>10 (7.1)</td>
<td>7.3 (4.3)</td>
<td>-1.75 (-3.27)</td>
<td>-3.54 (-3.87)</td>
<td>-1.42 (-1.64)</td>
<td>-3.73 (-1.64)</td>
<td>-2.25 (-2.2)</td>
<td>-1.1 (-0.8)</td>
<td>1 (1.13)</td>
</tr>
<tr>
<td>Average lateness of Jobs delivered late</td>
<td>2.4 (2.18)</td>
<td>5.3 (5.25)</td>
<td>0 (0)</td>
<td>8.3 (8.3)</td>
<td>12.4 (12.0)</td>
<td>8.8 (9.2)</td>
<td>2.33 (2.33)</td>
<td>1 (1)</td>
<td>4.6 (4.5)</td>
<td>2.25 (2.25)</td>
<td>3 (3)</td>
<td>6.8 (6.8)</td>
<td>8.5 (6.3)</td>
</tr>
<tr>
<td>Total no. mats/% accepted produced</td>
<td>76:82%</td>
<td>72:68%</td>
<td>78:82%</td>
<td>42:86%</td>
<td>54:96%</td>
<td>54:91%</td>
<td>90:72%</td>
<td>90:79%</td>
<td>84:82%</td>
<td>84:83%</td>
<td>90:90%</td>
<td>72:67%</td>
<td>48:40%</td>
</tr>
<tr>
<td>Surface/% accepted</td>
<td>36:78%</td>
<td>30:73%</td>
<td>48:83%</td>
<td>12:92%</td>
<td>24:100%</td>
<td>18:100%</td>
<td>54:87%</td>
<td>54:65%</td>
<td>54:78%</td>
<td>54:65%</td>
<td>54:91%</td>
<td>36:47%</td>
<td></td>
</tr>
<tr>
<td>Pattern/% accepted</td>
<td>42:86%</td>
<td>34:59%</td>
<td>48:85%</td>
<td>24:100%</td>
<td>18:100%</td>
<td>48:100%</td>
<td>60:100%</td>
<td>54:96%</td>
<td>54:91%</td>
<td>54:91%</td>
<td>36:64%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base/% accepted</td>
<td>48:100%</td>
<td>48:98%</td>
<td>48:98%</td>
<td>36:86%</td>
<td>42:98%</td>
<td>42:88%</td>
<td>60:73%</td>
<td>60:100%</td>
<td>54:98%</td>
<td>53:94%</td>
<td>48:100%</td>
<td>30:100%</td>
<td>24:58%</td>
</tr>
<tr>
<td>recorded : used</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>.95</td>
<td>1.25</td>
<td>1</td>
<td>1</td>
<td>1.14</td>
<td>.85</td>
<td>1.42</td>
<td>.96</td>
<td>.94</td>
<td>1</td>
</tr>
<tr>
<td>standard : used</td>
<td>.91</td>
<td>1.11</td>
<td>1</td>
<td>1.3</td>
<td>.94</td>
<td>1.11</td>
<td>1</td>
<td>1.10</td>
<td>.67</td>
<td>1.54</td>
<td>.84</td>
<td>1</td>
<td>1.06</td>
</tr>
<tr>
<td>recorded : used</td>
<td>.83</td>
<td>1</td>
<td>1</td>
<td>1.05</td>
<td>1.29</td>
<td>1</td>
<td>.88</td>
<td>.79</td>
<td>.78</td>
<td>.89</td>
<td>1</td>
<td>1.04</td>
<td>.67</td>
</tr>
<tr>
<td>standard : used</td>
<td>.89</td>
<td>1</td>
<td>1</td>
<td>1.16</td>
<td>1.09</td>
<td>1</td>
<td>.86</td>
<td>.79</td>
<td>.78</td>
<td>1.30</td>
<td>.88</td>
<td>1.12</td>
<td>.83</td>
</tr>
<tr>
<td>Standard minutes worked</td>
<td>96</td>
<td>115</td>
<td>134</td>
<td>58</td>
<td>78</td>
<td>62</td>
<td>139</td>
<td>137</td>
<td>139</td>
<td>122</td>
<td>119</td>
<td>125</td>
<td>87</td>
</tr>
</tbody>
</table>

* Explanatory notes will be found overleaf.
(a) The figure includes all groups that ran for the full 40 minute period. Three groups were unable to complete the game and their results are not included.

(b) Experimental groups numbers 6 and 7 were 5-man groups; all the other groups in Figure 6.8 were 6-man groups.

(c) Three of the Jobs issued to the groups were split into two parts. Numbers in parentheses in Figure 6.8 refer to these three "extra" Jobs.

(d) Overall average lateness =

\[
\frac{\text{total no. of minutes late} - \text{total no. of minutes early}}{\text{total no. of Jobs delivered}}
\]

(e) Average lateness of Jobs delivered late =

\[
\frac{\text{total no. of minutes late}}{\text{no. of Jobs delivered late}}
\]

(f) Effectiveness of stock usage is measured for each type of material by two ratios. The first, amount recorded as used to amount actually used indicates how well stock usage was recorded and controlled. The second, standard amount that should have been used to amount actually used, indicates how economically each type of material was used.

These ratios are to be interpreted as follows:

- recorded : used  
  \[
  \begin{align*}
  &1, \text{ inefficient recording} \\
  &= 1, \text{ accurate recording} \\
  &= 1, \text{ inefficient recording}
  \end{align*}
  \]

- standard : used  
  \[
  \begin{align*}
  &1, \text{ inefficient usage} \\
  &= 1, \text{ usage as per standard} \\
  &= 1, \text{ efficient usage}
  \end{align*}
  \]

(g) Standard minutes worked is calculated by adding the standard times for all completed Jobs and for completed stages of work in progress for each group as a whole.
calculated to examine the variances of the results of each type of group on each performance measure. A *t* - test (Yeomans, 1968b, p.103), the calculation of which is affected by the *F* - test result, is then conducted to examine the difference between the respective means.

1a. Number of quotes given (out of 18):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>n</em></td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td><em>x</em></td>
<td>15.17</td>
<td>16.40</td>
</tr>
<tr>
<td>(\sum(x-x')^2)</td>
<td>10.84</td>
<td>7.20</td>
</tr>
<tr>
<td>(s^2)</td>
<td>2.17</td>
<td>1.80</td>
</tr>
</tbody>
</table>

\[F = 1.2056, \text{ not significant}.\]
\[t = -1.4347, \text{ significant at the .10 level}.\]

1b. Number of quotes given (out of 21):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>n</em></td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td><em>x</em></td>
<td>18.1667</td>
<td>19.0</td>
</tr>
<tr>
<td>(\sum(x-x')^2)</td>
<td>10.8334</td>
<td>10.0</td>
</tr>
<tr>
<td>(s^2)</td>
<td>2.1667</td>
<td>2.5</td>
</tr>
</tbody>
</table>

\[F = 0.8667, \text{ not significant}.\]
\[t = -0.9045, \text{ not significant}.\]
All groups had the option of declining to quote a due time for any order, perhaps through lack of time to calculate the quote, or because of the quantity of work already in the system. There appears to be little difference between standard and experimental groups on this performance measure.

2a. Number of Successful quotes (out of 18):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>x̄</td>
<td>12.330</td>
<td>14.20</td>
</tr>
<tr>
<td>Σ(x-x̄)^2</td>
<td>5.3334</td>
<td>2.80</td>
</tr>
<tr>
<td>s²</td>
<td>1.0667</td>
<td>0.70</td>
</tr>
</tbody>
</table>

F = 1.5329, not significant.
t = -3.2484, significant at the .01 level.

2b. Number of Successful quotes (out of 21):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>x̄</td>
<td>15.33</td>
<td>16.80</td>
</tr>
<tr>
<td>Σ(x-x̄)^2</td>
<td>5.3334</td>
<td>6.80</td>
</tr>
<tr>
<td>s²</td>
<td>1.0667</td>
<td>1.70</td>
</tr>
</tbody>
</table>

F = 1.5937, not significant.
t = -2.0907, significant at the .05 level.
To be successful, a job quote had to fulfill two criteria; it had to be given to the Umpire within 2 minutes of the job being offered, and the quote had to be within the "allowed time" for that job, as shown on the order issue sheet. The experimental groups, therefore, appear to have performed slightly better on this measure than standard groups.

3a. Number of Jobs Delivered (out of 18):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>7.50</td>
<td>12.0</td>
</tr>
<tr>
<td>$s^2$</td>
<td>6.30</td>
<td>0.50</td>
</tr>
</tbody>
</table>

$F = 12.6$, significant at the .05 level.
$t = -4.1962$, significant at the .01 level (d.f. = 6).

3b. Number of Jobs Delivered (out of 21):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>10.50</td>
<td>14.60</td>
</tr>
<tr>
<td>$s^2$</td>
<td>6.30</td>
<td>0.30</td>
</tr>
</tbody>
</table>

$F = 21$, significant at the .01 level.
$t = -3.8915$, significant at the .01 level (d.f. = 6).
In terms of the number of jobs actually completed and delivered during the game, not only were experimental groups significantly better than standard groups, but their performance is significantly more consistent than that of the standard groups.

4a. Number of Jobs Delivered Late (out of 18):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>4.330</td>
<td>3.40</td>
</tr>
<tr>
<td>$\sum (x - \bar{x})^2$</td>
<td>43.3334</td>
<td>21.20</td>
</tr>
<tr>
<td>$s^2$</td>
<td>8.6667</td>
<td>5.30</td>
</tr>
</tbody>
</table>

$F = 1.6352$, not significant.
$t = 0.5735$, not significant.

4b. Number of Jobs Delivered Late (out of 21):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>5.0</td>
<td>3.60</td>
</tr>
<tr>
<td>$\sum (x - \bar{x})^2$</td>
<td>64.0</td>
<td>25.20</td>
</tr>
<tr>
<td>$s^2$</td>
<td>12.80</td>
<td>6.30</td>
</tr>
</tbody>
</table>

$F = 2.0315$, not significant.
$t = 0.7314$, not significant.
There is, therefore, no difference between standard and experimental groups in terms of the number of jobs which they delivered late (i.e. after the due time which they quoted).

5a. Overall Average Lateness (out of 18):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>3.4167</td>
<td>-1.9380*</td>
</tr>
<tr>
<td>$s^2$</td>
<td>37.9857</td>
<td>1.1067</td>
</tr>
</tbody>
</table>

*This negative mean indicates that the deliveries of experimental groups were on average early.

$F = 34.3250$, significant at the .01 level
$t = 2.0915$, significant at the .05 level (d.f. = 5).

5b Overall Average Lateness (out of 21):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>1.310</td>
<td>-2.5240</td>
</tr>
<tr>
<td>$s^2$</td>
<td>18.4705</td>
<td>1.009</td>
</tr>
</tbody>
</table>

$F = 18.3057$, significant at the .01 level.
$t = 2.1171$, significant at the .05 level (d.f. = 5).
The performance of standard groups on this measure was significantly more variable than that of experimental groups. As well as this consistency of performance, experimental groups were also significantly better at delivering jobs on time or early.

6a. Average Lateness of Jobs Delivered Late (out of 18):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$x$</td>
<td>6.20</td>
<td>2.6360</td>
</tr>
<tr>
<td>$s^2$</td>
<td>20.600</td>
<td>1.7272</td>
</tr>
</tbody>
</table>

$F = 11.9616$, significant at the .025 level.
$t = 1.8310$, significant at the .10 level (d.f. = 5).

6b. Average Lateness of Jobs Delivered Late (out of 21):

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$x$</td>
<td>6.1550</td>
<td>2.6160</td>
</tr>
<tr>
<td>$s^2$</td>
<td>20.5082</td>
<td>1.6311</td>
</tr>
</tbody>
</table>

$F = 12.5732$, significant at the .025 level.
$t = 1.8289$, significant at the .10 level (d.f. = 6).

As with overall average lateness, experimental groups were significantly more consistent in their performance in terms of average
lateness of late jobs, and slightly better overall than standard groups (but this result is not particularly significant).

7. Total Number of Mats Produced:

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>63.0</td>
<td>87.6</td>
</tr>
<tr>
<td>$s^2$</td>
<td>226.8</td>
<td>10.8</td>
</tr>
</tbody>
</table>

$F = 21.0$, significant at the .01 level.
$t = 3.8915$, significant at the .01 level (d.f. = 5).

Experimental groups produced significantly more tablemats than standard groups, and the performance of the standard groups is again much more variable than that of the experimentals.

8. Number of Mats Accepted:

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>52.6667</td>
<td>71.40</td>
</tr>
<tr>
<td>$\sum(x-\bar{x})^2$</td>
<td>579.3334</td>
<td>129.20</td>
</tr>
<tr>
<td>$s^2$</td>
<td>115.8667</td>
<td>32.30</td>
</tr>
</tbody>
</table>

$F = 3.5872$, not significant.
$t = 3.4866$, significant at the .01 level.
All tablemats produced by each group were checked for quality after the game had been run. Participants were told that the tolerance of a good mat was \( \pm 2\) mm, but in the quality check, they were actually allowed \( \pm 3\) mm. All mats conforming to this latter standard were accepted, and experimental groups seem to have performed significantly better on this measure, i.e. their output of "usable" mats was higher. This particular result, however, does not indicate that the quality of experimental group products was better than that of standard groups. On the contrary, the overall proportions of mats accepted were approximately equal for both groups (83.6 per cent and 81.5 per cent for standard and experimental groups respectively). Because these proportions are similar, and since experimental group output was higher overall, they have produced significantly more "usable" mats.

9a. Recording Stock Usage:

The quantity of materials issued to each group was the same, and it was possible to compare actual stock usage with that recorded on the Stock Withdrawal and Excess Requisition Sheets.

<table>
<thead>
<tr>
<th>Surface Material</th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>accurate</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>inaccurate</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

---

Using the Fisher exact probability test,

\[ p = 0.1623 + 0.0022 = 0.1645 \]
This indicates that the accuracy of stock withdrawal recording by the experimental groups was rather poorer than that of the standard groups.

9b. Actual Stock Usage (compared with Standard):

From the job cards, the standard amounts of each type of material that each group should have used could be calculated.

<table>
<thead>
<tr>
<th>Surface Material:</th>
<th>Standard Usage</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>standard or less</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>more than standard</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Base Material:</th>
<th>Standard Usage</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>standard or less</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>more than standard</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>6</td>
</tr>
</tbody>
</table>

\[ p = 0.3030 + 0.0030 = 0.3060 \]

\[ p = 0.0649 + 0.0022 = 0.0671. \]
Thus, for the surface material, there appears to be little
difference between standard and experimental groups in the effectiveness of their stock usage, but experimental groups seem to have utilised their base material to somewhat less effect than standard groups.

10. Standard Minutes Worked:

This figure could again be calculated from the job cards after the game had run, knowing which jobs each group had completed, including completed stages of work in progress.

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>x</td>
<td>90.50</td>
<td>131.2</td>
</tr>
<tr>
<td>$s^2$</td>
<td>909.50</td>
<td>97.2</td>
</tr>
</tbody>
</table>

$F = 9.3570$, significant at the .05 level.
$t = 3.1122$, significant at the .025 level (d.f. = 5).

Again not only is the performance of experimental groups superior to that of standard groups, but it is also less variable.

Summary:

There is no significant difference between standard and experimental groups on the following performance measures:

1. Number of quotes given;
4. Number of jobs delivered late;
8. Number (Quality) of mats accepted.
Standard groups performed better than experimental groups on the following measures:

9a. Recording stock usage;
9b. Actual (Base) stock usage.

Experimental groups performed better than standard groups on the following measure:

2. Number of successful quotes.

Experimental groups performed better, and on the whole more consistently, than standard groups on the following measures:

3. Number of jobs delivered;
5. Overall average lateness;
6. Average lateness of jobs delivered late;
7. Total number of mats produced;
10. Standard minutes worked.

The Five-man Experimental Groups:

The performance of these groups was, on the whole, much worse than that of the six-man experimental groups, but about the same as that of the standard groups. Although these five-man groups have an apparently superior productive capacity compared with the standard groups, the loss of one person seems to have disproportionately affected their performance. The combined materials - and information - processing tasks involved appear to have been too much for the five-man groups to deal with. This lends some validity to the initial assumption that the superior capacity of the experimental groups would be offset by the additional time they would require to operate their information system.
Appendix II, Section 7: The Tutorial Feedback Questionnaire Results.

Introduction

During the week following the running of each game, all participants who were present at their timetabled tutorial were asked to spend the first half hour of that tutorial period writing answers to the following two questions:

1. List all the production problems that you believe you personally encountered in the game, giving a brief description of each.

2. List any other problems you believe your team encountered, with brief explanations.

These replies were then collected and the other half of the tutorial took the form of a general discussion of the game and the production management problems of relevance to real-life conditions which were illustrated.

A total of 79 usable replies were obtained, 37 from standard and 39 from experimental group participants, and three from "observers" who could not be placed in a group but who watched the others and answered Question 2 only. There was, therefore, an overall response rate of 81 per cent.

For the purposes of this analysis, respondents were divided into their three main groupings: standard managers, standard operators, and experimentals. The numbers of respondents in each of these three divisions are shown in Figure AII.6.
<table>
<thead>
<tr>
<th></th>
<th>Number of replies received</th>
<th>Total possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPERIMENTAL groups</td>
<td>39</td>
<td>46</td>
</tr>
<tr>
<td>Managers</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>Operators</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>STANDARD groups</td>
<td>37</td>
<td>48</td>
</tr>
<tr>
<td>Observers*</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>79</strong></td>
<td><strong>97</strong></td>
</tr>
</tbody>
</table>

Response rate = 81 per cent

*Three participants were not allocated to groups but watched the others work.

Figure AII.6: Replies received to the Tutorial Feedback Questionnaire.
Content Analysis: Procedure

A content analysis of the replies to these questions was achieved by copying each listed problem statement onto a separate card which was coded for group number and type, and job title of respondents from standard groups. The 496 cards, or "problem statements", were then sorted into the five main categories shown in Figure AII.7 and twenty six sub-categories or sections listed in Figures AII.8 to 12. The experimental group replies account for 48 per cent of the total number of problem statements, standard group operators and managers together for 52 per cent, (operators 23 per cent, managers 29 per cent).

This process was considerably more difficult than for the Opinion Questionnaire, a number of sorts being required to establish the final classification. In discussing the problems of determining categories for analysis, Holsti (1968) summarises the procedure which was followed in this case:

"In the absence of standard schemes of classification, the analyst often is faced with the task of constructing appropriate categories by trial-and-error methods. This process usually consists of moving back and forth from theory to data, testing the usefulness of tentative categories, and then modifying them in the light of the data." (p.646)

A key-word analysis proved possible for only three sections, and cards were sorted mainly by "theme", that is by the problem area to which the statements referred, or to which they mainly referred. To minimise the possibility of including a statement in more than one category, an effort was made to concentrate only on the manifest content of each statement; once one begins to "read between the lines" of a statement, to examine its latent content, its relevance to other categories may become apparent. It was not, however, possible to
<table>
<thead>
<tr>
<th>Category</th>
<th>STANDARD Operators</th>
<th>STANDARD Managers</th>
<th>STANDARD Total</th>
<th>EXPERIMENTAL</th>
<th>TOTAL</th>
<th>%age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The production process.</td>
<td>36</td>
<td>24</td>
<td>60</td>
<td>55</td>
<td>115</td>
<td>23</td>
</tr>
<tr>
<td>2. Production scheduling and control.</td>
<td>34</td>
<td>70</td>
<td>104</td>
<td>68</td>
<td>172</td>
<td>35</td>
</tr>
<tr>
<td>3. The paperwork.</td>
<td>7</td>
<td>10</td>
<td>17</td>
<td>26</td>
<td>43</td>
<td>9</td>
</tr>
<tr>
<td>4. Group organization and communications.</td>
<td>25</td>
<td>22</td>
<td>47</td>
<td>58</td>
<td>105</td>
<td>21</td>
</tr>
<tr>
<td>5. Miscellaneous.</td>
<td>13</td>
<td>19</td>
<td>32</td>
<td>29</td>
<td>61</td>
<td>12</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>115</strong></td>
<td><strong>145</strong></td>
<td><strong>260</strong></td>
<td><strong>236</strong></td>
<td><strong>496</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Chi-square for whole table = 23.8228, significant at .01 level.
" " operators and managers only = 13.4205, significant at .01 level.
" " operators and experimental only = 4.2483, not significant.
" " managers and experimental only = 16.8168, significant at .01 level.
" " standard and experimental in total only = 9.7978, significant at .05 level.

