IMPLEMENTING ASPECTS OF MANAGEMENT ACCOUNTING

IN A LOW VOLUME MANUFACTURING

ENGINEERING CONCERN

by

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Implementing Aspects of Management Accounting in a Low Volume Manufacturing Engineering Concern.

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SUMMARY

This thesis is a result of a two year practical project on a teaching company scheme between the University of Aston and William Cotton Limited.

It examines the implementation of a control system into the company, looks at why this is necessary, the benefits it will have and assesses the techniques which are required to provide the systems.

The project concludes that standard costing principles based on sound standards, linked with an efficient actual costing system and variances presented quickly and in a format which encourages accountability, will provide such a control system. This will produce work force motivation which is the key ingredient when aiming towards cost control.

The principles developed in this thesis are primarily intended to improve and extend generalized knowledge of costing techniques. Hence, it is hoped that such innovations can be installed and adapted by any low volume manufacturing engineering company to improve its own techniques via the use of a computerised materials management package for its operational product costing capabilities.

Keywords: Standard Costing, Control System, Product Costing, Materials Management.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter will provide an explanation of why the management accounting techniques to be outlined are important to the company concerned. Firstly, the purpose and origins of cost and management accounting will be examined, followed by a discussion of how the impact of computer technology has improved the accounting functions.

The chapter will examine how the manufacturing system operating within an organisation, influences the accounting techniques that are necessary for a firm to adopt in order to receive the benefits mentioned in the purpose of management accounting.

The chapter will conclude with a brief description of the problems faced by the company and an explanation of how the thesis will develop to illustrate the solving of some of these problems.

1.2 The Project's Main Conclusion

The project was carried out in conjunction with the University of Aston and William Cotton Ltd on a teaching company scheme. It is contended that if the company implements the principles recommended, management will be provided with an effective control

system which goes beyond the present system of qualifying , to a quantifying procedure supplying the necessary motivation for the work force, (first line, departmental and top management).

It will produce a report which provides useful and meaningful data in a format which it is contended is superior to the format supplied by the recently purchased manufacturing system. (i)

There are other benefits to be obtained by implementing the management accounting principles recommended in this thesis. These will be discussed at the appropriate stage of the thesis development and summarized in the conclusions in Chapter 11. However, let us start by looking at the purpose of management accounting, as much of the work will involve the development of principles from this discipline.

1.3 The Purpose of Management Accounting

There are many definitions which exist for management accounting: (1) simplified it is the application of accounting techniques to provide all levels of management with relevant information to assist them in managing the organisation.

Manser (2) has stated "A management accountant can provide a service to top management interested in earning a satisfactory profit by co-ordinating the

(i) Wm Cotton had recently purchased a Hewlett Packard 3000.

effort of all functions in:-

a) acceptance of the accounting profession into the management team

b) profit engineering

c) budgeting control

d) standard costing

e) the nature of finance

f) the reduction of wasteful practices

g) specific ad hoc assignments.

If the management accountant is to aid management, the accountant has to decide what the function of management is.

As Batty (3) says; forecasting, planning, organising, motivating, co-ordinating, controlling and communicating are the seven major management processes and conventional accounting makes a valuable contribution to them all. Table 1.1. illustrates what specific convential accounting techniques influence the management processes. By conventional accounting it is meant the three major accountancy orientated sub systems : financial accounting, budgetary control and cost accounting, with management accounting incorporating the latter two.

Although it is realised that the introduction of many accounting techniques could help improve the effectiveness of the accountant, this thesis will mainly be dealing with the cost accounting and standard costing techniques.

PROCESS	MANAGEMENT DEFINITION	THE FUNCTION MANAGEMENT ACCOUNTING HAS ON THESE PROCESSES
FORECASTING	Deciding what should be done.	Plans converted into money, and plan which is most profitable chosen.
PLANNING	Determining policy and formulating plans to achieve desired objectives.	Advise mgt how to raise funds, and supply information for decision making
ORGANISING	Responsibilities are defined and lines of authority laid down.	Having work centres and cost centres with responsibility accounting gives a more efficient business structure.
MOTIVATING	Establishing sound leadership and getting most out of employees, through high standards ofmorale and cooperation.	Setting realistic targets standards and ensure adequate leaders are promoted by result comparison.
CO-ORDINATING	Ensuring different departments work together to ensure maximum profit.	Financial resources should meet planned requirements for instance, goods in stock to meet demand but not tyeing up too much capital.
CONTROLLING	Analysis of results to ensure actual and planned operations coincide.	Control through standard costing, budgets, comparision of planned P&L accounts and balance sheet with actuals.
COMMUNICATING	Transmitting instructions and information within the organisation to outside customers and suppliers.	Results can be incorporated into reports informing managers, shareholders, creditors, employees and general public.

Table 1.1 Influence of Management Accounting on Major Management Processes

This is because by focusing on such techniques the company would gain most benefit (see chapter 6).

Cost accounting is concerned both with internally and externally generated costs and will give a detailed analysis of the cost of producing a finished product into its constituent elements, in other words, material labour and overhead. Unlike financial accounting, which is a legal requirement, cost accounting is optional and the degree of complexity depends entirely upon the company concerned.

The purpose of cost accounting is to provide data which will assist management in:-

(1) Deciding between alternatives
(2) Clarifying the role of all levels of employee in plans
(3) Communicating these plans
(4) Determining a price to charge
(5) Making stock valuations
(6) Control by supplying feedback reports
(7) Deciding between make or buy decisions

To achieve the above it is necessary for a number of techniques to be in operation. (An explanation of these techniques is given in Chapter 4). However, the two important techniques are historical and standard costing and these provide the major basis for control

within the organisation.

1.4 Origins of Cost and Standard Costing

The development of costing systems can be seen as far back as the 12th and 13th century, when Genoese merchant travellers allocated revenues and expenses to numerous sponsors throughout each voyage. Such concepts developed throughout the 14th, 15th and 16th centuries providing systems which enabled a crude cost of production to be determined.

It was during the reign of King Henry VII that the earliest forms of standard costing systems were developed and it involved the standard material requirements calculated by the wool merchants who wanted to curb waste in material usage.

Progress was slow in both disciplines and it was not until 1885 before the next major strides began to take place. Cost accounting grew because of the increased competition within engineering companies, necessitating the need for knowing the cost to produce a component. Thus allowing management to determine the profit margin. Standard costing advancements were mainly due to the growth of scientific management and the disadvantage of cost accounting.

In 1911 G Charter Harrison introduced the first

complete standard costing system at the Boss manufacturing company in Kerwanee, Illinois. The overall growth continued and by 1933 standard costing was used as a tool for fixing prices, stock valuation and cost analysis, as there had been

> "an acknowledgement of the fact that there is in reality a basic economic cost of producing a given article or commodity which can effectively be used as a 'yardstick' or 'rule' for increasing the degree of efficiency represented by actual cost". (4)

Although cost accounting and standard costing are now established management accounting techniques, there is criticism levelled against them due to their time consuming aspect (5). However, with the development in computer technology much of the 'number crunching', problem can be removed which accounted for this time problem.

1.5 The Impact of Computer Technology

Computers were first introduced into manufacturing industries throughout the 1950's and initially this was only into large companies because of cost restrictions. However, with the advancement in technology, corresponding price reductions and advancement into other areas of the firm, the computer has become an acceptable tool for small business's.

This subject is looked at in more detail in chapter 9, with reference to the costing system and computer technology which is specifically required by Wm Cotton Ltd.

When it is said that the system should be specifically for a company, it is because there are a number of manufacturing methods operating within industry, each having an associated established costing system. Hence, it is important to ensure that the correct match is maintained.

1.6 The Costing Systems Associated with Manufacturing

There are two basic forms of manufacturing systems, these being Process and Specific order manufacturing. There are further variations within these types and the subdivision of these categories along with their main characteristics are summarised in table 1.2.

The most widely used costing system within the process industry is operation costing and would be used by companies manufacturing chemicals, paper, food, paint etc. Basically, the cost of each unit is found by dividing the total costs for a period over the number of units produced in that period.

Specific order industries are where non-standardised products or services are manufactured or supplied. The main associated costing system is specific order costing and its purest form can be found where work is undertaken to customers specific requirements, such as in civil or building engineering. This is known as job costing and is similar to contract costing, except that contract costing is normally

Table 1.2. Main Manufacturing Systems and Summary

Specific Order Costing	Operation Costing
Job Costing (1) Not Producing Goods for Stock. (2) No two orders necessarily alike. Building contractors, Civil Engineering, Furniture, Printing.	Process Costing (1) Where one or more standard items are produced. (2) Manufacturing process established. (3) Work Flows Continuosly. Bakeries, Shoes, Brewing, Chemical Processes, Food Manufacturing.
Contract Costing (1) As above only of longer duration. (2) Work broken into sub orders. Civil Engineering, Building.	Service Costing (1) Where standard services are provided.
Batch Costing (1) Batch of standard articles produced. (2) Unit Cost = Total Cost ÷ final quantity. General Engineering. Car Manufacturing. Electronic Engineering.	

of a longer duration.

Batch costing is a form of specific order costing and of particular interest to this project because Wm Cotton Ltd are concerned with Batch manufacturing. Wm Cotton manufacture about one third of their requirements for parts in batches, taking advantage of a reduction in unit costs due to machines being reset less. This type of manufacturing is used in general engineering and car production. The remaining two thirds, the company purchase from outside suppliers.

Running a processing costing system is far easier than any of the various specific order costing systems. However, ease of operation should not be the main criterion for installation. The system exists to provide information for the management to manage the company. Although certainly, ease of operation and more importantly cost, have to be taken into consideration.

In deciding upon the costing techniques necessary to provide the management with this information, it is necessary to understand the problems within the manufacturing and accounting departments.

1.7 Problems Within the Company

The manufacturing system needed to be understood

because the majority of the data used by accounting originated from this area. However, the company did have manufacturing problems which influenced the accuracy of this data. They were operating an historical cost system which they found time and resource consuming and had no way of quantifying their performance in order to provide an effective management control system. The stock valuation was complicated and costly and because of their reliance on manual systems manipulation of data was inflexible.

Thus the initial terms of reference for the project wereto implement a standard costing system which would overcome these problems providing an effective control system and stock valuation procedure. The original intention was for the standard costing system to be part of a material management computer package purchased by the company and available for use within a short time of starting the project.

However, because of delays the package did not arrive until shortly before the project was due to terminate. Thus the principles of the system were developed on an Altos micro computer supplied by the University and on site at the company. These principles could then be switched to the company's computer when it became possible.

1.8 Thesis Structure

The thesis will start by giving a brief introduction

to the company and the background of the project. Chapter 3 is a literature review which develops into Chapter 4 where the various management accounting techniques which would prove beneficial to the company are discussed. Chapter 5 goes on to examine the present manufacturing system operating within the company and how this influences the accounting system. A brief look at the proposed M.R.P.(i) manufacturing system is observed, as accounting in the future will derive information from this system.

Chapter 6 looks at the problems in the accounting area, progressing on to why it is failing and what procedures should be developed in order to provide a control system. Chapter 8 looks at the work completed by the author and how this supplies the control system. This is followed by an explanation of M.R.P.(ii)* which specifically looks at how the accounting functions fit into the integrated manufacturing system.

Finally, the project is discussed and conclusions listed.

(i) M.R.P. stands for Materials Requirement Planning.

