

## **Production Engineering**

Who needs to know about production management techniques? Basically, anyone who wishes to work in any form of supervisory or management position. Use of the techniques is often the responsibility of the Production Manager, although in larger companies, special departments may be established to provide the information gathered by these techniques.

Even in a large company with specialist departments, the production manager will often be responsible for the use of the information from these departments and should therefore appreciate how the information is gathered, the problems this can cause, the advantages that it can create and the accuracy of the information itself.

In small companies, the jobs may be carried out by the manager him/herself.

### **Responsibilities of the Production Manager**

The responsibilities of this position are varied and wide ranging. The following is an example of the possible responsibilities - either direct or indirect - which the manager may have, depending on the size and strategy of the organisation.

1. Ensure production process continues smoothly
2. Meet production schedules and delivery dates
3. Monitor production processes
4. Optimise production
5. Organise production of new products, samples and tests
6. Ensure the performance and reliability of the equipment
7. Ensure the quality of the product(s)
8. Maintain the levels of the costs, and possibly reduce costs
9. Monitor available capacity
10. Monitor available skills
11. Maintain maintenance schedules
12. Maintain safety standards
13. Ensure supply of raw materials
14. Monitor storage and stores
15. Maintain conditions of work
16. Motivate staff and labour
17. Deal with Trades Unions
18. Assist in or organise training
19. Assist in or organise recruitment
20. Provide management information
21. Assist in the design of new products

22. Analyse complaints
23. Negotiate with customers over complaints
24. According to many --- “to carry the can when anything goes wrong”.....

It has often been stated that “ The main enemy of the Production Manager is the Sales and Marketing Department.”

However - it should be remembered that the viability and success of any organisation depends on the close liaison between the production manager and the sales and marketing departments.

Why is there likely to be conflict between the Production Manager and Sales and Marketing Department?

Requirements	
Production Manager	Sales and Marketing
Stability of production	Immediate change with fashion or style
Establishment of routines	Rapid changes to schedules
Building of expertise and experience	Immediate expertise
Sufficient quality	High quality
Large scale production - many machines per line or product.	Short runs, trials and re-orders
Long runs	Flexibility
High volume	High volume

It is important to understand that production management techniques are not limited for use in production processes. Many of the techniques have been used successfully or adapted for use in service industries, in distribution and in retailing.

In fact, they can be used in any organisation or operation involving people, activities and/or materials, e.g. office management, kitchen management.



## The Production Management Framework

We have already looked briefly at some of the responsibilities of the production manager, however it is useful to analyse the job and the responsibilities further, in order to determine the real area of responsibility of this position.

The responsibilities may be divided into the following areas, known as **the 5 P's** (as an alternative to the less impressive four P's of marketing):-

Product  
Plant  
Processes  
Programmes  
People

The production manager must be involved in each of these areas. If we look at each of the areas we may see how and why the PM should be involved.

### **Product**

performance -

aesthetics -

quality -

reliability -

quantity -

selling price -

delivery dates -

changes in design -

changes in product -

### **Plant**

future demands -

layout & design of buildings -

performance and reliability of equipment -

maintenance of performance -

safety of installation & operation -

social responsibility -

pollution -

## **Processes**

available capacity -

available skills -

types of production -

layout of plant & equipment -

safety in method of operation -

maintenance requirements -

costs to be achieved -

## **Programmes**

timetables for delivery dates satisfaction -

timetables for purchasing -

timetables for manufacturing -

timetables for maintenance

timetables for cash supply -

timetables for storage availability -

timetables for transport and distribution -

## **People**

wages -

safety operation and safety education -

conditions of work -

motivation -

recruitment -

Trades Unions -

training -

Any manager may be involved with many of the areas. The importance of each area will vary with the type of organisation, the size of the company, the type of company - manufacturing or service, management policy, time etc.

## Management Production Techniques

What type of techniques are available?

- Analysis of production types and methods
- Group technology
- Method study \*\*
- Work measurement \*\*
- Materials handling \*\*
- Estimating & planning
- Quality control
- Quality assurance
- Costing
- Scheduling & loading (see Quantitative methods)
- Linear programming (see Quantitative methods)
- Line of balance
- Critical path analysis
- PERT - Program Evaluation & Review Technique
- Materials control
- Determination of Site Location
- Quality circles \*\*
- Work study \*\*
- Network theory (see Quantitative methods)

## Work Study

Work study is simply the study of work and how it is carried out.

Most people consider work study to be a modern science, however there are examples documented earlier than the modern era.

Ref. History of Scientific Management - by H Atkinson - in Engineering & Industrial Management - 1919

The majority of information on work study is much more recent. The father of modern work study is generally regarded as Frederick Winslow Taylor. His work in this area was carried out between the late 1880s and the start of the first world war in 1914.

In WS, work is considered as any form of human work, and hence any form of human work may be studied. It is not limited to the shop floor or even to manufacturing.

In modern manufacturing, WS is used as an aid to management in the optimisation of total resources for the accomplishment of the organisation's objectives.

This course will not train you to be proficient in WS, it will simply examine the activities involved in WS and the advantages and disadvantages with might come from its use.

It is useful to define the terms to be used.

## Definitions

### **Work Study - BS 10001**

A generic term for these techniques, particularly Method Study and Work Measurement, which are used in the examination of human work in all its contexts, and which lead specifically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvement.

### **Method Study - BS 10002**

The systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods of reducing costs.

### **Work Measurement - BS 10003**

The application of techniques designed to establish the time for a qualified worker to carry out a specific job at a defined level of performance.

## **The Objectives of Work Study**

There are THREE major objectives of work study:

1. to obtain the most effective use of human effort
2. to make the most effective use of plant and equipment
3. to evaluate human work and effort

Stated simply - WS is the determining of facts and the use of these facts as a means to improving activities.

Work study is one of the Productivity Sciences which also include

O & M - Organisation and methods  
OR - Operational research  
Network analysis  
Systems analysis  
Ergonomics  
Value engineering etc.

Work study involves the use of both work measurement and method study. This is shown on the following page.

## **Method Study**

Method study is used first in work study. It is sometimes known as motion study, as it is a study of movement and methods.

Method study enforces a disciplines and systematic approach to problem solving and/ or cost reduction.

### **Stages of Method Study**

1. Select - or Define problem
2. Record - or Collect Data
3. Analyse the data and present solution
4. Examine & develop a new method
5. Define and evaluate the new method
6. Install the new method
7. Maintain the systems

## **1. Select - or Define problem**

The problem definition is the first and most important stage. Often it is also the most difficult stage.

Often it is the most neglected stage.  
*Why would it be neglected?*

*What is the effect of this?*

This is not a cost effective solution.

### **Other reasons for selecting an area for study**

The selection of an area for study may be because of a requirement to reduce costs, or to improve the safety record.

There are pointers which may suggest that studies might usefully be carried out in areas. These pointers do not determine that a study would be useful but only lead the work study practitioner to likely areas.

### **Problem Pointers**

Poor use of Materials, -  
Labour -  
or Machine capacity -

Poor layout or poor operational planning -

Existence of bottlenecks of any type, -

A high level of variation in quality of product

Highly fatiguing work, high level of absenteeism and/or sickness & operator errors

Excessive overtime required to maintain a balanced production. - hidden bottlenecks?

Excessive complaints from employees without obvious reasons.

### **Following the Identification of a Pointer.**

The existence of a pointer is not necessarily the signal to go ahead with an investigation **unless** one or more of the following is likely to occur.

- a) increased production
- b) reduced costs
- c) reduced labour input -
- d) reduced material input -
- e) reduced machine input -
- f) improved quality without extra costs
- g) improved safety levels to be reached
- h) improved cleanliness and housekeeping
- i) reduced level of scrap materials or reduced reworking

If any of the above outcomes might reasonably be expected, then the manager is likely to approve an investigation together with its attendant costs.

## **2. Record --- Collect and Record Data**

This section of the process covers the collection and recording of all data.

Data is collected using a variety of methods including  
 observation  
 document analysis  
 discussions.

Data is recorded in forms to provide the maximum amount of information. This may be achieved in various ways for example:

### **a) Process Charts**

May be either:

Outline Process Charts - which give an overall picture including the materials input.

Flow Process Charts - which are more detailed referring to one process or one processor

### **b) Time scaled charts**

Multiple Activity Charts - showing relationships between processes or processors. - effectively a vertical Gantt chart.

Simultaneous Movement Charts (SIMO charts) - this uses the recording of movements of two or more parts of a workers body by means of either cine-film (past) or video (present).

### c) Movement charts

Travel Charts - for complex situations, to record the number of movements in a given time

Flow Diagram - which is a map or display, actual or stylised, of the workplace and the activity locations.

## **3 - Analyse the Data** **& 4 - Develop the New Method**

These two areas are best considered together. They are also best considered **away** from the working area.

When analysing data it is important to keep an open mind and to adopt a systematic approach

### **Objectives of this stage**

to remove unnecessary jobs  
to simplify jobs  
to reduce the job

to rearrange jobs.

A point to remember, when developing a new method it is normally true that the BEST solution is the SIMPLEST solution.

One method of analysing the data is by the Questioning Technique. This technique will test whether an activity is really necessary. It will also begin the planning of the new method.

It should be noted that OPERATION activities should always be tested **before** other types of activity.



*Why is this?*

## **The Questioning Technique**

This technique is performed using a series of questions in five groups. The questions are arranged in order of importance and should be used in the order shown.

