LINCOLN COLLEGE
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DEPARTMENT OF HORTICULTURE

BULLETIN 8

Economics and Management of Vegetable Production

Editor : T. M. Morrison

PROCEEDINGS OF A SHORT COURSE ON

ECONOMICS AND MANAGEMENT OF VEGETABLE GROWING

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PREFACE

The Vegetable and Produce Growers Federation for a number of years has been encouraging collection of costs of production of process crops. While this is valuable in maintaining a watching brief on processor pay-outs, it is only one factor in assessing the relative profitability of competing crops. The full science or art, of management must be brought to bear on the problems before any solution can be suggested.

With farmers diversifying into vegetable production and others likely to follow as processing expands into export it is opportune that a course such as this was held at this time. Some of the discussions show the pertinence of papers to problems facing the industry right now. Others show the way to the future.

The course offered a new look in education to vegetable growers. We have maintained that our greatest contribution to the established grower is to bring recent information to his notice - preferably after he has been in the industry for some time. With a recession in fresh vegetable prices, "economic" management is probably the most serious omission from growers' education. Fortunately in this department and others in the College we can present an expertise in this modern subject.

The papers do not attempt to answer all specific questions but are designed to give a base on which the individual grower can build for himself from his own experience. They also may serve to demonstrate to the grower that in horticulture we have a long way to go to fill the gaps in our "management" knowledge. It behoves all growers to help us and consequently themselves to acquire this knowledge.

Finally I must thank all lecturers at this course for they provided a stimulating four days and all growers who attended, for without a receptive audience no course can succeed.

T.M. Morrison
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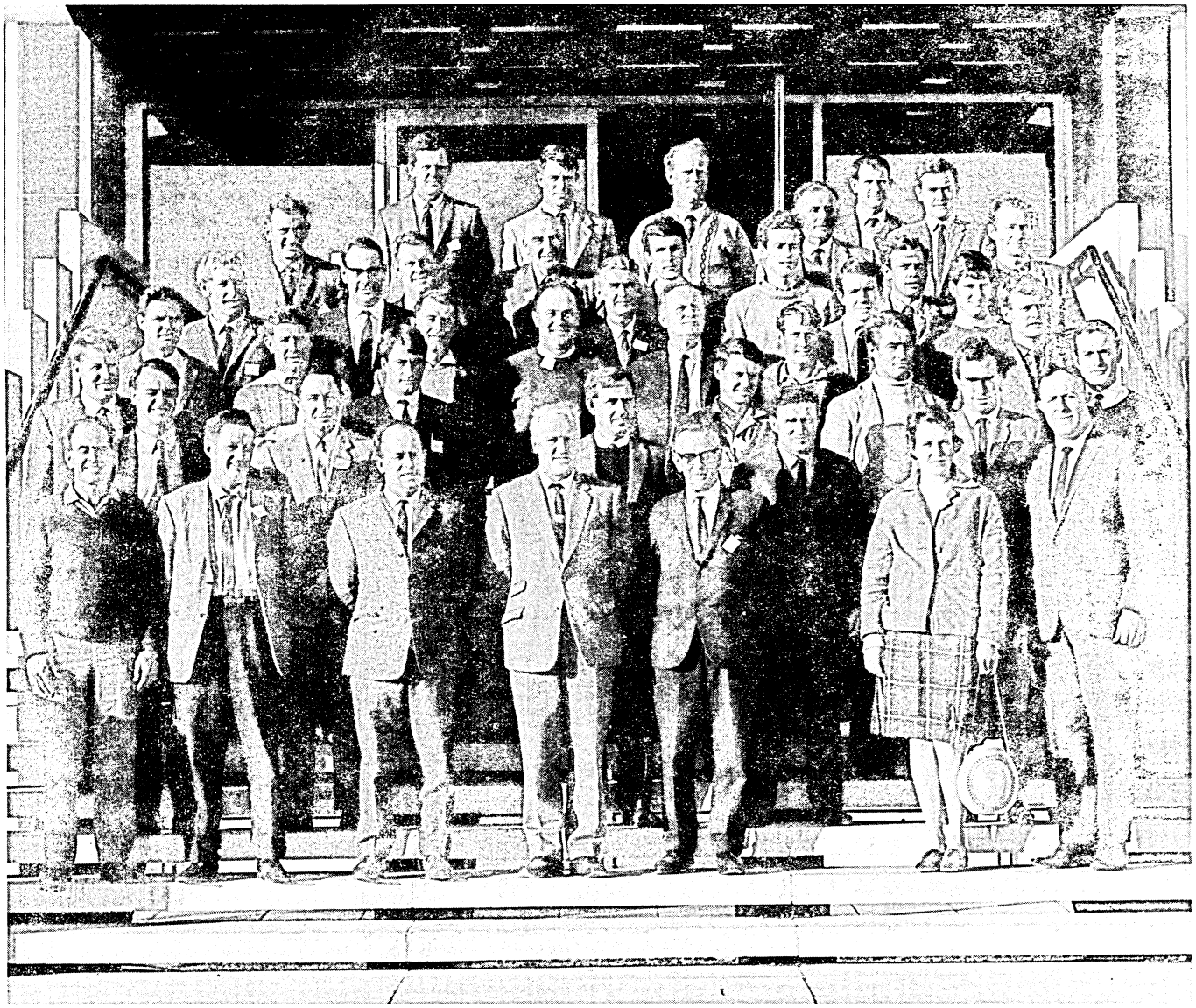