Figure AII.7: Content analysis of the Tutorial Feedback Questionnaire: the five main categories.
<table>
<thead>
<tr>
<th>SECTIONS</th>
<th>STANDARD</th>
<th></th>
<th></th>
<th>EXPERIMENTAL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operators</td>
<td>Managers</td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Production activities.</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>(b) Quantity v. quality.</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>(c) Knowledge of job requirements.</td>
<td>12</td>
<td>13</td>
<td>25</td>
<td>13</td>
<td>38</td>
</tr>
<tr>
<td>(d) Pressure of work.</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>(e) Quality of equipment.</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>(f) Insufficient equipment.</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>36</strong></td>
<td><strong>24</strong></td>
<td><strong>60</strong></td>
<td><strong>55</strong></td>
<td><strong>115</strong></td>
</tr>
</tbody>
</table>

Chi-square for standard and experimental in total only = 13.8811, significant at .01 level.
" operators and experimental only; } not possible.
" managers and experimental only; }

Figure AII.8: Category 1 – The Production Process.
Chi-square for standard and experimental in total only = 21.4139, significant at .001 level.
" managers and experimental only = 17.4519, significant at .01 level.
" operators and experimental only, not possible.

**Figure AII.9: Category 2 – Production Scheduling and Control.**

<table>
<thead>
<tr>
<th>SECTIONS</th>
<th>STANDARD</th>
<th></th>
<th></th>
<th>EXPERIMENTAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operators</td>
<td>Managers</td>
<td>Total</td>
<td></td>
<td>Operators</td>
</tr>
<tr>
<td>(a) Quoting due times.</td>
<td>0</td>
<td>12</td>
<td>12</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>(b) Determining job priorities.</td>
<td>2</td>
<td>12</td>
<td>14</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>(c) Job progressing.</td>
<td>9</td>
<td>13</td>
<td>22</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>(d) Line balancing.</td>
<td>20</td>
<td>18</td>
<td>38</td>
<td>26</td>
<td>64</td>
</tr>
<tr>
<td>(e) Tracing jobs.</td>
<td>3</td>
<td>15</td>
<td>18</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>34</strong></td>
<td><strong>70</strong></td>
<td><strong>104</strong></td>
<td><strong>68</strong></td>
<td><strong>172</strong></td>
</tr>
<tr>
<td>SECTIONS</td>
<td>STANDARD Operators</td>
<td>STANDARD Managers</td>
<td>Total</td>
<td>EXPERIMENTAL</td>
<td>TOTAL</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------</td>
<td>-------------------</td>
<td>-------</td>
<td>--------------</td>
<td>-------</td>
</tr>
<tr>
<td>(a) Difficulty in filling in paperwork.</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>(b) Time taken filling in paperwork.</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>(c) Forgetting to fill in paperwork.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>(d) Mislaying forms.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>7</strong></td>
<td><strong>10</strong></td>
<td><strong>17</strong></td>
<td><strong>26</strong></td>
<td><strong>43</strong></td>
</tr>
</tbody>
</table>

No statistics possible.

*Figure AII.10: Category 3 - The Paperwork.*
<table>
<thead>
<tr>
<th>SECTIONS</th>
<th>STANDARD</th>
<th></th>
<th></th>
<th>EXPERIMENTAL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operators</td>
<td>Managers</td>
<td>Total</td>
<td>Operators</td>
<td>Total</td>
</tr>
<tr>
<td>(a) Organization.</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>(b) Task allocation.</td>
<td>5</td>
<td>8</td>
<td>13</td>
<td>27</td>
<td>40</td>
</tr>
<tr>
<td>(c) Communication.</td>
<td>7</td>
<td>6</td>
<td>13</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>(d) Information.</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25</td>
<td>22</td>
<td>47</td>
<td>58</td>
<td>105</td>
</tr>
</tbody>
</table>

Chi-square for standard and experimental in total only = 25.9309, significant at .001 level.

operators and experimental only,
managers and experimental only,
not possible.

*Figure AII.11: Category 4 - Group Organization and Communication.*
## SECTIONS

<table>
<thead>
<tr>
<th>Sections</th>
<th>Operators</th>
<th>Managers</th>
<th>Total</th>
<th>EXPERIMENTAL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Job satisfaction/frustration.</td>
<td>7</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>(b) Game not long enough.</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>(c) Couldn't see clock.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>(d) Material usage.</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>(e) Layout.</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(f) Preliminary discussion.</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>(g) Others.</td>
<td>1</td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>13</strong></td>
<td><strong>19</strong></td>
<td><strong>32</strong></td>
<td><strong>29</strong></td>
<td><strong>61</strong></td>
</tr>
</tbody>
</table>

No statistics possible.

*Figure AII.12: Category 5 - Miscellaneous.*
entirely reduce the process from a judgement task to a clerical task. In the discussion that follows, therefore, examples of statements placed in each category are given to enable the reader to assess the extent to which objectivity has been achieved. Where quoted statements are from standard group participants, the respondent's job-title is also given.

Content Analysis: Results

The replies of the two largest classes playing the game (Industrial Management and Diploma in Business Administration) were sorted independently in the first instance, but as any differences between the pattern of these groups' replies were minor, they have been combined for analysis. (The Industrial Management replies were sorted first; the subsequent sort of the Diploma class replies added three sub-categories: 1b, 5e and 5f.)

The nature of the replies made it possible to begin by analysing each individual's reply as a whole, that is, drawing no distinction between personal and group problems. Once the categorisation had been established, the statements were re-sorted differentiating between the two questions. The proportion of statements in reply to each of the two questions, shown in Figure A11.13, is consistent between the groups, about 60 per cent of all statements recorded as personal problems, 40 per cent as group problems. There is no difference between experimental and standard groups, but there is a slight difference between standard managers and standard operators. The former concentrated more on personal problems (66 per cent of their statements), whereas the standard operators produced a higher
proportion of statements concerning team problems than any other grouping (47 per cent of their statements).

<table>
<thead>
<tr>
<th></th>
<th>% of statements in</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
</tr>
<tr>
<td>Experimental</td>
<td>59</td>
<td>41</td>
</tr>
<tr>
<td>Managers</td>
<td>66</td>
<td>34</td>
</tr>
<tr>
<td>Operators</td>
<td>53</td>
<td>47</td>
</tr>
<tr>
<td>All Standard</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

**Figure AII.13:** Percentages of statements in reply to the two questions.

The pattern of the specific content of these replies, however, is significantly different. Figures AII.14 and AII.15 illustrate, for questions 1 and 2 respectively, the number of statements recorded in each category by each of the three groupings. For personal problems, the difference between the patterns of responses of experimentals, standard operators and standard managers is highly significant (see Figure AII.14). But for the team problems, there is not a significant difference between the groupings (see Figure AII.15).
Figure AII.14: Analysis of replies to question 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Experimental</th>
<th>Standard Operators</th>
<th>Standard Managers</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Process</td>
<td>42</td>
<td>28</td>
<td>14</td>
<td>84</td>
</tr>
<tr>
<td>Production Scheduling and Control</td>
<td>42</td>
<td>15</td>
<td>54</td>
<td>111</td>
</tr>
<tr>
<td>Paperwork</td>
<td>22</td>
<td>4</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Group Organization and Communication</td>
<td>22</td>
<td>4</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>11</td>
<td>10</td>
<td>8</td>
<td>29</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>139</strong></td>
<td><strong>61</strong></td>
<td><strong>96</strong></td>
<td><strong>296</strong></td>
</tr>
</tbody>
</table>

Chi-square = 37.0065: significant at .001

Figure AII.15: Analysis of replies to question 2.

<table>
<thead>
<tr>
<th>Category</th>
<th>Experimental</th>
<th>Standard Operators</th>
<th>Standard Managers</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Process</td>
<td>13</td>
<td>8</td>
<td>10</td>
<td>31</td>
</tr>
<tr>
<td>Production Scheduling and Control</td>
<td>26</td>
<td>19</td>
<td>16</td>
<td>61</td>
</tr>
<tr>
<td>Paperwork</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Group Organization and Communication</td>
<td>36</td>
<td>21</td>
<td>12</td>
<td>69</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>18</td>
<td>3</td>
<td>11</td>
<td>32</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>97</strong></td>
<td><strong>54</strong></td>
<td><strong>49</strong></td>
<td><strong>200</strong></td>
</tr>
</tbody>
</table>

Chi-square (combining categories 3 and 5) = 6.5415: not significant
Notes for Figures AII.14 and AII.15.

Note 1

Between Questions 1 and 2:

Experimentals,
Chi-squared = 30.0734 : significant at .001

Standard Operators,
Chi-squared = 25.9957 : significant at .001

Standard Managers,
Chi-squared = 8.8776 : significant at .05.

Note 2

On Question 1:

Between Experimentals and Standard Operators;
Chi-squared = 11.9666 : significant at .02

Experimentals and Standard Managers;
Chi-squared = 17.6949 : significant at .01

Standard Operators and Standard Managers;
Chi-squared = 25.5458 : significant at .001.

Note 3

On Question 2:

Between Experimentals and Standard Operators,
Chi-squared = 5.2701 : not significant

Experimentals and Standard Managers,
Chi-squared = 2.9781 : not significant

Standard Operators and Standard Managers,
Chi-squared = 4.1707 : not significant.
The three groupings all show significant differences in the content of their replies to the two questions (see Figures All.14 and All.15, Note 3).

For experimentals, the main emphasis in Question 1 is placed equally on problems concerning the production process, and production scheduling and control, which together account for about 60 per cent of their problem statements in reply to this question. In reply to Question 2 dealing with team problems, category four ranks as the most important, concerned with group organization and communications. This category alone accounts for about 37 per cent of the statements in reply to this question. Also under team problems, much less emphasis is given to problems concerning the production process, and the paperwork.

For standard operators, the main personal problems are predictably those concerning the production process, whereas the main team problems perceived are those related to group organization and communication, the latter accounting for almost 40 per cent of these statements. This increased emphasis on category 4 is more clearly explained by reference to the breakdown of that category by section given in Figure All.11. Their emphasis is placed on problems different to those of experimental groups.

For standard managers, problems of production scheduling and control, again predictably, are ranked as most important under Question 1. The standard managers gave the smallest proportion of statements in Question 2, but again category 2 is the largest, categories 1, 4 and 5 each containing between one quarter and one fifth of all these statements. Problems with the paperwork do not figure at all with the standard managers as team problems.
It appears, therefore, that all three groupings were significantly aware of the problems which the rest of their team had and which were different to their own problems. Some respondents tended to answer both questions in their reply to the first restating problems already mentioned in the first question. This may account for the smaller proportion of statements recorded under this question.

Turning to the differences between the three groupings in their replies to each question, further analysis of Figure AII.14 concerning personal problems, gives the following results:

there are significant differences in the content of replies between:

1. experimentals and standard operators,
2. experimentals and standard managers,
3. standard operators and standard managers.

See Figures AII.14 and AII.15, Note 2.

1. The experimentals gave the strongest, and equal, emphasis to problems concerning the production process, and production scheduling and control (each accounting for about 30 per cent of the statements). The standard operators, on the other hand, predictably listed problems concerning the production process as most important (45 per cent of their statements), with problems of production control ranking a distant second (about 25 per cent). Standard operators recorded comparatively few statements here concerning either paperwork problems or group organization and communication, categories which taken together amount to about 32 per cent of experimentals' statements.

2. By far the most important personal problems for managers were those of production scheduling and control, the other four categories combined accounting for only 44 per cent of the statements.
3. The differences between standard operators and managers are again the expected ones. Operators rank problems of production process first and production scheduling and control second, managers ranking these vice versa. The managers also place more emphasis on categories 3 and 4, but the difference is slight.

The pattern of experimental group replies to Question 1, therefore, while differing significantly from both standard operators and managers, appears to lie in emphasis somewhere between the two, placing no greater importance on either of categories 1 and 2, the main difference between the two standard groupings.

In their replies to Question 2, concerning problems of the team as a whole, there is no significant difference in the pattern of replies between the three groupings (see Figure AII.15). Similar comparisons were examined here as for Figure AII.14, but the differences found to be significant there prove not to be significant in this case (see Figures AII.14 and AII.15, Note 3). Because of the significant intergroup differences between replies to the two questions, and because the intra-group differences on Question 2 are not significant, the procedure of combining these two sets of responses and treating them as a whole for the remainder of the analysis is felt to be justified. Further detailed analysis of the results so combined is postponed until the nature of this material has been described.

Categorisation:

From this point, the content analysis combines the two questions and no further distinction is made between replies falling under either heading. The five main categories were divided into the sections shown in Figures AII.8 to AII.12 and a description of the content of each category and section follows.
Category 1: The Production Process, Figure AII.8.

This category includes problems related to the manufacturing process, the physical (material processing) activities of cutting, patterning and stapling involved in the game.

1a: Production Activities:

A number of participants found the actual production processes difficult; all 12 statements in this section are from operators (from standard groups) or those mainly concerned with operator tasks (from experimental groups). Typical problems mentioned were:

Standard groups:

Bulldog clips slipping taking time; (Surface Operator)

Sometimes it was difficult to effectively clamp the paper together, which meant that the sheets other than the top one were out of shape, and had to be trimmed; (Surface Operator)

Cut patterns that were passed on to me were not accurately cut, so I had the problem of drawing patterns on some not very accurate cuttings; (Pattern Operator)

Problem of drawing vertical lines on the mats. Whether to take guide marks at top and bottom or just top. This task took up time; (Pattern Operator)

Cutting through six sheets of paper and leaving all the edges parallel to each other at the same time. These usually had to be trimmed down slightly but that wasn't at all difficult; (Base Operator)

Experimental groups:

One of the problems was getting the paper correctly cut out. When I clipped the paper together and started to cut out, bottom sheets moved causing them to be smaller or bigger than the size stated;

Cutting off corners also seemed to take a lot of time;
Wrong sizes of product cut out for me to draw patterns on;
Inability to carry out instructions on sheet of previous members - as Pattern I was last in production line so materials and jobs had to be returned back down the line to get done properly before I could proceed.

Comment:

The task of Pattern Operator was a comparatively simple one; the Surface and Base Operators experienced difficulty in cutting several sheets of paper simultaneously without them shearing. The production tasks appear to require a degree of "skill" for their effective performance. In the interests of realism, a task that could be performed perfectly without practice would not have been desirable, whereas a task taking even 15 minutes to learn would have been impractical. It would seem, therefore, that with these tasks which are simple to learn but which are not so easy to perform accurately without practice, the game has approximately the right level of "technological complexity" consistent with the function of a realistic simulation.

Making the same products with the same equipment, experimental and standard groups do not differ in the number and content of replies in this section, except that none of the standard group managers mention it.

1b: Quality versus Quantity:

The potential conflict between these two objectives was noted by a few participants:
Standard groups:

Another problem was that I was not sure whether the maximum quantity of mats was my main objective or whether the quality was a more important target; (Base Operator)
Operators kept close to tolerance levels and therefore took much longer for the job than the specified standard time; (Foreman)

Operating staff had considerable difficulties - one took excessive care and thereby exceeded standard times; (Controller).

Experimental groups:

It is not easy to finish the work with accuracy in a short time;

Jobs came in very quickly and to maintain work flow had to sacrifice some quality;

As it was, I experienced considerable difficulty in matching quality control with the required speed of production.

Comment:

Again there is no difference between standard and experimental groups in this section. A few standard group managers recognised this problem, however, and the frequency of replies in this section might have been greater if an inspection procedure for finished mats had been incorporated in the game (as was originally intended).

1c: Knowledge of job requirements:

The statements in this section express various degrees of confusion and uncertainty as to what was required of the participants in the game.

Standard groups:

Initially, no one was quite sure what to do - particularly the Foreman, Storeman and Production Controller; (Surface Operator)

Foreman - blunderhead. Very unsure of what to do; (Surface Operator)
Not fully understanding the job requirement sheet with respect to the numbers of each element we had to produce and the process stages; (Base Operator)

One of the major problems faced by the team was remembering the rules of the game in the time allotted; (Pattern Operator)

The instructions for the job were too complicated to be read at once for every one of my functions to be carried out automatically as the occasion demanded; (Storeman/Progressor)

There was not enough time to find requirements of job as Storeman and integration into the whole system; (Storeman/Progressor)

The Job Description was misunderstood at the beginning of production and the specified six mats were not adhered to; (Foreman)

Not enough familiarisation with rules and line of control and command, e.g. worker did not know procedure for mistakes; (Foreman)

Some members were not clear as to what their duties entailed. This was the major problem; (Controller)

It was important for effective production for everyone to stick to their job definitions, which were very closely defined; (Controller)

Experimental groups:

Perhaps if we knew the forms and the system better then the paperwork might have been less of a hurdle. I think it was really the unfamiliarity of them as part of a production process that was the problem;

We were a bit unsure what to do. This caused troubles when doing the job, e.g. send two pieces of paper when you had to make \( \frac{1}{2} \) dozen, or misreading the order of production (surface to base before pattern, etc.);

Problem of everyone having to get to know his own job and everyone else's so that he could help when not busy - this got better as time went on;

Proficiency and "knack" for the task not really developed until midway through the game;

It was found that there was a learning time of around 40 minutes. By the end, we felt as though we were getting into some routine.
Comment:

These statements reflect the induction problem discussed above on p.629. The briefing session, at which the game was introduced and described and job descriptions were handed out, proved to be an inadequate introduction for participants. Even working slowly through a dummy job did not effectively fill this gap in every case, and most groups settled down to a smoother work rhythm after two or three jobs had been processed. To have simplified the game still further would have detracted significantly from its content. The performance results discussed above show that most groups did successfully produce most of the orders offered to them and did not collapse in chaos after the first ten minutes. This is still a problem, however, and the only solution would be to have a longer "training" session before the game actually began, processing a number of jobs to establish the working pattern. This was, however, not feasible due to timetabling restrictions.

There are twice as many statements from standard groups as from experimental groups, for which there are two possible reasons.

First, the standard groups were given separate, and for the managers lengthy, job descriptions which read on their own outside the game situation may have been difficult to assimilate. These job descriptions attempted to pattern their activities and interactions, requiring rather detailed knowledge of precisely what was to be done in a given set of circumstances. As the job descriptions had not been learned properly, there was therefore bound to be at least initial confusion as to who was to do what, and when.

Second, experimental groups were issued in common with the group working description which placed as few restrictions as
possible on their activities and interactions, leaving these matters for each group to determine for itself. Since they could decide amongst themselves, within the framework of the game, what each was going to do, the experimental groups apparently did not see the problem as one of "knowledge of job requirements" but as problems of "organization" and "task allocation". These are discussed below.

1d: Pressure of Work:

An impression gained at the time the games were run, from participants' comments and facial expressions as they left at the end, was that their experience had been a tiring one. This section contains statements confirming that impression.

Standard Groups:

Then there was a lot of pressure on, as at the end of the game, the strain was quite high; (Surface Operator)

Being asked to do too much in the time given; (Base Operator)

Had to consider too many calls at the same time; Foreman wanting jobs shifted and material withdrawn from stores while the Controller was wanting a new job started and to know how the plant was working in relation with his own estimated times for jobs to be carried out; (Storeman/Progressor)

Quite a bit of paper to carry about - I was rushed pretty well and that was not having to consider switching an Operator or go into the procedure if someone had made a mistake; (Foreman)

We, as a group, encountered problems of a pressure situation; (Controller)

Experimental Groups:

A lot to do in keeping Surface and Base Operators supplied with material while still collecting new jobs and obtaining quotes for them;
I felt that the pace was too hot and would have preferred a slower rate of orders so that I would have had more time to use my artistic bent to the full in cutting out the various orders.

Comment:

Three quarters of these statements came from standard group participants and this is probably a reflection of the fact that in these groups the individual's work load could be materially affected by other members of the group "ordering" them to perform certain duties. The Storeman/Progressor can be requested simultaneously by Controller, Foreman, and perhaps Operator, and this proved difficult for some. A few Operators also found the work rate rather fast.

Members of experimental groups, on the other hand, were free to determine their own work pace within mutually agreed limits. These groups were not limited to having only three Operators and this may have reduced work pressure for the group as a whole, although other problems were created instead (e.g. problems of quoting and line balancing).

1e: Quality of Equipment:

The six statements in this section come from participants apparently ignoring the proverb - "a bad workman always blames his tools":

Standard Groups:

Bulldog clips were too small and fiddly to be able to place quickly and accurately; (Surface Operator)

Scissors were uncomfortable and stiff. Needed a pair of left-handed scissors; (Surface Operator)

Experimental Groups:

Stapler broke.
Comment:

No comment.

1f: Insufficient Equipment:

The experimental groups in particular found that they could have used more equipment, e.g. scissors and rulers. This created line balancing problems, and this and section 2d below are closely related. The criterion for inclusion in this section is the specific mention of lack of equipment, or lack of appropriate equipment.