* M.R.P. II stands for Manufacturing Resource Planning.

CHAPTER 2

COMPANY BACKGROUND AND THE TEACHING COMPANY SCHEME

2.1 Company Background

William Cotton Limited was established in 1894 and is presently part of the William Cotton Group Limited which itself is owned by Dostour Engineering. The company produces machine tools for the textile industry and over the last fifteen years has seen major changes in its structure, size and market strategy.

Prior to 1982, it was a subsidiary of Bentley Engineering (i) which itself was owned by the Sears Engineering group and throughout the 1950's and 1960's it underwent boom conditions employing up to 2000 people. and turning out 20 machines a month. These machines were large"CRP fully fashioned knitting machines""with many design variations and costing upwards of £200,000 each. The company failed, however, to reinvest enough profits into research and development of new products, such that when the boom conditions abruptly ended in the mid 1970's, major inroads were made into Cotton's market by foreign competition which could offer cheaper machines, faster due by dates, and machines which had adapted to the change in fashions.

(i) Bought by Bentley Engineering in 1965.

The extent of this decline nationally is highlighted by a report by the National Economic Development Board showing that output of the textile machine industry in real terms had declined more than any other engineering sector since 1975, with employment in the industry falling from 47,000 in 1970, to 20,000 in 1980. This reduction in workforce was felt at the Cotton plant which was drastically reduced to 239 in the early 1970's, leaving an underutilisation of 330,000 sq feet and a stock level of four million pounds.

During the mid '70s the market showed signs of recovery and in 1976, Sear's new chairman, Sir Monty Finniston, invested £½ million per year on new products for Wm Cotton, (i) ensuring that if a major recession was to strike again the firm would not just have to depend on the CRP for survival, but could fall back on less expensive and higher sales volume products. This investment has led to the company producing flat bed knitting machines with microprocessor control which knits unshaped lengths of material, and allowing

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(i) The company purchased the German company Singer Alemania, the rights of a partly developed Italian weaving machine and knitting machines,and assembled by the FN Comapny of Belgium.

easier pattern changes, new miniaturised fully fashioned machines with microprocessor control and a revolutionary weaving machine with a moving drum section, instead of the traditional shuttle (i). Thus the workforce steadily rose from 200 to 430 by 1982.

These new machines and market recovery were not, however, enough of a guarantee for Sears to hold on to Wm Cotton as it still represented a substantial part of Sears Engineering interest pre-tax losses of £15.7 million in 1979 and 1980. Hence they offered the management at Wm Cotton Ltd a chance to buy out the company. The offer was accepted and in January 1982 they obtained a fiftyfive per cent equity stake, believing the CRP, new products and the trimmings which had taken place during the recession were enough of an incentive to dispel doubts about the company's future, and causing Mr Cyril Atkinson, the new chairman to comment:

> "it was not a decision taken speedily. We had a good financial basis and the long term forecasts were examined by all the partners".(6)

This uncertainty has been proven and in spite of initial success which saw the workforce climb to as

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(i) For fuller details of the products, see appendix 2(i).

high as 470, severe cash flow problems forced the management team to relinquish the majority of their equity to the present holding company of Dostour Engineering Limited. Their initial strategy has been to relieve the cash flow problem by reducing overhead, resulting in a reduction to 260 in the workforce by the end of 1983.

Concluding, Wm Cotton Ltd has seen two changes in ownership throughout the last five years and during this time has seen the company change from a single product firm with many variations, to a multi-product firm, again all with variations. This change has resulted in new parts to be produced using different production methods creating a demand for new storage areas and a stock control system. Whereas in the past the old informal system of supervisory control was acceptable on the single product because of the large buffer stocks, there was now a requirement for management control systems which had to co-ordinate and control the resources of the company. Due to these problems a feasability study was carried out by the University of Aston (7) at Wm Cotton Ltd which in turn resulted in establishment of a teaching company scheme at the organisation.

2.2 The Teaching Company Scheme at Wm Cotton Ltd

A Teaching Company Scheme calls for a partnership between an academic institute (university or polytechnic) and company, which tries to:

> "improve postgraduate training and performance in manufacturing industries". (8)

The objectives can be summarized as follows:-

(i) To develop closer understandings between universities and manufacturing industry

(ii) To advance manufacturing methods in British firms

(iii) To attract able graduates into manufacturing industry

(iv) To enable universities to develop systematic understanding of manufacturing engineering, based on experience of practical industrial problems.

Thus bearing in mind the companies problems and the aims of a Teaching Company Scheme, a partnership was established between Wm Cotton Ltd and the University of Aston in Birmingham, with the aim of implementing new management systems and technology by developing relevant projects (i). This project is the last of the second stage and concerns the development of standard costing.

(i) Previous project titles are given in Appendix 2(2).

CHAPTER 3

LITERATURE SURVEY

From the outset of the project the objective was to implement a standard costing system as part of a materials management package. (i) Thus the initial survey began by examining the principles of standard costing and assessing if this was the right technique for the company as it was soon discovered that:

> "there is a school of practical management accounting thought, that standard costing and variance analysis have become a time consuming and sometimes a downright misleading exercise"(9)

The principles of standard costing were found to be well documented and established, although up to date literature was somewhat lacking in the specific areas of Batch costing, and solving the problems associated with setting up standard times for the operations required in the manufacture of batches. As Cluett (10) points out, many of the textbooks place emphasis on cost classification and data manipulation to calculate the variances. Although this proved helpful in understanding the principles of standard costing, it was not specific to solving the main problems that were being encountered, these being the actual

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(i) The Material Management Package was a computerised manufacturing system which was in the process of being purchased by Wm Cotton Ltd and is discussed more fully in Chapter 9.

determination of the standard time for each operation, the collection of relevant data, processing within a short time and ensuring data accuracy. Although in general the literature recognises these problems, it does not detail how to solve them or place any significance to their relevance. It is contended if these problems are not solved the system will not operate sucessfully. One author who does recognise these problems is Inman (11, 12,13), who not only acknowledges the problems but puts forward a view that there should be a movement back towards actual costing, with the emphasis being on current costing. In his opinion, standard costing takes up too much time and resources and quotes Horngren's description as being 'more of an exercise in forecasting ability'.(14) Further, a successful introduction of current costing will speed up reporting to management by eliminating variance analysis and avoid the problem of having to write variances to the profit and loss account. Inman argues that the motivational aspect can be maintained by using trend and ratio analysis which have the added advantages of being quick to prepare, clear and concise.

Although Inman's arguements do have a merit of truth, the problems associated with standard costing are not insolvable. By implementing computerisation with standard costing, the calculation times can be greatly reduced along with the time delay between incurring

costing and producing the variance analysis. True, the initial problem of establishing standard costs is time consuming and difficult, but once completed (and again if computerisation is available) the process of re-issuing standards on a yearly basis is simplified. The reasons for this are discussed more fully in Chapter 9 section 2.2.1. Lastly, the most important part of Inman's arguement on trends ratio analysis supplying the motivation, is not convincing. It is contended that the motivational aspect is the crucial factor in supplying and operating a control system; as Woodward argues (15) within Batch manufacturing industry

> "management efficiency depends entirely upon the first line supervisor's skill in the making of clinical judgement, and on the personal performance of the operators".(16)

Cluett (17) backs up this view by saying that the big controllable cost in batch manufacturing industry, is the direct labour cost and rightly this is the place where companies tend to concentrate their effort. Thus it is recognised that the key is motivating the work force; a trend and ratio analysis merely provides a historical recording of how well the section is performing, whereas with standard costing a target time is entered for the operator to complete the job. This is the objective for the operator. The variance analysis lets all concerned know if this objective has been met.

Anthony and Reece (18) recognise the influence of this goal displaying the results by arguing that,

> "motivation is strong when the goal can be attained with some effort" and
>
> " it is important that reports on performance be made available and acted on quickly".

Although it should be pointed out that merely having a goal is simply not enough to provide this motivation, but this goal must be an agreed standard by the work force with their knowledge that management is taking an 'interest' in their performance.

Thus as Inman and Horngren point out, standard costing is a measure of forecasting ability. However, provided this ability is good enough, and the problems overcome, standard costing will provide the crucial factor of motivation for the control system. This must be backed up by quick, clear and concise variance analysis which will indicate how well operators were performing.

Having decided that standard costing was the technique to form the basis for implementing the control system, the next stage in the survey was concerned with associated complementary techniques; these being actual, responsibility, absorption and marginal costing which were all examined (19,20,21,22,23,24,25, 26 & 27).

Again , well documented and established techniques were used, although the benefits of marginal costing were more appreciated in theory than practice.

In reading the costing textbooks, as with standard costing, the view put forward by Cluett was agreed by the author that "the latter studies of costing textbooks tend to concentrate on the rationale, concepts and mechanics of cost collection, classification and data manipulation". (28)

Textbooks placed emphasis on using the costs for strictly costing purposes and not for control purposes which it is felt is more important in the operation of a company. Another criticism, (although understandable) is the assumption that resource is available for the processing of the data and cost collation. This was not the case at Wm Cotton Ltd, where resource was scarce. With the reduction in manpower within the costing department and the aim to reduce overhead further, the extent to which the techniques could be implemented could not be as detailed as the textbooks suggest.

For example, in the literature,emphasis is placed on having overhead rates for work centres, whereas this would give more accurate information,the work associated with such an exercise would have to be assessed so as to indicate the accuracy which was

worthwhile obtaining. Thus the extent to which the techniques should be implemented depends upon what the company really required and could afford and not to the extent that was suggested in much of the literature.

Once the accounting literature was surveyed, MRP and MRPII was examined because this was the proposed manufacturing control system and as such, the implications of such a system on the accounting has to be understood. There were very few textbooks on the subject (29,30,31) but those available were heavily slanted towards implications for the production and inventory control system.

This was to be expected as the systems were initially production orientated and as Bowers (32) pointed out:

> "the accounting profession has given scant attention to the development of automated production control techniques, although the financial implications ought to be evident. The accounting function of manufacturing entities fails to appreciate the need for the development of sophisticated production control techniques. Accountants fail to support the development of such systems which require the support and talent of every department concerned."

However, this view is altering with recent articles having been published, (33,34,35, 36,37,38,39,40,41, 42,), giving an airing to the subject and explaining the impact of the accounting function. This subject is discussed in Chapter 9, but it is the accounting techniques which were introduced at the beginning of this chapter which will now be expanded upon.

CHAPTER 4

A DISCUSSION OF THE VARIOUS TECHNIQUES AND APPLICATIONS AVAILABLE TO WM. COTTON LIMITED

4.1 Introduction

One of the major conclusions of this thesis is: if Wm Cotton Ltd was to successfully implement the management accounting techniques outlined in this chapter, it would greatly improve the operational efficiency of the business.

However, as Goodlad (43) rightly points out, management accounting is not simply just a matter of implementing techniques, but these should be aimed at providing an accountancy system which helps the management manage the company. He then argues that the 'techniques which most aid management in their planning, control and decision making roles (44) should be the ones to adopt.'

Of the many management accounting techniques which could be adopted such as Budgeting Control, Internal Auditing, Internal ratio Analysis, Capital Expenditure, Project Assessment, Long Term Forecasting Study, to name but a few, it is proposed to limit this review to the techniques which formed the major part of the practical project at Wm Cotton Ltd and to techniques which were associated with the project and

will be of particular benefit to the company in relation to the planning control and decision making aspect.