WORK STUDY

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The purpose of this lecture is to explain work study principles, and how they apply to all industries, including farming.

Work study consists of two main subjects

a) Methods study - a procedure for analysing or improving ways of doing work

b) Work measurement - a procedure for finding out the amount of time required for the performance of specified jobs. The times established are used for comparing the efficiency of different ways of doing the same job and planning future operations.

To put this simply work measurement assesses the proper time to be allowed for a job. It is only in the last 20 years or so that any real thought has been given to the application of work study to the farming industry.

A repetative work such as milking is an obvious example where work study has been successfully applied to farming. However, many other operations on the farm, including the design and study of buildings, give ample scope for the application of this method of investigation.

In this lecture, time will only permit the consideration of how method study only, may be applied. Method study can be broken into six steps, as follows:

1) Select the problem
2) Discover, measure and record existing methods
3) Examine the effectiveness of existing methods
4) Develop improved methods
5) Install the improved method
6) Maintain the improved method

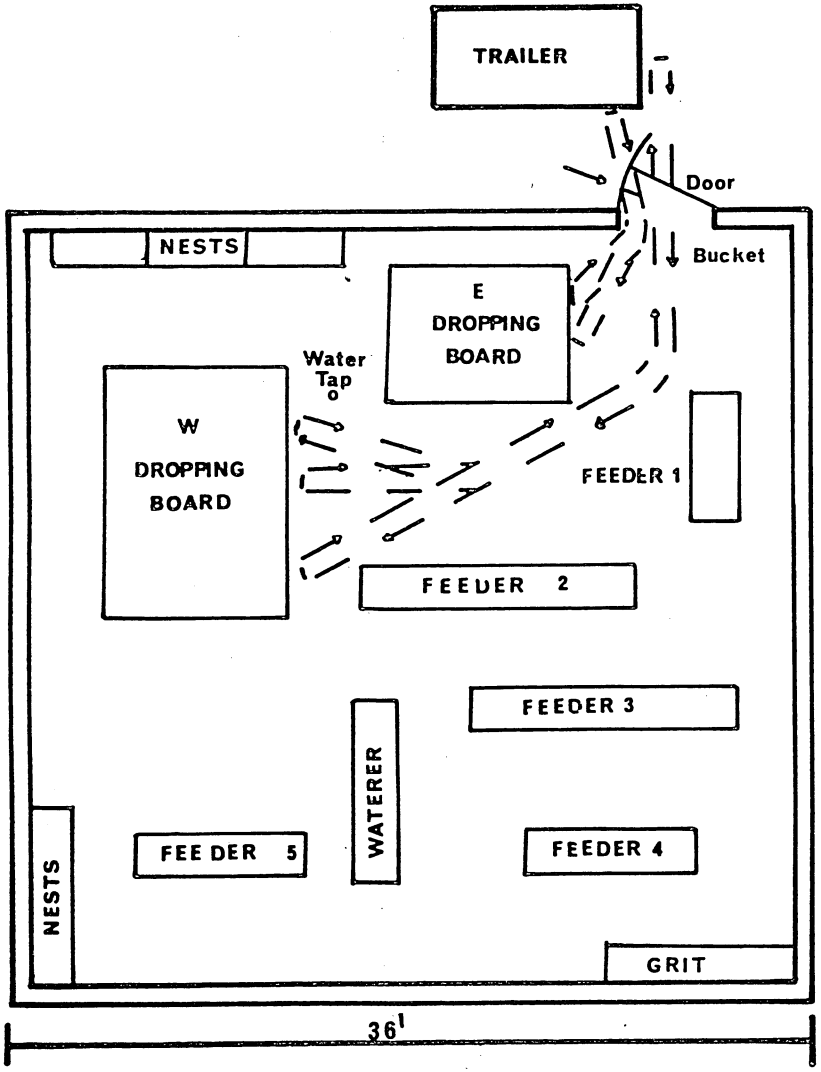
These steps are usually reduced to the following single words:

1) Select
2) Record
3) Examine
4) Develop
5) Install
6) Maintain

1) SELECT

It is first necessary to select the particular problem which has to be solved. It might apply to part of, or all, of an enterprise. In an orchard, it could apply to the whole process from the picking of the fruit until it is crated and ready for delivery to the market; or to one operation only, e.g. grading the fruit.