Standard Groups:

Tool racks to hold scissors etc. in easy reach would be useful as tools often got lost under sheets of paper; (Surface Operator)

Some members of the team were initially held up due to lack of staples; (Storeman/Progressor)

Experimental Groups:

There was the lack of equipment in the pattern department which prevented speeding the process by having two people do the job simultaneously. This caused delay at some points;

There was a bottleneck at pattern due to there being only one ruler and one pen;

Not enough tools at each position for more than one person to be able to work efficiently - it was frustrating, for example, when one tried to help Surface because he suddenly had squares to cut out and corners to cut off and there was only one pair of scissors;

Shortage of equipment for others to help Operators that get swamped, e.g. there was only one pen at the Pattern Operator whereas it would probably be better to have two;

Another problem was a stapling machine which ran out of staples during the game;

Some lack of appropriate working tools, e.g. could have done with a 6" ruler when having to pattern the 8 x 8 cm squares, and could have done with a less messy pen.
Comment:

As this experiment attempts to assess the difference between two forms of group organization, it was necessary to control for the amount of equipment provided, which was identical for all groups. But by removing the restrictions regarding the allocation of workers to activities, the experimental groups became acutely aware of the limitations imposed by the equipment provided. This again contributed to the line balancing problem discussed below (2d).

Just how much of a limitation this was may best be judged from an inspection of the performance results; on the whole the experimental groups produced more, earlier, than standard groups.

The standard groups did not really have this problem at all. One statement refers to a lack of staples, the result of an oversight by the Umpires; the other two statements offer suggestions as to how extra equipment would have improved performance rather than to requesting more of the same.

Category 2: Production Scheduling and Control, Figure All.9

This category includes problems related to the clerical (information processing) activities involved in quoting due times for orders, and ensuring (or attempting to ensure) that they are processed efficiently and on time.

2a: Quoting Due Times:

Statements concerned with the problems of allocating or quoting due times for jobs are placed in this section.
Standard Groups:

Although this was meant to represent the real-life situation, I felt the job quotes came in too quickly; (Controller)

Pressure because of time necessary to quote a finish time for a job. There was always pressure to fit a job into the schedule or else lose the job. Often two jobs were given at the same time; (Controller)

Quoting quickly enough, i.e. being offered a job while I was filling in the Load Planning Chart, and having to finish this before quoting effectively; (Controller)

I should have taken more time to analyse our individual system in priority to making quotes that could not get through; (Controller)

Keeping overall track of the situation on the production line was difficult while at the same time coping with estimates; (Controller)

Personally, I encountered problems of piling up quotes when the system was overloaded and probably causing the errors made at the operative level due to pressure; (Controller)

Experimental Groups:

The business of quoting a time for completion of a possible job while in the process of working on another one was a minor irritation causing delay for both quoting and working operations;

The first problem was setting up some system of noting the times at which each operation would end hence allowing a quote to be given for the next job. Sheets were available at each operation but in the time allowed for quoting this was not an easy method. I had to take note, on the master sheet, of every stage of the job hence making it difficult for the person doing the job as he or she did not know when this job had to be finished;

The Storeman seemed to have to rush about a great deal at times, particularly when new jobs and quotations were coming in thick and fast. His prime job as provider of materials tended to become secondary to the role of co-ordinating quotes to possible jobs and chasing other jobs through the production line, helping if and where he could;

Trying to give quotes for one job when in the middle of another. It was confusing trying to estimate one job while you were still in a rush to complete the existing job;
Time pressure - problem of managing to make the quotation quickly and efficiently;

Perhaps one mistake was that I filled in each department's Load Planning Chart myself. This meant that we sometimes did not have enough time to formulate a proper quotation time;

On several occasions I had to make guesses about quotations, having regard to the actual work load of each operative, rather than the load scheduled.

Comment:

Although experimental groups adopted different procedures, all their members may have been involved in determining order due times. In each standard group, only the Controller had this responsibility. This explains why there are twice as many statements in this section from experimental groups than from standard groups, and why all but one of the standard groups' statements came from Controllers (the other being contributed by a Foreman).

Most of these statements mention that not enough time was available for an accurate quotation to be calculated, and certainly the "two-minute rule" did emphasise the need for in one case an efficient Controller, and in the other for an efficient system for obtaining a due time from the whole group. For the experimental groups, achieving such a system was a major problem, or was at least seen as such. Looking again at the performance results of the experimental groups, particularly at the extent to which jobs were delivered early, it may be concluded that the experimental groups created this problem for themselves. Bent on productivity, they appear to have generally ignored the quoted due time once it was given and strived to complete each order in the shortest time possible, regardless of how early its delivery would be. This
strategy interfered with the quoting system to a large extent, and while relatively few jobs may have been delivered late, the overall accuracy of their quotes was poor. The experimental groups do not appear to have realised that this was happening, and it is interesting to speculate how they might have altered their tactics had this been pointed out to them.

2b: Determining Job Priorities:

This section comprises statements referring to the problem of determining the sequence in which orders were to be done once in the factory, i.e. determining relative job priority.

Standard Groups:

There was no marking on jobs to indicate those that were priority jobs; (Surface Operator)

Tendency for job priorities to be ignored; (Storeman/Progressor)

I tried to chase up the job priorities but found difficulty in communicating to the Storeman/Progressor; (Foreman)

For a rush priority job it was difficult to know whether to hold back the Pattern Operator who had just started a normal job, for the Surface Operator to finish the priority job and give it to Pattern; (Foreman)

One member did not adhere to the priority list, although at this time it was up to date, with the result that the work was coming in late; (Controller)

Experimental Groups:

The major problem was related to the flow of work. On some occasions (the majority) I had to await the arrival of the next job or else had to judge whether to
assist another team member in the interim period. On other occasions I was faced with two jobs arriving at the same time and had the problem of deciding which to do first;

No planning of processes that was in any way very effective, so I was given jobs in wrong order;

Not always told which of two jobs should be given priority but we could find that out relatively easily by calling over to the person by the quotation times sheet;

We found ourselves doing jobs in a different order than that in which they had been given to the group, because of congestion in our department;

The Lead Planning Charts for each operator were not synchronised because the individuals at Surface, Pattern and Base filled in the chart at each position and did not know when, e.g. Surface was going to pass the job on to Pattern.

Comment:

Of the standard group statements, only two are from Operators. This is to be expected as it is the Foreman who uses the Job Priority List, the Controller who determines the relative priorities, and the Storeman/Progressor who is expected to move completed jobs as soon as possible. The statements from experimental groups are concerned more with the loading of the group as a whole, rather than with determining priorities on individual jobs, and this was a problem of which all group members were aware regardless of their own specific task or tasks. The scheduling process was not a simple one, the requirements for each job which determine the routing being such that a straightforward rule like "doing the job with the lowest job number first" could not be relied upon.
2c: Job Progressing:

The physical movement of jobs from activity to activity gave rise to the problems which have been included in this section.

Standard Groups:

Working area became very cluttered when scrap was not removed and finished jobs were left lying; (Surface Operator)

Jobs being left on Base Operator's desk; (Surface Operator)

Progressor knowing where work was initially; (Surface Operator)

Perhaps on occasions the Progressor was a little slow in transferring jobs from one Operator to the next on the list; (Storeman/Progressor)

Time pressure to redistribute work and hand in final products; (Storeman/Progressor)

An initial problem was that the position of the stores in relation to the production line made transporting materials from stores to Operators difficult; (Storeman/Progressor)

It was difficult for the Storeman/Progressor to realise when new work was required; (Foreman)

Transferring of completed jobs at one operation to the next operation was slow since the Stock Controller was involved; (Foreman)

Experimental Groups:

On two occasions orders had been completed at the pattern stage but were left for about five minutes before handing on to the next stage;

There was no one taking the jobs from one department to the next so some were left lying on desks.

Comment:

The experimental groups in general did not have this problem as
jobs did not have to lie until the designated person removed them, as in the standard groups.

2d: Line Balancing:

This is the largest section in this category and comprises statements expressing the difficulties in maintaining a steady flow of work at each activity. The production process has some of the characteristics of a three-station assembly line, and the typical problems of maintaining a smooth work flow were compounded by the fact that jobs did not necessarily undergo the same sequence or number of operations in the course of manufacture.

Standard Groups:

Pattern man was overworked; (Surface Operator)

Frequent slack periods; (Surface Operator)

It became rather pointless trying to better the standard time when you spent two minutes waiting between some jobs; (Surface Operator)

Finding one or more batches being brought before you had finished the first; (Pattern Operator)

It took at least a minute less than the standard time for me to complete each job. Then I had to wait for my next job; (Base Operator)

Lack of sufficient work or too much idle time; (Base Operator)

We did not optimise the utility of the people on the team, therefore as a base cutter, I spent a lot of time with nothing to do; (Base Operator)

If one Operator was a slow worker (as was the case with one of ours), all the work got clogged up at his desk while the other two had very little to do; (Storeman/Progressor)

Work piled up at particular Operators. Pile up of work shifted - sometimes at surface, sometimes at base; (Storeman/Progressor)
As most of the jobs started at Surface, this Operator had a backlog; the Pattern Operator could just keep pace and the Base Operator was redundant for much of the time; (Foreman)

The Foreman had some problems with controlling the workforce. Movement of workers in response to work troughs could have been improved; (Foreman)

Output rate of Operators varied significantly. Bottlenecks occurred due to the variance in output. Transferring of Operators did not help to increase production at Pattern or Base; (Foreman)

Our team encountered problems of operatives either overworked or not doing any work. The problem was solving this; (Controller)

Some members were not able to work continuously; again this was due to lack of time; (Controller)

Experimental Groups:

There was a bottleneck in the Pattern department. This demonstrated one of the problems of working "in line". The person on the production line one step further on than the Pattern department was not able to work full time and the people before the Pattern department slowed their work rate to alleviate the bottleneck;

We did not have enough work to do causing a bottleneck in the Pattern department;

The main problem that the team encountered was the discontinuity which resulted in the Pattern section. The other sections seemed to run quite smoothly, but work was held up here;

Work was held up at Pattern and even with two people working there it was not eased;

Work balance not distributed evenly. Some operators working hard all the time;

Periods with no specific job to do then periods of too much work. Work tended to come in bursts with several jobs to do all at once then periods with no set jobs to do;

Occasionally there were unproductive periods - 1 to 2 minutes at the most - while either waiting for a new job or for one from another section of the group;
Team encountered problem of uneven work flow;

The problem with workflow was apparent in each area of work, but was overcome at least to a degree as the game progressed and as the "controller" in particular was able to regulate the workflow better;

As the game progressed the bottleneck at Pattern lessened and the problems grew less as everyone found out exactly what was expected of them.

Comment:

For the standard groups, this was basically a problem of erratic work load for the individual Operators, while for the experimental groups it was the pattern operator(s) in particular who disrupted production. The reason for the bottleneck at the Pattern activity, which many of the experimental group statements in this section refer to, is that two people at each of the Surface and Base activities could speed up production by dividing the work, but in the Pattern activity this was not so easily done. There was little that a second person in the Pattern activity could do to help, and so that activity became overloaded. This problem is related to that of Section 1f, "Insufficient Equipment". But as with Section 2a, "Quoting Due Times", this was a problem which need not have arisen had the experimental groups been aware of the extent to which performance levels exceeded that required by their quoting.

2e: Tracing Jobs:

This section includes statements expressing the problems of finding (and losing) jobs and monitoring and recording their progress through the factory.
Standard Groups:

One incident which could have been disastrous for the team was that one of the members of the production line finished his part in the production of a certain job and passed it on to the next person indicated on the job card, and not via the Progressor. This resulted in the Job Movement Card not being filled in. If not for the fact that the Controller enquired about that job, the Foreman would not have asked me in what stage of the process this job was at and it could have been produced late; (Storeman/Progressor)

My main problem lay in trying to keep track of the activities of other team members, specifically the Storeman, in order to update my Job Priority List; (Foreman)

The Controller only informed me of a new priority as it was being sent out to the Operators. As a result, the Job Priority Sheet was of little use, and much of my time was spent checking which jobs were in process and which were waiting to start; (Foreman)

The team encountered one problem where the Foreman and Storeman/Progressor lost track of a job. This occurred when the Surface Operator handed the job straight to the Pattern Operator and not to the Progressor. Although the job was finished on time, no one knew; (Controller)

I needed a more accurate table of what the hold-ups were in the system and the time limits taken at each operative level. The Storeman and I shared this sheet of information and it was in high demand by both of us; (Controller)

Difficulty in keeping a record of how the work on each job was progressing and knowing if the job was finished before the time quoted or not; (Controller)

Keeping track of jobs in progress; (Controller)

Experimental Groups:

The administrative side of the game tended to lapse under pressure of work and at one stage, because of this, we could not instantly trace the whereabouts of a job which was becoming more and more overdue.

Comment:

All but two of these statements come from standard groups,
Standard group Operators were apparently not aware of this problem and experimental groups do not appear to have encountered this problem at all. This is at least partly due to the fact that standard group managers had specific responsibilities in this respect whereas the experimental group participants did not have their attention drawn to this problem in a prespecified manner. Where an experimental group did lose track of a job, however, it was probably quickly found due to the comparatively free communications which members had with each other.

Category 3: The Paperwork, Figure All. 10.

This category includes statements expressing problems with the various sheets and forms used in the game.

3a: Difficulty in Filling in the Paperwork:

The statements in this section are loosely connected in stating problems or difficulties in using the respective forms.

Standard Groups:

Material was protected by too many forms and so inaccessible; (Surface Operator)

Difficulty in understanding the paperwork system. The paperwork involved in some cases seemed to hinder or confuse the flow of work through the department; (Base Operator)

Form filling difficult as well; (Foreman)

Initially, there was some difficulty in identifying the uses for the various forms. It would have been advisable to obtain blanks beforehand so that each member of the group would have been familiar with his own paperwork; (Controller)
Experimental Groups:

Only getting to understand the Job Activity Sheet by the time it was too late to keep it up to date;

There was also possibly misunderstanding about filling in job times for each department;

Difficult to fill out the Load Planning Chart in advance as it should be;

A number of the "workers" did not know how to fill in their work sheets.

Comment:

Although the paperwork was kept as simple as possible, the forms themselves giving a reasonably clear indication of how they were to be used, a number of participants apparently had trouble in understanding them. It is probably true to say that the paperwork which the experimental groups used was more difficult to understand and use effectively than the standard groups' forms. This is not reflected in the number of statements included in this section, as the experimental groups perceived this as a general problem of quoting due times (Section 2a) rather than as specific problems with individual forms.

The difficulties of both groups in this area are largely due to the inadequacy of the initial induction process, which has already been discussed.

3b: Time Taken Filling in the Paperwork:

The time required to fill in the paperwork was seen by some participants as interfering with what they felt to be more important activities.
Standard Groups:

Filling in the timesheet which took up valuable time; (Pattern Operator)

Time wasted in finding the correct form; (Foreman)

Experimental Groups:

Had too many jobs coming in at one time, couldn't fill out forms;

The time scale was so short that the filling out of forms took up too much time;

Inability to fill in time sheet, went straight on to next job without filling up a time sheet, job was more urgent;

Trying to keep paperwork up to date while continuing production. It was difficult to keep a record of what one was doing while trying to get all the jobs done quickly enough;

The main problem seemed to be in keeping in with the paperwork. The time spent thinking about what to fill in on these forms must have wasted time;

Paperwork - working quickly it was not easy to keep the timing sheet clear - mistakes were unavoidable.

Comment:

The experimental groups experienced this problem to a greater extent than the standard groups. The forms which they used should have taken longer to fill in in some cases, but their additional productive capacity in terms of the number of Operators they could use was expected to offset this apparent disadvantage. The experimental groups did not realise this and concentrated on output as their prime objective.

3c: Forgetting to Fill in the Paperwork:

Inclusion in this category is self-explanatory.
Standard Groups:

Filling in forms - tendency to forget; (Surface Operator)

Operators failing to fill in forms didn't help; (Foreman)

Experimental Groups:

Recording data on time sheets etc. Everyone seemed to forget about time sheets;

My main problem was remembering, and if I could remember, getting the time to fill in the load sheets and job quotation sheets. This was probably because I had to flit from one function to another and back again, and I lost count.

Comment:

The small number of statements in this section may reflect the extent to which this was perceived as a problem by participants. But it is a poor indication of the extent to which, especially in the experimental groups, participants did omit to complete the requisite paperwork in the course of the game.

jd: Mislaying Forms:

This section is also self-explanatory.

Experimental Groups:

The Pattern Operator managed to mislay the job sheets or order sheets, further complicating matters;

Also mislaying the Job Quotation Sheet after getting quotes or when obtaining material from stores; if it had been on a board it might have helped.

Comment:

Apparently insignificant in itself, this section comes at the
end of a list which illustrates the much greater problems which the experimental groups had with the paperwork. It would, however, be wrong to conclude from this that, in the game, the experimental groups had a less efficient "information system". Instead of using the paperwork, they relied on a purely verbal communication system which, in terms of a 40-minute exercise, is probably more efficient than a paper one. Further discussion of this point is reserved for a later section.

Category 4: Group Organization and Communication, Figure All.11.

This category comprises four sections which deal with problems of organization, communication, information and task allocation respectively. These sections were the last to emerge from the sorting process and inclusion in Sections 4a, c and d (Organization, Communication, Information) is determined by a key-word analysis on those statements not sorted into other categories.

4a: Organization: key words - organization, co-ordination:

Standard Groups:

Our firm was not a formal organization since the Controller was often in direct contact with the Operators; (Base Operator)

A lack of organization existed initially, possibly due to the novelty of the game, but this soon disappeared; (Storeman/Progressor)

The first main problem was co-ordination - between the Controller, the Foreman and the Storeman. We needed a feedback system so that the problems of the system could be brought out and the group could work on these as a unit; (Controller)
Experimental Groups:

The group tended to organize itself into much the same format as was intended to be operated on Wednesday, except that two people worked on Pattern;

No co-ordination within the group, therefore jobs were lost and forgotten and done wrong. A method of getting jobs in on time is very important;

The group needed more co-ordination;

There was a general lack of organization and our group would have benefited from a more formal hierarchy of managers and workers;

We needed someone to co-ordinate the action of the group as a whole;

Initial lack of co-ordination due to the "unit cell" system;

Initially there was a lack of organization but this was probably because it was only a short run; over a period the group would decide among themselves which job each was to do having had this experience of what job entails;

Should have discussed more how we were going to work - would have solved some of our co-ordination problems;

Team encountered problems of co-ordination of effort;

Lack of co-ordination - as a democratic group we had to participate yet without definite duties it became ill co-ordinated.

Comment:

This section and the one which follows, "Task Allocation", are closely related and discussion of both sections has been deferred until after presentation of the latter.

4b: Task Allocation:

This section comprises problems of allocating or distributing work to group members. The statements from experimental groups have here been further subdivided: about half refer to problems of task allocation, the others suggest solutions to these problems.
Standard Groups:

The first person drawing patterns was too slow and eventually the Foreman decided to change the Surface and Pattern workers around; (Base Operator)

Resource allocation - not the best people for the jobs, if physical and language handicaps are considered; (Base Operator)

Two of the Operators were swapped, but the new Operator, although he was good at his previous job, was not much better than the Operator he had swapped with; (Storeman/Progressor)

When the Controller wished to start a new job, he gave the job sheet straight to the Storeman/Progressor, thereby making the post of Foreman virtually redundant; (Foreman)

The distribution of jobs in the first place was random; if we had given the jobs out as we thought we could have done them, we might have avoided the communications problems; (Foreman)

Our team had one rather slow Operator and one rather fast Operator whose roles I would have swapped had the game lasted any longer; (Foreman)

Experimental Groups' Problems:

Teething troubles in getting started, getting any of the jobs started properly. Jobs needing done and a volunteer to do it;

If I had had the authority as a manager, I would have replaced the Pattern man because he was not working efficiently;

Too many people all trying to do one job, particularly to begin with. In some ways they were merely confusing one another. Admittedly things began to work better towards the end;

Arguments among rest of "team" as to whose fault things were, as there appeared to be no clear line of responsibility;

Experimental Groups' Solutions:

Eventually it had to be arranged that one of the Surface workers filled in the charts only so that I could continue
with the Pattern work uninterrupted. After the rearrangement work became more efficient and we were able to finish the jobs according to the schedule that we had suggested.

The other problem that I observed was in the Pattern activity. The standard time for each model was very restricted. So I helped providing the worker and helping him to find the pattern in the correct position, filling his sheet and taking care for the next stage of production.

As work began to build up, however, the "unit cell" system did allow more than one person to work at a given job and hence clear the backlog. In this respect, at least, the "cell" system was more effective;

A lot to do in keeping Surface and Base Operators supplied with material (and giving quotes as well). This was lessened by the Operators moving the jobs and if necessary obtaining their own material;

The work was slack for a while which made the team think that each person could move on his work to the next operation;

A system whereby one person kept a record of all the departments and their commitments, and thus was in a position to look at all the data and give a quote rather than running round every department individually (within the allotted two minutes) would, I feel, be more efficient and less irksome.

Comment:

Since standard groups had their task allocations specified in detail, it is not surprising that the experimental groups should see this as more of a problem. The attention of experimental groups was concentrated to some extent on the business of organizing the team and distributing work between the members.