However, before looking at these techniques, a brief explanation of the classification and nature of costs will be given, as it is felt important to have an understanding of these terms in order to appreciate their operation.

4.2 The Classification of Costs

It is possible to classify costs according to their common characteristics and this classification is important because it "is an essential step in the summarization of detailed costs". (45)

Costs can be divided into major functions such as production, marketing, research and development, administration etc. These functions can be further sub-divided into cost or work centres. For instance, in the Production Department there might well be an assembly and machine shop, and within the machine shop there will be turning, milling, drilling etc.

The majority of expense incurred within manufacturing companies arises within their manufacturing departments. Such expenses are known as the cost elements. The major ones being:

1. Material Cost
2. Labour Cost
3. Overheads

For a definition of the above element, see appendix 4 (1). Each element can be divided into direct or indirect costs. Direct costs are those which can be identified with, and allocated to, cost centres or cost units and can be measured directly to the product and contribute directly to converting raw materials to a saleable product or part. Whereas indirect costs are those which cannot be directly identified with, but have to be apportioned or absorbed by the cost centre or unit on a suitable basis.

The direct costs of production when added together constitute the prime cost. The indirect costs of production added together with other non production costs, for instance, sales, distribution, research and development and administration, form the overheads for a company. (For a summary of these costs see table 4.1).

The nature of costs concerns the relationship between cost and activity level. The generally appreciated relationships being fixed, variable and those which have a combination of both elements. A fixed cost has no change in relation to the change in the activity level (fig 4.1.)examples are:

Table 4.1

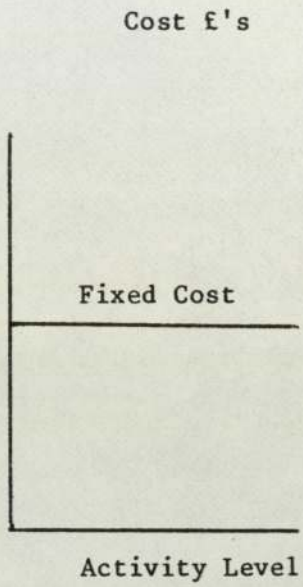
Cost Elements Within a Manufacturing Environment

Direct Costs			
(1)	Direct Materials	A	
(2)	Direct Labour	B	
(3)	Sub Contract/Direct Expenses	C	
	Total Prime Cost	A+B+C i.e.	P
Indirect Factory Costs			
	Indirect Labour (management, supervision maintenance, cleaning, lost time, sickness, training, etc.)	X	
	Indirect material (maintenance, material, processes, power, gas, light, heat, water, rent, rates, insurance, depreciation, etc.)	Y	
	Total Indirect Cost	X+Y i.e.	Z
	Total Factory Cost		P+Z
Administration and other Costs			
	Admin. Costs	G	
	Selling Costs	H	
	Distribution Costs	I	
		G+H+I i.e.	J
	Total Costs	P+Z + J	

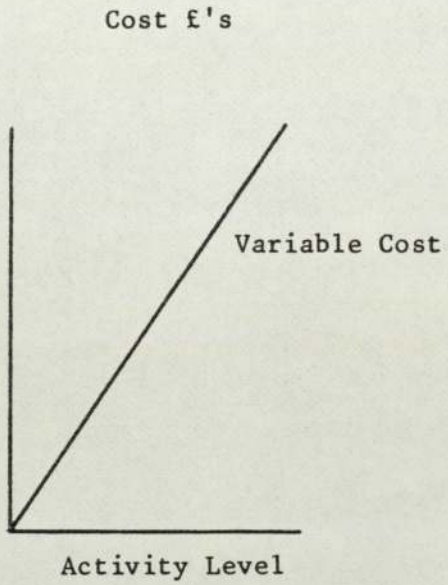
depreciation and rent. At the other extreme is variable cost. If reference is made to fig. 4.2 it can be seen that with this form of cost, as the activity level increases, there is an increase in total variable cost, but the unit cost remains the same (slope of the line). Examples are raw material and direct labour.

Killough and Leininger point out (46) that costs containing both fixed and variable costs are either a semi-fixed cost or a semi-variable cost. They differentiate by saying a semi fixed cost is a stepfunction (fig. 4.3) examples being supervision and inspection. The relationship being as activity increases there comes a time when additional supervision is necessary: the cost increases but remains static until time for another increase.

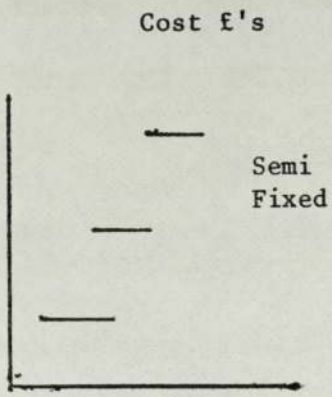
A semi-variable cost has a fixed and variable cost component. An example being wages based on a basic salary plus a commission. See fig. 4.4.



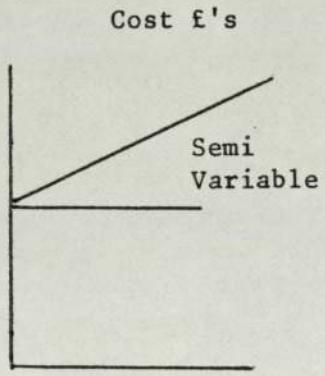
FIXED COST Fig.4.1



VARIABLE COST Fig.4.2



Semi Fixed Fig.4.3



Semi Variable Fig.4.4

4.3 Determination of Elements of Cost and their Nature

To determine the cost elements and their nature requires a number of separate systems, each system recording a specific element, such as the cost of purchased parts, raw material, sub contract, labour and overheads. Each might require a separate recording procedure with varying complexity. For example, it is far easier to record the cost of an outside purchased item than obtaining the machining and labour cost for an inside manufactured good which undergoes twenty production operations. Therefore to obtain the costs there has to be an Actual Costing system (technique 1.) which is made up of a number of smaller systems which accurately record, collate and bring together all the cost elements.

However, this is not enough, albeit an improvement, on having no recording by informing management what its costs are; it does not inform management what its costs should be. The technique used for the latter is Standard Costing (technique 2). Correctly applied, the variances (i.e.difference between standards and actuals) are analysed by management and where necessary corrective action taken. To help ensure that this corrective action is taken, it is imperative that people are held responsible for clearly defined work centres and specific areas, and the controllable costs associated within these areas, hence the need for technique 3, Responsibility Accounting.

These three techniques can form the basis for a good management cost control system and are the techniques mainly concerned with the author's practical project. However, one other technique which it is felt should be briefly discussed is the method for allocating overhead, because it is felt the present systems under operation are not accurate enough. Summarizing, the techniques to be examined are:

(1) Actual Costing

(2) Standard Costing

(3) Responsibility Costing

(4) Overhead Allocation

4.3.1.

Actual Costing

Actual costing is a process of accumulating costs after they have been incurred. Systems must be set up to record cost elements. The disadvantages of such a system are numerous; the recording and paperwork is time consuming with limitations on accuracy. It informs management of an historical situation. In other words what the goods have cost. Its other main use is for stock valuations. The effectiveness as a control system can only be seen when it is complemented with standard costing.

4.3.2.

Standard Costing

The definitions of a standard cost are too numerous and

depend on which standard is required. Table 4.2 displays the various types of standard costs. The one chosen from the possibilities listed has associated advantages and disadvantages. It is felt that as William Cotton Ltd requires an effective control system the standard cost should encourage this aspect. Such a standard is the 'expected' which would provide motivation and other realistic uses, such as setting selling prices and valuing stocks.

The differences ('variances') between what these products should cost (standard cost) and what they are (actual) are analysed and if the variance is of significance, it is brought to the attention of management and corrective action is taken to ensure the adverse variances are not repeated in the future.

Although variance analysis can become rather complex, companies usually concentrate on variances that they consider more important. In the situation of Wm Cotton there would initially be emphasis on Direct Labour costs as this is the area where the company can make significant improvement by implementing control. (Appendices 4(2) and 4(3) give the different variances with their associated calculations and possible causes). Although to achieve these improvements standard costing will have to be implemented alongside Responsibility Accounting.

Type	Characteristics	Possible Benefits or Disadvantages
Ideal Standards	1. Theoretical standards which may never be achieved. 2. Output maximum, minimum losses in material time and services used. 3. Often unattainable and therefore unrealistic. 4. Except in ideal conditions which rarely exist, the variances are very large.	1. Can indicate the expected targets. 2. May encourage cost reduction provided standards are not impossible. 3. The large variances may discourage managers and workers so that control is ineffective.
Expected (Attainable Standards)	1. Aim for a high level of efficiency which is capable of being achieved. 2. Realistic allowances are set for normal losses and waste. 3. There is an effective matching of activity and costs. 4. Variances reflect the efficiency of managers.	1. Targets are realistic. 2. Managers know the standards can be obtained and therefore should accept them as norms. 3. Control should be effective. 4. Provided there is a challenging of the standards with a view to improvement, cost reduction will be encouraged.
Past (Performance Standards)	1. Often represents an average of previous actual costs. 2. Usually not true standards at all. 3. No attempt made systematically to establish the standards.	1. May or may not represent reasonable targets. 2. Can be useful for starting a system, but should not be regarded as acceptable yardstick.
Normal Standards	1. These represent an average for a period - say for the trade or business cycle. 2. They are a theoretical concept rarely applicable in practice.	1. For planning and control may have little relevance. 2. Sometimes may be of value for considering long-term effects of decision

(i) Different types of standard costs J Batty Advanced Cost Accounting. P.202

Table 4.2 Types of Standard Costs (i)

4.3.3.