PRESENT METHOD



PROPOSED METHOD

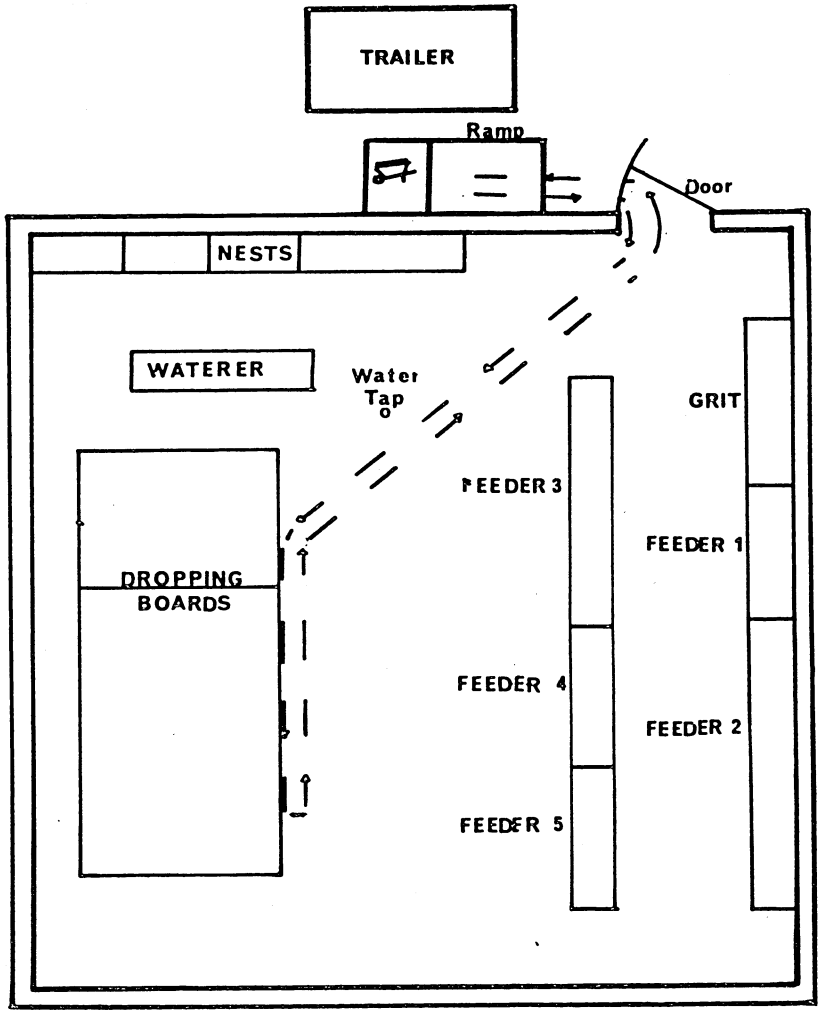


FIG.1

It is necessary in such a study that you are sure that the study is applied to that part of the process where it is desired to make an improvement, and also initially to that part which involves the greatest expenditure. Take for example a case where a study is to be made in order to reduce the labour costs involved in harvesting and packing fruit.

It may be found that 65 per cent of the total labour costs are involved with picking and only 5 per cent of the labour costs taken up with making cases. Therefore, it would be logical to make our initial study into picking methods, since this appears to be the greatest area where labour costs could be reduced.

2. RECORD

It is necessary to record all steps in the operation you are studying. You must only be interested in what actually happens - not what you believe to happen. The information can be recorded in a number of ways by means of flow process diagram, flow process charts and multiple activity charts.

Flow Process Diagram:

The flow process diagram is a drawing, usually to scale, showing, by means of lines, the routes followed on transport, by a person or by a material (not together).

Some flow diagrams also incorporate the symbols used for flow process charts (see below). The process diagram for the existing process of clearing manure from the dropping board in a fowl house is the left hand diagram of Fig. 1, the right hand diagram being the improved system after a method study had been carried out. A flow process diagram would usually be associated with a flow process chart.