Of the experimental group statements concerning organization, several expressed the sentiment that efficiency could have been improved had they organized themselves in a more autocratic manner. This feeling is also reflected in the task allocation section, the last statement quoted expressing the desire for a single "controller"
to take charge of quoting and scheduling. The reluctance to participate in group decision making is in evidence here in some of the statements. A number of the experimental group statements, however, offer constructive suggestions as to how these problems were or could have been overcome, without necessarily incorporating a degree of autocracy.

40: Communication: key words - communication(s), contact:

Standard Groups:

No contact with others; (Surface Operator)

Lack of contact between Operators; (Surface Operator)

Communication between departments was bad; (Base Operator)

General lack of communication between the Controller, the Foreman and the Storeman; (Foreman)

The team were not sure how far ahead or behind schedule they were as there was no direct contact with the Controller; (Controller)

Experimental Groups:

Communications could have been improved: times predicted for part of a job to be done by did not always relate to the actual situation;

Communications between each other. Two people going to do the same job at the same time.

Comment:

In contrast to the problems of organization and task allocation, it appears to have been the standard groups which suffered more from
communications problems than did the experimental groups. This is again largely due to the prespecification of roles and the handling of information. For example, only the Storeman knew when jobs had been moved from activity to activity, only the Controller could decide which job should be given priority at each activity.

4d: Information: key words - information, knowledge, "no idea", feedback:

Standard Groups:

No idea what was happening as a whole; (Surface Operator)

Lack of feedback - we had no indication as to whether the jobs we had done were done correctly; (Base Operator)

Lack of feedback as to my performance. I was not aware of any mistakes or work done well, i.e. I couldn't monitor or measure my own performance and thus correct or alter my performance; (Base Operator)

No idea of how accurate cutting should be - Foreman didn't seem to care; (Surface Operator)

The game was not long enough to develop a smooth flow of information from the Controller down to the ranks; (Foreman)

Experimental Groups:

Lack of information. Though our group did not get the instruction yet I was searching for the job as Controller had no knowledge;

No feedback on what we were doing wrong as the game progressed;

Not every member of the group had complete knowledge of what was going on so that one sometimes did not know what position could be helped best when one had a free couple of minutes. However, we all could shout at each other and so find out what we wanted to know.

Comment:

Again the standard groups had more problems in this area than
the experimental groups. The last statement quoted above is of assistance in explaining why this should be so. Experimental group members were free to move around and communicate as they pleased and could find things out for themselves without waiting until the person with the relevant form became free.

**Category 5: Miscellaneous, Figure AII.12.**

This category contains seven sections which could not be included in any of the other four categories.

5a: Job satisfaction/frustration:

**Standard Groups:**

Cutting out little pieces of paper isn't my idea of an interesting job. So boredom would be a great problem in such jobs; (Base Operator)

Soon became bored as novelty wore off; (Surface Operator)

Only one major problem - I was bored stiff; (Base Operator)

The other problem was the definite lack of enthusiasm among the Operators. There seemed to be no motivation which led to slowness of work and hence orders becoming later and later as the game progressed; (Storeman/Progressor)

**Experimental Groups:**

Lack of motivation to organize firm properly;

The main problem that our team suffered from was lack of motivation and incentive since the game seemed more like a joke than anything else.

**Comment:**

The Operators in the standard groups at least discovered for themselves (in 40 minutes) just how boring such jobs can be.
The two statements from experimental groups are not concerned with job satisfaction as such, but with a general lack of enthusiasm to participate in the exercise at all.

5b: Game not long enough:

Standard Groups:

I suspect that if we had played the game for longer and learned our respective roles better these problems could have been resolved; (Foreman)

Had we played longer, more of the game's intricacies would have become apparent; (Foreman)

Experimental Groups:

Too short a time for familiarity with job and relationships with other jobs;

Host of the problems encountered could have been overcome through experience of the situation. The combination of being confused as to the actual game; how it was supposed to work; and how our group was trying to work it created a temporary difficulty which I think would have improved with time;

Time was too short to encounter most of the problems which would occur in a real situation.

Comment:

It was gratifying to discover no statements suggesting that the game would have been better had it been shorter. A possible reason for all the statements in this section coming either from standard managers or experimentals is that they felt themselves to be learning more about the situation they were operating. The standard operators, however, rather than managers or experimentals, complained of boredom.
5c: Could not see the clock:

Standard Groups:

Only two members of the team could see the clock - the referee stood in the way of it for most of the game; (Storeman/Progressor)

Experimental Groups:

Clock should have been in a better position.

Comment:

In some cases, a number of games were run in each of the rooms used, and only one clock was available per room. It was thus highly probable that at least at times some participants would be unable to see it.

5d: Material Usage:

Standard Groups:

Kept forgetting to check if jobs could be done on available scrap instead of fresh sheets every job; (Surface Operator)

Efficient use of raw materials - i.e. what to do with off-cuts or scrap, return them or re-use them; (Base Operator)

Experimental Groups:

We had a very high usage of material, probably due to fast working as new sheets always allowed a number of sheets to be cut at the same time.

Comment:

Given the duration of the game, participants in both types of
group concentrated on what they saw to be more important aspects of the exercise, rather than on ensuring that what they knew was scrap paper in any case was used effectively.

5e: Layout:

Standard Groups:

If we were going to work on a bureaucratic system, we should have structured it even more (e.g. one job order was lost behind a chair). This would involve setting out specific places for placing job priority sheets, time sheets, etc; (Controller)

Experimental Groups:

Physical set up was in wrong order - should have had design at middle of a line to resist tendency to go direct from surface to base.

5f: Preliminary Discussion:

Standard Groups:

Could have done with a small amount of time before the game actually started to discuss what everyone was going to do; (Controller)

Experimental Groups:

The group should have discussed about the job earlier as no meeting of the group was called before the game;

We didn't do any preliminary study of the procedure in detail.

5g: Others:

Four statements in this section (two standard and two experimental)
discuss problems of authority.

One Operator was not willing to accept my decision. He did not continue with the job when instructed and would rather argue the point than do anything about it. On being transferred to another (I hoped easier) section, he discontinued communication and co-operation with me;

(Foreman)

There was no authority invested in us to replace the Pattern man as unfortunately this poor chap was totally unsuited to perform the menial task before him, perhaps suggesting that labour relations between men should play an important part in such a system. (Experimental)

The remaining statements mention mainly mistakes which the group or individual members made, e.g.:

- Cutting out bases in anticipation to find that the order was for surfaces only;
- Losing a pencil;
- Delivering half-finished jobs;
- Passing on jobs without the Job Card.
Discussion

Having given above a general description of the results of the content analysis, it is of interest to compare in more detail the content of the tutorial feedback questionnaire replies (a) between standard operators and managers, (b) between standard groups as a whole and experimentals, (c) between standard operators and experimentals, and (d) between standard managers and experimentals. The content, in terms of numbers of statements, of the sections in the content analysis permit statistical evaluation in only a few cases. Where this has been possible, the results are given with the relevant figure (see Figures AII.7 to AII.12). The four levels of comparison will be analysed taking each category in turn, after the results of the combined content analysis, given in Figure AII.7 have been examined.

The Main Categories

(a) standard operators and managers;

From Figure AII.7 there is a significant difference between the pattern of replies of standard operators and standard managers (chi-square = 13.4205, significant at the .01 level). Just under a third of the operators' statements fall into category 1, "the production process". This category contains less than 17 percent of the managers' statements, just under a half of which are in category 2, "production scheduling and control". Managers and operators, therefore, have listed more frequently problems concerning those aspects of the game with which they were most closely connected, operators with the physical production activities, managers with the clerical production control procedures.
(b) Standard groups as a whole and experimental groups;

The difference between the pattern of replies of standard and experimental groups is a significant one (chi-square = 9.7978, significant at the .05 level). Exactly 40 per cent of standard group statements are concerned with "production scheduling and control", category 2, which includes less than 30 per cent of experimental group statements. The latter recorded a higher proportion of statements (almost 25 per cent) in category 4, "group organization and communication" than the standard groups (18 per cent). The standard groups had more problems organizing the flow of work, the experimental groups had more problems organizing themselves.

(c) Standard operators and experimentals;

The pattern of replies of these two groups is not significantly different (chi-square = 4.2483). This contrasts with the result obtained from Figure AII.14 above which showed a significant difference between the replies of these two groups in answer to the first question of the tutorial feedback questionnaire. Combining the answers to the two halves of the questionnaire has eliminated the apparent differences between the replies of standard operators and experimentals. The similarities between their respective tasks is in some ways close, with most of the experimental group members undertaking at least some direct production work during the course of the game. Categories 1 and 2, therefore, account for between 50 and 60 per cent of both groups' replies, category 4 accounts for just over 20 per cent in each case.
(d) Standard managers and experimentals;

The difference between the replies of these two groups is significant (chi-square = 16.8168, significant at the .01 level). The managers listed a smaller proportion of statements in category 1, "the production process" than experimentals (16 to 23 per cent respectively); but listed a much higher proportion in category 2, "production scheduling and control", which accounts for just under half their statements and 29 per cent of experimentals' statements. In other words, managers and experimentals appear to differ in a manner similar to that between managers and operators, described under (a) above. This supports the conclusion reached in (c) above that, overall, the content of the replies of experimentals conforms more closely to that of standard operators than to standard managers.

Similar comparison will now be made between the groups' replies within the sections of each category.

Category 1: The Production Process;

(a) Standard operators and managers;

Statistical analysis of these figures is not possible; they are too small to permit the calculation of a valid significance test. There are, however, some interesting differences between their replies from which conclusions may tentatively be drawn.

It is hardly surprising that operators list more problems concerning the production activities than managers did. Sections 1a, e and f combined account for exactly half the operators' statements in this category, but there is only one manager's statement in these sections. Managers and operators are, on the other hand, in comparative agreement over the problems of knowledge of job requirements.
(one third of operators' statements, about one half of the managers').
This is explained by the induction problems of the exercise which
have been discussed above.

(b) Standard groups as a whole and experimentals;

From Figure All.8 there is a significant difference between the
content of the replies of these two main groupings (chi-square =
13.0011, significant at the .01 level, sections 1e and 1f combined
for purposes of calculation). The major difference here lies in
the experimental groups' problems with insufficient equipment,
section 1f. They were given exactly the same amount of equipment as
the standard groups but as they could use more group members as
production workers, this problem soon became apparent. The standard
groups would have found it hard to use extra equipment without breaking
the rules of the game. The experimental groups also have a smaller
proportion of statements in section 1e, "knowledge of job requirements",
no doubt due to the fact that they had to determine most of these for
themselves.

(c) Standard operators and experimentals;

Over the sections in this category, the replies of operators and
experimentals appear to be similar (but the figures again preclude
statistical analysis). The only major difference is in section 1f;
about one third of the experimentals' statements concern the problem of
lack of equipment, discussed under (b) above. As "operators", many of
them found it frustrating to be prevented from lending assistance to an
overworked teammate through lack of tools.
(d) Standard managers and experimentals;

Here there are two major differences. In comparison with standard managers, experimentals are more concerned with the problems of production activities and lack of equipment, sections 1e and 1f, which account for well over half their statements. There is only one standard manager's statement in these two categories.

Category 2: Production Scheduling and Control:
(a) Standard operators and managers;

Well over half of the operators' statements concern problems of "line balancing", section 2d, as they appear to have experienced either excessive amounts of idle time during the game, or periods of slack alternating with periods of furious activity. Only the managers, on the other hand, would really be aware of the problems of quoting due times, section 2e, which none of the operators mentioned. Overall, the managers appear to have been aware of a wider spectrum of problems in this category, including the determination of job priorities, job progressing, and tracing the whereabouts of jobs in the system.

(b) Standard groups as a whole and experimentals;

From Figure AII.9 there is a significant difference between the replies of these two groups in this category (chi-square = 21.4139, significant at the .001 level). About a third of the experimental groups' statements are in section 2a, "quoting due times", whereas just over 11 per cent of standard group statements are in this section. The system for arriving at due times for orders involved all the experimental group members and was more difficult to operate than the one-man method used by standard groups. On the other hand,
experimental groups had comparatively few problems concerning either job progressing or tracing jobs, sections which together amount to only 12 per cent of their statements, but account for almost 40 per cent of standard groups' statements.

(c) Standard operators and experimentals;

There are no statements from standard operators mentioning the problem of quoting due times, section 2a. A third of the experimental group statements are listed in that section, and although statistical analysis is again not possible, this would seem to be a significant difference. This has been seen in both (a) and (b) above where managers listed this problem more than operators, and experimental groups listed it more than the standard groups as a whole. A second notable difference between these groups is that standard operators gave a rather higher proportion of statements concerning "line balancing" than experimentals.

(d) Standard managers and experimentals;

There is a significant difference between the replies of managers and experimentals in this category (chi-square = 17.4519, significant at the .01 level). Three major differences are the much higher proportion of experimental groups' statements concerning problems of quoting due times, and the higher proportions of standard managers listing problems of "job progressing" and "tracing jobs", sections 2c and 2e.
Category 3: The Paperwork:

(a) Standard operators and managers;

This is the smallest of the five main categories (containing less than 9 per cent of all recorded statements), and once again no statistical evaluation is possible. Standard operators and managers appear, however, to have experienced similar problems in respect of the paperwork.

(b) Standard groups as a whole and experimentals;

Overall, the experimental groups seem to have found their paperwork more difficult than the standard groups did. (Just over 6 per cent of all standard group statements and over 11 per cent of experimental group statements are in this category.) There is little doubt that the experimental groups' paperwork was more difficult to use in the time available; apparently the experimental groups regarded trying to fill in the paperwork as a waste of valuable production time, and section 3b, "time taken filling in paperwork" contains almost half their statements in this category.

(c) Standard operators and experimentals;

There are no differences between these groups indicated in this section.

(d) Standard managers and experimentals;

If a difference can be said to exist, (and the figures are rather small), it is that the managers complained of the difficulty of their paperwork, section 3a, whereas the experimentals considered that the time taken to complete it was excessive, section 3b.
Category 4: Group Organisation and Communication:

There is overall a significant difference between the replies of standard and experimental groups within this category (Figure AII.11; chi-square = 25.9309, significant at the .001 level). This appears to be due to the experimental groups' preoccupation with problems of organisation and task allocation (86 per cent of their statements) in contrast to the standard groups' emphasis on problems of communication and information (60 per cent of their statements). The following comparisons are, therefore, examined combining section 4(a) with section 4(b), and section 4(c) with section 4(d).

(a) Standard operators and managers;

<table>
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<th>Problem</th>
<th>Operators</th>
<th>Managers</th>
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</thead>
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<td>Organisation and task allocation</td>
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<td>11</td>
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<tr>
<td>Communication and information</td>
<td>17</td>
<td>11</td>
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</tbody>
</table>

Figure AII.16: Standard operators and managers; statements in category 4 combining sections 4(a) with 4(b) and 4(c) with 4(d).

From Figure AII.16, there does not appear to be a significant difference between the replies of managers and operators in this category (chi-square = 1.5798).
(b) Standard groups as a whole and experimentals;

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<th>Experimental</th>
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<tbody>
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<td>Communication and information</td>
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</table>

Figure AII.17: Standard groups as a whole and experimentals; statements in category 4 combining sections 4(a) with 4(b), and 4(c) with 4(d).

Figure AII.17 again indicates (as with Figure AII.11) that there is a significant difference between the replies of standard groups as a whole and the experimental groups in this category (chi-square = 24.1693, significant at the .001 level). The organisation structure of the standard groups seems to have created for them typical problems of communication and obtaining information; the experimental groups have largely avoided these problems but the design of the group working situation focussed their attention on the organisation of their groups and the allocation of tasks to group members.

(c) Standard operators and experimentals;

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<th>Experimentals</th>
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</table>

Figure AII.18: Standard operators and experimentals; statements in category 4 combining sections 4(a) with 4(b) and 4(c) with 4(d).
From Figure A11.18 there is a significant difference between the replies of standard operators and experimentals in this category (chi-square = 24.3894, significant at the .001 level).

(d) Standard managers and experimentals;

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<th>Managers</th>
<th>Experimentals</th>
</tr>
</thead>
<tbody>
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</table>

Figure A11.19: Standard managers and experimentals; statements in category 4 combining sections 4(a) with 4(b), and 4(c) with 4(d).

Again, the difference between the replies of these groups is significant (chi-square = 11.5339, significant at the .001 level). The statements of the standard managers are divided equally between the two problem areas in contrast to the high proportion of the experimentals' statements concerning organisation and task allocation.

Category 5: Miscellaneous:

(a) Standard operators and managers;

Over half the operators' statements in this category are in section 5a, "job satisfaction/frustration". The managers have only 1 statement out of 19 here.

(b) Standard groups as a whole and experimentals;

Again, the major difference lies with section 5a, where one quarter of all standard group statements in this category fall, as opposed to only 2 out of the 29 experimental groups' statements.
(c) Standard operators and experimentals;

Here, the emphasis of standard operators on job satisfaction and frustration is contrasted by the six experimental group statements suggesting that the game would have been better had it been longer, section 5b. There are no operators' statements in this section. There are also five statements from experimental groups making the suggestion that some preliminary discussion would have improved their performance in the game; again, there are no statements from operators in this section (5f).

(d) Standard managers and experimentals;

The one noticeable difference here is with section 5f, "preliminary discussion", where there is one manager's statement, and five experimental groups' statements.

Summary

In terms of problems encountered in the game, therefore, the following were the main differences between the groups:

(a) standard operators encountered more problems with

1a: The production activities,
1e: Quality of equipment,
1f: Insufficient equipment,
2d: Line balancing,
5a: Job satisfaction/frustration, in comparison with

standard managers encountered problems with

2a: Quoting due times,
2b: Determining job priorities,
2e: Tracing jobs.
(b) standard groups as a whole encountered more problems with

1c: Knowledge of job requirements,
2c: Job progressing,
2e: Tracing jobs,
4c: Communication,
4d: Information,

in comparison with experimental groups which encountered problems with

1f: Insufficient equipment,
2a: Quoting due times,
3b: Time taken filling in paperwork,
4a: Organization,
4b: Task allocation.

(c) standard operators encountered more problems with

2a: Line balancing,
4c: Communication,
4d: Information,
5a: Job satisfaction/frustration,

in comparison with experimental groups which encountered problems with

1f: Insufficient equipment,
2a: Quoting due times,
4a: Organization,
4b: Task allocation,
5c: Game not long enough,
5f: Preliminary discussion.

(d) standard managers encountered more problems with

2c: Job progressing,
2e: Tracing jobs,
3a: Difficulty filling in paperwork,

in comparison with experimental groups which encountered problems with

1a: Production activities,
1e: Insufficient equipment,
2a: Quoting due times,
3b: Time taken filling in paperwork,
4a: Organization,
4b: Task Allocation,
5f: Preliminary discussion.
Appendix II, Section 8: Evaluation of This Simulation Game as a Teaching Device.

This production system simulation game was designed both as a research experiment and as a teaching device to be used on production management courses. For students who have little or no experience of this kind of work environment, simulation gaming has significant advantages over conventional lecturing techniques. The success of this exercise may be attributed to four factors: both final versions of the game are practicable, the participants enjoyed it, participants learned something of the typical problems of production management, and the game appears to be a fairly realistic simulation of a production system.

Although the pilot run of the original version of the game quickly degenerated into chaos, both the final versions of the game are workable as the performance results in general indicate. There are problems in introducing the students to the exercise which could be overcome by using more than one dummy job to illustrate the operation of the factory and its paperwork. This drawback has not seriously affected the results presented here, however, although improved induction methods would be recommended for similar future exercises.

The participants enjoyed the exercise. This is indicated in their responses to the opinion questionnaire, and in their comments when discussing the exercise in tutorials. This appears to be a typical reaction to simulation exercises of this type (see, for example, Taylor and Walford, 1972, and Gibbs, 1974).
The content analysis of replies to the tutorial feedback questionnaire indicates that participants' awareness of several typical production management problems was stimulated. Their initial reaction, from the opinion questionnaire, was that they had not learned very much, but the content analysis indicates otherwise. Without knowing precisely what problems the game would focus participants' attention on, it was not possible to structure the feedback tutorial in the most effective way. Armed with this knowledge, a more valuable feedback session could be designed for future use.

The content analysis also indicates that this exercise contains a degree of realism. Not only are some of the problems encountered design specific (e.g. experimental groups had problems of organisation - standard groups had problems of communication), but between standard operators and managers, a number of problems encountered are role specific. It is predictable that operators would have more problems with the production activities than managers, and that managers would have more problems with production scheduling than operators. The content of the replies falls into precisely this pattern.

The success of the game as a teaching device, its practicability and its realism, have a significant bearing on the discussion of the hypotheses in Chapter 6 above.