Responsibility Accounting

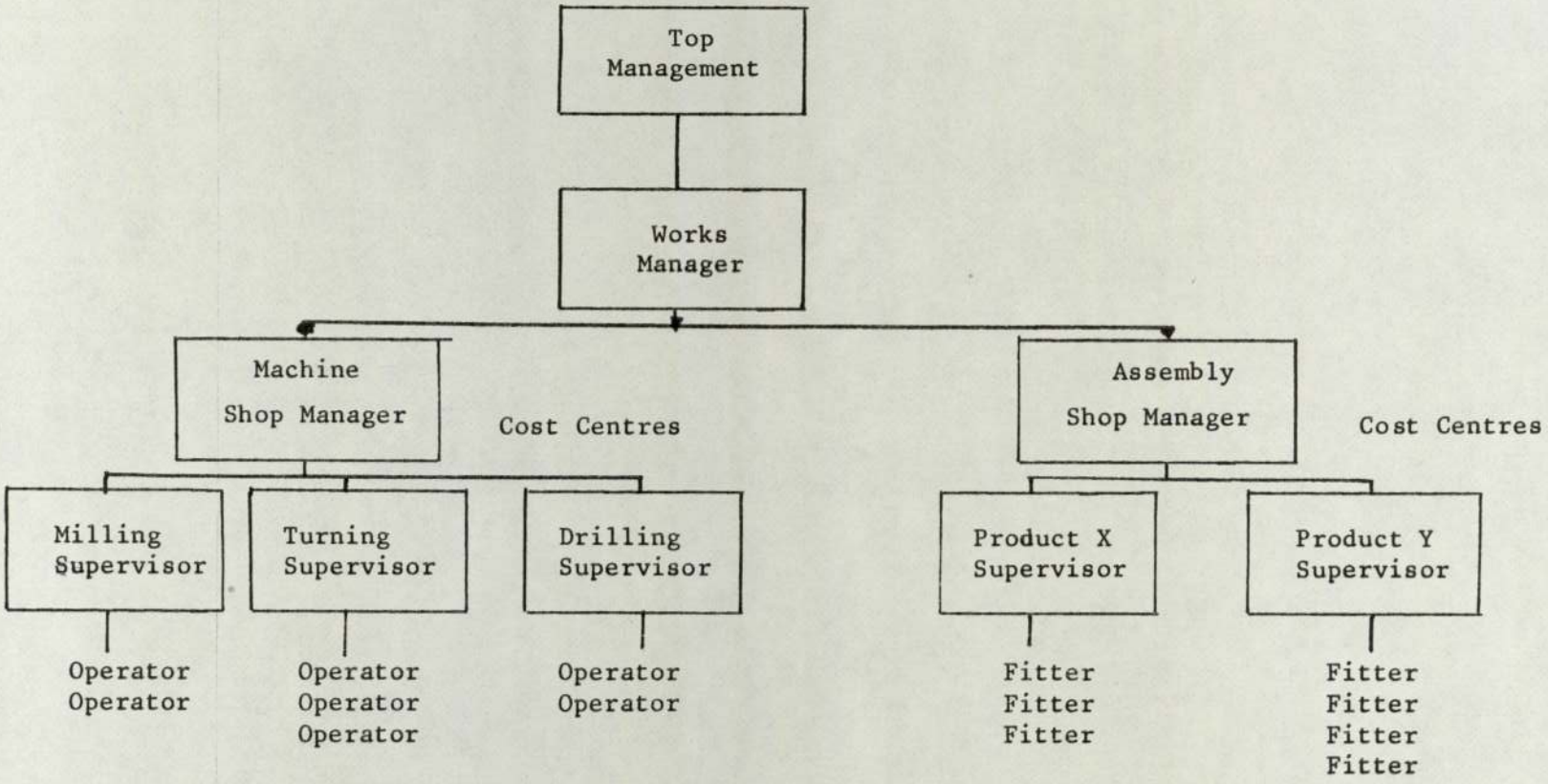
Sizer correctly points out "people, rather than analyses or reports, control operations" (48) and responsibility accounting is a recognised tool used to motivate people.

If a responsibility centre is likened to a cost centre "in that it has inputs which are physical quantities of material, hours of various types of labour... it works with these resources... it produces outputs which are classified as goods" (49).

Responsibility accounting provides information about these inputs and outputs in relation to the specific responsibility centre. There are four types of responsibility centres, - investment centres, profit centres, cost centres and revenue centres. Although all of these could be used in some way at Wm Cotton Ltd, this project will deal with cost centres as the others require budgets, and as such, are not directly relevant.

Cost centres are typified by a production department or subsidiary of a department, and a diagram giving a example of responsibility accounting in relation to cost centres is shown in fig. 4(5). From this diagram it can be seen that an operator is held responsible

Fig. 4.5 Example to Show Resposibility Accounting



to his Cost Centre Foreman, the Foremen report to their Shop Managers, who in turn report to the Works Manager. The Works Manager is responsible to Top Management.

It is contended that by providing the right information in the right format at the right time to the right people, motivation can be achieved. The operator needs to know what time it should take to do the job, how long it took him and how he has performed over a time period in relation to other operators. The time period should ideally be a day but a week would suffice. The Foreman wants to know how well the Operators under his control are performing individually and as a group in comparison with other cost centres. He would like this information on a daily or weekly basis.

The Works Manager motivates his Shop Managers but would probably like access to the performance of the Cost Centres and Operators. Top Management would need to know if overall targets are being met and if not, the problem areas.

Although this system is more for Direct Labour, overhead allocation cannot be ignored because in the proposed manufacturing system to be installed by the company, overhead rates have to be entered for different cost centres.

4.3.4

Overhead Allocation

The method of allocating overhead is normally done in one of two ways; either absorption costing or marginal costing.

4.3.4.1

Absorption Costing

Absorption costing is the most widely used technique and is defined by the I.C.M.A as 'a principle whereby fixed as well as variable costs are allocated to cost units".

With this technique, all the indirect fixed and variable costs of production are allocated by a suitable basis to a productive department, then hourly rates or percentages are calculated, which will allow the recovery of the overhead. For example, a department incurred £1,000 worth of overhead in 200 hours of production, then £5 of overhead (1) is incurred for every hour of production in this department. Using such a technique it becomes possible to determine the full cost of a good, value the stock and work in progress and price it.

This is the basis of the system operated by Wm Cotton Ltd and there are associated disadvantages. When

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(1) Reference to commonly used formulae. Appendix 4(4)

using absoption costing methods it is necessary to forecast the expenses which will be incurred, using past results. In such cases there will be an under or over absorption of overhead. In the above example if the actual overhead incurred was £1,200 and the rate had been charged based on £1,000 i.e. £5 an hour, then there will be an underabsorption overhead because the rate which should have been charged is £6.

Also because no differential has been made between fixed and variable costs, vital information is absent which is essential in the management decision making process. Suppose demand for a product dropped and spare capacity became available, it can be argued that a firm should be prepared to reduce its price to win a contract as long as the price is above the variable cost of the product and making a contribution towards fixed cost. Absorption costing does not recognise this factor because fixed and variable costs have been amalgamated in the determination of the cost of the product and hence the cost of the product cannot be deduced.

Similiarly, if management wanted to calculate the effects of changes of volume and type of output when the fixed costs would not alter, then information presented using absorption principles would not make this possible.
A technique which does overcome these problems is

Marginal Costing. However, the proposed computerised manufacturing system which was to be implemented was not able to distinguish between fixed and variable costs and for this reason overhead allocation was going to have to continue to be done on the absorption basis. Although it should be pointed that the method presently being used by Wm Cotton Ltd needed improvement. However, marginal costing principles are briefly explained should it become possible or desirable to switch to these principles in the future.

4.3.4.2

Marginal Costing

Marginal costing does differentiate between fixed and variable costs and calculates the contribution of product per product group towards fixed costs. The contribution being the difference between the selling price and the variable costs. (See Table 4.3 which outlines the principles of marginal costing).

	Product 1	Product 2	Product 3	Total
Sales Price	200	300	400	900
Variable Cost	100	150	200	450
Contribution	100	150	200	450
Fixed Costs	---	---	---	250
Net Profit	---	---	---	200

Table 4.3. Principles of Marginal Costing.

Using this approach, more meaningful decisions are now possible. The firm knows how low it can drop its price and still make a contribution towards fixed costs (although this is only a short run decision). It indicates what products sales effort should concentrate upon and help in make or buy decisions.

Thus marginal costing is useful when looking at cost-volume-profit relationships. It should be stressed that marginal costing has to be understood and not effect long term pricing policy which has to take into account the recovery of fixed costs. There are practical difficulties operating this technique, the foremost being the separation of costs into fixed and variable categories and it can complicate stock valuations.

4.4 Summary

So far a number of techniques have been introduced which if successfully implemented and operated would provide Wm Cotton with a control system and help improve the decision making process.

The following discussion will look at why these techniques have not been implemented before and although subjective in places, the opinions of company personnel have been taken into account.

4.5 Discussion: Why Techniques Have not Been Implemented Before.

The technique of actual costing has been operating for a number of years and has associated with it a number of cost collection systems. The costs are entered onto the Bill of Materials and rolled up to find the cost of a machine. This is based on the latest cost known for the part. Although this technique does not need to be introduced, it needs to be improved upon because it is time and resource consuming. Hence, at the outset of this project the manual costing system was too costly for the company to bear and the need was for a costing system which was both efficient and cheap.

There are a number of reasons for the company not having standard costing. The obvious being that as the actual costing system was not efficient there was little point in having a standard costing system. The resulting variance analyis would be performed with such a time lag, hence producing meaningless performance reports having little motivational impact. Even if actual costing was efficient there would need to be a considerable effort by the company to obtain accurate and meaningful time standards for machine operations and price standards for purchased parts. To obtain the time standards would require work study devoting considerable resource and the purchasing

department would have to devote effort to obtain price standards. In view of the short term problems, the company had not justified devoting time to obtaining these standards.

The implementation of responsibility accounting has not been attempted because this aspect is heavily related to variance analysis and without this there is no real reason for its existence. Although specific work centres had been set up for administration purposes which could be amended when standard and actual costing techniques were implemented.

It is contended that although Wm Cotton's are presently using absorption costing techniques, they are insufficient in the Production overhead area.

Presently the Prodution overhead is calculated by totalling all the Production overhead costs and dividing them by a total of Fitting and Machine hours worked to obtain a direct Hourly Labour Recovery Rate. For example, costs are as follows:

	Machining	Fitting	Total
	O'hd £'s	O'hd £'s	
	75	25	100
Direct Hrs Worked	50	50	100

Wm Cotton overhead rate would be calculated as £1 per direct labour hour. Therefore, a job which takes 5 hours

machining and 2 hours fitting, would incurr an overhead of £7; whereas correctly, there should be two overhead rates, one for machining and one for fitting. The machining overhead rate would be £1.50 an hour, whereas the fitting is £0.5 an hour. Thus the correct overhead for the job would be:

$$(5x1.5) + (2x0.5) = £8.5$$

Using Wm Cottons present method, anything which is machine intensive tends to have too low an overhead apportioned to it, whereas machines which are assembly orientated have too much overhead allocated to them.

The Marginal Costing Technique is not operational and would involve a good deal of time to sort the overhead into fixed and variable cost, and has not been introduced in the past because it involved change and it might have been felt that the benefits offered by such a system do not outweigh the problems associated with change.

4.6 Conclusion

At the outset of this project, the company did operate actual costing, however, this was time and resource consuming. To implement standard costing would take additional resource and with little payback unless the problems with actual costing could be removed. Cost and work centres were available, although they were not in use because standard costing was not in operation. Absorption costing is in use, however, it is

argued in its present format, not accurate enough.

To implement the techniques mentioned, requires considerable effort from the company and the remainder of this project is devoted to this subject. In the next chapter, the manufacturing environment and the proposed alterations to this environment are examined. The reasons for this examination are explained in the introduction of Chapter five.

CHAPTER 5

THE MANUFACTURING SYSTEM WITHIN Wm COTTON LTD and THE CONTROLS POSSIBLE

5.1 Introduction

Once the present manufacturing system at Wm Cotton Ltd is understood, it becomes possible to visualise where the costing aspects slot into the system. It becomes apparent that if there are problems within the manufacturing system, these will be reflected in the performance of the costing system.

The purpose of this chapter is to explain the operating of the manufacturing system and show the interrelationships with costing. Major problems with the manufacturing system will then be reviewed and it will be shown how the controls can be improved upon by installing an MRP (Materials Requirement Planning) system. Lastly, a comment will be made on the effect of installation on costing.

However, it should be noted that although Wm Cottons had four distinct manufacturing systems, dependent on each specific operation, (these being:

1. Manufacture of Ace Machines
2. Manufacture of Intarsia Machines
3. Manufacture of Sales Spares
4. Refurbishment of Machines)

essentially all operations fall under the framework of one system, albeit with slight modifications. It is this framework which will be analysed by looking at the decision making process, information flow and physical movement of material on a departmental basis; concluding with a flow chart of the integration of the whole system. Firstly however, the initial decision of the management meeting needs to be reviewed.