Flow Process Chart:

The flow process chart for either man or materials (men and materials cannot be recorded simultaneously on the same chart) divides all work into five categories which are recorded by these symbols:

Symbol	Activity	Description
○	OPERATION	Something is done; typing a letter; picking an apple
□	INSPECTION	Something is checked: inspecting fruit to see it is sound; checking a tank to see how much water is in it
⇨	TRANSPORT	Something is moved: walking from a tractor to open a gate; water moving along a pipe line
▽	STORAGE	Something is stored for a considerable time or taken out of circulation: wheat in a silo THIS IS APPLIED TO MATERIALS not PEOPLE
D	DELAYS OR TEMPORARY STORAGE	Something or someone is temporarily taken out of circulation: man waiting to catch a bus; sack of potatoes awaiting the truck to take it to market.

Simple Example of a Process Chart - Man type

Starting a car

Open door	○
Get into car	⇨
Close car door	○
Pull out choke	○
Foot on accelerator	○
Turn on key and starter	○
Check petrol gauge	□
Wait until engine warms up	D
Push in choke	○

Fig. 2 shows a flow process chart for cleaning hen droppings and Fig. 4 shows the flow process chart for an improved method of cleaning droppings after work study has been carried out.

Multiple Activity Charts

These charts record the sequence of events occurring to more than one man and to more than one machine or material. Man, machines and materials can be shown simultaneously on one chart.

Various solid or hatched symbols record the activites in progress, e.g. a recognised set of symbols for an activity chart is:

Man or machine working

Man or machine idle

Man moving from one place to another

Man holding material or equipment

Man inspecting

It should be noted that the shading and hatching of the above symbols in relation to the activities shows is not mandatory. The person who is using the chart can formulate any type of symbol to cover any activity, but the ones above seem to be those most commonly used for the activities shown. Fig. 5 shows a multiple activity chart for toasting three slices of bread.

3. EXAMINE

Flow process charts should be examined in order to determine the essential jobs first. The essential jobs or "do" operations are either 'operations' or 'inspections'. Transport, storage and delays are not considered "do" operations since they merely enable the essential operations to take place. The second step is to analyse the "do" operations and this is

PROCESS CHART — MAN / ~~PRODUCT~~ ANALYSIS

Original / ~~Improved~~ method

Process: CLEANING HEN HOUSE DROPPING BOARDS

Starting at: OPEN DOOR AT BEGINNING

Ending at: CLOSE DOOR AT END

Charted by: JOHN SMITH

at: CLAY FARM, CAMFORD

on: JANUARY 6TH 1957 am pm

Operator: ABEL BROWN.

		Present		Proposed		Difference	
		No	Time	No	Time	No	Time
O	OPERATIONS	34					
□	INSPECTIONS						
→	TRANPORTS	30					
D	DELAYS						
▽	STORAGES						
DISTANCE TRAVELLED		252 FT.		FT.		FT.	

Item	Detail	Symbol	Distance Travelled (in feet)	Recorded Time	Lapsed Time	Notes
1	OPEN DOOR	O□→D▽				
2	WALK THROUGH	O□→D▽	2			
3	CLOSE DOOR	O□→D▽				
4	PICK UP BUCKET	O□→D▽				
5	TO E BOARD	O□→D▽	5			
6	CLEAN PART E BOARD	O□→D▽				
7	TO DOOR	O□→D▽	5			
8	OPEN DOOR	O□→D▽				
9	WALK THROUGH	O□→D▽	2			
10	CLOSE DOOR	O□→D▽				
11	TO TRAILER	O□→D▽	5			
12	EMPTY BUCKET	O□→D▽				
13	TO DOOR	O□→D▽	6			
14	OPEN DOOR	O□→D▽				
15	WALK THROUGH	O□→D▽	2			
16	CLOSE DOOR	O□→D▽				
17	TO E BOARD	O□→D▽	5			
18	CLEAN PART E BOARD	O□→D▽				
19	TO DOOR	O□→D▽	6			
20	" "	O□→D▽				
21	" "	O□→D▽				
~~5422~~	CLEAN PART W BOARD	O□→D▽				
~~5523~~	TO DOOR	O□→D▽	27			
~~5624~~	OPEN DOOR	O□→D▽				
~~5725~~	WALK THROUGH	O□→D▽	2			
~~5826~~	CLOSE DOOR	O□→D▽				
~~5927~~	TO TRAILER	O□→D▽	5			
~~6028~~	EMPTY BUCKET	O□→D▽				
~~6129~~	TO DOOR	O□→D▽	5			
~~6230~~	OPEN DOOR	O□→D▽				
~~6331~~	HANG UP BUCKET	O□→D▽				
~~6432~~	CLOSE DOOR	O□→D▽				
33		O□→D▽				