Modified versions of this game were also run with a class of 15 year old pupils at a school outside Edinburgh. As a "work experience" experiment, this was highly successful (see Evans, Buchanan and Selkirk, 1975, for a detailed account of that experiment).
APPENDIX III:

PRODUCTION SYSTEM SIMULATION GAME MATERIALS.
APPENDIX III - CONTENTS

This Appendix is divided into the following seven Sections:

Section 1: The Design Process.
Section 2: Umpire's Order Issue Sheet and Job Cards.
Section 3: The Paperwork for the Standard Game Design.
Section 4: The Paperwork for the Experimental Game Design.
Section 5: Umpire Procedure.
Section 6: Format of the Opinion Questionnaire.
Section 7: Routine Control Operations in the Standard Design.
Appendix III, Section 1: The Design Process.

For the purposes of this research, two designs were required, a "standard" design, and an "Experimental" design. The results of the experiment are based on a comparison of the performance of the participants in these respective groupings.

An initial standard design was drawn up and tested with a group of members of staff and postgraduate students in the Business Studies Department. The performance and comments of this group led to significant modifications to the game which appeared to be too complex to learn in the time available. Despite some fundamental alterations at this stage, this problem was never completely overcome and is further discussed below.

The redesigned game was then tested with a group of Business Studies students (an Honours degree class) and since no further modifications to the design seemed necessary, the results of the performance of this group have been included in the analysis presented in Appendix II, above.

An experimental design was then tested with a different group of staff members and postgraduate students. This design seemed to be satisfactory and suffered no modifications; the results of this group's performance are therefore also included in the above analysis.

Design Complexity

As explained above, some major characteristics of the initial design were dropped as a result of the first test run. During the game itself, and in the feedback session afterwards, it became clear
that the initial design was too complex. The participants were unable to cope with the variety of tasks that they were required to carry out in the time give (at this stage the duration of the game had been set at 1 hour). The aspects of the design which were subsequently eliminated concerned stock and quality control.

Stock control:

The group was given a small start stock which would run out after about 15 minutes. They were provided with a Stock Order Sheet which the Storeman carried but the Foreman had to authorise its use. The Umpire operated certain "rules" governing the "delivery" of stock, eg, there would always be a 4-minute delay between order and delivery.

Quality control:

Once delivered, orders were checked immediately by the Umpire who returned all unsatisfactory mats to the Production Controller. These mats had then to be reprocessed along with a "Rectification Job Card".

Substantial chaos was created when stock was not ordered, and when it was, not delivered when expected; when faulty orders started working their way back through the production system holding up other work, confusion was complete.

Both of these aspects were therefore dropped from the game. Future groups were given more than enough stock to complete the game, and the quality of the mats produced was checked by the Umpires only after the games had been run.

Two conclusions may be drawn from this experience. First, it is essential that a simulation such as this should attempt to focus upon only a limited number of key aspects of the real situation that
is to be simulated. Attempts to portray reality more closely may
serve only to obscure the nature of the process that is to be explored.
Second, pretesting is an indispensable phase of the design process;
this is time consuming and potentially frustrating but only pure
chance is likely to produce a workable design at the first attempt.
Appendix III, Section 2: Umpire's Order Issue Sheet and Job Cards.

This Section includes the Umpire's Order Issue Sheet and the complete set of Job Cards used in both versions of the game. The Job Cards that were actually used were A4 size, and these have been photo-reduced for inclusion here. The Order Issue Sheet has two sets of columns at the right hand side and could thus be used twice.
<table>
<thead>
<tr>
<th>Job No.</th>
<th>Time of Issue</th>
<th>Allowed Time</th>
<th>Standard Group</th>
<th></th>
<th>Experimental Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01/1</td>
<td>00</td>
<td>any</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01/2</td>
<td>00</td>
<td>any</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>00</td>
<td>any</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>00</td>
<td>any</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>00</td>
<td>36</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>05/1</td>
<td>02</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05/2</td>
<td>02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>04</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>06</td>
<td>54</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>06</td>
<td>42</td>
<td></td>
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</tr>
<tr>
<td>09</td>
<td>10</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/1</td>
<td>12</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10/2</td>
<td>12</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>18</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>63</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
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<td>15</td>
<td>28</td>
<td>64</td>
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<td></td>
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</tr>
<tr>
<td>16</td>
<td>30</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>30</td>
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</tr>
<tr>
<td>18</td>
<td>32</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stock at end of game: Surface(printout): ______ sheets
Base(A4): ______ sheets
<table>
<thead>
<tr>
<th>Job No.</th>
<th>Standard Material Requirements</th>
<th>Specification</th>
<th>Quantity</th>
<th>Standard Time (Factors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. BASE</td>
<td>20 cm x 3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2. Pattern</td>
<td>20 cm x 3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3. Base</td>
<td>20 cm x 3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Specification:
- Standard Material Requirements
- 20 cm x 3

- Activity:
  - 1: BASE
  - 2: Pattern
  - 3: Base
<table>
<thead>
<tr>
<th>Job No. 01/2</th>
<th>JOB CARD</th>
<th>Quantity: 6 doz.</th>
<th></th>
<th>Job No. 02</th>
<th>JOB CARD</th>
<th>Quantity: 6 doz.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BASE</td>
<td>6</td>
<td><img src="image" alt="Base Diagram" /></td>
<td>3</td>
<td>1. SURFACE</td>
<td>3</td>
<td><img src="image" alt="Surface Diagram" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. PATTERN</td>
<td></td>
<td><img src="image" alt="Pattern Diagram" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. BASE</td>
<td>6</td>
<td><img src="image" alt="Base Diagram" /></td>
</tr>
</tbody>
</table>

Staples
<table>
<thead>
<tr>
<th>Job No: D3</th>
<th>JOB CARD</th>
<th>Quantity: 4 doz.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Material Requirements</td>
<td>Specification</td>
</tr>
<tr>
<td>Activity:</td>
<td>1. SURFACE</td>
<td><img src="image1" alt="Surface Diagram" /></td>
</tr>
<tr>
<td>Activity:</td>
<td>2. PATTERN</td>
<td><img src="image2" alt="Pattern Diagram" /></td>
</tr>
<tr>
<td>Activity:</td>
<td>3. SURFACE (REMOVE CORNERS)</td>
<td><img src="image3" alt="Surface Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Job No: CA</th>
<th>JOB CARD</th>
<th>Quantity: 4 doz.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Material Requirements</td>
<td>Specification</td>
</tr>
<tr>
<td>Activity:</td>
<td>1. SURFACE</td>
<td><img src="image4" alt="Surface Diagram" /></td>
</tr>
<tr>
<td>Activity:</td>
<td>2. PATTERN</td>
<td><img src="image5" alt="Pattern Diagram" /></td>
</tr>
<tr>
<td>Activity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Standard Material Requirements</td>
<td>Specification</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>1. SURFACE</td>
<td>1</td>
<td><img src="image" alt="square diagram" /></td>
</tr>
<tr>
<td>Activity:</td>
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<tr>
<td>Activity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Job No: 06
**Standard Material Requirements**
**Specification**
**Standard Time (minutes)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>1. SURFACE</th>
<th>1</th>
<th>4</th>
</tr>
</thead>
</table>

### Job No: 07
**Standard Material Requirements**
**Specification**
**Standard Time (minutes)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>1. SURFACE</th>
<th>6</th>
<th>5</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>2. PATTERN</th>
<th>5</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>3. BASE</th>
<th>6</th>
</tr>
</thead>
</table>

**Quantity:** 1 doz
<table>
<thead>
<tr>
<th>Activity</th>
<th>Standard Material Requirements</th>
<th>Specification</th>
<th>Standard Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SURFACE</td>
<td></td>
<td>3 x 15 cm</td>
<td>5</td>
</tr>
<tr>
<td>2. PATTERN</td>
<td></td>
<td>5 x 15 cm</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. BASE</td>
<td></td>
<td>6 x 15 cm</td>
<td>3</td>
</tr>
<tr>
<td>2. PATTERN</td>
<td></td>
<td>7 x 15 cm</td>
<td>2</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job No</td>
<td>JOB CARD</td>
<td>Quantity: 1 doz.</td>
<td>Standard Material Requirements</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>10/1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Activity:</strong> BASE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Activity:</strong> BASE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ACTIVITY: BASE

**Specified Dimensions:**
- Width: 8 cm
- Height: 15 cm

**Note:** The diagram on the right side of the page is not clearly legible due to the quality of the image.
<table>
<thead>
<tr>
<th>Job No.</th>
<th>JOB CARD</th>
<th>Quantity: 120s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job No.</td>
<td>JOB CARD</td>
<td>Quantity: 120s.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SURFACE</td>
<td>3</td>
<td><img src="image" alt="Surface Diagram" /></td>
<td>5</td>
<td>1. SURFACE</td>
<td>1</td>
<td><img src="image" alt="Surface Diagram" /></td>
<td>4</td>
</tr>
<tr>
<td>2. PATTERN</td>
<td></td>
<td><img src="image" alt="Pattern Diagram" /></td>
<td>2</td>
<td>2. PATTERN</td>
<td></td>
<td><img src="image" alt="Pattern Diagram" /></td>
<td>2</td>
</tr>
<tr>
<td>3. SURFACE (REMOVE CORNERS)</td>
<td></td>
<td><img src="image" alt="Surface Diagram" /></td>
<td>2</td>
<td>3. BASE</td>
<td></td>
<td><img src="image" alt="Base Diagram" /></td>
<td>7</td>
</tr>
</tbody>
</table>

**Notes:**
- Surface: 3 layers, 18 cm, 15 cm, 5 cm
- Pattern: X
- Base: 8 cm, 8 cm, 2 cm, 2 cm, 1 cm, 7 cm, 1 cm
- Standard Time for Surface: 5 minutes
- Standard Time for Pattern: 2 minutes
- Standard Time for Base: 7 minutes
<table>
<thead>
<tr>
<th>Activity</th>
<th>Standard Material Requirements</th>
<th>Specification</th>
<th>Standard Time (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Base</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Base</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>----------</td>
<td>------------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>Activity:</strong></td>
<td><strong>Standard Material Requirements</strong></td>
<td><strong>Specification</strong></td>
<td><strong>Standard Time</strong></td>
</tr>
<tr>
<td>1. SURFACE</td>
<td>6</td>
<td><img src="image" alt="Surface Diagram" /></td>
<td>5</td>
</tr>
<tr>
<td>2. PATTERN</td>
<td><img src="image" alt="Pattern Diagram" /></td>
<td>7</td>
<td>2. PATTERN</td>
</tr>
<tr>
<td>Job No: 17</td>
<td>Job No: 18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Activity:</strong> 1. SURFACE</td>
<td><strong>Activity:</strong> 1. SURFACE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard Material Requirements</strong>:</td>
<td><strong>Standard Material Requirements</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Specification</strong>:</td>
<td><strong>Specification</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard Time (minutes)</strong>: 4</td>
<td><strong>Standard Time (minutes)</strong>: 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Activity:</strong> 2. SURFACE (REMOVE CORNERS)</td>
<td><strong>Activity:</strong> 2. BASE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Specification</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Standard Time (minutes)</strong>: 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Activity:</strong> 3. SURFACE (REMOVE CORNERS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Specification</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Standard Time (minutes)</strong>: 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix III, Section 3: The Paperwork for the Standard Game Design.

This Section includes a complete set of the different forms that were used in the standard version of the game. These forms were printed on A4 size paper for actual use, but have been photo-reduced for inclusion here.
The standard design uses ten separate forms which are described here in terms of name, person using the form, and function:

Form name: LOAD PLANNING CHART  
Holder: Controller  
Function:  
As orders, or Jobs, are received the Controller enters the work to be done at each activity onto this chart, in pencil, and thus calculates a due time or quote. Job quotes that are unsuccessful are erased from the chart. Each activity thus has its work load scheduled a number of minutes in advance.  
Because there are various combinations of routings of Jobs through the factory, it is not necessarily the case that each activity should give priority to jobs with lower Job Numbers. The Foreman, therefore, carries a JOB PRIORITY LIST which the Controller updates, as Jobs are successfully quoted for, using the LOAD PLANNING CHART.  
This form is actually a large Gantt chart and it has time scale in minutes on the first of its three sections, the others having been left blank for the Controller to use as he wishes.

Form name: JOB PROGRESS SHEET  
Holder: Controller  
Function:  
When a quote has been successful, the Controller enters the details of standard times for the Job, as shown on the JOB CARD,
and the due time he has just given, onto this sheet.

As the Storeman/Progressor moves Jobs from activity to activity he fills in a JOB MOVEMENT CARD and the Controller uses this to discover where Jobs are in the system and how close they are to completion. From the JOB MOVEMENT CARD, the Controller can cross off completed activities on the JOB PROGRESS SHEET.

On completion, the Storeman/Progressor delivers the Job to the Umpire and informs the Controller of the actual delivery time; this is also entered on the JOB PROGRESS SHEET and gives the Controller feedback on the accuracy of his quoted due times.

Form name: JOB PRIORITY LIST
Holder: Foreman
Function:

The Controller schedules the work load of each activity on the LOAD PLANNING CHART. The sequence in which Jobs are to be performed at each activity are then listed, by the Controller, onto the Foreman's JOB PRIORITY LIST. Thus when an Operator has completed work on one Job, the Foreman tells him which job to start next. It need not be that Jobs with lower Job numbers have priority.

Form name: PERFORMANCE ANALYSIS SHEET - SURFACE
(The PERFORMANCE ANALYSIS SHEETS for PATTERN and BASE are combined on a separate form)
Holder: Foreman
Function:

The Foreman has a separate PERFORMANCE ANALYSIS SHEET for each activity. This provides him with a comparison between the
actual time an Operator has taken to perform an activity and the standard time for that activity thus giving some indication of the Operator's efficiency. The actual time is obtained from the OPERATOR WORK RECORD, the standard time is given on the JOB CARD.

Form name: OPERATOR TRANSFER SHEET
Holder: Foreman

Function:

If the Foreman finds that an Operator has insufficient work to do, or if he believes that an Operator may perform more effectively at a different activity (the PERFORMANCE ANALYSIS SHEET may give this indication) he can inform the Controller and request that the Operator be transferred, perhaps exchanged with another Operator. The Controller must authorise any such transfers and sign the OPERATOR TRANSFER SHEET. He may know of a Job just received which will require an Operator in the activity concerned. All transfers of Operators, including the transfer of an Operator back to the activity he was moved from are recorded on this form.

Form name: JOB MOVEMENT CARD
Holder: Storeman/Progressor

Function:

Each time the Storeman/Progressor moves a Job from one activity to another, and when he delivers a Job from its last activity to the Umpire, he records the move on this form. This information is used to update the Controller's JOB PROGRESS SHEET at intervals as required by the Controller.
Form name: STOCK WITHDRAWAL SHEET

Holder: Storeman/Progressor

Function:

Each time the Storeman/Progressor issues material from Stores to an activity, he is required to register the withdrawal on this form. It is only used when withdrawing material to the "standard material requirements" shown on the JOB CARD. If scrap material can be used for a particular Job, or for part of a Job, the Storeman/Progressor enters only the number of complete sheets issued, which may be zero if the job can be made entirely from scrap.

Form name: EXCESS MATERIAL REQUISITION

Holder: Storeman/Progressor

Function:

When an Operator spoils material and more is required to complete a Job, the Storeman/Progressor again enters the number of complete sheets which he has to issue, in excess of standard requirements. The procedure for issuing scrap material, described above, also applies here.

Form name: OPERATOR WORK RECORD

Holder: Surface, Pattern and Base Operators.

Function:

Each time an Operator commences work on a Job he enters on this form the Job Number, the time started, and the name of the activity he is working at. When work on that Job is complete, he enters the time at which it was finished. Each Operator retains
his own operator work record in the event of transfer to another activity. The information carried on this form is used by the Foreman to update his PERFORMANCE ANALYSIS SHEETS.
| DEPARTMENT | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Surface    |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Pattern    |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Base       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| DEPARTMENT |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Surface    |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Pattern    |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Base       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| DEPARTMENT |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Surface    |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Pattern    |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Base       |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
## JOB PROGRESS SHEET

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<th>Job Number</th>
<th>Standard Times in Departments:</th>
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<td>Surface Pattern Base Surface</td>
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## PERFORMANCE ANALYSIS SHEET - SURFACE

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### STOCK WITHDRAWAL SHEET

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<th>Material Type</th>
<th>Time Withdrawn</th>
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### EXCESS MATERIAL REQUISITION

<table>
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<th>MATERIAL TYPE REQUIRED</th>
<th>REQUIRED FOR JOB NUMBER</th>
<th>NO. OF MATS FOR WHICH MATERIAL IS REQUIRED</th>
<th>SIZE OF MAT</th>
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<tr>
<th>OPERATOR'S SURNAME</th>
<th>TRANSFERRED FROM ACTIVITY TO ACTIVITY</th>
<th>CONTROLLER'S AUTHORIZATION</th>
<th>TIME OF AUTHORIZATION</th>
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<th>OPERATOR WORK RECORD</th>
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<td>Operator Surname:</td>
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Appendix III, Section 4: The Paperwork for the Experimental Game Design.

This section includes the forms that were used in the experimental version of the game, but does not include those forms common to both versions. Once again these forms have been photo-reduced from A4 size.
**Experimental Design: Paperwork.**

**Form name:** JOB QUOTATION SHEET  
**Function:**

As the Umpire offers jobs, the workers at each activity estimate when that Job can be finished at their activity. This is done using the information given on the JOB CARD, and the LOAD PLANNING CHART. Thus, a typical Job will show a cumulative quote across Surface, Pattern and Base, and the group thus arrives at a due time. This may be the estimated completion time for the last activity, but it depends on how well the group is performing; they may feel confident in giving a lower quote, or they may allow themselves some slack.

Once a completed Job has been delivered, the actual delivery time is entered on this form, giving the group feedback on the accuracy of quotes.

**Form name:** LOAD PLANNING CHART  
**Function:**

Each activity has its own LOAD PLANNING CHART, which shows only the loading for that activity. When a Job is offered for quote, the chart is completed for the length of time the worker(s) at that activity think it will take them once they receive it from the stores, or from the previous activity. This enables an estimate to be given on the JOB QUOTATION SHEET.
Form name: **ACTIVITY WORK RECORD**

Function:

There is one of these forms kept at each activity. Each time a worker at an activity starts a job, and each time he completes work on a job, he enters the time against that Job Number on this form. He thus has instant feedback on his performance in comparison with the standard time. If there are two people working at one activity, they each record what work is done on each Job and, since the standard time given is always for one operator, they can compare it with their combined actual times.

This allows the worker, or workers, concerned to improve on the accuracy of the quote estimates given on the JOB QUOTATION SHEET, and the estimated loading of their activity on the LOAD PLANNING CHART.

Form names: **STOCK WITHDRAWAL SHEET**  
**EXCESS MATERIAL REQUISITION**

Function:

These forms are identical in nature and usage to their counterparts in the standard design with the single exception that they are not necessarily held and completed by a Storeman/Progressor.

This completes the list of forms used in the experimental design. Forms used in the standard design which are redundant here are:

**OPERATOR TRANSFER SHEET:** Group members are free to move from task to task by mutual arrangement;
JOB PRIORITY LIST: each activity determines its own loading and hence its own priorities.

PERFORMANCE ANALYSIS SHEET: group members monitor their own performance.

For reference, the additional forms used in this version and their closest equivalents in the standard version are as follows:

<table>
<thead>
<tr>
<th>JOB QUOTATION SHEET</th>
<th>equivalent to</th>
<th>JOB PROGRESS SHEET</th>
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<tbody>
<tr>
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<td>OPERATOR WORK RECORD</td>
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<td>(Activity) LOAD</td>
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<td>(Controller's) LOAD</td>
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<td>FLANNING CHART</td>
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LOAD PLANNING CHART:

|   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
### JOB QUOTATION SHEET

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<th>Quoted Due Time For Each Activity:</th>
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### ACTIVITY WORK RECORD:

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Appendix III, Section 5: Umpire Procedure.

This Section includes the set of notes that were given to each Umpire as instruction for running the games.
ULFIRE PROCEDURE

1. The layout of each group, with all necessary equipment will be arranged before participants arrive. When they do arrive, check that the group has the correct job descriptions.

2. Explain that there will be a brief learning period in which Job 00 will be processed. Jobs that are already at activities must not be worked on at this stage but may be examined by the person concerned when not otherwise occupied. Ask each person to look first at his job description and the paperwork to ensure that he knows his job.

3. Start processing JOB 00 - Standard Games:

Give the JOB CARD 00 to the Controller telling him you will explain the quoting procedure shortly. He is to assume that he has successfully quoted for this job and filled in the necessary forms. Ask him what he should do next (call the Storeman/Progressor). Ask the Storeman/Progressor what he should do next (take JOB 00 to stores, remove the required quantity of Surface material - printout - and fill in the STOCK WITHDRAWAL SHEET, take this to the Surface Operator; he does not fill in the JOB MOVEMENT CARD at this stage). Make sure that this is carried out correctly.