5.2 Management Meeting and Policy

The Executive Director of the company will come to a decision by examining confirmed sales, forecasts and trends and lay down an initial build schedule for a specified length of time (normally 3 months). This decision is then passed on to departmental heads along with an outline of variations in machine guage, width etc. When confirmation of orders is received by the board, a detailed specification is decided upon which again is fed onto departmental heads. Although this decision is fed on to all managers, the initial action stems from the stores.

5.3 Stores

Once the stores receive the unspecified board decision, they produce shortage sheets of the standard items on a stage basis by making reference to the Parts list, Stock records (see Appendix 5.1). This information is then passed on to production control who take the

necessary steps to ensure delivery of the shortages. Thus works and purchase orders are issued from production control and purchasing respectively. The stores receive about 200 fabricated and 360 purchased parts a week and are responsible for updating the stock records.

Incoming into the stores with the supplied purchased parts is an advice note informing Goods Received personnel what has been delivered. The purchasing department issues a copy of the purchasing order (see Appendix 5.2) to the stores, informing them what to expect. Upon the receipt of Purchased Goods at Goods Inwards, the advice note (see Appendix 5.3) and purchase order are compared to ensure the correct parts have been delivered. The Goods Inwards copy of the purchase order is returned to purchasing only when all the items on an order have been delivered (this may not be in one delivery). Photo copies of the Advice Note are passed on to purchasing on a regular basis.

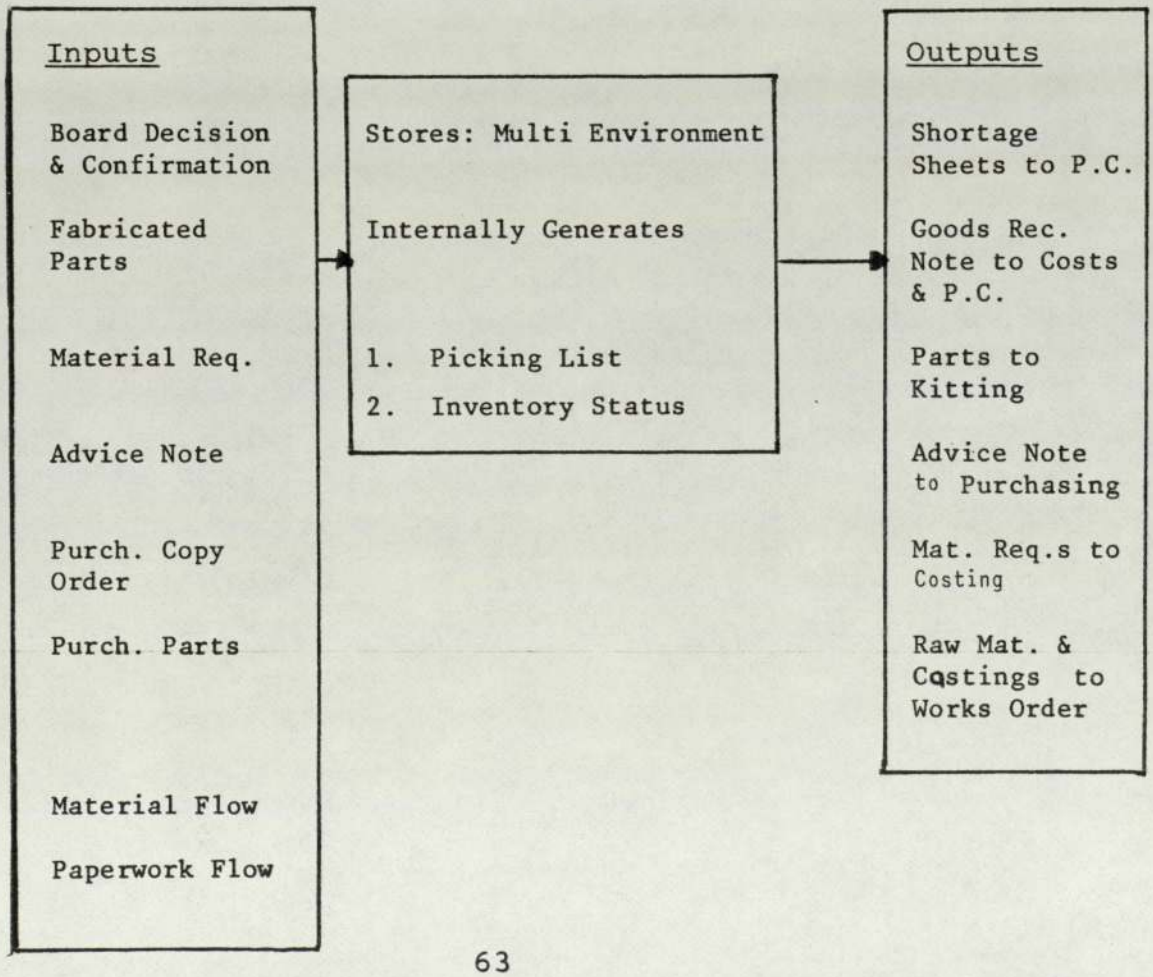
The works orders will require a material requisition for raw material. This requisistion is received by steel stores if steel stock is required and the main stores if castings are needed. The material requisitions (see Appendix 5.4) are fed on to the costing department, informing costing what material has been used.

Another major function of the stores is to kit parts

from a picking list for the fitters. This is done when stores personnel feel it can issue the majority of parts, again informing production control if it finds shortages. Production control and costing are informed if stores receive purchase parts or inhouse supplied parts via a Goods Received note (see Appendix 5.5) on a weekly basis.

Upon confirmation by the board of detailed specifications, the stores will repeat all the above procedures for the variable options. Fig. 5.1 shows the Inputs and Outputs from the stores.

Fig. 5.1 Inputs and Outputs from Stores



5.4 Production Control

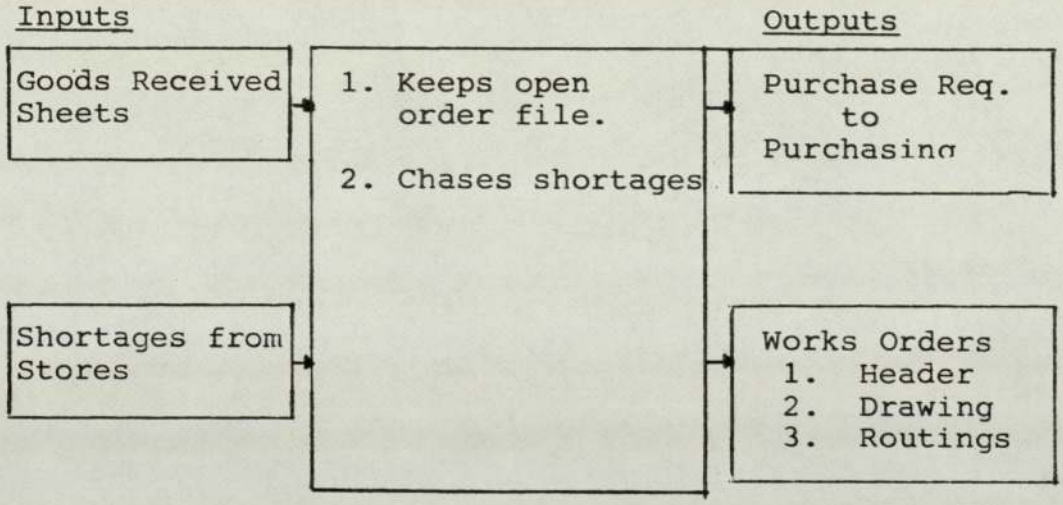
Upon the receipt of the shortage sheets, production control first of all checks the open order file to ensure the part is not already on a works or purchasing order. If this is not the case, and the part is bought out, a purchase requisition is raised(see Appendix 5.6) and then taking into account the lead time of the parts, the requisitions are fed into the purchasing department. To indicate to production control there is an open order on this item, the part details are entered into an open file.

If the part is an inhouse manufactured item, the stock records are examined to see if the raw material it is manufactured from is in stock. If not, a purchase requisition is raised for this material. If the material is in stock, a works order is raised instead.

To raise a works order the following is required: a unique batch number, a copy of the drawing of the item, a header (indicating what the part is manufactured from), and three copies of the routing. (See Appendix 5.7). The routing is a record of the operations which go into the manufacture of a completed part. The header is used later as the material requisition and gives details of the raw material required.

The order is then issued on to the works (Production Progress) and as with the purchased items, the part details are entered into the open file. Upon receipt of the 'goods received sheets' from stores, open orders are removed from the open file. Fig. 5.2 shows the inputs and outputs of the production control system.

Fig. 5.2 Inputs and Outputs from Production Control



5.4.1 Production Progress (Works Orders)

The production progress department is part of production control and keeps a monitor on the whereabouts of a works order. When progress receives the works order details, it retains one copy of the routing; this is fed into an open file. The other remaining data is split; the header becomes a material requisition and is fed either to the steel, or main stores. The second copy of the routing goes to the operator who will perform the first operation, whereas the remaining routing and drawing remain with the job.

The routing which was passed to the operator is returned to production progress. When the operation is complete, production progress, now knowing an operation has been completed, records this on their copy in the open file. The operators routing is then passed back for the next operation, and the time an operator takes to perform an operation is recorded on a job card by the operator. (See Appendix 5.8.i.-5.8.iii)

Once a batch is completed, the parts are returned to stores, inspected and the stock records adjusted accordingly. Fig. 5.3 shows a flow diagram indicating the procedure of production progress.

Another function of production progress is to record the time spent by fitters in the assembly and fitting of machines. Assembly at Wm Cotton's is carried out in two distinct areas; the vee bed knitting machines are on a track basis, whereas the intarsia assembly is carried out on a static frame. The on and off times of the fitter are booked on to four distinct cards (see Appendix 5.9.i - 5.9.iii).At the end of each week progress calculates the time each operator has spent on frames, reconciles this figure with the clocked hours, then the cumulative times for a machine are totalled at the end of each week to give the total assembly time allocated to a machine (see Appendix 5.10). This process is continuous until the machine is completed and despatched. The assembly figures are

then passed on to the costing department for machine costing. A problem with the procedure here is that each type of machine has an assembly target time. When preparing the cumulative time taken on assembly, in order to be meaningful the cumulative time should give an indication of how much of the machine has been completed, thus forewarning if a machine is going to be over target. At the moment, target time and cumulative time only trigger off action when the target time is exceeded.

5.4.2. The Purchasing System (Purchase Orders)

Purchasing is again part of production control, although quite often it receives purchase requisitions from outside this function, for instance, maintenance, general office etc. The number of purchase orders raised per week is between three and four hundred, with a choice of supplier upwards of five hundred. The purchase order life is between 4-6 weeks with a maximum of about 24 weeks.

Upon receipt of the requisition, the Part Number order file is examined. This is a file held in part number order, giving details of the required part along with the names of suppliers. The supplier file is then cross referenced, which contains information such as price, delivery time, conditions etc. The supplier offering the most favourable conditions is chosen and purchasing raises a Purchase Order. (See Appendix 5.2.)