### **1) Purpose**

What is being done?  
Why is it being done?  
What else could be done?  
What should be done?

### **2) Place**

Where is it being done?  
Why is it being done there?  
Where else could it be done?  
Where should it be done?

### **3) Sequence**

When is it being done?  
Why is it being done then?  
When else could it be done?  
When should it be done

### **4) Person**

Who is doing it?  
Why is that person doing it?  
Who else could be doing it?  
Who should be doing it?

### **5) Means**

How is it being done?  
Why is it being done that way?  
How else could it be done?  
How should it be done

When developing any new method, the new approach must be tested against several criteria.

Method objectives

Project objectives

Cost relationships

Acceptability

Safety

## **5 - Define and Evaluate the New Method**

By this stage, a new method, a revised method, or even a short list of new methods has been developed.

The first stage of the defining of a new method is the presentation or layout. This presentation allows the Work Study manager to 'sell' the new method. The first presentation is to supervisory staff and to management. Providing this is approved the presentation may be made to ONE operator.

The presentation to the operator is imperative as he/she is the one person who can most easily kill a method by creating problems in the evaluation.

Following the presentation(s), the operator must be trained in the new method, until he/she is both familiar and competent in the method.

Only then can the evaluation take place. This evaluation is the assessment of the new method against the old method and it must be tested against the criteria used in the previous section,

- i.e. Method objectives
- Project objectives
- Cost relationships
- Acceptability
- Safety

## **6 - Implementation**

This is one of the most difficult stages of the process and consists of several sections, some of which may be very time-consuming.

- a) Present and 'sell' the new method, changes etc. to all the operators concerned who will be using the new method.
- b) Plan for any changes in equipment or plant which may be necessary. Plan for any layout changes
- c) Draw up instructions. This includes a detailed descriptive breakdown of the method, plus an instructor's manual for training future operators.
- d) Train all persons necessary. This will include all current operators and may include supervisory staff, instructors and/or training staff and even possibly line managers.
- e) Design and implement controls for the operators, to ensure compliance with the method.
- f) Maintain and update the system and the information throughout the changeover.

## **7 - Maintain**

The method should be monitored for some time following the completion of stage 6. This should be done on a regular or an irregular basis to ensure that variations do not occur.

There is a long term requirement to monitor on a less frequent basis for an extended period.

## **Work Measurement**

(see definition)

### **Objectives of Work Measurement**

- a) To assist in Method Study by the comparison of times for alternative methods.
- b) To ensure realistic schedules of work may be prepared.
- c) To be used as a basis for realistic and fair incentive schemes.
- d) To aid Process Control - the monitoring of the utilisation of both machines and labour.
- e) To aid in estimating for future planning.
- f) To provide a firm basis for Budgetary Control Schemes.

### **Work Measurement in Practice**

The definition states “at a defined level of performance”. This defined level is known as **standard performance**.

#### **Standard Performance.**

A worker working at standard performance would, in one hour, produce one standard hour of work.

Any activity must be measured in standard hours (or standard minutes) NOT in observed time.

### **What does Work Measurement Actually Show?**

It provides THREE aspects of a job's TIME.

- 1) How long does it take to do the job?
- 2) How long should it take to do the job?
- 3) How quickly could the job be done?

**There are however several pitfalls which can occur in this type of work.**

- 1) Too much emphasis may be laid on the measurement aspect.

In many industries, including textiles and clothing, the use of work measurement is given too much emphasis, particularly when used as a basis for payment schemes.

The result of this emphasis is the possible continuing use of poor methods in order to maintain a **seemingly** efficient operation

The remedy is the proper use of method study **before** work measurement.

2) Costs may exceed possible benefits.

The costs of work measurement form, both the cost of the study and/or any errors or misapprehensions built into the figures, may exceed the expected benefits which could be gained.

3) Labour may work to the quota rather than maximising performance.

Once a target has been established, then change will be more difficult. Staff will work up to the target in normal situations but if the target is low, then they will tend to work down to it.



*What if the target is too high? -*

## **Techniques Used for Work Measurement**

### **A. Time Study**

In this approach, the activity being carried out is broken down into individual elements. Each element is identified and then timed a suitable number of times to ensure a consistent result.

Performance rating is included in with the observed timings to create a standard time.

In addition, there should be a relaxation allowance included to provide an accurate time for long term operation.

Performance rating is a measure of the level of performance of the individual doing the activity compared with the expected performance of an average worker.

The system requires the use of a trained work study practitioner and is accurate but expensive.

### **B. Production Study**

This method uses a continuous observation over a specified period. It is used most effectively to determine the relative occurrence and the frequency of occurrence. This is a less labour intensive method as it may be carried out by semi-skilled labour, however it does require a constant presence.

An example of the use of this method is

### C. Activity Sampling

This method of measurement is a non-continuous method. Here, a series of observations of a situation are made over a more prolonged period. The observations may be regular or random depending on the situation.

A more detailed description of activity sampling follows this section.

**Note** - The above methods all use direct observations of the activity.

### D. Synthesis and Analytical Estimating

Within any organisation, an industrial engineering department, or work study department, will study many activities and jobs. Within these activities, many of the elements of these activities will be similar or even exactly the same.

By using element timings for exactly equivalent activity elements, the costs of the department can be reduced. If the elements are exactly equivalent, and have been obtained by time study, then the method is known as SYNTHESIS

If the element times have been obtained from similar activity elements, rather than exactly equivalent ones, then the process is known as ANALYTICAL ESTIMATING.

These times may be used for existing activities or for new activities which may be otherwise unavailable to study.

### E. Predetermined Motion Time System - PMTS

This is a technique where standard times are established for a wide range of basic human motions.

The method used is

1. to analyse the activity into its elements as in previous methods
2. to build up an activity time by adding all the standard times of each of the identified elements.

NOTE - Where work measurement is carried out for use in payment systems, then it must be performed by a skilled practitioner.

## **Activity Sampling**

### **Definition.**

A technique in which a large number of observations are made, over a period of time, of one or of a group of machines, processes or workers. Each observation records what is happening at that instant and the percentage of observations recorded for a particular activity or delay is a measure of the percentage of time that that activity occurs.

Certain types of work may be difficult to study using standard work measurement

techniques, for example warehouses. A full production study would be time consuming and expensive. This technique, developed on statistical work by Tippett, allows 'snap' observations to be built into a picture of the whole.

It is an ideal system for assessing machine efficiency in a large department, and can easily demonstrate the average stoppage rate.

The technique is very similar to statistical quality control, where large numbers of products are inspected to give an expected confidence level of defect expectation.

### Activity Sampling in Practice

Obviously, the accuracy of activity sampling will depend on the number of observations. Few and infrequent observations will provide a low level of accuracy, whilst many and frequent observations will give highly accurate but more expensive information.

It is, therefore, particularly important that the observer knows the optimum number of observations necessary for a particular study. This number can be calculated quite simply once an approximate picture of the situation is established, using the following formula.

$$N = \frac{4P(100-P)}{L^2}$$

where        N = Number of observations  
              P = Approx. occurrence of factor as a percentage of N  
              L = Acceptable accuracy in occurrence of factor being studied - (percentage)

This formula will give the accuracy of the study within 95% confidence limits.

eg.

A worker is studied using activity sampling, and 32 observations are noted. Of these 75% showed that the worker was performing useful work. If we assume that we would like to check that the worker is performing at this level continuously, plus or minus 10%, ie. between 67.5% and 82.5%, how many observations would we need to provide 95% confidence in the result.

$$P = 75\%$$

$$L = 10\%$$

Hence

$$N = \frac{4 \times 75(100-75)}{10 \times 10}$$

$$N = \frac{300 \times 25}{100}$$

$$N = 75$$

However, after performing 75 checks, the value of P was found to be only 70% so the extra data could be used to assess the new requirement for the number of checks.

$$N = \frac{4 * 70(100-70)}{10 * 10}$$

$$N = \frac{280 * 30}{100}$$

$$N = 28 * 3 = 84$$

Hence more checks would be required, ie. a total of 9.