Ask the Surface Operator what he should do and ensure that the Foreman knows what the Surface Operator is doing. (He must fill in his OPERATOR WORK SHEET, draw the 20X20 cm mat on one sheet of paper, clip the other sheet under this and cut out the mats; when this is done, fill in the OPERATOR WORK SHEET - the clock will show time 00 throughout this phase.)
While the Surface Operator is cutting, show the Foreman how to use the PERFORMANCE ANALYSIS SHEETS.

When the Operator has finished, ask the Storeman what he should do next (move the job to the next activity - pattern - filling in the JOB MOVEMENT CARD and removing scrap material to the stores.)

At this stage, ask the Foreman to make sure that JOB 00 goes correctly through the remaining operations. Return to the Controller and explain the quoting procedure to him:

--- a job is offered;
--- quote is given in terms of minutes into the game;
--- the Controller has two minutes in which to give this quote, if he takes longer, the job is automatically lost;
--- you will see the allowed delivery time on the Order Sheet, any quotes given which exceed this time prevent the job being given;
--- there will come a point where the Controller will have to quote times beyond the duration of the game, if they are to be realistic - make sure that he knows that he can do this.

How the quote is calculated:

--- he examines the JOB CARD (give as an example JOB 00 the standard times and routing for which are Surface (4), Pattern (2), Base (4). This JOB CARD will, of course, still be in the system.

--- he tries to fit the job onto the LOAD PLANNING CHART. Do not have him put JOB 00 on the Chart as Jobs 01, 02 and 03 are already filled in for him.

--- he should make allowances for delays as he thinks fit, adding this onto the expected completion time of the last activity. The allowances given will in due course be affected by the information
he obtains regarding the working of the system. For this he uses the JOB PROGRESS SHEET which tells him if jobs have been late, or are running late, and if one activity is overloaded and may cause delays.

--- if the quote is successful, he fills in the LOAD PLANNING CHART and the JOB PROGRESS SHEET, then calls the Foreman to fill in his JOB PRIORITY LIST, based on the schedule on the LOAD PLANNING CHART.

--- remind the Controller that it is important that he gets information from the Storeman's JOB MOVEMENT CARD and uses this to update the Foreman's JOB PRIORITY LIST and his own JOB PROGRESS SHEET.

When JOB 00 has been delivered, show the Controller how his JOB PROGRESS SHEET can be updated using the Storeman's JOB MOVEMENT CARD.

N.B. CHECK AT THIS STAGE THAT ALL PAPERWORK HAS BEEN FILLED IN CORRECTLY AND POINT OUT THE IMPORTANCE OF THIS TO THE GROUP.

(i.e. check -

3 Operator Work Records - one line;
2 Performance Analysis Sheets - one line;
1 Stock Withdrawal Sheet - two lines, one for surface, one for base;
1 Job Movement Card - three lines, Surface to Pattern, Pattern to Base, and Base to "Delivered".)

Remind the Foreman and Storeman to use the EXCESS MATERIAL REQUISITION if extra material is needed for a job; remind the Controller that he can use the OPERATOR TRANSFER SHEET as required.

Check JOB 00, has it been made correctly?

Remove the scrap paper produced with this Job;

Ask for any further questions.

Last, tell Operators that their first Jobs are in front of them.
Wait until the other groups in your room are ready to start as all will run simultaneously, using the same clock.

N.B. THIS LEARNING PERIOD MUST NOT EXCEED 15 MINUTES.

3. Start Processing JOB 00 - Experimental Games:
Group layout will be similar to the standard game layout, and all materials will be laid out in advance.
Groups will again consist of 6, but if numbers are short, 5-man groups may be run.
As people are allocated to your group, ensure that they each have a copy of the Group Working Description, you will be provided with spares. Tell them to arrange themselves according to the "Suggested Initial Allocation" if they so desire. They do not, of course, have to adhere to this - make sure that they realise this.

Dummy Job: Explanation of the quoting procedure is rather difficult.

Each Job is issued to the group by placing the JOB CARD onto your desk at the appointed minute, and shouting "JOB" as loudly as necessary. The group has the responsibility for picking it up.

The "two minute" rule applies. Impress upon the group that they may have to stop what they are doing in order to produce a quote in time.

It is up to the group to decide how the final quote is arrived at and who gives it to the Umpire. There are two forms through which to do this:

1. The LOAD PLANNING CHART.

There is one of these at each activity and this allows the person(s) working there to plan the work load in advance. Each activity thus has its own counterpart of the Controller's LOAD PLANNING CHART used in the standard game.

2. The JOB QUOTATION SHEET.

This is the form used to quote the due time for each order.
Someone in the group must enter the number of the Job being quoted for, then (using the routing on the JOB CARD as a guide) each activity in turn must estimate the number of minutes into the game that they will take to complete that part of the Job. As the JOB CARD accompanies the JOB QUOTATION SHEET, each activity can see the standard times (for one operator) and by checking with the LOAD PLANNING CHART, estimate a completion time. It is obvious but will doubtless need pointing out that where there is more than one activity to a job, the second and subsequent activities may not begin before the previous ones have been completed.

The first three jobs will be filled in as illustration on the LOAD PLANNING CHART and JOB QUOTATION SHEET and you can use this to speed up the explanation.

Have the group enter Job 00 onto the JOB QUOTATION SHEET, but not onto the LOAD PLANNING CHART as this will clash with the loadings of Jobs 1 to 3 which are already entered.

Once you have explained the quoting procedure with Job 00, ask the group to process it – only 2 mats have to be made – and ensure that as they do this all paperwork is filled in correctly:

--- material must be obtained from stores and the STOCK WITHDRAWAL SHEET filled in;

--- the Job must be brought to each activity in turn, filling in the ACTIVITY WORK RECORD each time;

--- where two people work at one activity, each must enter their contribution to each Job independently;

--- explain the use of the EXCESS MATERIAL REQUISITION;

--- when the Job is delivered to the Umpire, the JOB QUOTATION SHEET must be filled in.
Because group members have not been allocated to specific tasks in advance, ensure that at the start of the game they know who is to collect Jobs from the Umpire, who is to give the Umpire the final quote for each order, and who is to deliver finished Jobs. It does not have to be the same person all the time; they can make up their own rules such as "person on last activity delivers", and so on.

Once Job 00 is finished, settle any remaining problems with the group. Then inform whoever is operating the "digital clock" in your room that you are ready to start. All groups in the room will run simultaneously, using the same clock.

N.B. THIS LEARNING PERIOD MUST NOT EXCEED 15 MINUTES

4. Running the game:

The issue times of Jobs are given on the Order Issue Sheet. Enter on this sheet the time quoted for each Job (or No Quote if a quote is not given within two minutes of offering the Job). If the quoted time is less than the Allowed Time, hand the Controller (or the group) the JOB CARD. Note - only one quote is required for each split Job.

When Jobs are delivered, keep the JOB CARDS and materials together and record the delivery time.

If during the game you see the group making obvious errors, point this out to them.

Common errors are:

- processing other than 6 mats - all Jobs have an order quantity of 6, except for Job 00.
- failing to fill in paperwork.
• filling in paperwork incorrectly.

• removing more material from store than is indicated on each JOB CARD.

• moving equipment from activity to activity - this is not permitted, in either version if the game.

If the group forgets about something that they are entitled to do, remind them. Operators can be transferred from activity to activity in the standard design of the game; the group can change its work allocation at any time in the experimental design.

5. At the end of the game, give each team member a copy of the Opinion Questionnaire. While they are filling this in, collect all equipment and all the paperwork. Collect unfinished mats with their appropriate JOB CARDS.

Count the quantity of both types of material remaining in the stores, and record these amounts on the Order Issue Sheet.

Lastly, collect the Questionnaires.
Appendix III, Section 6: Format of the Opinion Questionnaire.

OPINION QUESTIONNAIRE

SURNAME: ___________________ Group No: _____________ Job: ___________________

1. Rate how much you enjoyed the game on the following scale by putting a tick in the space corresponding to your opinion.

very little : : : : : very much

2. Rate how much you think you learned about production from the game:

very little : : : : : very much

3. From what happened in the game, what do you consider to be the single most important feature of a production system?

4. Rate your team's overall performance:

very poor : : : : : very good
Task Distribution

Measurement:

The Foreman or Storeman/Progressor may recommend that Operators should be transferred to other activities, either because their work at one activity is poor, or because one activity has a disproportionately high load.

Comparison:

The Foreman or Storeman/Progressor may suggest to the Controller that an Operator be transferred to another activity. The Controller assesses the value of such suggestions by referring to his LOAD PLANNING CHART. He will know, for example, if a job has just been taken that will provide work for an Operator who would otherwise have been idle.

Decide action:

The final decision on allocation of Operators to activities is made by the Controller. To authorise transfers, he must sign the Foreman's OPERATOR TRANSFER SHEET.

Take action:

The Foreman ensures that Operators are transferred as required.

Methods of Work

Measurement:

Work methods are described on the Operators' JOB DESCRIPTIONS. It is possible, however, that in the course of the game, an Operator may find a better or faster way of performing his activity.

If an Operator does find an improved method, or if problems are
encountered, the Foreman must be informed. The latter is responsible for monitoring the methods of work being used.

Comparison:

The Foreman will check the methods of work being used.

Decide action:

The Foreman will decide whether or not a particular method of performing an activity is appropriate.

Take action:

The Foreman will direct the Operators to perform their work in the manner which he feels is most suitable.

Material Usage

Measurement:

The Storeman/Progressor records all materials usage on the STOCK WITHDRAWAL SHEET.

Comparison:

When issuing materials, the Storeman/Progressor must discover whether or not complete sheets of material are necessary, or if partly used sheets could be used for another job.

Decide action:

The Storeman/Progressor must then decide what materials to issue for each particular job, in order to make the most economical use of the materials available.

Take action:

The Storeman/Progressor withdraws and delivers all materials to the requisite activities.
Operator Efficiency

Measurement:

The Storeman/Progressor may detect from the EXCESS MATERIAL REQUISITION which Operators are making mistakes. The Foreman also has access to this information and, apart from personally scrutinising each Operator's work from time to time, he maintains a PERFORMANCE ANALYSIS SHEET for each activity indicating the standard versus actual times taken on each job by each Operator.

Comparison:

If the Storeman/Progressor notices that an Operator is producing poor quality work, he must inform the Controller. If the Foreman feels that an Operator is not working satisfactorily, he too must inform the Controller.

Decide action:

The Controller, on the advice of the Foreman and Storeman/Progressor, decides whether or not to transfer an Operator to another activity. The Foreman may speak to the Operator to persuade him to try and improve his work.

Take action:

The Foreman may thus persuade the Operator to improve, or may suggest better work methods to him. If the Operator is to be transferred the Controller must give his authorisation by signing the OPERATOR TRANSFER SHEET, and the Foreman ensures that the transfer is carried out.

Scrap Quantities

Measurement:

Each time that mats have to be scrapped, the Foreman must
use the EXCESS MATERIAL REQUISITION which indicates not only the amount of material required but the number of mats which have had to be scrapped.

Comparison:

The Foreman decides whether or not the amounts of scrap produced at any activity are excessive. The Storeman/Progressor who delivers the material is also in a position to gauge the frequency of such occurrences. Either the Foreman or the Storeman/Progressor may approach the Controller and suggest that the Operator responsible be transferred.

Decide action:

The Foreman may decide what action to take if the amounts of scrap produced at an activity are excessive. If the Controller is made aware of the circumstances, he will decide what action to take, such as transferring the Operator responsible to another activity.

Take action:

The Foreman may alter the Operator's work methods, or persuade him to work more carefully. The Controller authorises the transfer of Operators where appropriate by signing the OPERATOR TRANSFER SHEET, and the Foreman ensures that such transfers are made.

Product Quality

Measurement:

There is no formal inspection of the mats that are produced, at least during the game itself. But the work process provides built in checks in that successive activities will be difficult or impossible where earlier activities have not been performed properly. Thus if surfaces are cut to the wrong size, their bases will not fit;
and where the pattern has been drawn wrongly, the surface activity of removing corners will produce a mat of the wrong design. Product quality is thus checked by the Operators, and by the Foreman making casual observations.

Comparison:

The Operator who detects such errors must inform the Foreman in any case.

Decide action:

The Foreman will decide whether or not a particular job should be reworked, and what action is necessary to see that this is done as quickly as possible.

Take action:

If a job is to be remade, more material will be required. The Foreman completes the EXCESS MATERIAL REQUISITION which he then gives to the Storeman/Progressor. The latter delivers the required material to the specified activity and returns the sheet to the Foreman. It is the Operator, of course, who rectifies the mistake.

Throughput Time

Measurement:

The Storeman/Progressor records the delivery of each job on his JOB MOVEMENT CARD. It is also possible to tell from this card how long each job has spent at each activity. The Controller keeps a record of completed jobs and their delivery times on his JOB PROGRESS SHEET which he updates as often as he feels necessary from the Storeman/Progressor's JOB MOVEMENT CARD. He can also record that jobs have completed individual activities by crossing out the entries in the "Standard Times" columns on his JOB PROGRESS SHEET as they appear on the JOB MOVEMENT CARD.
Comparison:

The Controller compares actual with quoted delivery times on the JOB PROGRESS SHEET. Used in conjunction with the LOAD PLANNING CHART, this gives the Controller an indication of the accuracy of his quoted due times.

Decide action:

If throughput times are too long, the Controller may try to remedy this by lengthening his quoted due times (with the attendant possibility of losing some jobs) or he may decide to move Operators to different activities.

Take action:

The Controller decides on all due times quoted, and is also responsible for authorising the transfer of Operators. The Foreman makes sure that Operators are transferred as required.
APPENDIX IV:

ADDITIONAL CASE STUDY MATERIALS.
APPENDIX IV - CONTENTS

This Appendix is divided into two Sections:

Section 1: Wilkie and Paul, Tin Box Production.

Section 2: Transcript of a Recorded Interview with a Test Chargehand at Ferranti.
Appendix IV, Section 1: Wilkie and Paul, Tin Box Production.

Introduction

The second case study reported in Chapter 5 above was carried out at Wilkie and Paul Ltd, in Edinburgh, a company which manufactures two types of product: thermo-formed plastics, and tin boxes. Both of the company's production units were studied in the course of this research and the plastics production unit forms the basis for the case study already presented in Chapter 5. These case studies attempt to illustrate (a) a technique of organizational analysis, (b) a means of generating job and organizational redesign choices, and (c) how the effects of job and organizational design changes can be calculated in advance. The results of the third case study that was conducted at Wilkie and Paul in their tin box production department are similar to the results of the two case studies already reported. To have included this third case study in Chapter 5 above would therefore have been superfluous. This third case study may thus serve to illustrate further the main points of Chapter 5.

Wilkie and Paul Tin Box Production: the Products

There are approximately 90 people directly employed in the company's new factory manufacturing tin boxes. Most of these containers are used for packing biscuits and a few are used for pharmaceutical products.

The production process begins with the ready printed tin plate which is purchased from a company in Tyneside. There are three main types of tin container; round, rounded corner, and locked corner. Rounded corner tins may be either square or rectangular,
and the corners are rounded in either case. Locked corner tins are square or rectangular tins with sharp 90 degree corners. The three main types of tin may be made in various sizes.

The largest biscuit manufacturers in Britain pack their products in these tins which are on general sale throughout the country. But the numbers of biscuit manufacturers are small and Wilkie and Paul rely on two or three large customers to take most of their output in repeat standard orders.

**Production Facilities**

The organization chart of the tin box production department is given in Figure AIV.1. A plan of the new factory layout (see Chapter 5 above) was not available at the time of writing. The production processes are carried out by the sections listed in Figure AIV.2. The day shift works from 8.00 am to 5.00 pm Mondays to Thursdays, closing at 2.30 pm on Fridays. An evening shift of 20 to 40 female Operators works from 6.00 pm to 10.00 pm Mondays to Thursdays only. There are 10 female Operators who work a "school hours" shift from 9.00 am to 2.45 pm each day.

There are two main production sections under one Production Manager. The cutting section is supervised by one Supervisor assisted by a Chargehand, both male. The assembly sections are supervised by two other male Supervisors and four female Supervisors. The male Supervisors are concerned mainly with the satisfactory functioning of the machinery and carry out at least half of the maintenance and repair work. They deal only with the more serious problems where female Operators are concerned.

It is unusual for all six assembly lines to be in simultaneous operation. Production requirements and priorities determine which lines will be used each day. The lines not in use are repaired, set
Figure AIV.1: Organization chart of Wilkie and Paul Tin Box Production Department.

Managing Director

Divisional Manager

PRODUCTION MANAGER

SUPERVISOR

Chargehand

SUPERVISOR (FEMALE)

OPERATORS

Cutting

Purchasing Officer

PRODUCTION CONTROLLER

STOCK CONTROLLER

PRODUCTION CLERKS

Transport/Despatch Manager

SUPERVISOR (Despatch and Raw Materials Stores)

Operators

Assembly

EXAMINERS

OPERATORS
Figure AIV.2: Wilkie & Paul, Tin Box Production Sections.

<table>
<thead>
<tr>
<th>Section</th>
<th>Operators (Day Shift)</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting:</td>
<td>6 (male)</td>
<td>6 Cutting Machines</td>
</tr>
<tr>
<td>Press Shop and Ancillaries:</td>
<td>15 to 20 (female)</td>
<td>4 Blanking Presses 1 Cover Press 1 Bottom Press 1 Shrink-Wrap</td>
</tr>
<tr>
<td>Assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rounded Corner:</td>
<td>24 (female)</td>
<td>2 Assembly Lines</td>
</tr>
<tr>
<td>Locked Corner:</td>
<td>20 (female)</td>
<td>2 Assembly Lines</td>
</tr>
<tr>
<td>Round Tins:</td>
<td>18 (female)</td>
<td>2 Assembly Lines</td>
</tr>
<tr>
<td>Others:</td>
<td>3 Setters (male) and 4 Service Labourers.</td>
<td></td>
</tr>
</tbody>
</table>

Figure AIV.3: Wilkie & Paul, Tin Box Production Process.
for the next scheduled product, or simply left on standby in case one of the other lines should break down. Operators are moved from line to line as required and most of the work on the assembly lines is simple and repetitive. Normally, about 75 per cent of the available machinery is in use at a particular time.

As with the plastics production department, the figures given here for female Operators are approximate. Labour turnover is very high and there can be significant variations in the numbers employed from month to month. The assembly day shift may have between 60 and 90 Operators. The work is monotonous, the metal sheets cause frequent cuts, there is a good deal of heavy lifting to be done (even for the female Operators) and the machinery is extremely noisy.

When the new factory began production, the one maintenance department serviced both factories (ie the plastics department as well) and the company hoped eventually to alter this arrangement.

Production Process

Incoming orders are received and filed by the Sales Office Manageress who sends a messenger to the tin box factory with a copy. (At the time of writing, the sales office was situated in the old factory, about a quarter of a mile from the new one.) This order is logged by the Production Controller who quotes a delivery date for the sales office, and informs the Divisional Manager.

On receipt of every order for tin boxes, the Production Controller places an order with the tin plate printers for the appropriate material. The company does not carry any stock of tin plate in excess of immediate requirements, and the delivery time of printed plate must be added to the manufacturing time in order to calculate a delivery date for the customer. On arrival at the factory the tin plate is checked for quantity and the amount delivered is
Order scheduling and progressing are practically identical to that in the plastics production department. The Production Controller has a load board on which to plan the work of each machine for several weeks in advance, and with which to calculate delivery dates for orders. The Production Controller prepares a weekly programme for the cutting section and for each assembly line. A "progress sheet" is made out for each order indicating the customer, the order quantity, the product and the specifications necessary for its manufacture. The progress sheets, along with the weekly programme, are given to the Supervisors at the beginning of each week and, unlike the plastics production department, requisition cards are issued for the necessary material.

Orders are thus scheduled to run on specific assembly lines on specific days, but as there are inevitable mishaps and delays, constant adjustments must be made to the programme. A daily programme is therefore issued which is based on the current version of the weekly programme. The Production Controller is in close contact with the Supervisors, passing through the production area several times a day. The Production Controller notes any delays as they occur, updates the programme as necessary, and informs the sales office of any significant delays to particular orders.

The basic steps in the production process are shown in Figure AIV.3. The tin plate arrives in large sheets and strips printed with several designs, for lids or bodies, on each sheet. These must be cut out before they can be used on the assembly line. For some items, lids (or "covers") and bottoms in particular, this task is performed on the blanking presses which stamp out the required shapes from the sheets. The cutting section is scheduled to operate ideally one week, and at least one day, in advance of the assembly section's
The Operators who work on the cutting machines also check each sheet for printing flaws, colour deficiencies, scratches and so on. The strips of plate that are left as scrap are reweighed in large crates and are returned to a firm in West Hartlepool for remelting.

The Operators each count the number of sheets cut per day and at the end of each shift the Supervisor totals the counts from all Operators, and enters this figure on the "daily sheet" copies of which are taken to the Work Study Department and the Production Controller's office.