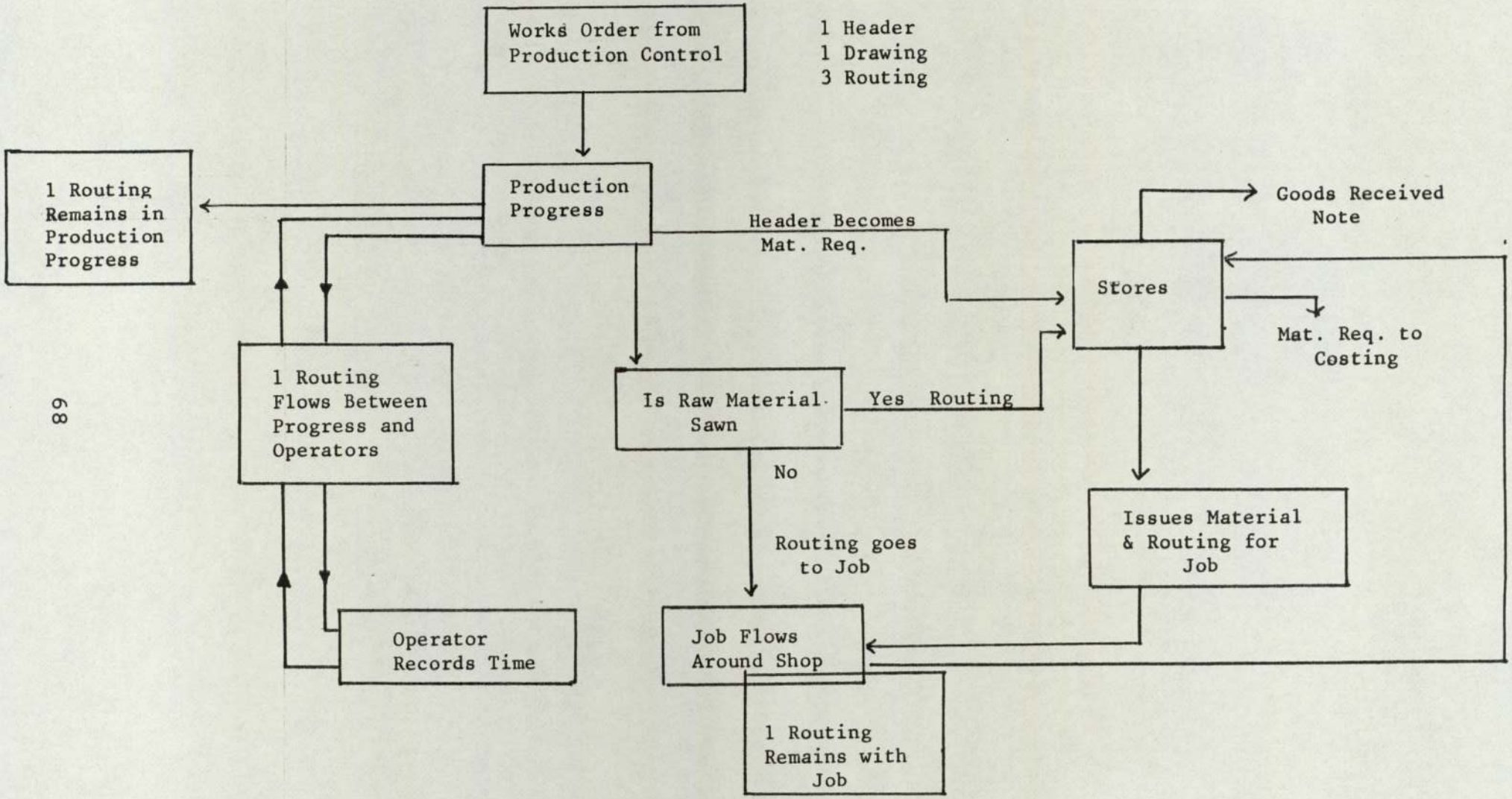


Fig. 5 (3) Flow Diagram of Production Progress

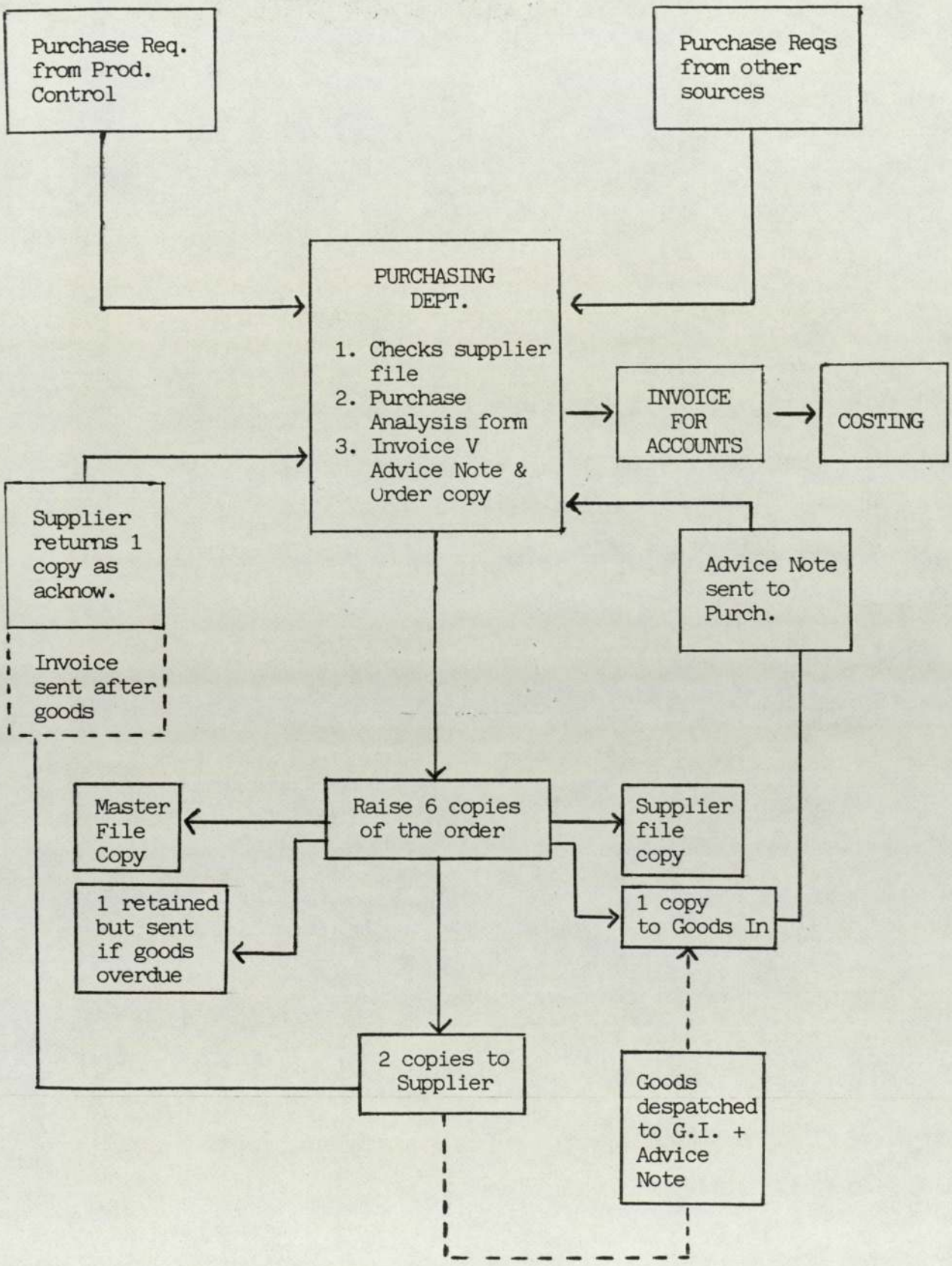
This involves the duplication of six copies of the order and their individual destinations are shown in fig. 5(4).

The purchase order is then placed with the supplier selected who acknowledges receipt of the order by returning one of their two copies of the order to purchasing. Should the delivery become overdue, an overdue copy notice is sent to the supplier.

As mentioned in section 5.3., upon receipt of the goods by 'goods inwards' the suppliers advice note is compared to G.I.'s copy of the purchase order and a photocopy of the advice note is sent to purchasing. Purchasing receives G.I.'s copy of the purchase order back from G.I.'s only when the order is complete. In purchasing, the advice note is pinned to the back of their copy of the order and awaits receipt of all the advice notes for the order and notification when the delivery is complete.

The advice notes are rechecked by personnel from the accounts department and when the supplier's invoice is received, the two are compared to ensure the correct price has been charged. Upon satisfaction, the invoice is passed to accounts for payment, the invoice then passed on to costing for the purchased price of the parts to be brought up to date.

Fig. 5(4) THE PURCHASING SYSTEM WITHIN WM COTTON LTD.



At the end of each week, the purchasing department completes a time consuming purchasing cost analysis which compares the previous price with the present price. (See Appendix 5.11).

5.5 Summary of the Manufacturing System with Relation to Costing.

In fig. 5.5, the preceeding discussion has been presented and summarized. In this summary, the integration of the costing function within the various departments can be seen. Costing utilizes data from a number of sections i.e.:-

1. The labour required to manufacture a part.
2. The material used from material requisitions.
3. Labour required to assemble a machine.
4. Cost of purchased items.
5. Various indirect costs with machining and assembly.

5.5.1.

Labour Cost

The method of booking time in the machine shop altered during the duration of this project. Prior to 1982, the recording of operators time was carried out on a batch card. Each time an operation was issued by the progress department, a batch card was issued for the operator to enter details about the batch. These details included:-