**Once these checks had been completed, a final calculation should be done to ensure that the number required had not changed.**

### Rated Activity Sampling

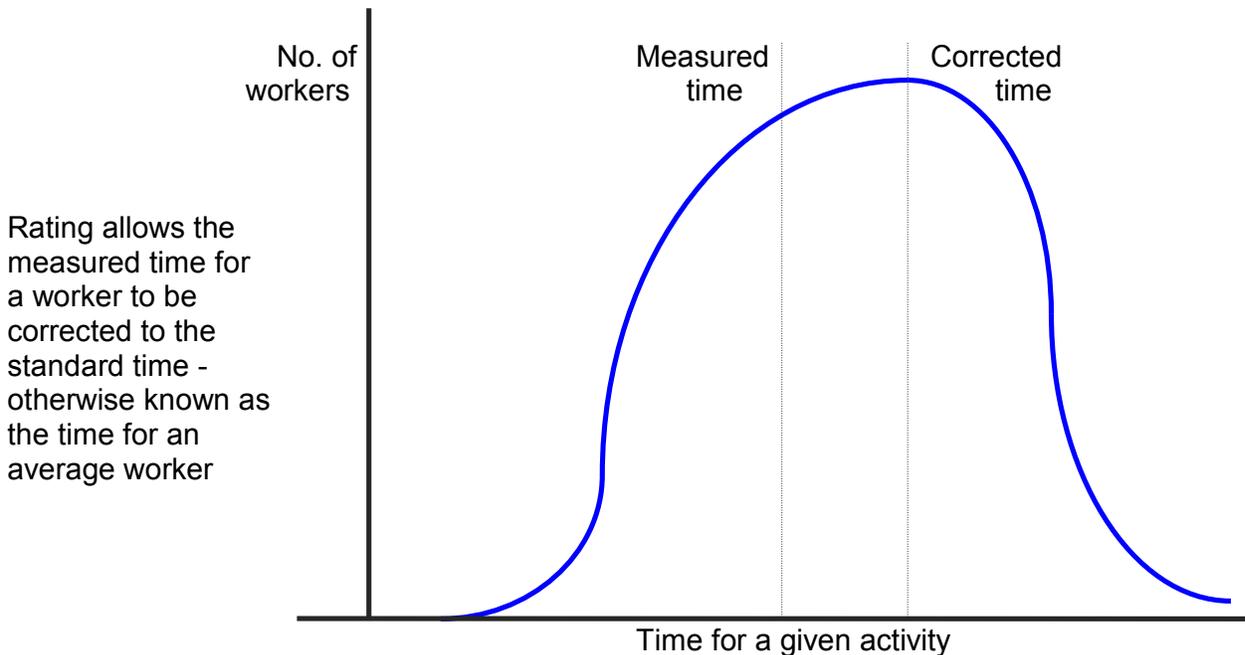
#### **Definition**

An extension of activity sampling in which rating is applied so that, where the frequency is known, work content may be established in addition to the proportion of time occupied by other activities or delays.

Ref. - Production & Operations Management - Muhlemann A/Oakland J/Lockyer K - Pitman (6<sup>th</sup> Ed 1992/3)

### Rating

Rating of work activities is a particularly difficult area for non-specialists as it is so subjective. It must be noted that there is no ideal target time for a job for ALL workers, as each works at their own rate, and target times, based on ratings, are only totally suitable for "The Average Worker"



## Rating Systems

There are four main methods used for rating.

1. Effort based
2. Objective based
3. Levelling
4. Collective rating.

### **1. Effort based**

With effort based systems, an activity is broken down into individual elements and each element is timed and rated. Standard times may then be calculated for each element, and hence the total activity time may be calculated.

Effort based rating may be based of one or more factors, these might include

Rating on the British standard is based on a normal activity of 100

To calculate a standard time is simple as shown by the following formula

Basic Time for Job (if performed at a rating of 100) - BT

Observed Rating - OR

Observed Time - (Actual time taken) - OT

Standard Rating (= 100) (British Standards system)

Basic Time for Job =  $\frac{\text{Observed Rating} \times \text{Observed Time}}{\text{Standard Rating}}$

$$\mathbf{BT} = \frac{\mathbf{OR \times OT}}{\mathbf{100}}$$

### **2. Objective based**

This is a two part system for each element of the job being assessed.

First stage is the **timing** and the assessment of the **pace** of work. This used to be done using film, now the normal method would be using video.

The observed element times are then corrected to allow for the pace of the activity. This must also consider the amount of energy required by the worker to complete the element.

The corrected element times are then totalled to give a corrected total time for the activity. This is the **standard time**.

### **3. Levelling**

Levelling is normally applied over the whole operation or activity, not separately for each element.

The observed time for the complete activity is corrected by the use of reference tables which allow for the grades of skill, the effort needed, the level of consistency and the working conditions etc.

The tables will provide a levelling factor, which may be used to calculate the levelled time, which represents the average time taken to complete the activity by an average worker working at normal performance.

### **4. Collective rating.**

With this system, the timings are measured without any allowance for the rating. The times are then considered by a panel or committee of management and workers/workers representatives, who will assess the times and judge a rating or levelling factor to be applied to the figures.

The target times will be based on the results of the assessment. Typically the members of the group will include a foreman, the production manager, a work study officer and a union representative.

## **Allowances**

An important point to note is that even when the target times for all activities are calculated these are only target times for the working part of the job under consideration.

People can not work continuously all day without any break or without any relaxation time. Allowances for some breaks and 'stopped time' must be included in the calculations.

There are two types of relaxation allowances:-

- a) Constant allowances
- b) Variable allowances

#### **a) Constant allowances**

These are standard allowances agreed between management and labour representatives, which are added to the target times as a straight percentage.

Constant allowances cover the personal needs -

drinking toilet etc.

and fatigue  
basic fatigue -  
visual fatigue -  
environmental conditions -

Constant Allowances	Examples of Allowance Values	
	Male	Female
Personal Needs	5%	7%
Fatigue	4%	4%
Total	9%	11%

**b) Variable allowances**

These are special allowances made, often in the short term, to allow for special situations or circumstances.

Long term variable allowances may occur with certain machines or in certain work areas. e.g. when a machine takes time to start up and to slow down - (this is an unoccupied time allowance)

or - when two or more machines are likely to be stopped at the same time - (this is an interference allowance.)

**The Effects of Work study** 

Work study is a powerful tool used properly, it can however be dangerous in the wrong hands. It is not a tool to be wielded indiscriminately by amateurs, it must be used carefully by those who understand it and who can draw reliable conclusions from its results.

In addition, the use of work study in the workplace will always have some effects, even if the results are not used. The activity itself can affect people both workers and those studying them.

**The effect on the investigator.**

The investigator has a position of power. He/she must be systematic and objective - NEVER subjective, and must never bring 'baggage' to the investigation.

**The effect on the workforce studied.**

Being studied can cause anxiety. Workers will often initially increase their activity and their speed of working, this extra effort will cause stress.

Alternatively they may work slowly, trying to create a greater time for the job. Either way the stress will tend to cause irritation, alienation and a range of other problems.

The work study practitioner can minimise the problems by involving the workforce from the start of the operations. This approach should create enthusiasm, flexibility and possibly, help and advice.

It is not only the worker being studied that should be involved, the union representatives may be involved. In addition, other workers may be involved as any new method may be dependent on earlier processes or have repercussions on later processes.

Work study used properly can

- improve productivity
- improve methods and safety
- improve wages
- improve working conditions

If used incorrectly it can

- create unrest
- increase labour turnover
- reduce wages
- reduce the level of safety
- even reduce production.

For further guidance on performing work study in the workplace read -  
The Time Study Manual - Enrick  
The Industrial Engineering Manual - Enrick

## **Payment Systems**

In a large company - payment systems may be dealt with by a range of departments including the:

- Personnel Dept
- Industrial Relations Dept

In medium and smaller sized companies (SMEs) the production manager may be closely involved in the system.

The very small companies - the production manager may **operate** the payment systems.

 Payment systems are important to all staff and employees, from the lowliest unskilled worker right up to Senior Management. Hence everyone should know something about:

- the purposes;
- the advantages;
- the limitations.

### **Objectives of payment systems**

Before examining the working of payment systems - first we need to examine the objectives of payment systems.

The objectives of payment systems may be of TWO types

a) Implementation Objectives

These relate to changing a current situation - either increasing the performance of existing plant or starting up a new plant

b) Continuation Objectives

These relate to situations where there is a need to maintain a specified level of performance.

Examples of individual objectives in each group may be identified as follows:

**Implementation Objectives**

1. To reduce labour costs per unit by a specific factor
2. To improve quality
3. To pay competitive wages for the job, for the location, for the industry, in order to attract the right level of labour
4. To attract the right type of labour
5. To retain the existing workforce, particularly if trained.
6. To create a scheme which is acceptable to the workforce
7. The scheme must be seen to be fair, equitable and understandable.
8. The scheme should compensate all relevant workers for any general or specific poor working conditions.

**Continuation Objectives**

1. Helps to ensure that management has the greatest control of production, of wages and all associated costs.
2. The scheme should be capable of being controlled at reasonable costs
3. It should allow for changes in methods of working and should encourage flexibility in the workforce
4. It should maintain maximum plant efficiency
5. It should maintain a given level of output and a given level of quality for a given level of costs
6. It should recognise and reward individual effort, skills, knowledge and contribution
7. It should help to retain the workforce, especially those with useful skills.

8. It should encourage good time-keeping and discourage absenteeism.
9. The scheme must be seen to be fair, equitable and understandable.
10. The scheme should compensate all relevant workers for any general or specific poor working conditions.

It is worth noting that some of the objectives are common to both situations  
 These are the ones that refer to:  
 the retention of the workforce;  
 being seen to be fair;  
 being easily understood.

The objectives in the lists are not equally weighted for importance.

In fact in certain instances - some objectives may be in conflict. Resolving any conflict between objectives must be given a high priority.

When considering the objectives - it may be necessary to establish the priority of the objectives before any planning can take place.

### **Elements of Pay**

The pay of a worker may be made up from several elements.

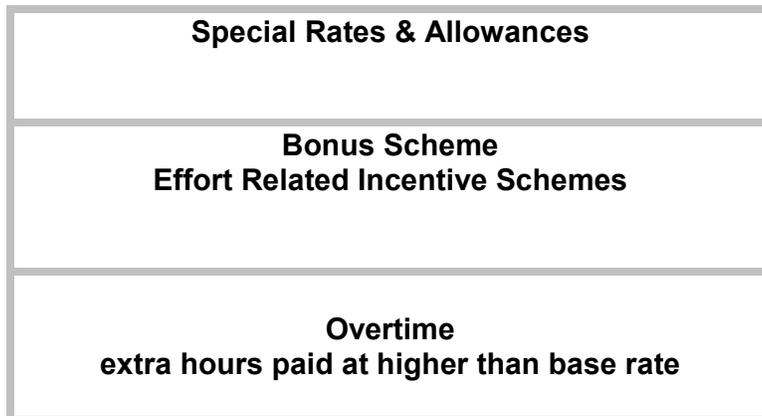
#### **Base Rate**

The simplest form of payment is a set payment - normally based of the number of hours worked. This is known as the BASE rate.  
 This guarantees a set basic minimum wage.