FIG 2

PROCESS CHART — MAN / ~~PRODUCT~~ ANALYSIS

~~Original~~ / Improved method

Process: CLEANING HENHOUSE DROPPING BOARD

Starting at: MOVING WHEELBARROW

Ending at: EMPTY BARROW INTO TRAILER

Charted by: JOHN. SMITH.

at: CLAY FARM, CAMFORD

on: JANUARY 23RD 1957 ~~am~~/pm

Operator: ABEL. BROWN.

SUMMARY

		Present		Proposed		Difference	
		No.	Time	No.	Time	No.	Time
O	OPERATIONS	34		6		-28	
□	INSPECTIONS						
→	TRANSPORTS	30		6		-24	
D	DFLAYS						
▽	STORACES						
DISTANCE TRAVELLED		252 FT		90 FT		162 FT	

Item	Detail	Symbol	Distance Travelled (in feet)	Recorded Time	Lapsed Time	Notes
1	PUSH WHEEL BARROW TO DOOR	O □ → D ▽	8			
2	OPEN DOOR	O □ → D ▽				
3	PUSH IN WHEELBARROW	O □ → D ▽	6			
4	CLOSE DOOR	O □ → D ▽				
5	TO BOARD	O □ → D ▽	24			
6	CLEAN BOARD	O □ → D ▽				
7	TO DOOR	O □ → D ▽	38			
8	OPEN DOOR	O □ → D ▽				
9	PUSH OUT WHEELBARROW	O □ → D ▽	6			
10	CLOSE DOOR	O □ → D ▽				
11	PUSH BARROW UP RAMP	O □ → D ▽	8			
12	EMPTY BARROW ONTO TRAILER	O □ → D ▽				
13		O □ → D ▽				
14		O □ → D ▽				
15		O □ → D ▽				
16		O □ → D ▽				
17		O □ → D ▽				
18		O □ → D ▽				
19		O □ → D ▽				

FIG. 4

done by asking questions in a certain order. The five questions are:

WHAT? WHERE? WHEN? WHO? HOW?

The object of the questions is to examine systematically the "do" operations under investigation. The facts should be obtained as they are and not as they appear to be - it is important to ignore any preconceived ideas, and no new methods should be considered until all unsatisfactory features of the existing method have been exposed.

In order to systematically examine the "do" operations a "critical examination" form has been devised. See Fig 3* which shows a critical examination of a "do" operation in the removal of hen droppings. The left hand column of the chart establishes the facts about the operation. The answer to the first question "what is achieved?" should establish the work that is actually done, not the purpose of the work. In the case of the removal of fowl manure from the dropping board, the purpose of the work is to clean the dropping boards - what is actually achieved is the removal of manure from the dropping boards.

The second column considers the facts and asks "are these operations necessary?" while at the same time considering the advantages and disadvantages.

The third column attempts to find an answer to the second column. It sees if the job can be done in any other way.

The right hand or fourth column considers what should be done. It decides between suggestions in the third column, and the original method. This is really your answer column which dictates what is the best thing to do.

Although we have described the columns down the page, it is recognised that the best method of answering the critical examination chart is across the page. Each line across the page deals with one point and arrives at a final answer in regard to this point.

The other chart that can be examined is the multiple activity chart and in this case an attempt should be made to find the limiting factor. If the limiting factor is not obvious, then concentrate on the weakness in the process such as periods of idleness and lack of balance between men and machines. If we study Fig. 5 where three slices of bread are being toasted, we notice that the operation has long periods of idleness and that the right hand side of the toaster is working for only half the time. Therefore, the left hand side of the toaster is the limiting factor since it has two much work to do.

Fig. 6 shows how this limiting factor can be reduced in order that both sides of the toaster do the same amount of work. What is happening here of course is that the examination and the development tend to be part of the one operation.

* Page 125

4. DEVELOP

This step is not so simple since it is not possible to develop a system similar to the critical examination method. The first approach is to make sure that the "do" operations are done in the right ways, in the right order, in the right time and the right place by the right man. Remember "do" operations are the essential ones in any process.

The second stage is to devise convenient movements in order that the essential operations can be put into practice. There are two main ways of developing an improved system.