The tin lids are made on a Cover Press which hammers the flat, now cut, printed plate into the desired shape. The Operator feeds the plate "blanks" into the machine and activates the press with a foot control. She briefly looks at each lid for flaws. The Bottom Press does exactly the same operation for the bottoms or bases of the tins, with the exception that these are not ready for immediate use but still require a flange to be made which is used to join the base onto the tin's body walls. The press Operators add up the numbers of covers and bases produced, and the number scrapped, and give these figures to the Supervisor to enter on the daily sheet.

The assembly lines consist of a series of machinery, fed by Operators and connected by conveyor belt, which respectively bend, flange, press and stamp the flat tin plate into tin boxes. Strips of plate printed as the tin walls are fed into one machine at the end of the line. Here they are curled for round tins, or bent into the correct shape for square or rectangular tins. The strips fall off this machine onto a conveyor belt which leads to the next machine where a flange is put along the bottom edge of the walls, ready for joining to the bottom. The next part of conveyor belt leads to the machine which closes the walls together, usually by pressure on
another flange. Bottoms are fed into the next machine on the line which joins them, again by pressure, to the walls. At each point along the line, Operators are required to feed the machines as the conveyor is not able to orientate the tins correctly.

At the end of each line stands an Examiner who checks each tin for flaws as it comes to her. This Examiner places the tins on pallets ready for packing. Once a pallet is loaded with its quota of tins, the Supervisor makes out a ticket stating the quantity and type of tins, and this is fixed to the pallet. The system is identical to that used in the plastics department. Before wrapping, the requisite number of lids is put with the tins on the pallet which is then taken to the "shrink-wrap". This device envelops the pallet in polythene sheet, ready for despatch to the customer. The pallets are then moved to the transport bay by fork-lift truck.

The wrapped pallets are labelled and the Supervisor's ticket is removed when the tins are despatched. These tickets are returned to the Production Controller and the orders are checked off in a "despatched stock file".

The Work Study Department

As there is only one such department for both factories, the description of the work of this department given in Chapter 5 above applies here also. The Work Study Engineers set performance rates for the assembly lines and these are used in the calculation of bonus payments. But here the Production Manager has more scope in altering the speed of the lines. If a line is working satisfactorily he can easily "wind it up a couple of notches" to obtain higher output.

The Production Control Section

This section has its own separate staff in each factory and
although the job titles are slightly different, they perform the same functions. The only "variance" that is calculated here, however, is the "materials variance" showing the difference (if any) between the quantity of tin plate drawn from stores and the quantity of tin boxes made plus scrap. Fairly accurate estimation can be made of scrap quantities since there is always some material spare at the edges of the tin plates that have been "blanked". This allows calculation of the "true" scrap rate, i.e., the quantity of good material that has been wasted. A weekly report is compiled and circulated as with the plastics department variance reports.

**Identification of Control Factors**

<table>
<thead>
<tr>
<th>Control Factor</th>
<th>Section:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Quality of materials used</td>
<td>both</td>
</tr>
<tr>
<td>2. Size of work force</td>
<td>both</td>
</tr>
<tr>
<td>3. Hours of work</td>
<td>both</td>
</tr>
<tr>
<td>4. Output</td>
<td>cutting</td>
</tr>
<tr>
<td>5. Output</td>
<td>assembly</td>
</tr>
<tr>
<td>6. Order throughput time</td>
<td>both</td>
</tr>
<tr>
<td>7. Machine maintenance</td>
<td>both</td>
</tr>
<tr>
<td>8. Product quality</td>
<td>both</td>
</tr>
<tr>
<td>9. Scrap quantities</td>
<td>both</td>
</tr>
<tr>
<td>10. Operator efficiency</td>
<td>both</td>
</tr>
<tr>
<td>11. Task distribution within section</td>
<td>cutting</td>
</tr>
<tr>
<td>12. Task distribution within section</td>
<td>assembly</td>
</tr>
<tr>
<td>13. Material costs</td>
<td>both</td>
</tr>
<tr>
<td>14. Labour costs</td>
<td>both</td>
</tr>
</tbody>
</table>
Routine Control

The routine control operations are described here using the same format as was used in Chapter 5 above to describe these operations in the plastics production department at Wilkie and Paul. One control factor - methods of work - is omitted because this is determined by the machinery in use in the factory.

Planning and Primary Decisions

These operations were conducted in a manner identical to that for the plastics production department described above, and will not be described again here. Some changes to the staffing of the tin box production department were to have been made, due to the move to the new factory, but when this case study was conducted, no such changes had either been made or agreed upon. These changes would in no way affect the conclusions of these two case studies of Wilkie and Paul.

The Routine Control operations are described in the following pages:
1. Quality of materials used.

<table>
<thead>
<tr>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>This operation is carried out before the tin-plate is used in the assembly sections. The cutting and press section <strong>operators</strong> visually inspect their material for printing flaws, colour deficiencies, scratches etc., as they use it. The cutting section <strong>supervisor</strong> often checks material in store before it is cut or pressed, and the <strong>production manager</strong> occasionally performs a casual inspection on passing through the materials stores.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>The <strong>operators</strong> decide how bad their material is. If uncertain, they inform the <strong>supervisor</strong> who may in turn approach the <strong>production manager</strong> in more serious cases. The supervisor or production manager decide if material still in store is good enough to be used.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decide Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The <strong>operators</strong>, on deciding that their material is more or less unsatisfactory, decide whether to scrap it immediately or allow it to proceed in case it may be of some use. The <strong>supervisor</strong> if involved must make a similar decision and if an order is to be stopped must decide which order to begin next. Work on the delayed order may not commence until good plate is obtained. In such cases, the <strong>production manager</strong> and <strong>works manager</strong> decide upon action to minimise delays.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Take Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The <strong>operators</strong> place all scrap in bins adjacent to their machines. The <strong>supervisor</strong> ensures that jobs are stopped as necessary and that fresh orders are commenced in their place.</td>
</tr>
</tbody>
</table>
2. Size of work force.

<table>
<thead>
<tr>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Personnel Assistant maintains a file of all employees. The Production Manager monitors the size of the labour force with respect to the department's output.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Personnel Assistant amends the file as employees leave or are hired. The Production Manager determines the adequacy of the labour force to meet the budget required.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decide Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Production Manager decides whether more labour or less is required - seldom the latter. He completes a requisition form which is given to the Personnel Manageress. The Production Manager may normally increase the labour force up to the budgeted expenditure limit, but the Personnel Manageress may contest any requisition. The latter also decides upon all recruitment methods and dismissals.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Take Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Personnel Assistant deals with advertisement placement and other administrative details. All prospective employees are interviewed initially by the Personnel Manageress. The cutting section Supervisor interviews all prospective candidates for his section, and the Production Manager interviews all prospective male employees.</td>
</tr>
</tbody>
</table>
3. Hours of work.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Comparison</th>
<th>Decide Action</th>
<th>Take Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>A <strong>Supervisor</strong> gives the <strong>Personnel Manageress</strong> a daily list of late-comers and absentees. The <strong>Personnel Assistant</strong> keeps a permanent record of this. The <strong>Production Manager</strong> and <strong>Works Manager</strong> monitor the total number of hours worked with respect to the department output.</td>
<td><strong>The Personnel Manageress</strong> determines the severity of each individual case of poor timekeeping or attendance. <strong>The Production Manager</strong> and <strong>Works Manager</strong> determine the adequacy of the total number of hours worked to meet the budgeted output.</td>
<td>In individual cases, the <strong>Personnel Manageress</strong> decides whether to reprimand, dismiss or take no action. <strong>The Production Manager</strong> and <strong>Works Manager</strong> decide whether or not to alter the hours of working of the factory with the advice of the <strong>Personnel Manageress</strong>. To increase output, more overtime may be sanctioned; to obtain extra labour, special shifts may be arranged such as those which suit married women with young children.</td>
<td><strong>The Personnel Manageress</strong> reprimands and dismisses where necessary. <strong>The Production Manager</strong>, along with the <strong>Personnel Manageress</strong>, ensures that any alterations to working hours are adhered to. He may have to find extra Operators willing to work added overtime.</td>
</tr>
</tbody>
</table>
4. Output, Cutting.

<table>
<thead>
<tr>
<th>Measurement</th>
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</thead>
<tbody>
<tr>
<td>The Operators count the number of sheets which they cut and the Supervisor totals the counts from all Operators at the end of each day. This is entered onto the &quot;daily sheet&quot; which is given to the Production Clerkess. A Work Study Engineer is given a copy of each day's output figures for the bonus calculation. The Production Controller has an overall view of each section's performance from the &quot;load board&quot;.</td>
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<table>
<thead>
<tr>
<th>Comparison</th>
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<tbody>
<tr>
<td>The Production Controller monitors the output level to ensure that it is satisfactory. The Production Manager and Works Manager are informed of the current situation by the Production Controller.</td>
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<table>
<thead>
<tr>
<th>Decide Action</th>
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<tbody>
<tr>
<td>The Production Controller re-schedules jobs when any order is stopped. The Production Manager is consulted when it appears that this will have to be done. In serious cases the Works Manager may be involved in deciding appropriate action. Extra overtime may be sanctioned (see Hours of Work).</td>
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<table>
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<tr>
<th>Take Action</th>
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<tbody>
<tr>
<td>Alterations to the scheduled programme are made by the Production Controller who prepares a revised schedule and issues it to the (male) Supervisor who ensures that the re-scheduled work is begun.</td>
</tr>
</tbody>
</table>
5. Output, Assembly.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Comunication</th>
<th>Decide Action</th>
<th>Take Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Examiner at the end of each assembly line takes an hourly count of output (see Operator Efficiency) which (male) Supervisors total on the &quot;daily sheet&quot;. This information is given to the Production Clerkess and a Work Study Engineer for output records and bonus calculation respectively.</td>
<td>Same as CUTTING</td>
<td>Same as CUTTING</td>
<td>Same as CUTTING</td>
</tr>
<tr>
<td>Measurement</td>
<td>The female Supervisors note existing or potential delays and inform the Production Controller who visits each of the sections several times a day to check on performance. The Production Controller has an overall view of the department's output performance on the &quot;load board&quot;. The male Supervisors can tell by the cumulative output total kept on the progress sheet for each order how near that order is to completion.</td>
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<tr>
<td>Comparison</td>
<td>The male or female Supervisors decide whether anything they can do will keep production on schedule. The Production Manager is informed if an order is going to be delayed and the Production Controller may consider some re-scheduling.</td>
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<tr>
<td>Decide Action</td>
<td>The male or female Supervisors may decide upon any action they consider appropriate. In serious cases, the Production Manager and/or the Works Manager is involved. Extra overtime may be worked to complete orders on schedule; idle machinery may be put into service. The Production Controller decides what action is necessary if re-scheduling of orders is required.</td>
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<tr>
<td>Take Action</td>
<td>Male or female Supervisors may reprimand Operators for slacking; they may give Operators assistance to clear work and speed throughput; they may be able to re-allocate Operators more effectively. The Production Controller draws up new schedules if necessary and issues them to the Supervisors. It is sometimes possible for the Production Manager to increase the pace of the assembly line machinery.</td>
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<tr>
<th>Measure</th>
<th>Comparison</th>
<th>Decide Action</th>
<th>Take Action</th>
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<tbody>
<tr>
<td>An <strong>Operator</strong> or female <strong>Supervisor</strong> is normally the first to detect a machine fault or breakdown. The <strong>Work Study Engineers</strong> prepare a &quot;weekly performance sheet&quot; for all sections indicating the respective amounts of and reasons for down-time.</td>
<td>Often, the male <strong>Supervisors</strong> are asked to correct the trouble. They may contact a <strong>Setter</strong>, a <strong>Maintenance Operator</strong> or an <strong>Electrician</strong>, depending on the nature of the fault, if they cannot effect the repair. The <strong>Production Manager</strong> investigates any recurring problems detected from the &quot;weekly performance sheet&quot;.</td>
<td>Depending on the fault that has developed, the <strong>Setter</strong>, <strong>Maintenance Operator</strong>, <strong>Electrician</strong> or <strong>Supervisor</strong> will decide what to do about it. The <strong>Production Manager</strong> and/or <strong>Works Manager</strong> are consulted when major breakdowns occur; they also decide what action to take to remedy any recurring problems.</td>
<td>The <strong>Setter</strong>, <strong>Maintenance Operator</strong>, <strong>Electrician</strong> or male <strong>Supervisor</strong> repairs the fault that has developed. The male <strong>Supervisors</strong> are also responsible for preventing the reoccurrence of faults where possible. They may be required to give <strong>Operators</strong> some additional instruction; an idle line may be brought into use.</td>
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<tr>
<td><strong>8. Product quality.</strong></td>
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<tr>
<td><strong>Measure Quality</strong></td>
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<tr>
<td>Cutting and Press Operators visually inspect their products as they are made. Examiners at the ends of the Assembly lines inspect each finished tin. Male and female Supervisors make periodic quality checks and the Production Manager occasionally tests a tin to destruction.</td>
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<tr>
<td><strong>Compare</strong></td>
<td></td>
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<tr>
<td>Cutting and Press Operators decide whether or not their items are satisfactory. If uncertain, they consult a Supervisor. Examiners on the assembly lines work in the same manner. If the Production Manager discovers poor quality products he must decide whether or not any action should be taken.</td>
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<tr>
<td><strong>Decide Action</strong></td>
<td></td>
<td></td>
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<tr>
<td>Cutting and Press Operators decide what action to take when their products are sub-standard. Examiners on the assembly lines decide what action to take when poor finished tins are being produced, and both male and female Supervisors may be required to assist in solving certain problems. The Production Manager and/or Works Manager decide what action to take in more serious cases.</td>
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<tr>
<td><strong>Take Action</strong></td>
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<tr>
<td>Cutting and Press Operators place any poor quality items into a scrap bin. The Examiners on the assembly lines do the same. Male and female Supervisors may have to organise the switch of production from one line to another; individual Operators may be re-allocated to different tasks.</td>
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</table>

The cutting section Supervisor totals the number of strips scrapped daily on the "daily sheet". The Press Operators count the number of sheets they scrap and the male Supervisor records the totals on his "daily sheet". The Examiners on the assembly lines count the number that they scrap and the male Supervisor enters the totals on his "daily sheet". These sheets go to the Production Clerks who calculates the "materials variance" and circulates a weekly report.

The appearance of excessive scrap quantities is investigated by the Production Controller. Through the circulated report, the Production Manager and Works Manager may develop an interest, to determine how bad the situation is.

Excess scrap may be produced by poor material, faulty machinery or operator negligence. Depending on the seriousness of the situation, the Production Manager and/or the Works Manager may be required to decide upon suitable action.

The Production Controller may arrange for further material to be purchased. The Production Manager ensures that any technical defects in the production process are remedied, this responsibility being sometimes delegated to the male Supervisors. Most problems concerning the female Operators are dealt with by the female Supervisors.

The cutting section Supervisor is in or near his section constantly and has adequate opportunity to monitor the work of his Operators. In the assembly sections, the female Supervisors maintain a similar visual check but also take an hourly count of output which is chalked onto a board in the section along with the standard output rate for that job. Female Supervisors train all female Operators, male Supervisors train Setters, providing good indication of their capabilities.

In each section, the appropriate Supervisor decides whether or not a particular Operator's performance warrants corrective action. If an hourly count is significantly low, a male Supervisor investigates to determine the reason. Serious cases of Operator inefficiency are brought to the attention of the Production Manager.

The male or female Supervisor in each section normally decides what action to take. The Production Manager determines the appropriate action in more serious cases. If dismissal is considered, the Personnel Manageress must be consulted.

Male or female Supervisors may reprimand Operators, the female Supervisors normally dealing with the female Operators. The Supervisors may place Operators on different jobs or on different lines. For cases of gross negligence, there is an endorsement system similar to that of the plastics department. The Production Manager issues these in person. The Personnel Manageress deals with all dismissals.
### 11. Task distribution within section - Cutting

<table>
<thead>
<tr>
<th>Measurement</th>
<th>The cutting section Supervisor decides whether any re-allocation of Operators would be beneficial.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>The Supervisor decides which Operator's to re-allocate and to where.</td>
</tr>
<tr>
<td>Decide Action</td>
<td>The Supervisor re-allocates the Operators as he deems necessary.</td>
</tr>
</tbody>
</table>

There is little movement of Operators between jobs, each Operator having his own machine. If some re-allocation is desirable, perhaps to cope with a difficult order, the Supervisor determines this.

| Take Action |
|-------------|------------------------------------------------------------------|
|             | There is no movement of Operators between sections.              |
12. Task distribution within section - Assembly

| Measurement |
| --- | |
| Normally, the male and female **Supervisors** have an adequate knowledge of the current situation. |

| Comparison | |
| --- | |
| For minor adjustments, to cope with small alterations in loadings, the male or female **Supervisors** decide if any action need be taken. If particular problems arise likely to create delays, the Production Manager examines the situation. |

| Decide Action | |
| --- | |
| Male or female **Supervisors** may decide to move Operators as they feel it necessary. The **Production Manager** may also decide to reallocate Operators to different machines and jobs if desirable. |

| Take Action | |
| --- | |
| The female **Supervisors** ensure that Operators work on the jobs to which they have been assigned. (The female Operators rotate jobs every hour, remaining on the same line.) |

© There is no movement of Operators between sections.
<table>
<thead>
<tr>
<th>13. Material costs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The <strong>Cost Department</strong> compiles statements on the cost of materials used from information received from the Production Control section. Weekly and monthly reports are circulated.</td>
</tr>
<tr>
<td><strong>Measurement</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>The <strong>Production Manager and Works Manager</strong> monitor these reports to detect any anomalies in materials costs.</td>
</tr>
<tr>
<td><strong>Comparison</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Any excessive rises in costs are investigated by the <strong>Production Manager</strong> and/or the <strong>Works Manager</strong> who decide what action can be taken. The company is dependent upon a single source for all its material (printed tin plate) and any cost reductions must be made internally.</td>
</tr>
<tr>
<td><strong>Decide Action</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>The <strong>Production Manager</strong> ensures that the necessary action is undertaken. Material of marginally poor quality may be used; Operators may be instructed to be as careful as possible. Much of this work is delegated to the <strong>Supervisors</strong>.</td>
</tr>
<tr>
<td><strong>Take Action</strong></td>
</tr>
</tbody>
</table>
14. Labour costs.

The Work Study Clerkess uses the daily returns to calculate the standard hours achieved for bonus calculation, and the number of man-hours clocked up. The Cost Department compiles statements of actual expenditure, but the standard and man-hour figures are the ones generally used.

The Production Manager and Works Manager receive, from the Work Study Department, daily statements of the previous day's performance in terms of standard hours and man-hours. They decide whether the figures indicate that action may be necessary.

The Works Manager decides what action is necessary to reduce labour costs. The amount of overtime may be reduced rather than cut the labour force.

The Production Manager is responsible for seeing that the appropriate action is undertaken.
15. Other costs.

<table>
<thead>
<tr>
<th>Measure Cost</th>
<th>The Cost Department arranges payment and maintains records of all overheads (electricity costs, earplugs, floor cleaning equipment etc.).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>The Production Manager and Works Manager receive monthly statements from the Cost Department on cost levels and they decide if any action is necessary.</td>
</tr>
<tr>
<td>Decide/Action</td>
<td>The Production Manager and Works Manager decide on means of reducing excessive or rising costs. It is often possible to restrict the use of non-essential items, at least temporarily.</td>
</tr>
<tr>
<td>Take Action</td>
<td>The Production Manager ensures that the necessary action is undertaken.</td>
</tr>
</tbody>
</table>
16. Floor layout.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>The Work Study Engineers maintain plans of the factory layout.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>Anyone working around the shop floor, above Operator level, is likely to indicate where possible improvements might be made. The Work Study Engineers collate any such suggestions and their own opinions, and decide if any alterations would be useful.</td>
</tr>
<tr>
<td>Decide Action</td>
<td>The Industrial Engineer and the Work Study Engineers decide what improvements to the layout should be made. The opinions of the Works Manager carry some considerable weight. The Works Director is consulted where major changes are to be made.</td>
</tr>
<tr>
<td>Take Action</td>
<td>The Work Study Engineers prepare the final plans and put alterations into effect.</td>
</tr>
</tbody>
</table>
Appendix IV, Section 2: Transcript of a Recorded Interview with a Test Chargehand at Ferranti.

Two examples of the type of questionnaire used are included in this Section.
QUESTIONNAIRE FOR TEST/INSPECTION CHARGEHANDS (ROTATING COMPONENTS GROUP)

1. Introduction: I am trying to understand how the factory runs and I would like to know about the way in which the test/inspection section works. What is your section called?