It is also the basis on which payment for extra time is made - normally at a premium.

e.g. - Overtime Rates might be calculated as follows:  
 time and a third - 133% of basic for evenings  
 time and a half - 150% for Saturday mornings  
 double time - 200% for Sunday working  
 'intern' rate - 75% for young hospital doctors

Any final wage may consist of several sections –



## Base rate

Base rate will normally also be used as a basis for calculation of any **overtime rates**, **bonus rates** or **special payments**.

Bonus rates may also be known as 'Payment by Results'

### **Special Rates & Allowances**

Shift Allowances

Special allowances

Personal Rate

Job Rate

Job Rate covers the area where a system is designed to take into account;

the different skills needed

the knowledge required

the experience necessary

or poor working conditions.

This type of payment only takes into account the job - not the qualities of an individual worker.

There are various ways to develop a Job Rate

- It may be a collective agreement on the value of a particular job

- It may be decided as a result of Job Evaluation. This is an assessment of a job against a set of criteria.

[Reference - Job Evaluation - A Practical Guide for Managers – Pub - BIM Management Publications.](#)

While Job Rate is used as a calculation for a group, Personal Rate is used to reward **individuals**.

It may be used in different ways

a) **Banded Personal Rates** - could be used with managerial, supervisory, staff and technical grades. Each job has a set range, individuals may receive a salary within that range, based on the discretion of a superior.

b) **Merit Rating** - where workers are given a Merit Rating based on points for a variety of factors.

These might include:

level of co-operation

punctuality

originality

level of productivity

Merit rating can often be based on subjective judgements rather than accurate measurement -

### **Flexibility Bonus**

The Flexibility Bonus introduces the idea of the '**Floating Worker**' - otherwise known as a **Multi-skilled operative**.

The Flexibility Bonus is in recognition of the skills of the person and of their willingness to move from one job to another within the factory as required. This bonus is valuable to the employee as it is constant and requires no extra effort.

It is valuable to the employer as it helps to ensure maximum output.

The only problem is that if too many staff qualify for the bonus - then it loses much of its impact to the worker.

### **Progression and Promotion**

Many companies use Progression and Promotion as a means of rewarding good workers. This is normally a good incentive to good workers - however - most will understand the limits and the time delay inherent.

To the employer, there is a possible disadvantage, - it may be an error to promote a good worker to a position at which he/she may be only average.

## **Incentive schemes**

Incentive schemes are of TWO major types

- a) Non-Financial
- b) Financial - (or Payment by Results)

### **Non-Financial Schemes**

Non-Financial Schemes normally offer longer term benefits

They are normally used particularly for higher level staff - and in conjunction with financial incentive schemes.

Incentives might include:

There are other forms of incentive which do not fall clearly into the financial incentives area - as they have financial value, but are not necessarily based on 'Results'  
e.g. Use of a company car  
Share options

### **Financial Schemes**

With Financial schemes there are TWO basic approaches

a) Individual Incentive schemes

b) Group Incentive schemes

With either approach there is one factor to consider

--- The greater the control over output by a worker, the more effective the incentive.

With any incentive scheme there will be advantages & disadvantages to each approach.

## Advantages

Individual Scheme	Group Scheme
Individuals work at their optimum rate	Fast workers should encourage slower ones to improve
Good workers provide 'targets' for slower workers	Requires less measurement and less paperwork
Individual schemes highlight good and slow workers	Individual output may be measured by a scheme if required
	Less supervision required due to self motivation and peer group scrutiny and peer group loyalty

## Disadvantages

Individual Scheme	Group Scheme
More measurement of output - More paperwork	Faster group members may slow down to speed of majority of group
Has to depend on Self-motivation - no group loyalty	Group working and measurement can hide slow or poor quality workers— --or even the excellent worker.

## Choosing a scheme

Group schemes operate most successfully where teamwork is required.

Group payment schemes for groups with individual jobs and responsibilities can cause disagreement.

Once the decision has been made whether or not to use group payment schemes

THEN the consideration of

the measurement of output and

the calculation of pay

may take place.

It is important to remember that a Financial incentive scheme is simply a method of paying for work on a "per item produced" basis.

## **Payment Schemes**

The simplest form of incentive scheme is Piece work, where payment is calculated at a set amount for each item produced.

If each different item of production is priced - then annual recalculations may be necessary and protracted.

Pure Piece work means 'No Output - No Pay'

The payment per item may or may-not be calculated using work study methods. If based on Work study - the items will be valued in standard minutes.

This avoids the necessity for recalculation with wage adjustments, the time per item does not change.

Various Work Study based methods are available

Halsey-Weir system

Rowan system

(for details - see Lockyer)

### **Piece Work**

These systems are now uncommon, normally only used for :

Proportional schemes and those with a safety net are becoming more popular.

#### **Advantages of Piece work**

Advantages to Employer

- System is simple to run
- minimal supervision needed
- leaves management free to concentrate on other problems
- pay entirely reflects effort

Advantages to Employee

- operator has control of output
- operator can plan wages, (work harder when more cash is req'd)
- easy to understand
- easy to predict

#### **Disadvantages of Piece work**

Disadvantages to Employer

- has less control of production
- has less control of wage bill
- quality may suffer

Disadvantages to Employee

- earnings fluctuate - can cause problems with regular outgoings

- little variety of work
- little social contact

### **Hybrid Systems**

Most employers have now moved to Hybrid systems as a basis for payment.

#### **Proportional Schemes**

The simplest form of Hybrid system is - Piece work with a safety net - based on work studied figures. This is a proportional scheme with a safety net at possibly 75% of average/target earnings.

Advantages to Employer

- System is simple to run
- minimal supervision & administration
- annual increases are based on standard hour rate - simplifies negotiation
- increases productivity

Advantages to Employee

- operator has control of output
- operator can plan wages, (work harder when more cash is required)
- easy to understand
- easy to predict
- **minimum** wage is known

Disadvantages to Employer

- has less control of production
- variable wage bill
- quality may suffer
- 'Wage Drift' may arise if incentive is not seen as worthwhile

Disadvantages to Employee

- earnings can fluctuate - but less than without safety net.

Other Hybrid schemes exist which offer a variety of benefits and opportunities.

#### **Progressive scheme**

In a progressive scheme the bonus rate increases progressively - see OHP

e.g. up to target for rating of 100 the value of production might be equivalent to £1 per item

from 100 to 120 - £1.10 per item  
from 125 to 130 - £1.20 per item etc.

Advantages to Employer

- helps to maximise output
- minimises cost of overheads per item
- maximises savings on fixed costs
- increases profits - **part** of which pays increased wages

Advantages to Employee

- operator has control of output
- operator can plan wages, (work harder when more cash is req'd)

- chance to reach increased bonus levels

#### Disadvantages to Employer

- has less control of production
- has less control of wage bill
- direct labour costs increase rapidly
- can cause friction between employees working at different levels of performance
- quality may suffer
- safety measures may be disregarded

#### Disadvantages to Employee

- earnings can fluctuate
- incentive to rush causes stress
- safety measures may be disregarded

### **REGRESSIVE scheme**

Rather different to the Progressive scheme is the REGRESSIVE scheme. Here the bonus level reduces as the higher productions are reached.

e.g. up to target for rating of 100 the value of production might be equivalent to £1 per item

from 100 to 120 - 90p per item

from 125 to 130 - 80p per item etc.

Extra output still increases the wage but at a lower rate.

This system has extra advantages - but also carries some disadvantages.