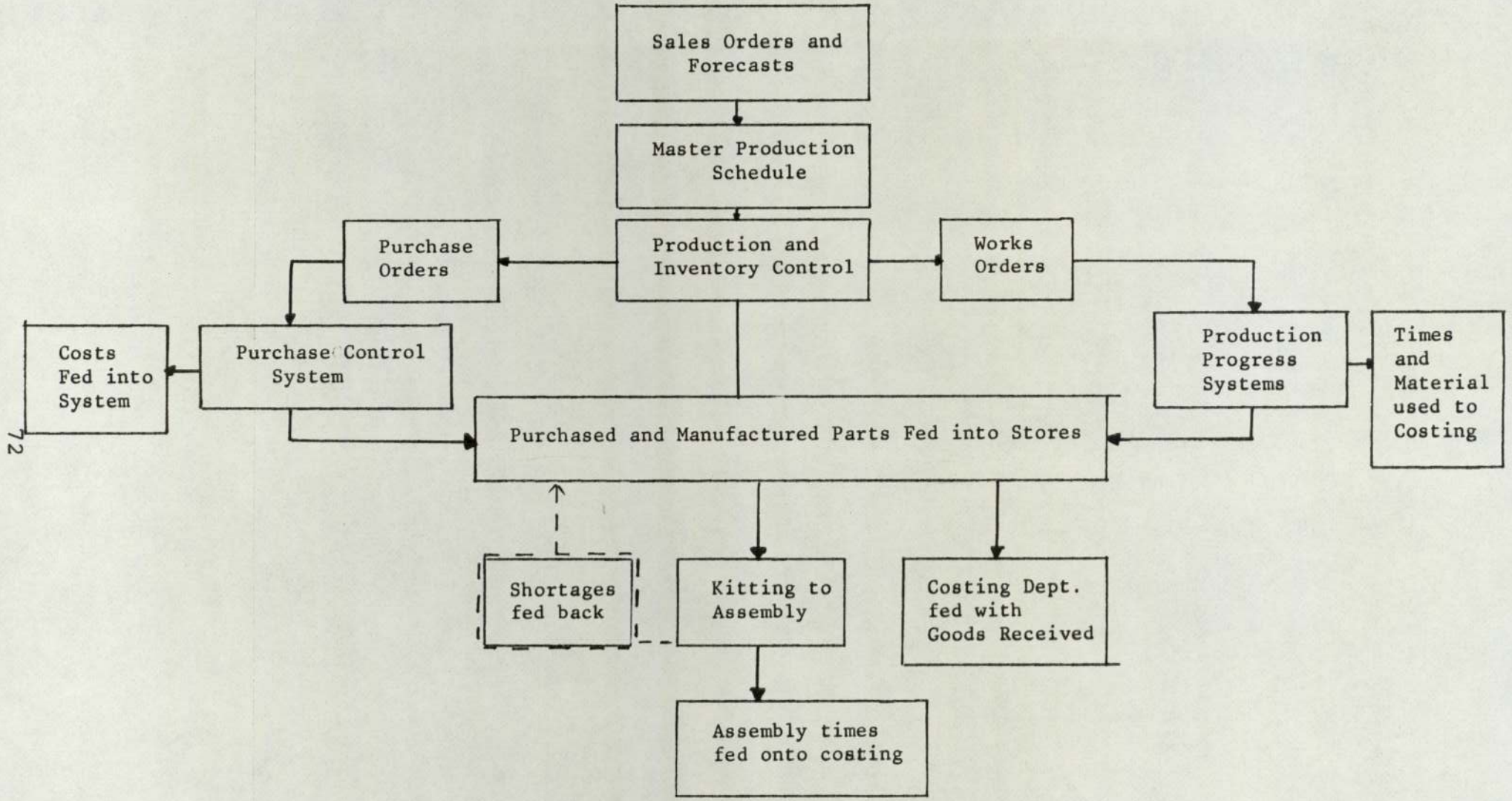


Fig. 5.5 MANUFACTURING SYSTEM at Wm. COTTON LTD.

1. Part number.
2. Batch number.
3. Operation number.
4. Work centre.
5. Date.
6. Time on.
7. Time off.
8. Hours worked.

This system generated about 1,500 batch cards a week and added to this were cards for any indirect jobs. The amount of paperwork generated was the main reason for the alteration of the system, and the system was altered towards the end of 1982, each operator having one job card and the batch details being entered onto this card (see Appendix 5.8.(i) - 5.8.(iii))

The costing process was achieved by the cost office multiplying the hours worked on the batch card by the wage rate, hence giving the cost for the operation. Once the cost for all the operations are known, and the goods received note is received from stores informing Costing the batch is complete, all the operations can be added together to give the total direct labour cost for the batch. This total labour cost is then divided by the number completed in the batch to give the unit labour cost for the batch. This unit labour cost is then booked onto a cost card for the part. Any excess work is booked to the Batch number.

Indirect jobs were formerly booked on to different coloured batch cards, but under the new system these jobs are booked onto the reverse of the new cards. (See Appendix 5.8(iii).

5.5.2.

Raw Material Cost

Raw material cost is in two forms; either as raw material in the form of steel stock, or as castings. The castings raw material will be dealt with under purchased items. The determination of the cost of steel stock, stems from the header which was used as the material requisition. When the requisition entered the steel stores, the length of bar booked out for the batch was recorded on the material requisition. When this was received by costing, they worked out the cost of the length and divided it by the completed quantity to give the unit material cost. This cost is booked onto the cost card for the component.

5.5.3.

Purchased Items Cost

The cost of the purchased item is obtained from the invoices upon their arrival in the costing department. The cost again is booked on to the component cost card. Although an uncomplicated process, it is only achieved after a significant time lag from the initial arrival of the invoice.

5.5.4.

Assembly Time

As mentioned in section 5.4.1., assembly times were obtained from production progress. Each fitter books on to a frame the machine number when he starts a job and books off when he finishes on that particular machine. Thus the amount of time on each machine can be determined and by multiplying by the wage rate, the cost can be calculated.

5.5.5.

Costing of a Machine

The costing of a machine would be achieved by a manual roll up of all the component costs used on the machine. This would be achieved by using the parts list and obtaining the latest component costs from the component cost cards. Assembly time would be added on and the direct labour hours found to obtain the overhead, which is absorbed on direct labour hours basis. Although this process has a number of problems, these are not specifically dealt with until Chapter 6. However, the problems of the manufacturing system are discussed because the data supplied from this system is fundamental to the successful operation of the proposed costing system. Also, as there were proposed changes to a 'Material Requirement Planning system', the impact of this on the costing system and the proposed management control techniques, this project is concerned with, has to be assessed.

5.6 Problems with the Manufacturing System

The reasons for the problems of the manufacturing system were introduced superficially in Chapter 2. However, the fundamental problem arose because the initial system began with a shortage sheet. This meant that the company was always trying to solve a problem, whereas a company should try to anticipate a problem and take the corrective measures before the problem is a reality. Added to this, vast amounts of data had to be handled manually in all parts of the system. This volume would mean mistakes and shortages were inevitable. Hence, the running of these systems were costly in resource and it was with these problems in mind that a study carried out by the University of Aston in March 1979, recommended the company to implement an MRP computer based system. Thereby resulting in:

1. Reduced inventory.
2. Less stock outs.
3. Improved manufacturing efficiency.

Before going on to look at how this sytem would improve the controls at Wm Cotton, MRP is briefly explained.

5.7 Materials Requirement Planning

'Material Requirement Planning' is simply a computer program for production. It enables management to time in the most efficient way the ordering and manufacturing of components and subassemblies (50).

As a concept MRP has been around for a long time, but as has been argued, (51), "much of the MRP logic has always been available but primarily because of high data processing costs, its use has been expensive. Now, however, computation costs are declining, while inventory costs are rising".

Basically, MRP is a technique which can be used to effectively plan and control production and materials flow. The logic of MRP is based on the fact that the demand for materials parts and components depends on the demand for end products. Using this concept four central elements are required to drive the technique.

1. The Master Production Schedule.
2. The Bill of Materials File.
3. The Inventory Status File.
4. Materials Requirements Planning Package.

5.7.1.

The Master Production Schedule

The Master Production schedule indicates when finished products should be completed so that customer orders or finished goods inventory requirements can be met. To construct a Master Production schedule, it requires information on the future demand, the firm order commitments, and current finished good inventory levels. The accounts dept. might well use this file for predicting purchase commitment.

5.7.2.

The Bill of Materials File

The Bill of Materials File contains information about every part, including its relationship to subassemblies and/or finished products. It contains the information detailing the raw materials, components, sub assemblies and assemblies that make up a final product, along with the quantities and their sequence of assembly. This is of significant importance with standard and actual costing because it indicates what parts are used on a machine.

5.7.3.

The Inventory Status File

This is a record of the actual inventory level of each item. The file is kept up to date by the input to the computer of the issue and receipts by stores. The file also contains other important data such as lead times bin locations, safety stock (if any) etc. The data again is essential to the accounting department for stock valuations.

5.7.4.

'Materials Requirement Planning Package'

In order to explain the logic of MRP, a simple example is worked through which indicates the various elements.

1. The master production schedule states what is needed to supply a widget in 7 weeks time. As the time needed to assemble the widget is 1 week, it follows that Parts have to be ready for assembly by week 6.

2. The Bill of Material and inventory status file are as in Table 5.1.

Bill of Material			Inventory Status	
Qty	Description	P/M	Stock	Lead Time
2	Wooden Side	P	1	5
1	Wooden Peg	M	0	1
1	String	P	0	1
1	Book of Instruct-ions	P	0	4

Table 5.1

Bill of Materials and Inventory Status File

3. The MRP package issues a report saying:

a) 1 wooden side to be purchased, place order in Week 1. (i.e. 6-5).

b) String to be purchased, place order in Week 5 (i.e. 6-1).

c) Book to be purchased, place order in Week 2 (i.e. 6-4).

d) 1 Peg to be manufactured in Week 2, (i.e. 6-4).

Thus if this MRP package and computational machinary is available, it is possible to plan works and purchase orders so that materials arrive when they are needed, thereby reducing inventory and ensuring against stock outs. Fig. 5.6. shows a diagram of the inputs and controls possible with

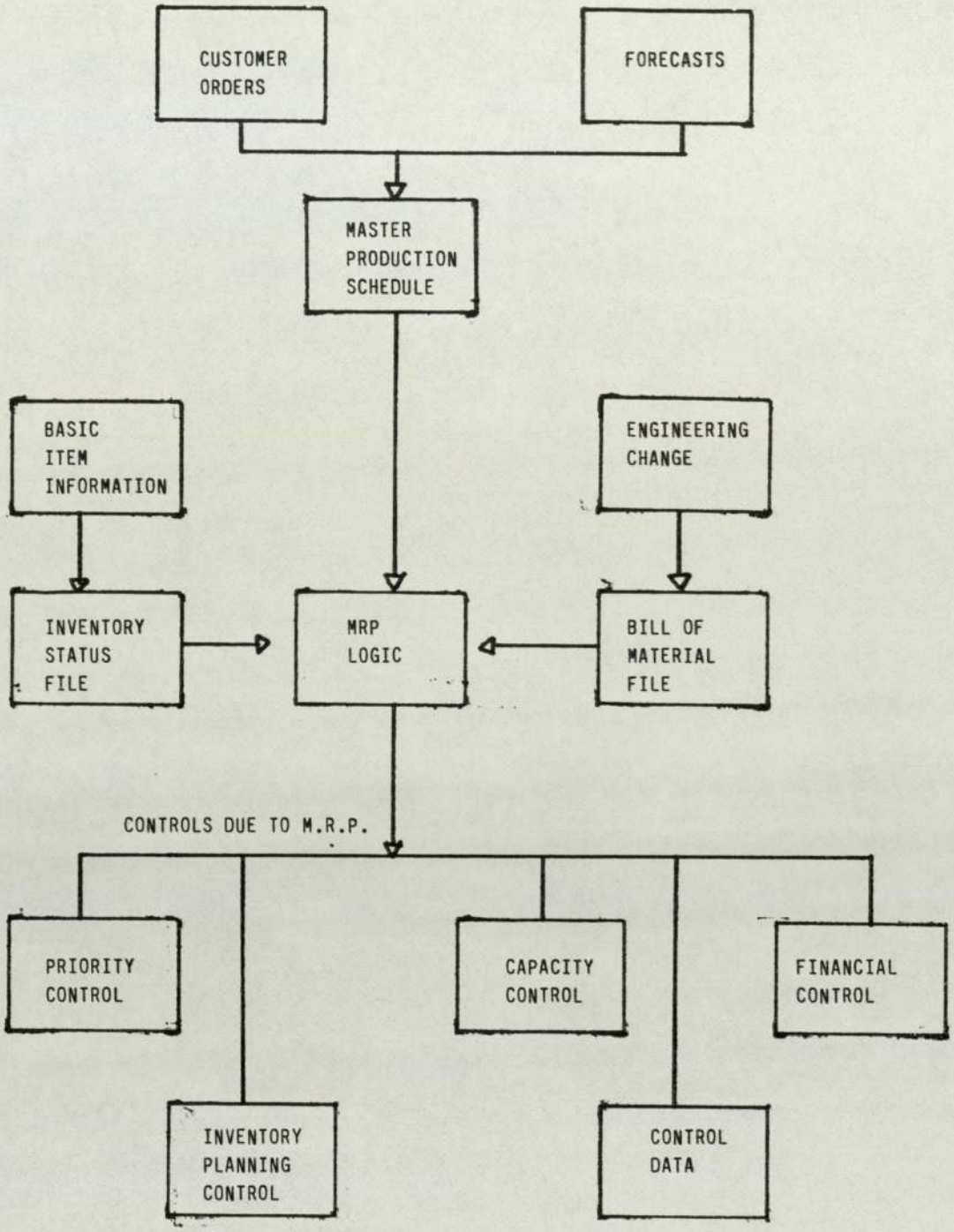


Fig. 5.6 INPUTS AND CONTOLS POSSIBLE OF M.R.P.