2. How many operators do you have in your section?

3. Could you describe the work that they do?

4. Can you tell me how the bonus scheme works?

5. I would like to ask you some questions about a chargehand's job; what are your duties and responsibilities?

6. Can I ask you about the test/inspection procedures; what failure rate is expected for each product type?

7. Above what rate is failure regarded as unacceptable?

8. Who sets these rates? How?

9. What action do you take when the failure rate of a particular product becomes too high? What happens after that?

10. What do you do when the failure rate of a particular batch of items is too high? What happens after that?

11. What are the main problems with failure rates? prompts:
   - are they highly variable?
   - are they too high?
   - are standards set too high?
   - are they always achieved?
   - are they never achieved?
   - what is done about these problems?
   - examples?

12. (a) Could you describe what an operator does when he/she fails an item?
    (b) What record is made of this?
    (c) Where is it kept?
    (d) Who decides whether to have the item rectified or scrapped?
    (e) How does the rectification procedure operate?
    (f) Who authorises concessions on items that have failed?

13. (a) With regards to records kept of items that have failed, do you ever need to use them? Why?
    (b) Are these records used to calculate failure rates of products? (If so) who does this?
    (c) Who uses this information on failure rates?
    (d) Is this information used to provide advance warning that a batch will be delayed and may not be completed on time?
14. (a) How are records kept of the efficiency of the operators in your section?
   (b) Where are these records kept?

15. What level of efficiency are operators expected to achieve?

16. (a) What action do you take when you find that one of your operators is not working efficiently?
   (b) What happens after that?

17. What sort of problems arise over the efficiency of operators?
   
   prompts:
   • are all your operators up to standard?
   • when did you last have an operator whose work was not good enough?
   • do you have any sub-standard operators at the moment?

18. Could you describe how the period batch system works in your section?

19. Who calculates the period number in which a batch must be completed?

20. How is this number calculated?

21. (a) Is a record kept of the batches that come into and go out of your section?
   (b) What form does this record take?
   (c) What do you use this information for?
   (d) Who else uses this information? What for?

22. How do you know when a batch has been delayed in your section for some reason?

23. (a) What do you do when you discover that some items have been delayed in your section?
   (b) What happens after that?

24. What say do you have as to the way your section will be run in the future?
   
   prompts:
   • regular formal discussion meetings with superiors?
   • decision making responsibility in specific areas, eg, number of operators, layout of work benches, operating the period batch system?
   • participation of any kind?
   • examples?
1. Introduction: I am trying to understand how the factory runs and I would like to know about the way in which the assembly sections work. Which sections are you in charge of?

2. How many chargehands do you have?

3. Can I ask you about the work of the chargehands; could you describe their duties?

4. (a) What checks do they make to ensure that operators are doing their jobs properly?
   (b) What records are kept of these checks?
   (c) What is this record used for? By whom?

5. I would like to ask you some questions about a foreman's job; what are your duties and responsibilities?

6. What action do you take when one of the operators is found to be inefficient? What happens after that?

7. What problems arise over the effectiveness of operators?

8. Could you describe how the period batch system works in your sections?

9. Who calculates the period in which a batch must be completed?

10. How is this number calculated?

11. (a) Is a record kept of the batches that come into and go out of your sections?
    (b) What form does this take?
    (c) What do you use this information for?
    (d) Who else uses this information? What for?

12. How do you know when a batch has been held up in your sections for some reason?

13. (a) What do you do when you discover that some items have been delayed in your sections?
    (b) What happens after that?

14. How often do you receive a priority chasing list?

15. What action do you take with regard to the items listed on it?

16. Could you explain to me how the rectification procedure works?

17. What records are kept of items that have had to be rectified?
18. What say do you have as to the way in which your sections will be run in the future?

Prompts:

• Regular formal discussion meetings with superiors?
• Decision making responsibility in specific areas, e.g., number of operators, layout of work benches, operating the period batch system?
• Participation of any kind?
• Examples?
I = Interviewer  R = Respondent

I: What I am trying to understand is how the factory as a whole runs, and what I would like to know is the way your section runs. Could you start by telling me what your section is called?

R: Final Electrical Test.

I: And how many operators do you have?

R: At present, eleven. Five are women.

I: Could you describe the work they do?

R: Well, what happens is, a job comes in for final test. The men get the job first and they do a check through the schedule, and they do the electrical part and test the job against the test schedule. They do their part which is passed over to the women, and they do theirs. Do you want me to tell you exactly what it is?

I: Well, if you could give me some examples.

R: Ah, well, they do an insulation check, they do a resistance check, linearity, noise, various noise checks depending on what's called up on the spec.

I: Can you tell me how the bonus scheme works?

R: The bonus scheme works on a group bonus. What happens is we have a group bonus scheme for the men, and one for the women. We have four men involved in a group bonus scheme and it's just the jobs they do have a set time and when they make a bonus over the week, they all get paid the same. The same thing applies with the women. Now, the five women I have work in the dustproof and there's women outside in the female assembly inspection, and they are in the same group bonus as my women.
I: O.K. I would like to ask you some questions about the chargehand's job; what are your duties and responsibilities?

R: My job is to see that the job comes in, goes right through and out the door, and is done correctly and smoothly. This is mainly to sort out any problems. And that's really mainly what we are supposed to do. But we are involved in a lot more than that. Time is taken up in clerical work, and in my particular part just now. The problem is there used to be a clerkess on that job which was made redundant two or three years ago, and the job was just passed over onto the chargehand. The chargehand's job originally was just strictly supervision. We had a clerkess to do the job of booking in and booking out. And we were just strictly saying - that man does that job, that woman does that job, and this was it. But it's now changed a bit and it's an accepted fact that there's a lot of paperwork involved in the job that was not there before.

I: What sort of paperwork?

R: Well, the job comes in from production, say, and I then check the job against the test card, check it's right, then enter up in a book the information, book it in and date stamp it, put it in the appropriate bin as to where it's to go; and it then travels round, it comes back to me, and I've then to check over the card the figures that the inspector or inspectress has done to see any queries, to sort them out and decide whether it's pass or fail. I then book it out by making it pass or fail. I've also to enter up on the bonus by saying if a man's done a six-gang pot, I've to make sure he gets credited with a six-gang pot. And every job that each individual does, I have to enter this up. There's quite a bit of paperwork involved.

I: Can I ask you about the actual test and inspection procedures themselves; what failure rate is expected for each product type?

R: What's expected? To get between 60 and 70 pass rate, they're quite happy. Production seems to be quite happy round about this. They are saying they are quite happy but obviously they are looking for a better one.
I: Above what rate is failure regarded as unacceptable?

R: Well, I can't really say what production would say. You see, all we do is give them the figures. I can have a job and get it back ten times. Are you talking about one job or the overall job?

I: The overall job, for different products.

R: Well, pots seem to be the worst. Motors don't have a high failure rate, a very good pass rate, and digitisers is the same. The pot rate, if it gets less than 50 per cent, 40 per cent, then I think they start kicking. I would say that would be unacceptable if they started to get 30, 40 50 per cent regular.

I: How is this rate set?

R: Well, what they take into account is we give them the figures of the pass and fails every day, and we have a graph and it's posted up and at the end of the month Jim McDonell comes up with the pass rate and the fail rate for production and it's there for them to look at. But what action they take or what is acceptable to them, I really can't say.

I: What action do you take when the failure rate of a particular product becomes too high?

R: Well, on one particular job in the test procedure we have a system where when I book in a job, if it's on card 4, that means it's been back to me four times for the same check, the foreman has to sign the back of the test card. Now that really is about all I can really do. It's up to the foremen in production to take the action as regards that particular job. He decides what's to be done. Obviously, if certain faults keep coming back, it's not being done by production, I bring it then to the notice of our foreman, and he passes the message on. But in general we do nothing, just record the failures and pass that information on to production. A few years ago we used to have a very good analysis of faults. We used to record all the faults on a sheet of paper. For every pot that you booked out, you had to put down, it failed noise, it failed insulation, it failed resistance, and how many gangs failed and there was quite a lot of information went to production through that and they could always check back on these figures. But when they made the redundancies and they paid off the clerkess, this work had to stop. Nobody does this now. The nearest we have
is what I do. For the information production want, they can only get it through the work I do.

I: Exactly what information do you give Jim McDonell every morning?

R: Well, I give Jim McDonell a list of how many units have failed, how many have passed, how many units have come in from production, the total number of gangs I have in test at that time, and that's about it. I work it out and give him the figures on a piece of paper. He then transfers that information onto a graph. This is done every day and he squares the whole lot up at the end of the month.

I: What are the main problems with failure rates?

R: I would say noise is the biggest failure that we have. Angular failures, I get quite a few, but there's a concession that lets away quite a few of them. But I would say noise was the biggest one.

I: Would you say that the rates were liable to vary from time to time or are they fairly stable?

R: They're pretty stable. You expect so many in a month or whatever and you're never really disappointed. It's always round about the same. You get the odd pot comes round 10 or 12 times and this is ridiculous really - a lot of time wasted on one particular pot. But this is production's pigeon. They should have sorted it out on card three or four. I don't think they're as tight on this as they should be. But it's easy to say from the other side, but the boys run into problems building pots. I built pots myself, so you can appreciate some of the difficulties you run into.

I: Could you describe what a girl does when she fails an item?

R: If they fail on insulation, and this is the first check that they do, the girls that I have, this is not procedure, it shouldn't be done but they do it, is to get one of the other girls to double-check it which only takes a second to say - look, that's a failure. She says that's it. Now that sort of thing keeps her .... The reason we do this is because there's quite a number of units we have failed and sent back to production for an insulation failure and they check it and can't find it. Now it comes back on this girl; she says - but I failed that - and
This happens quite a lot and there are explanations for this. It's an intermittent failure and it's possibly burnt itself out and it's cleared. But what she does, she fails the pot, it fails insulation, on the card whatever gang it was, that's it.

I: This goes on the record card?

R: She enters any failures on the record card and that's all she does. She stamps each operation she does and says if it's pass or fail anyway.

I: Yes, and where are these record cards kept?

R: The record cards - I keep the fail card. If a pot passes on the first card, that's it, it carries on with the job. If it fails, I write out a new card, it goes through to production, and it goes back in. If it passes or fails, the previous fail card I keep for that day. I then put an order and hand out to Betty Unwin outside and she files them away and she keeps the fail cards. All cards are kept outside.

I: Who decides whether an item has to be rectified or scrapped?

R: I decide whether it's pass or fail. If the operator marks down the failure, I have a concession that I can say up to certain limits. And it's only to certain types of pot this applies. Then McDonell can do this. He can concede some more. And if I find that production could give a concession, I give the card to production and hold the job. Then they send upstairs to the planners or whoever it is and they sort it out, if it's feasible. But normal procedure if taken off the test schedule, I say it's a pass or fail and I decide. I mark - fail.

I: Who decides whether that item is to be rectified or scrapped?

R: That is production foreman and production chargehand. They are the two to decide on this. But really I think it's just left to the chargehand, but anything at all and he sees the foreman.

I: But with respect to concessions, it would really depend on the item itself?
R: That's right. If I send a pot back and I say that's failed, if it's not one of the concessionable pots then I send it back. It's up to the foreman on production. He can then still go for a concession himself on that item, and if he gets it, good enough. I have to change the card back to a pass.

I: When an item gets sent back for rectification, does this involve you in any extra paperwork?

R: Yes. It's easier for me to pass a pot than it is to fail.

I: What exactly happens with respect to the paperwork?

R: Well, we've got to make out a new card. This is what you would say it is. A new record card, whereas on the other one I just mark "PASS" instead of marking "FAIL". I have a big FAIL stamp, I just put on the card on both sides of it.

I: Do you keep copies of all these extra record cards that you fill out for rectifications?

R: No, they are just filed anyway.

I: Whereabouts?

R: Betty Unwin is the one that keeps all record cards for all items.

I: Do you ever need to go and use them for any particular reason?

R: Yes, sometimes it's the case has arisen when we want to find out what it failed on on card 1. It could be on card 5; we just want to check back so we go and dig out the fail cards and just see what it's actually failed on. Production use this system as well.

I: Is that set of records used to calculate the failure rates of particular products?

R: No, well, the card number is marked on the card. The failure rate is only decided on the information Jim McDonell gives
production. It's what he says. Production don't keep any record themselves as regards failures or passes. They depend on test saying you had a 60 per cent pass rate or whatever it was this month.

I: Do you know if this information is ever used to provide advance warning that an order is going to be delayed for some reason?

R: I suppose they do. I think they take this into consideration. There's some have tight tolerances and they know that they're going to have a bit of difficulty in getting them passed, if they have a big failure rate on maybe one particular type of pot because the customer's tolerances make it so. And they say, well, we're going to have trouble with this. I suppose that they must stall for the time, for the period number that they're given.

I: How do you keep a record of the efficiency of the operators in your section?

R: We have a system now where I do an overcheck which is at eight times a month. I check the work. If a chap's doing a certain operation, I take it any time, take one job that he's done and just check that it's right. And I do the same for the females as well and record that. Years ago before the clerkess was paid off we had quite a complicated system for recording. Every man had his own graph for how many jobs he done, you see, total jobs done, but not inefficiency - we didn't have an efficiency check at all until this group bonus scheme came.

I: But you now keep a written record of the results of your overcheck?

R: Yes.

I: Where is that record kept?

R: I keep it.

I: What level of efficiency are your operators expected to achieve?

R: It's very high. I couldn't really say a figure. But it's very high, there are very few mistakes. They are only checking a number. I can take any pot and the amount of
pots a man is doing if a man's doing 60 gangs in the one day, I'm only checking one gang, maybe two gangs out of that month, well, sorry, eight gangs out of that month. Now if he's doing 60 a day, the chances of picking a bad one ....... really ....... so I don't think it's a good system. Personally, I don't think it is. I think there should be a better one.

I: What action would you take if you thought that one of your operators wasn't up to standard?

R: Up to standard?

I: Yes, if they weren't working as efficiently as they should be?

R: Oh, they would be told the trouble. Told why and asked why, if there was any problems for themselves; if they were having problems, why, and if they could give an explanation; if there was nothing sort of staring you in the face then you would let them know anyway.

I: What would happen after that?

R: Well they would just carry on and be checked again.

I: But if their work continued to be bad?

R: Well, I think action would be taken possibly by the foreman.

I: What sort of problems arise over the efficiency of your operators?

R: I think for all of them it's the calculations and you've got quite a lot of calculations to do. And if he makes a mistake in his calculations then he can say that angle's failed and he sends it back to production. Production check it and they find it's OK and they send it back in to me and I get the man to recheck it and I can't argue if he's got the figures down in his book that he checked it wrong the first time, but he may say, "Oh, I've made a mistake". This could happen. This is really what it is. We have a check to find out this with a lot of jobs come back which is the repair section where they can find out if it's an operator's fault, tester's fault by the results there because we have a record of every angle taken. The books the chap puts his figures onto is kept for, I think 2 years.
I: When did you last have an operator whose work wasn't good enough?

R: I don't think ... no, I can't say we've not had one that's not been good enough. Maybe one that's not working as hard as she should have been, but that's a different thing altogether. I can't mind of anyone who wasn't good enough in the sense that they just can't do the job.

I: You couldn't say this was a regular occurrence?

R: No, no. I think we've had one or two chaps that are not fast enough. You know, they do the job all right, they can check the job, but it takes too long to check it.

I: What happens in that case?

R: Oh, well, he's no good. And if one of the operators we have just now does the same thing, he's told about it. And this happened last year.

I: What happened in that case?

R: Oh, he was told off. He was informed by the foreman, not by me; I brought it to his attention, we discussed it and he said he would have a word with the chap and explain it, because it was involving the bonus scheme which stands out a lot more - it was involving the other chaps as well.

I: Did his work improve after that?

R: Yes it certainly did, very much so.

I: Could you describe to me how the period batch system works in your section?

R: I just load the jobs into the bin and the operators take them out themselves. I don't actually give them to them physically, unless it's a special job or I'm wanting that one done. But I load them in the period batch numbers and they just work to the period batch system as it is. That's it.
I: And are the jobs always taken in strict rotation?

R: They are, yes. Well, I would say they are now because they never used to be. I'm talking about 6 weeks ago, or 4 weeks ago at the most. It was very awkward for me to work to the period batch system because we had a lot of priorities, and a lot of jobs wanted out in a hurry and different things, and they could change it to suit themselves. But we just got into the way where we said these jobs came in today and they are getting done and they go out. And I had a sort of different system to period batch. My turnover is a lot quicker than any production and this was, .... , anyway it came to their notice and it got changed. I had to work strictly only to period batch. Any job that any operator did had to be the lowest number.

I: And you now work strictly to this system?

R: We did, up until last Monday. Then we got information from Mr. Bryce who saw Harry Edwards who said, scrub the period batch system for this week, we want as many pots out the door as we can. So they just suited themselves. And back on today. I'm working a period batch today. I will do until I get told otherwise.

I: Which way is quicker, working period batch system or working one of your own systems?

R: One of my own systems. Personally, for test, I can produce pots out the door faster.

I: How do you do it?

R: Well, the, eh, by picking the jobs. Production want as many pots out the door at the end of the month, as well as they've got to keep up with the orders from customers. They can't get both, I don't think so, because they've got a backlog and this is what happens. The period batch numbers as far as I'm concerned with, say, a 2-gang pot, that could take that man, because it's a special pot, say a ratio pot, now he's got a lot of readings to take on this. It's what we call a bad job. It's going to take the man two hours to do this and he's only producing two gangs. But I can give that man a job that in the two hours he can do maybe 20 gangs. Now I'm getting that 20 gangs out. But if I work strictly I could have a lot of bad jobs which slow it up, the flow through. Whereas, if I want to I can split this up and I could still get the job done. It seems a bit silly but it can work out.
I: You can actually get work out the door faster by choosing jobs.

R: That's right, yes.

I: Are you liable to continue working the period batch system?

R: Yes, I've been instructed to work strictly to period batch until they come back and say we want you to produce the pots, which is exactly what I was doing before. It could happen next week, maybe the last week of the month if the output's low and they're looking for a lot of pots.

I: In that case, what's the advantage of sticking to the period batch system?

R: I don't think there's any. The trouble is that it's not at the final stages that the hold up is obviously. If you've got a backlog, it must be at the beginning. There must be something wrong at the beginning and you can only do the jobs that you are getting in. If you're getting period batch numbers that are away back that's not your trouble. I've never really worked to the period batch number as such. Up till now, it was frowned upon by a lot of people when they heard. But, let's face it, we went for months and months. I was quite happy, the foreman approved, so that was quite clear as regards that and the job was going out the door just the same. It makes no difference to me what system they want. If they want the period batch system strictly, that's up to them. I could have a man or two men sitting doing ratio pots all week on that period batch system that they're working and then my work's piling up at the back. Whereas I can then split it by saying to a man, you do these bad jobs and I get the operator doing all the quick jobs, and I'm getting all the jobs done. But if they want strictly two men to sit doing ratio pots, slow jobs, for any length of time, then obviously they're not getting the same output.

I: It holds everything else back?

R: Yes, and this is what we sort of try to avoid.

I: Is a record kept of the batches of jobs that come into and go out of your section?

R: Yes, I book them in and I write the job number, batch number, test number, how many units is in it, how many gangs, and I
have a column for booking it out. So they can look at that book and see when that came in and when it went out.

I: And it's from this book that you make up the list that you give to Jim McDonell?

R: Yes.

I: Who else uses this book?

R: Anybody can use it. If production want to know if a certain job's in test, if I'm not there, they can look at the book if they want to find if it's in test. And each day's dated and they can look through the book themselves or they ask me. It's really myself that uses it. It was stopped. This book was stopped two years ago when they changed the system and payed the clerkesses off. They stopped the system and didn't have any booking in. But I pressed for it which was giving me more work. But I needed it because people were coming asking me for jobs and I had to go and look at every job I had in the place. I had no record of where it was. By changing the system, I then had to go and look at every job physically. If Bob Bryce says, "have you got such and such a job", I had to go and look at every job physically to find it, to tell him if I had it. But now, I just look in the book and if it's not in the book then I've not got it.

I: Is the information in the book used for calculating any other statistics?

R: Well, McDonell uses it. He can tell each month how many digitisers, how many motors come in, how many pots came in to test. And this is where he gets the information. He does this every month.

I: Does he abstract any other information from the book?

R: No, not as far as I know.

I: How do you know when a batch has been delayed in your section for some reason?

R: The operator tells me if there's such a thing we can't do, and I hold the job up.
I: What happens in that case?

R: Well, I find out why it's held up and I report it to McDonell and that's it. It could be the pen recorder's broken and we can't do that particular job till the pen recorder's fixed. So the job is held up in test until this is fixed.

I: It gets put into the held-up bin.

R: Yes that's it.

I: What say do you have as to the way your section will be run in the future?

R: Very little. Virtually none.

I: How about the number of operators you have. Who decides that?

R: That's decided by Harry Edwards and George Kay. They decide that through Bert Arnott. He decides really. But it's at that level. Jim McDonell and I have nothing to do with that really. Well, I don't anyway. I don't know what Jim really does.
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