#### Advantages

- discourages excess production
- maintains control over wage costs
- maintains satisfactory quality
- any errors in rate fixing or in the time study are less costly
- lower spread of earnings
- lower variation in earnings
- extra production is at a reduced cost

#### Disadvantages

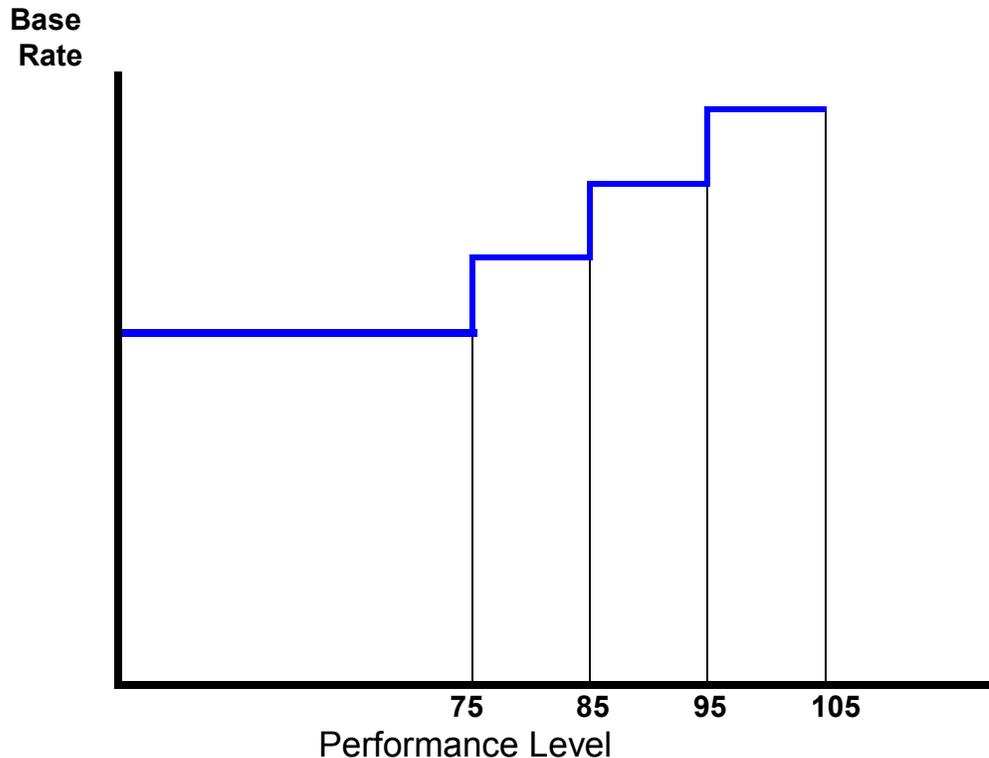
- employees dislike the fact that the employer gets greater benefit for the extra output
- the system can create an unofficial 'ceiling', a maximum production per employee below the actual achievable level
- there is less incentive for good workers
- there is a danger of 'pools' of work-in-progress



## Payment for a Contracted Level of Performance

### a) Banded Bonus Scheme

This is based on a work measured performance scale, but in this case the scale points are grouped into bands.



Each operator is placed on a band based on their recent average performance. Consistent performance above (or below) the band allows movement to a different band, representing the new performance.

Each employee receives a fixed bonus payment dependent on the band in which they are placed.

#### **Advantages**

- earnings are more predictable
- it is easy to understand
- workers can expect less variation in wages
- good workers can earn higher wages
- system allows minimum level of administration
- maintains a close control on wage costs
- maintains control of production
- maintains steady cost per item

## Disadvantages

- If operators get stuck on a certain band, it weakens the incentive to improve
- there is a constant danger of bands being consolidated into the basic rate at times of annual negotiation
- problems can arise if the bands are too wide, if the step to reach the next band is too great the motivation is lost
- too narrow bands defeat the object, causing rapid fluctuations of wages

## **b) Measured Daywork (MDW)**

This represents a fixed wage rate for an agreed, high level of production. The incentive is to reach the target but not to exceed it.

Systems exist where if the operator exceeds the target for a specific period, then he/she receives an increase, moving to the next pay level. (or vice versa)

This variation, of course, tends to the previous scheme - the banded bonus scheme.

In normal operation MDW tends to stabilise  
output  
quality  
and wages.

It does NOT maximise an individual's production, but it does normally give a high average production.

It is particularly useful in independent work situations.

It is one of the few systems that might be introduced throughout the workforce of a department, excepting only supervision and technical support.

For the system to work effectively, management must ensure that:  
materials are available  
non-productive time is allowed for  
employees must avoid bottlenecks and stockpiling

## **Advantages**

Employers

- it is useful where work measurement is difficult
- it helps to ensure production is stable
- it helps management control costs fully

Employees

- provides a stable level of pay

## **Disadvantages**

- Although disputes will be less frequent, the annual bargaining round will be more protracted

- shop stewards etc. can resent the loss of control, and the centralisation of negotiations
- there may be some resentment over the loss of control, by workers, over their own earnings and pace of work

**c) Stepped Measured Daywork**

This is the equivalent to the banded schemes. Instead of moving to a new point, workers who consistently achieve high productivity will move to a new band. These bands are generally wider with few levels. A move in level is therefore a significant move.

This may reduce the incentive to reach the higher levels, particularly by average workers.

**d) Plant-Wide Incentive Schemes (Profit Sharing)**

These type of systems are based on the index of performance for the whole plant. Each worker receives a basic wage plus a bonus related to the index performance of the company.

The index may be calculated in various ways,

- in the Priestman scheme the index is based on the level of output
- in the Scanlon plan, the index is based on a ratio of the labour cost to the total sales value.

Various other methods exist.

With any of these, an increase in the index brings an equivalent percentage increase in wages.

**Advantages**

- means more worker participation
- increased worker loyalty and motivation
- problems of the company are seen by management and workers as joint problems,

**Disadvantages**

- the rewards are seen as long-term and this reduces the incentive for many workers
- individual workers may feel unable to influence the overall performance and hence loses motivation

**e) Productivity Agreements**

Although productivity agreements are NOT necessarily financial incentive schemes, they do have the same objectives.

Any review of payment systems in a factory should include some productivity “package”. A full package could include agreements of a range of factors and working practices.

e.g. overtime working -  
flexibility -

Restrictive practices -

working hours -  
Manning levels

Shift allowances -

## **f) Other Payments**

- i) Loyalty payments - paid for a variety of factors
  
- ii) Age related payment - These are now much less common and less important since the age of majority was lowered to 18.

However - they still exist in many companies for under-18s, and in some of the professions, here however they are equated to payment for relevant experience, gained over a set time period.

- iii) Indirect payments - similar to Non-financial incentives
  - company car
  - company pensions
  - company share schemes

The objectives of these types of payments are simple -

- the reduction of labour turnover
- the retention of experienced staff
- increasing loyalty to the company

## **g) Fixed Payments**

Fixed payments could be based on a fixed basic wage plus an incentive paid, after agreement to maintain a high level of performance.

With this system there is likely to be no financial sanction if the level of performance is not achieved. There is therefore, a heavy reliance on trust.

### **Advantages**

gives increased job satisfaction  
increases involvement with the company

This type of system is seldom seen below the level of supervisors. It is usually seen as suitable only for levels of management.

Can be seen up to board level.

### **Points to Note :-**

- In any factory - in any department - it is unlikely that ALL the workers are going to be paid using the same payment scheme.
- A payment scheme only has to be suitable for a single job to be a useful method of payment. e.g. Ring doffers will be paid on a different scheme to card tenters and cone winders.
- The greater the control over output by a worker, the more effective the incentive.

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Chap.8

## **Materials Management**



### **Materials Classification**

Raw Materials

Purchased & prepared materials

Components

In-process materials - work-in-progress

Finished products

Consumable materials - wrappings, packaging, hangers, cartons etc

Equipment items - spare parts, lubricants etc.

### **Materials Management**

The management of materials in an organisation is a very important area. Poor performance in this area will affect the whole of the organisation's operations, particularly

- response speed
- quality
- customer satisfaction
- profits and costs

The job of materials management can be considered in different ways.

- it can be considered as a total concept, overseen throughout the organisation wherever materials exist
- it can be a function of production planning department
- it can be part of quality control and quality assurance departments

Wherever materials are managed from, there are FOUR major functions which must be performed.

Analysis & Planning

The organisation of all activities and methods

Co-ordination

Co-ordinating activities, monitoring methods and interpersonal relationships

Motivation

Motivation of people in their respective roles

Control

The monitoring and checking of facilities and achievements against the planned achievements

Materials management is obviously an essential part of the organisation's activities.

Materials must be available

in the right place  
at the right time  
in sufficient quantities  
of sufficient quality  
at the right price.

There are FIVE major stages of materials management.

1. Purchasing
2. Inventory Control & Materials Forecasting
3. Storage Facilities & Materials Handling
4. Packaging & Stock Preservation
5. Quality Control

## 1. Purchasing

The purchasing department are most frequently responsible to either the Managing Director or the Senior Accountant. However they may in certain circumstances, be responsible to the production manager.

Purchasing planning must be done in conjunction with  
sales forecasts  
& production schedules.

Within a single factory, there should be only one purchasing section. Effective operation of this section will ensure

minimum cost per item  
maximum power over suppliers  
Maximum discounts  
minimum cost of operation

However if several autonomous or semi-autonomous operations share the same plant or site, or if a company has several factories, then **Decentralised Purchasing** may be more acceptable.

## **The Advantages of Centralised Purchasing**

- 1 Policy
- 2 Power
- 3 Systems

## **The Advantages of Decentralised Purchasing**

- 1 Flexibility
- 2 Closer Liaison
- 3 Responsibility

## **2. Inventory Control & Materials Forecasting**

Otherwise known as stock control.

This is not simply a method of ensuring that a company has a couple of parts in stock in case they are needed.

There are many sophisticated techniques to aid decisions on stock control.

All these techniques are simply methods of balancing costs against benefits.

**Materials Forecasting** is an important technique in the control of materials, it is however simply a method of balancing the cost of the techniques used with the probable cost of failure in terms of

- poor production
- lost sales
- loss of customer goodwill etc.

Materials Forecasting allows the purchasing department to estimate the requirements of the organisation over a specified period.

**Ordering Systems** are also an important part of the stock control area. There are a wide range of systems used to establish the optimum size and time of replenishment purchase orders. A few of the most common types are described below.

- i) **Cyclic -**  
Orders for all replenishment items are considered at the start of each specified period, e.g. monthly.  
If stock is insufficient to last until the end of the next period then an order is raised.
- ii) **Flow Control Systems**  
This is characterised by a continuous flow of orders and materials. It allows for low inventory levels, giving low costs.  
It is ideal for those companies with rapidly changing markets and products.
- iii) **Fixed Order Quantity System**  
In this system, the timing of an order is based entirely on the stock level.  
  