1. The critical examination will provide ideas and may show how some operations can be eliminated, others combined and how unnecessary movements may be eliminated. It could show that in the hand picking of certain crops, a high rate of production could be achieved if picking is carried out with both hands simultaneously, rather than using only one hand.

2. Another method is to use the better parts of systems developed by others - that is "to pick other people's brains".

Not all market gardeners would do the same job equally well and by studying various ways of doing the same job, it may be possible to pick the "eyes" out of the various methods and revise these to develop a better and more efficient process.

It will be appreciated that there is no golden rule to suit each case when you are trying to develop a better system. However, by critical examination of the facts and by knowledge acquired from observations, it should be possible to improve a number of the methods you employ.

To quote from N. Harvey - "specific problems will need specific answers and method study cannot produce these out of a hat - it can only direct your mind to the problem and guide it to sort out the remedies needed".

Over the years, a number of "principles of labour economy" have been evolved based on experiences. The principles which are set out below taken from the book "Farm Work Study" by N. Harvey, are designed to guide in the application of work study and must not be treated as laws, since they will not apply in all situations - they are however useful rules of thumb at this stage.

Principles affecting work done by hand in one place

i. Both hands should be used equally and simultaneously
ii. The hands should be kept close together so that both can be controlled by the eyes without excessive movement of the head
iii. Continuous circular movements of the hands at a steady rhythmic tempo are preferable to jerky, irregular movements
iv. Hands should not be used for holding things. Holding devices will set the hand free for productive work
v. Materials and tools should be placed in convenient positions before work starts

MULTIPLE ACTIVITY CHART

Original / ~~Improved~~ method.

Process: TOASTING BREAD

Starting at:

Ending at:

Charted by:

at: on:

Operator:

	WORKING TIME
	IDLE TIME

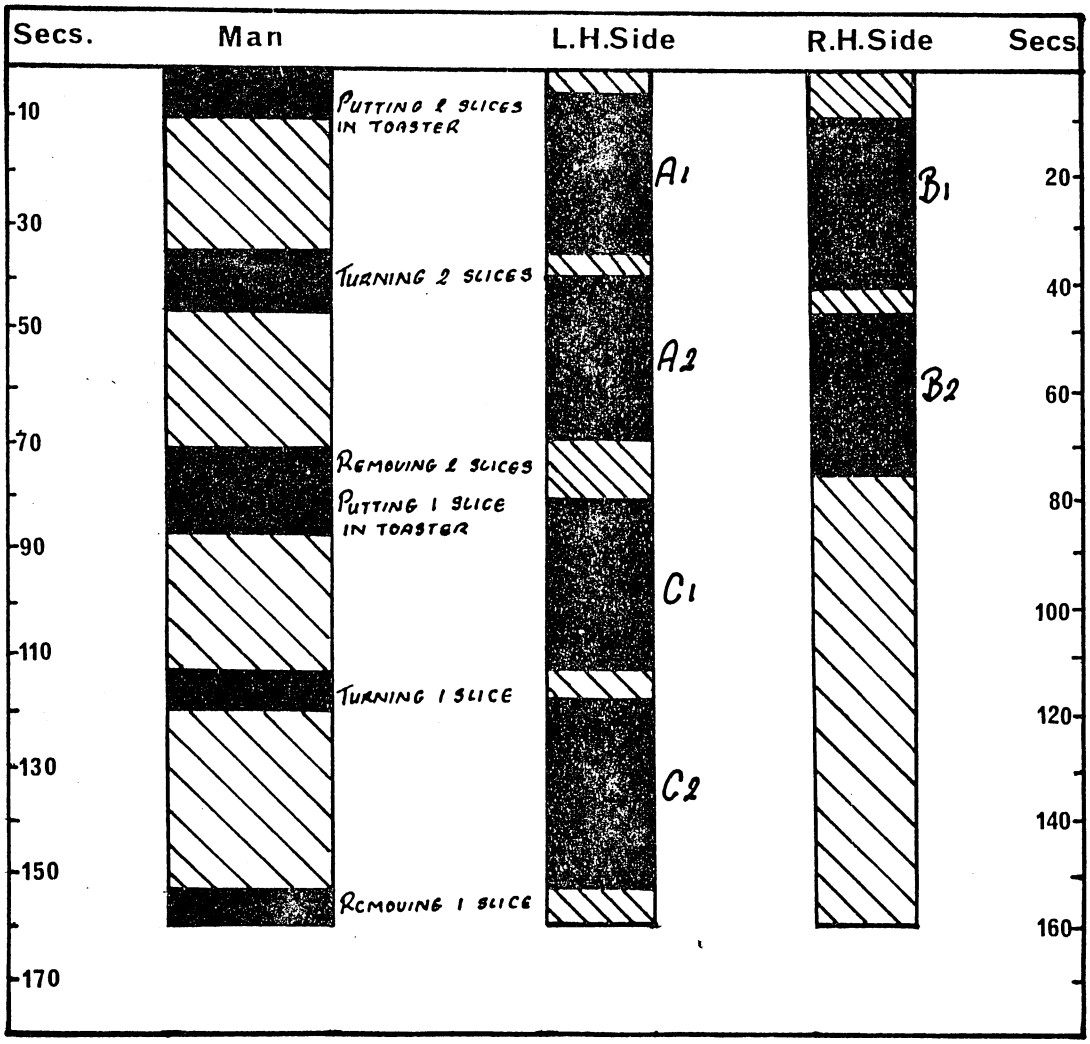


FIG. 5

G R M

MULTIPLE ACTIVITY CHART

~~Original~~ / Improved method

Process: TOASTING BREAD

Starting at:

Ending at:

Charted by:

at: on:

Operator:

	WORKING TIME
	IDLE TIME

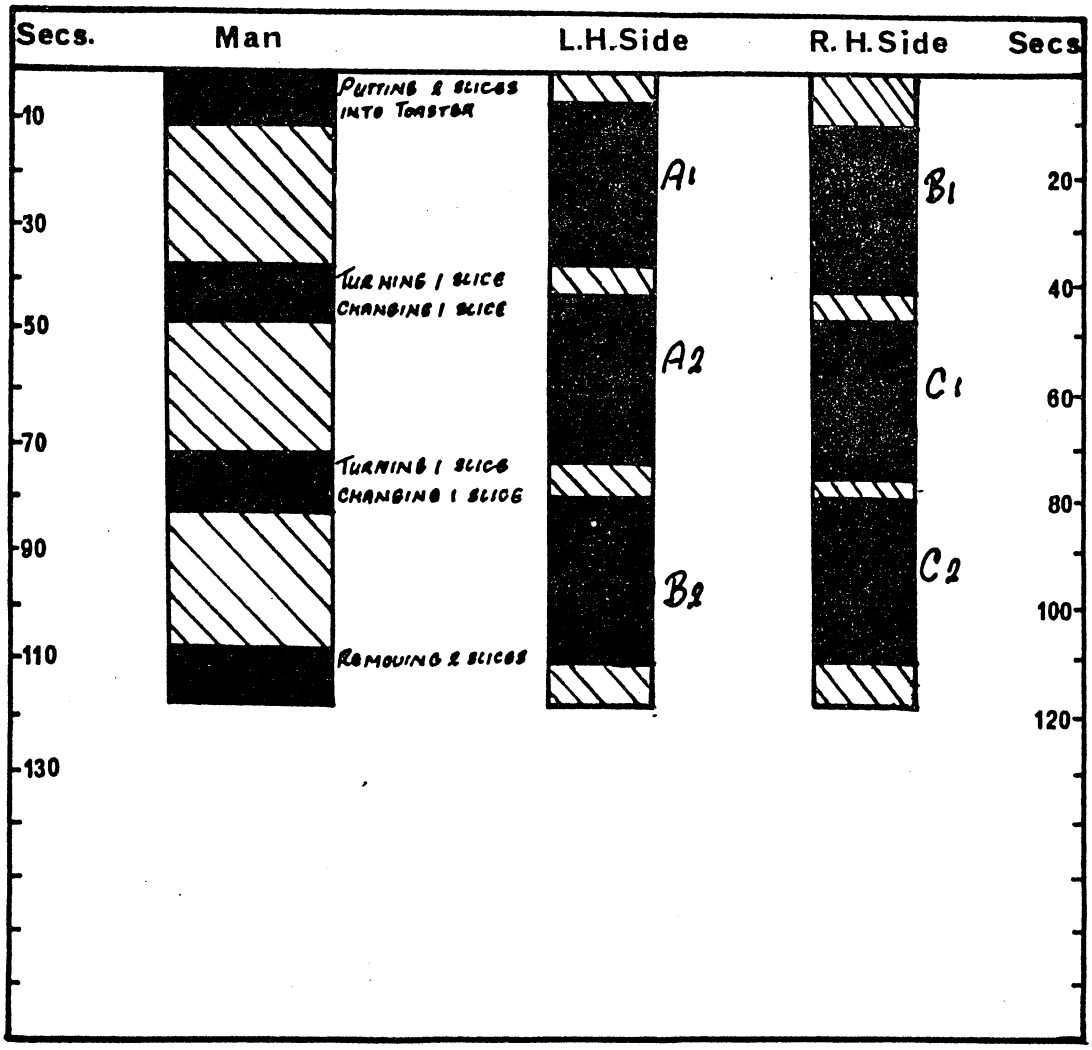


FIG.6

vi. Full loads reduce the number of trips by the hands
vii. A comfortable working position with proper working heights should be secured and maintained.