As soon as stock of a certain item reaches a pre-determined re-order level, then an order is raised for a pre-determined re-order quantity.
- iv) **Two bin system**  
Control is maintained by keeping stock in two physical locations. An order is raised when the first bin is empty - or almost empty.

There is a particular problem in that, if there is no system for the direction of staff to particular bins, then there may be difficulties with

old stock  
using both bins  
stock-outs.

Another difficulty - particularly if using actual bins for this system, is that for each item in stock, there will be different values required for

re-order level  
re-order quantity  
bin size etc..

Therefore all items of stock must be studied for - speed of usage  
length of life  
lead time.



Lead time is the delay between the perception of a need for an item to the time of its availability from stores. This is not simply the delivery time.



What does this actually entail???

### **3. Storage Facilities & Materials Handling**

This, of course, is an important area as materials are a major part of a firm's assets and storage facilities can affect the value of these dramatically.

#### **Requirements of a Storage System.**

- It must maintain the materials in good condition
- It must protect against pilfering by staff
- It must protect against damage in transit and in handling
- It must protect against deterioration in store
- It must identify and classify materials for speed and ease of access
- It must provide efficient use of storage space
- It must offer storage with immediate access for production needs
- It must maintain complete and detailed records.

All goods entering the organisation will be entered into a store and must go through the first stage which is the receiving stage. This stage is both clerical and manual.

#### **Goods Receiving Department**

Clerical Responsibilities

Manual responsibilities

#### **Types of Storage Systems**

a) Closed System

In this system, materials are stored in physically closed off sections. Entry is restricted to authorised personnel only, this includes storemen and may, in some cases, include production managers .

This type of system offers

•

#### b) Open Systems

Stores are not manned and are not physically closed to any employees. Any employee may collect goods from the store without requisition.

The system offers:

#### c) Random Access Systems

A variety of options are available in this area.  
Stock will normally be stored by size, by shape or by grouping in a manual operated system.

In a computer controlled system it is likely that there will be no logical system of storage apart from the most efficient.  
There will be no visual, chronological or process-based organisation, the probability is that it would be organised by size supported by a complex management facility.



This can be achieved with a simple system such as a storeman with a personal computer.

Alternatively, for a large-scale operation, a completely computerised warehousing system may be installed, where stacks are serviced by automatic fork lift systems, driven directly by the controlling computer.

Although extremely expensive to set up, there is a range of advantages of this type of system.



These include:

## Centralised and Decentralised Systems

The above systems may be used either in centralised or in decentralised facilities. Generally however, the more-expensive-to-operate closed systems are used in centralised operations where the stock contained will be of a higher total value. Where these are used in direct manufacturing supplies, it may be necessary to offer 24 hour access to ensure no delays in the manufacturing process, which will again increase the level of costs.

Decentralised system will more frequently use open systems, particularly highly decentralised systems.

In addition, for bulky or heavy goods, and low value items, then open stores are most likely. They are used also for mass production supplies where 24 hour production is the norm.

## Layout Design



Whichever type of stores system is used, it is important to consider the layout design of the stores. Good layout will maximise speed, minimise costs, maximise profits maximise morale.

Any layout must consider the following factors:

Access -

Flexibility -

Space Utilisation -

Good administration -

Safe storage -

Handling -

## Mechanical Handling

In all forms of industry, labour is expensive and companies have reduced manual handling to a minimum. This move has the added advantages that mechanical handling reduces the time of handling and reduces costs due to accidents.

The major advantages of mechanical handling may be summed up as:

1 - reduces the manufacturing cycle time

2 - reduces human fatigue factor

3 - minimises idle time

4 - provides a higher level of safety

5 - increases storage space available

➔ Examples of Mechanical Handling ---

Fork lift trucks  
Stacker trucks  
Hand trucks  
pallet trucks  
wheeled bins

Also

#### **4. Packaging & Stock Preservation**

◆ Stock Preservation depends to a great extent on two factors -  
storage conditions  
packaging

Packaging can vary wildly in quality and in cost. However there are certain advantages in providing good quality packaging.

- a) Packaging protects the product  
from abrasion,  
from moisture,  
from droppage and collision -

- b) Packaging facilitates handling
  - standard shapes for easy packing
  - easy stacking -
  - stores easily for user
- c) Packaging can help marketing
  - attractive product -
  - shows care has been taken in producing the product
  - enhances the sales display -
  - makes the product bigger -
- d) Identification ✳
  - This is necessary for all products whether they are industrial components or consumer products.

Packaging could be seen as a science in itself and it has been raised almost to an art form by the advertising industry. It is also a major aspect in marketing. However, for the industrial user the basic requirements of packaging are :

- maintaining a long and healthy shelf life;
- easy handling and safe stacking - preferably using standard sizes;
- should ensure safe delivery to final customer;
- should not add to the total cost;
- should take account of physical properties of product - corrosion resist, moisture resist.

## **5. Quality Control** ←

Quality control is a process that **MUST** continue throughout the factory in order to maintain the required quality standard.

The quality required for a product is the **MINIMUM** standard that will be acceptable to the customer and/or the consumer.

Note - Supplying a specific customer -

When supplying a specific customer, for example Marks & Spencer, the level of quality will be laid down by them.

In order to maintain quality and minimise costs it is important to discover defects and below standard materials at the earliest possible opportunity.

Hence, in order to obtain the best quality from your materials, and to maintain a standard quality of product, quality must be controlled:

- at incoming goods and materials
- with in-process materials and goods
- at the finished product stage

### **Incoming goods and materials**

These must meet our required standards - hence we need inspection or testing or either

all - OR - a random selection.

This may cause problems in that testing is expensive and some testing may be destructive.

### **In-process materials and goods**

In this area we are looking at the optimum level of control, balancing the costs of control against the possible costs of

waste

rejects

lost sales

reworking -

lost production capacity.

In textile processing, as in clothing production, some testing will be destructive.

### **Finished product stage**

As far as finished goods are concerned, it might be considered sufficient to rely on the continuing earlier processes to ensure the final quality, however inspection is an important final stage of quality assurance.

Again, the cost of the inspection process must be balanced against the possible costs of returns, customer dissatisfaction and possible lost orders.

## **Quality Management in the Factory**

In industry, there is often a problem of ensuring that the objectives of the management and the objectives of the labour force and similar -- and that both parties are working toward the same ends.

Without this matching of interests there is a much reduced chance of successful company operations.

Management must be vigilant to identify any new methods of

- assessing performance
- aligning the objectives of both management & labour

What is needed is a framework

- where workers & management may communicate freely
- where the worker feels they have a personal stake in the operations of the company
- where the worker has a real interest in the success of the company

Quality is an area where management and labour often have very different attitudes.

There is a tendency for workers in production to be less interested in quality than in the

level of production.

This can also be true of line managers and even some senior managers. Quality Circles are one method of improving both quality and production.

## **Quality Circles**

The forerunners of quality circles - "Worker's Groups" - were introduced in Japan in 1961. They were problem-solving groups.

They soon began to be known as Quality Circles. Quality circles rapidly spread through Japanese industry -

Total savings to Japanese Industry to 1978 has been calculated to be in excess of £25,000 Million.

In 1974 - several companies in the USA introduced quality circles

Lockheed

Honeywell - (now Bull)

A quality circle is

- a small group of workers  
about 8 people
- doing similar jobs
- in a certain department
- who are volunteers
- who meet regularly
- who identify, analyse & solve problems in their work area.

## **The Objectives of Quality Circles**

In the ideal system the following are real objectives of a well organised scheme.

### **1. Self-Development**

It is in the interests of an employer to train and to develop their employees' skills.

The training received by each member of a circle allows them to appreciate the company's needs and encourages them to help with the company's aims.

The skills learned will not only improve the work of the employee but also help to solve problems in their outside life.

Skills learned include  
Pareto analysis  
Cause & effect analysis  
Check sheets

### **2. Mutual Development**

The forming of quality circles train people to work in groups.

The skills learned are  
dealing with people  
working in co-operation towards a common goal

3. **Improvement in Quality**

Quality circles were started to produce a system to combat quality problems

Changes in customer attitudes to quality mean  
changes in the workplace  
changes in jobs and  
changes in the worker's attitude

4. **Communication and Attitude**

Improvement in communication - both horizontal and vertical.

Poor communication causes  
Misunderstandings and confusion  
Delays  
Dissatisfaction  
Tension and stress

Improvements in attitude offer many rewards  
Motivation  
Discussion of problems and solutions  
improved communication even during breaks etc.

5. **Waste reduction**

This is not only a reduction in processing waste, but also in  
Re-working time,  
Seconds quality items and  
Capacity (re-processed materials)  
Energy

Co-operation and communication will help to minimise all types of waste

6. **Job Satisfaction**

Quality circles can provide the sense of pride in a job.

They can offer  
a sense of employee value in a company  
a sense of ownership of a process  
provides achievement for 'many small cogs'

7. **Cost Reduction**

Management may offer QC's a chance to investigate the production of expensive products to advise on  
cheaper methods  
cheaper materials  
without loss of quality  
This is really - 'Value analysis'.

8. **Productivity**

Productivity can be increased in several ways  
Reducing costs

Eliminating rejects increases capacity

9. **Safety**

QC's help to improve safety by

Identifying more hazards around the factory

Using the experience of the workforce to overcome any hazards

10. **Problem Solving**

QC's help workers and management to solve problems by

Identifying the true nature of the problem

Providing more ideas for solutions

Collectively solve the problem

11. **Team Building**

Being part of a QC is being part of a team.

People meet and

get to know each other,

they get to like each other and

get to trust each other

they help each other

Teams motivate each other -

they tend to work more efficiently than individuals

12. **Linking Levels**

QC's can invite anyone in the company to their meetings.

This creates a wider knowledge and improves horizontal communication - between sections and departments.

Presentations to management create understanding and trust and will improve vertical communication - both up and down.

13. **Involvement**

Workers directly involved in QC's become

more involved

more interested

motivated

This may also be passed on to those who are only indirectly involved.

14. **Participation**

Participation in QC's may be difficult to encourage at the start of a project.

"Its just another management ploy"

Once QC's are in operation people are more keen to be involved.

15. **Absenteeism**

Absenteeism is the result of several problems. It may be caused by

Grievances

Poor motivation

Boredom

Lack of social contact

## Stress

All these can be improved by the use of QC's -

### Objections to Quality Circles

1. Resistance to change  
Many people fear change - change can bring -  
Loss of jobs  
More paperwork  
More work  
New problems without obvious solutions
2. Time  
No time for quality circles  
But QC's should reduce work in the long term
3. Loss of management authority  
Some managers feel that negotiation and even listening to suggestions is a loss of authority.  
There are still some old-style managers out there - "do as I say & don't ask why"  
In fact there are more of them than you might expect.
4. Members feel 'used'  
Members feel that they are simply working for the company and not for themselves  
- "Why should I help - that's management's job"  
Members need to be reminded that their jobs as well as their bosses jobs all depend on the success of the company.  
They must be encouraged to feel part of the company.
5. It's Quality Control's work  
Members must be made to understand that quality is everyone's responsibility  
The operator is the ideal person for finding quality problems.  
Everyone should be their own inspector.  
This will not normally work if the members are on a piece work scheme.
6. 'Not Invented Here' - and hence .....  
It may work with the Japanese but they are different.
7. ....It won't work here  
"We have tried all these new-fangled management theories before, - they didn't work then and they won't work now."

### **Problems Faced by Facilitators**

1. Results or Growth  
Pressures can exist in companies between  
Quality control who wish to see the programme grow  
Management who wish to assess its results first.
2. Ownership  
It is important that workers are encouraged to see some ownership in QC's however

problems can exist between managers wishing to own the programme.

3. Responsibility

The facilitator is responsible for the success of QC's.  
The facilitator usually has very little authority.  
Therefore he/she should be a good negotiator.

4. Loss of Enthusiasm

Enthusiasm is usually high at the start of a circle.  
A few successful projects will maintain this.  
However after everyone's pet problems are addressed -then enthusiasm may start to be lost.  
The facilitator must watch for this stage and inject new suggestions - problems - people.

5. Staleness

Staleness can be caused by

- Long projects
- lack of successful completions

Evidence of staleness is

- members missing meetings
- discussions wandering into unrelated subjects

Solution is the same as for lack of enthusiasm

6. Administration

As the number of circles increases the pressure on the facilitator increases.  
Circles will soon lose enthusiasm if they are abandoned by their facilitator.

7. Wrong Approach

If the circle sets off on a problem in entirely the wrong direction then it is the job of the facilitator to correct the direction.

This re-direction by the facilitator may cause problems with

- the sense of ownership
- the sense of value
- the sense of authority of the circles members

## **Economic Restraints on Textile Production Control**

With Textile production, there are certain economic restraints imposed by the operations, the materials and the customers.

- minimise cost of materials
- minimise stock levels
- ensure sufficient stocks
- minimise downtime
- minimise non-productive time

## **Decision Making in Textile Production Control**

There are certain decisions to be made in the PPCF and these decisions will be influenced by a range of factors, some of which are outside the control of the PPCF.

### 1. What is to be made?

This is a Marketing Department decision. Possibly a Sales department may be involved. Products will be made either

- for stock
- or against orders
- or as samples

### 2. How will it be made?

 This is a technical question and within the area of the PPCF. Various factors must be considered.

- machine suitability
- machine availability
- materials availability
- trained labour availability

### 3. Where should it be made?

For a manufacturing company, products would normally be produced internally to ensure effective use of capacity. In certain cases there may be reasons for contracting out the production including:

- lack of capacity
- lack of trained staff
- cheaper outside where special facilities available
- quality considerations
- time restrictions

#### 4. When should it be made?

Production of products must fit in with the production plan to ensure a maximum production efficiency.

The problems occur when the maximum production efficiency times do not match the delivery dates required by the customer. Then production plans must either be amended or negotiations with the customer must be attempted.

The above items are all relevant for textile production, however there are other considerations when dealing with textile production. The interdependence of processes, and the inability of manufacturers to adjust the order of process, limits the flexibility of manufacture.

The question of balance is also important. Machines and labour will experience non-productive time if the balance cannot be maintained.

In order to create effective and balanced production plans there is a need for a large amount of accurate, up-to-the-minute information on:

- current orders
- progress in the factory
- technical factors
- any problems
- job timings etc.

This is where a computer-based management information system can be particularly valuable.

## Location of Facilities

In discussing any area of managing production, one must consider the location of facilities. The behaviour of suppliers, staff and customers will vary with a range of factors including the type of site, the size and the position of the facility in terms of convenience, access cost and competition.

As all good estate agents will tell you, the THREE most important factors when buying a house are - location, location and location. The same is true when making decisions on company facilities.

In order to study the location of facilities, it is necessary to identify ALL the factors that may affect the economics of location.

Location considerations however, are not limited to manufacturing sites, but include outlets, depots, support services etc.. Location considerations affect the whole of the supply chain for all industries.

In considering the textile and fashion industries, this supply chain may stretch across the world and the study of location becomes a much wider study. It is therefore useful to limit this study of location to the later stages of the supply chain, the UK based operations, namely distribution and retail.

The two basic types of sites to be considered are distribution depots and retail sites. In real life, distribution depots may be of different types, major, local or thematic. Major depots may supply both local depots and larger outlets, local depots will supply only local outlets. Thematic depots are normally smaller but concentrate on a particular range, supplying only a subset of the goods, e.g. tailored garments or dairy goods.

Choosing the correct location for a supply depot will ensure:

- reduced delivery costs;
- quicker deliveries;
- less stock-outs;
- more customer satisfaction.

There are certain operations that minimise the use of depots by dealing directly with suppliers. This is only feasible where suppliers are local, or particularly dependable, or where the prices of goods are such that stockholding prices are very high, outweighing the distribution costs of rapid-response direct supplies.

The factors which must be considered in the location of distribution depots and outlets are different overall. Some of the factors are common, some are differently weighted.

It is important to consider the full range of factors which may affect the location of a facility, before one can determine methods for identifying best-choice sites.

### **The Factors to be considered in Assessing Location.**

1. Proximity to the market

For depots, by minimising the distance to the major markets, a company may minimise its transport costs, maximise the speed of response and provide the most effective support.

For outlets, the necessity for proximity is more pronounced. There will however, be choices to be made, dependent on the type of outlet, whether in town, city centre or out-of-town shopping centre. Proximity may be considered in terms of access by foot, by public transport and by car.

Problems may arise because the market is a dynamic force, location should be considered in the light of the longer-term company strategy.

2. Interaction with other sites.

For companies with multiple depots, coverage of the area to be supported, in conjunction with any other sites, may be adjustable. Location may be based purely on supply of customer sites or as a link in a country-wide network.

The choice of strategy for country-wide supply will depend on the type of product and the type of storage facility used. (see Stores Management - Random Access Systems : Production Management Notes)

3. Labour Availability.

Labour will be required to a greater or lesser extent, depending on type of site, depot or outlet. In either case, not only is the amount of labour important, but the skills available (and/or the availability of training) is an even more important factor.

Certain areas have particular skills but, for distribution and retail requirements, most sites have little need for high level skills apart from management, supervisory and computer system support.

For retail outlet sites, the range of skills required is further reduced, most higher level functions being carried out centrally.

4. Local Amenities and Transport Infrastructure.

Local amenities include communication systems, community services, housing and supporting infrastructure. The latter includes both public and privately supplied services, shops, leisure facilities, clubs etc. For a depot, local transport facilities here are simply staff transport, buses and trains, which, if not already available, might be organised by the company. This is only really possible where shifts are static and global.

5. Wider Transport Infrastructure

The size, range and type of product supplied will determine the range of transport systems needed. Opportunities exist for road, rail, air cargo, river/canal transport and pipeline, depending on the type of product.

For the input of textile and fashion products into depots, there may be a need for access to airports, even possibly to the railway system. The main requirement however, is for fast motorway access for heavy lorries. Goods bound for the UK will be shipped across continents by lorry, rather than using railway systems.

For textile and fashion products within the UK, the generally preferred distribution method from depots is by road transport. It appears for most companies that cost of distribution is secondary to the speed of supply.

From the point of view of retail outlets, the ideal site will combine lorry access for supply with suitable access for customers. Shopping centres will normally supply these two, separated by the internal road systems.

With either type of site the transport may be company owned, but is more likely to be contracted out, using large companies for reliability, or smaller companies (even owner drivers) to maintain tight control over cost.