Principles affecting routine work in and around buildings

i. Work areas should be close together to reduce movement. Place tools and supplies as near as possible to the place where they are used.
ii. Circular travel will eliminate back-tracking
iii. Full use should be made of the force of gravity
iv. Movement by wheeled vehicle is preferable to manhandling. Passages should be wide enough and smooth enough for tractors and trailers or trolleys
v. One operation should start where the previous operation ended
vi. Full loads reduce the number of trips
vii. Double-handling should be avoided
viii. Materials should be kept in buil whenever possible
ix. Definite places should be provided for all tools and equipment
x. Equipment should be fitted to the job.

Principles affecting man using equipment or men working together as a gang

i. Equipment should be fitted to the job
ii. The work should be planned to avoid idle time for men or machines
iii. The work should be balanced between the men or machines doing it. The limiting factor should not be one particular man or one particular machine.
iv. Small gangs generally produce more per man then large gangs
v. All machinery should be capable of bearing its seasonal loads without breakdowns, but spares should be available in case breakdowns occur.

It is necessary in the development stage to prepare flow process charts (and possibly flow process diagrams) or multiple activity charts of the new process in order to see that no essentials have been omitted. The right hand side of Fig. 1 gives the proposed flow process diagram for cleaning out the dropping boards in the fowl house and Fig. 4 shows the proposed flow process chart for the same operation. It is interesting to note that the 64 movements in Fig. 3 have now been reduced to 12 in Fig. 4 and furthermore, the distance of travel has been reduced from 250 feet to 90 feet.

It is desirable at this stage to prepare a financial statement showing the capital costs involved, if any, the cost of operating the new scheme and the estimated saving from the scheme. Work study with all its associated charts and procedures means nothing unless it pays.

5. INSTALL

The next step is to install the new method. Before the process is put into operation, ensure that a trial run takes place in order to draw up a chart of the trial for comparison with the chart produced during the "develop" stage. If there are any differences between the charts, these should be investigated.

It is also important when putting a new scheme into operation to see that everyone involved understands the process and knows the reason for it. Schemes are normally less complicated in agriculture than in industry.

6. MAINTAIN

It is necessary in any new process to see that it is maintained (or operates) along the lines it has been planned. Old habits die hard, and there could be a tendency to return to the old routine since learning a new way is initially harder than continuing the old way.

GENERAL

Remember work study is designed to improve the efficiency of an operation be it the picking of peas or the manufacture of a jet airliner. It is not the intention of the advocates of work study that people should work harder, and it could well be that as a result of these investigations, jobs could be easier, and at the same time, more productive.

Do not look on this as some high brow academic exercise, but as a tool which, used wisely, will help to improve the efficiency of your farming operations - try it.

Acknowledgement

Farm Work Study — Nigel Harvey
Work Study in Agriculture — Fraser and Lugg

CRITICAL EXAMINATION FORM

ITEM: Clearing part of east dropping board into bucket
Item No. on CHART: 6
CHART REFERENCE: Clay Farm, Camford, Loamshire (4/1/57)

THE PRESENT FACTS		ALTERNATIVES	SELECTED ALTERNATIVES
Purpose - WHAT is achieved? Manure is removed from the board	IS IT NECESSARY? YES NO IF YES - WHY? Hygiene	What ELSE could be done? Manure spread on floor	What SHOULD be done? As now
Place - WHERE is it done? Where board is	WHY THERE? Advantages Manure there Disadvantages Lot of walking	Where ELSE could it be done? Board could be moved wherever convenient	Where SHOULD it be done? Wherever convenient
Sequence - WHEN is it done? After: Bucket emptied Before: Bucket emptied	WHY THEN? Most convenient	When ELSE could it be done? Any time	When SHOULD it be done? As now
Person - WHO does it? Abel Brown	WHY THAT PERSON? His Job	Who ELSE could do it? Anybody	Who SHOULD do it? Abel Brown most convenient
Means - HOW is it done? By hand scraper into a basket	WHY THAT WAY? Tradition	How ELSE could it be done? By bigger scraper into wheelbarrow	How SHOULD it be done? By bigger scraper into wheelbarrow

Figure 3. FROM FARM WORK STUDY BY N. HARVEY

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