For city and town centre sites, large vans may replace the lorries used elsewhere. Evening and night-time deliveries may be necessary to avoid traffic delays and the possible resulting customer alienation.

**A point of note however, it is pointless for a company to choose a location which may be well served by motorway transport, e.g. the M25, if company transport is going to spend extensive time in traffic jams.**

6. Proximity to suppliers.

By locating close to suppliers, rapid access to goods and services may be achieved. This aids just-in-time systems and helps companies

maintain close communication. This factor become less important as the 'Wider Transport Infrastructure' factor is satisfied.

Where services are needed, proximity to suppliers may be more important, e.g. supporting large computer systems for sales ordering and/or warehousing. With these, delays in service may be extremely expensive.

## 7. Availability of Services

The services which need to be considered include:

- electric supply;
- water supply - drinking & industrial;
- drainage - this may include some waste disposal;
- disposal of other waste;
- gas supply;
- communications - phone, internet, mobile phones etc.;
- postal and courier services.

Some of the above may have limited need, e.g. gas supply.

Within the UK, electric supply will be available from the mains in almost all locations. For those outside the mains electricity coverage (some Scottish islands and a few isolated areas) other opportunities may be available, wind turbines, generators etc.

Piped drinking-water supply will be available in most locations, although for industrial use there may be cheaper alternatives (bore holes or stream/river water).

Drainage systems may vary in the allowances of dissolved waste materials, exceeding local limits may be very expensive.

Waste material disposal may have an effect on location if the waste is excessive, heavy, toxic or some form of notifiable substance.

Whereas electricity can be carried across large distances relatively cheaply, gas is very expensive to pipe.

Normal telephone communications are relatively inexpensive to connect, however obtaining access to mobile transmitters may be more expensive. For particularly heavy communication system users, city centres tend to be the preferred locations.

Postal and courier services are only really important to mail-order type operations.

For retail outlets, services are normally all available in most types of retail location.

## 8. Land and Climate

Land - is important for depots only. For most companies there is little to concern them apart from cost and possibly previous use. Local geology and previous use are important, as residues from previous occupants

may appear at any time. Reclaimed land from sealed landfill sites may develop methane gas problems, subsidence or seepage. These problems become more acute where toxic wastes were allowed in the landfill site.

Proximity to landfill sites can be a problem where seepage takes place. (Weston in the NW of England).

#### Climate

Climate is of little importance within the UK. However, relatively minor regional variations, may have an effect on location planners.

- Areas of Shropshire are the coldest in England.
- Buxton in Derbyshire is reputedly the town most likely to be cut off in the snow in England.
- The highlands of Scotland have more snow than anywhere else in the UK.
- The M62 motorway is the most likely in England to be blocked by bad weather.

Any of these might affect the choice of location of a depot, whereas none are likely to affect the siting of a retail outlet.

#### 9. Regional Regulations

Different regions have different by-laws and regulations. These may affect waste disposal, but are also likely to regulate the type of building that can be erected. Examples include the Lake District where new building is limited and any new building must appear to 'match' or merge with the landscape.

This may affect the cost of any building drastically, it may also limit the size and design of the building.

#### 10. Expansion Opportunities

A company will expect to expand, hence any site chosen should offer room for expansion. This might be by simultaneous purchase of extra land, it might simply be by buying options on extra land. This is normally more relevant to a depot site, a retail site in city or town centres, or in an out-of-town shopping centre, would be unlikely to have this option.

Company strategy must be totally confident that any expansion would be elsewhere, before choosing a depot site that JUST matched the current requirement.

## 11. Safety Requirements

Whilst actual safety is 'assured' anywhere within the UK, perceived safety is a factor to be considered.

For depots, safety on neighbouring sites is important. Chemical and explosives manufacturing sites are best avoided, as are sites storing chemicals or toxic waste.

For retail outlets, perceived danger areas in the extreme locality are best avoided, as customers automatically avoid these sites or they may even link the two sites in their mind.

Nuclear sites, power stations and sites such as Dounreay and Windscale, are normally included in the list of sites to avoid - even though they are:

"the safest sites in the UK, with safety procedures that ensure the accident rate at less than one in a thousand years" (BNFL advertising)  
It should be noted that, although the above statement is supported by the government (based in London), there are no nuclear sites in the south-east and the two nuclear fuel processing and reclamation sites are both at very considerable distances from London.

\*\*\*\*\* Where are the nearest Nuclear sites to London \*\*\*\*\*

Whilst this does not offer any comment on the validity of government statements and promises, it does usefully demonstrate the point that people who have the choice will avoid any perceived danger area, regardless of the level of risk. This has been found to be particularly true for women with families, and hence this factor is particularly important for the post-teen fashion industry.

## 12. Site Cost

The site cost may help to determine the choice of location.

Retail outlets are less dependent on the site cost as this cost is seen as a measure of the likely success of the retail operation. A city centre site is expensive but will draw in a greater amount of trade.

For out-of-town shopping centres, the cost of individual plots is determined by the floor area and frontage, by the passing trade, by the 'neighbourhood' or 'lifestyle grouping', and a range of other factors.

For depots, site cost may influence the siting locally, but it is unlikely to influence the choice regionally, except possibly in the London area.

## 13. Political and Cultural Considerations

Within the UK, the political situation has been almost irrelevant. In the past few years however, with the advent of devolution and the provision of a new mayor for London, local politics may begin to affect location choices. This could be due to the ability of these new bodies to impose local income taxes, offer local grants etc.

Cultural considerations include possible problems based on working women, religion etc. These aspects could affect either outlets or depots.

(also see 'Textile Economics' by the same author)

#### 14. Neighbours

There are some neighbours who you might want and there are others you might wish to avoid. For retail outlets, the location might be determined by the neighbours a company would like. For a high profile brand-leader company, a site in a 'Designer Village' might be desirable e.g. Cheshire Oaks.

For others, a site close to a competitor might be required.

Other companies might wish to site their outlet as far as possible from their competitors.

There are neighbours who might, through no fault of their own, pose a threat. Examples of these change with time, dependent on political situations in different parts of the world, but one example was EL-AL offices during the various Arab-Israeli wars.

For outlets, either retail or service, there may be certain 'locality' benefits, where similar companies group together in an area to provide a specialist service.

Examples include:

- banking and building societies - London & city centres;
- Chinatown & Rusholme in Manchester - for eating out;
- suppliers to various minority groups - food - e.g. Kosher in Prestwich, Asian in Rusholme;
- private educational institutions - Oxford, Cambridge etc. English language summer schools.

#### 15. Local Economic Considerations

For depots, a poor economic situation locally should ensure keen workers, minimum wages, minimum labour turnover and maximum profits.

For outlets, a healthy local economy is necessary for most industries, particularly higher-level fashion shops.

16. Special Grants, Regional Taxes and Import/Export Barriers  
Dependent on country and current government, certain sites may offer:
- special grants;
  - low-interest loans;
  - reduced rents (long or short term);
  - protected status.
- (also see 'Textile Economics' by same author)

## **Making Location Choices**

There are various methods for the validation of the choice of location.

### 1. Gravity-Sales System

The first method, the simplest and one that is suitable to determine a target area (or a region suitable for closer inspection) is the gravity-sales system. This is a mechanical system that uses only the geographical spread of the sales volume to determine the optimum site for a distribution depot.

Using a map of the whole sales area, on a tabletop, holes are drilled at the point of each outlet to be supplied. A ring is placed on the map and strings are attached around its circumference. The other ends of the strings are passed through the holes in the map. Weights, equivalent to the sales volumes of each outlet, are attached to the relevant strings. Gravity does the rest, pulling the ring into an equilibrium position, over the optimum area on the map for the site.

(A real-life exercise might have used stands and pulley-systems providing a friction-less, and hence more accurate tool, however modern systems are available to run on a PC)

This system might be used to define a starting area for other methods that would use a wide variety of factors in their operation.

One system that might be used is Linear Programming.

Another system is a simple evaluation technique, using a process similar to Job Evaluation.

The problem with this method is that the resulting figures, which are clear and unequivocal, are only as reliable as the accuracy of the weightings and the assessment figures for each.

See extract of weighting table - fig 1.

## Multiple Site Locations

The complexity of the decision-making process for multiple sites ensures that the decisions are at least based on commercially available computer software. For small numbers of sites, the company may carry out its own analysis.

For larger companies, using larger numbers of sites, the use of Geographical Information Systems (GIS) is necessary. These are extensive and complex systems requiring expert handling and will normally be available from a specialist consultancy.

Reference - *Production & Operations Management (6<sup>th</sup> Ed.) - Muhlemann, Oakland & Lockyer - Pitman - Chap. 11.*

Fig 1.

Facility Location Example

Factor	Weighting Max 10	Locn. A		Locn. B		Locn. C	
		Points	Score	Points	Score	Points	Score
1	9	8	72	9	81	3	27
2	1	0	0	1	1	1	1
3	10	7	70	5	50	9	90
4	5	4	20	3	15	5	25
5	3	2	6	2	6	0	0
6	4	2	8	4	16	2	8
7	6	2	12	2	12	2	12
8	2	1	2	2	4	0	0
9	8						
10	4	etc.					
11	2						
12	1	10	10	0	0	5	5
13	2						
14	3	etc.					
15	7						
16	5	1	5	10	50	5	25
<b>Total</b>			<b>340</b>		<b>322</b>		<b>395</b>

How valid are these figures???