MRP. These controls are explained in more detail in table 5.2.

5.8 Controls Possible with MRP

From Table 5.2 it can be seen that there are a number of substantial outputs from MRP and in Chapter 9 these outputs with relation to the financial controls are explained. In this chapter, MRP is taken a stage further into MRP II.

However, in spite of these advantages in the production and inventory control systems, the MRP does not provide a means of accountability in the financial section. Although with the proposed system, standard costs for products and operations can be entered onto the basic item information, there is no means within the system for entering actual costs at operations level and to have these costs compared to the standard by the individual operator and the cost centre. This is not meant to be a criticism of Materials Requirement Planning, but of the package in its present state, and it is felt important because in order to solve Wm Cotton's problem of promoting efficiency, a motivational control system needs to be implemented. Therefore, the conclusion of this section is that MRP will provide the necessary tools to process data and improve the manufacturing system. However the company

TABLE 5.2 CONTROLS POSSIBLE WITH AN MRP SYSTEM

TYPE OF CONTROL	CONTROLS POSSIBLE
PRIORITY CONTROL	1) What orders should be expedited 2) What orders should be de-expedited 3) What orders should be placed 4) What orders should be cancelled
INVENTORY PLANNING & CONTROL	1) Informs when an order quantity is required 2) What item is required 3) What quantity is required 4) When to raise the orders
CAPACITY CONTROL	1) MRP will provide the inputs to the capacity requirements system i.e. quantities and due dates of open and planned works orders 2) Feeding this data into shop scheduling system it will be possible for the company to see load on machine shop
CONTROL DATA	1) Engineering changes 2) Raw material substitution 3) Monitor scrap, demand, etc.
FINANCIAL CONTROL	Note cost data entered into basic item information file and Bill of Materials will allow 1) value of stock 2) work-in-progress 3) product costs 4) committed spend on B/O materials 5) planned spend on B/O materials

(i) Data from Alex George SRC Submission Teaching Company Prog. May, 1981.

Still needs an accountability system to compliment and make full use of the data.

CHAPTER 6

A Discussion of the Failings of the Present Costing System

6.1 Introduction

This chapter will outline the failings of the present costing procedures at Wm Cotton Ltd when the project was started in May 1982. However, before going on to look at these procedures, let us remind ourselves of the purpose of costing.

> "The application of accounting technques to provide all levels of management with relevant information to assist them in managing the organisation". (See 1.3.).

Hence, it is a necessity that the costing process must go further than simply costing the product, but must assist management in managing the organisation by providing the cost information in a format which is of use to management. If the procedures do not meet this objective then the department is failing in its function.

6.2 Problems

The failings of present procedures could be found in the following areas:

1. Accuracy
2. Resource Consuming
3. Time Consuming
4. Reliance on Manufacturing System
5. Inflexible
6. Stock Valuations
7. Records out of Date
8. Overhead Procedure
9. Costs not put to Meaningful Uses
10. Motivational Aspects

6.2.1.

Accuracy

As was previously stated, the booking on and off of jobs was performed by the operator. Although it would purely be subjective to say that this method was innacurate without any means of checking, it would be equally wrong to argue that this was an accurate method as time sheets completed by hand give only approximate times. The degree of accuracy would vary from individual to individual with the control of the supervisor having a major influence. To ensure accurate times, there should be a disciplined method with motivation to supply accurate recordings.

6.2.2.

Resource Consuming

The resource in the costing department at the beginning of the project consisted of seven full time employees

distributed as shown in Fig. 6.1.

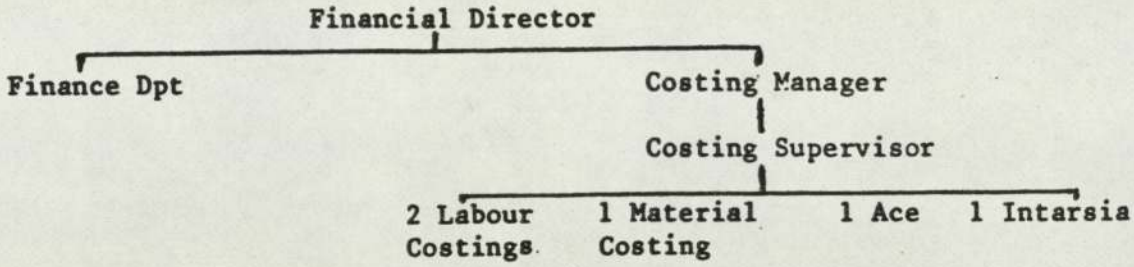


Fig. 6.1

THE COSTING DEPT.

In view of the financial difficulties the company was experiencing and the drastic need for reduction in overhead, coupled with the technology that is available, serious questions should and indeed were, asked about this amount of resource.

6.2.3. Time Consuming

The actual process of performing the costing was time consuming because it was based around manual searches. For example, when batch cards were received in the costing department for processing, the 'works order open file' which matched the batch card (i.e. same batch number) had to be found and then undergo transfer of information from the batch card to the work order file. Following this, calculations were performed on the base data to obtain the cost (time x wage rate).

Following notification from stores that a works order

was complete, (by a G.R. note) the works order file would again have to be searched, all the individual operation costs totalled up and divided by final quantity, to give direct unit labour cost. This information was then transferred on to a component cost card which was stored in part number order. Thus labour costing was an extremely time consuming task.

The raw material costing procedure was time consuming because it involved a number of cross references before a price/foot or metre was obtained. Costing the bought out parts, although straightforward, was really a repeat of work that had already been done in other departments, and in that respect was inefficient. Because Purchasing and Financial accounts had examined the invoices for purchased parts, it meant that there was a time delay before Costing received them. The end results of these time consuming processes was outdated costs, which were finalized far behind the completion dates of the machines and a system was required which would speed up the costing process.

6.2.4. Reliance on Manufacturing System

This is not a problem if the manufacturing system is efficient, but when this is not the case these inefficiencies are reflected in the costing process. If the paperwork is not recorded correctly in the manufacturing system, costing will have to deal with these errors. If there is an engineering change and

this is not reported to costing and entered onto their bill of material, again it will force costing errors. Therefore, if costing is to be efficient it is essential that the manufacturing system is operating well. If this is not the case, (and indeed Wm Cotton suffered this problem) then the costing process will have a struggle to operate efficiently. Although this is not a fault of costing, it should be pointed out that these inneficiencies should just not be accepted, but pressure should be brought to bear by the costing department to try and have them put right.

6.2.5. Inflexible

As the system relied on manual procedures it was important to have the correct system objectives. It is contended that because the objective was to cost the goods, the system, because of its inflexibility, could not adapt to providing information in a format which would help management manage the company.

For instance, the main file of cost data is held in part number order;if an ABC classification was required, the amount of resource needed would be vast. Suppose for example, trend analysis, work centre performance, make or buy decisions were required. It would mean much time and resource on behalf of the department, and operations like these would not be encouraged. Thus, the costing system was inflexible towards presenting data in a format which would help management.

6.2.6. Stock Taking Complications

Due to inadequacies in the manufacturing system, the validity of stock quantities was open to question, which meant a formal counting of stock on a yearly basis. This whole process took 2-3 months with the cost office supplying the majority of the labour following the physical count. The department would provide a Work-in-Process figure at this time.

The problem of stocktaking meant that the company could not easily find out what its stock was at any particular time and the process of stocktaking and Work-in-Progress valuations had to be made easier.

6.2.7. Out of Date Records

Another major fault with the present procedures was the reliance on stock recordings holding their cost at far below (and in some cases above) their current cost value. This practice stems from when the company acquired a vast amount of surplus stock in the early 70's. Much of this still remains and because of inflation the current cost of these items would be way above their book value cost. When it comes to costing out machines, the cost being entered for these parts is their early 1970 cost which is undervaluing the value of the machine. Although it is realised current cost accounting is a technique more associated with high periods of inflation, these out of date costs should be brought to a more realistic value.

6.2.8. Overhead Procedures

It is appreciated with overhead costing that the charge is an estimate and therefore bound to be inaccurate. However, an attempt must be made to apportion costs on some rational basis. It is felt that the method used by Wm Cotton and outlined in Chapter 4, section 4.5, is not a suitable method because of the inaccuracies it will cause and a more suitable system should be developed.

6.2.9. Costs for Decision Making

Again, this factor was mentioned in Chapter 4, section 4.3.4.2. Because the department's prime objective is to cost parts, it fails to recognise that cost behaviour is of prime importance in decision making and in the short period it may even be necessary to sell products at prices which do not cover total costs To supply data on such matters, it is necessary to distinguish between variable and fixed costs, which at present the costing department fails to do.

6.2.10. Fails to Motivate and Control

Lastly, and the most important failing, is the inability of the department to present the costs in a format which encourages management to motivate the workforce, and control costs by promoting efficiency. This should have been the major objective of the department, although it is recognised formal costing of products is still important.

6.3. Conclusion

The failings of the present procedures arise from an association of two main reasons.

1. The Departmental objective was wrong.
2. The system relied on inflexible manual systems.

If the departmental objective was changed to helping management manage the company, then this should encourage cost improvement, thereby providing costing and motivating. And if a computerised flexible system was introduced, much of the resource, time and inflexibility problems would be solved.

The other problems of accuracy: reliance on manufacturing system, stocktaking complications and overhead procedures could be solved when the H.P. manufacturing system was installed.

Solving these two would go a long way towards overcoming the ten failings, and Chapter 7 gives a method to achieve this.

CHAPTER 7

METHODS TO OVERCOME PROBLEMS AND PROCEDURE FOR THEIR INTRODUCTION

7.1. Introdution

Solving some of the problems outlined in Chapter 6 requires the application of the techniques introduced in Chapter 4. This chapter will look at these techniques and show how they will overcome the problems and look at a progression for their introduction.

7.2. Actual Costing

When the proposed H.P. 3000 materials management system is implemented, it would provide Wm Cotton Ltd with a facility to hold all its product costs and components at standard costs and total actual costs.

Total actual costs mean that 'in house' manufactured items can only have the end direct labour cost entered for the part. Thus the recording of actual costs for operations which make up the end cost was not part of the system. It would therefore be necessary to keep a separate actual costing system. However, it is proposed that the company moves away from the present manual system to a computer based system. This would save on resource and time by allowing increased data entry speed and search times. It would allow calculations

to be performed at much greater speed with reduced risk of error. The storage of data would allow greater flexibility because a computer program could be written which would alter the format of output of the data, thereby giving management diffent reports. This would result in less time between incurring the costs and presenting them in a format for use. Although there would be the drawback of the company changing from its present system to a new one, if this is successfully overcome, the first steps towards a control system will have been taken.

7.3. Standard Costing (Technique 2)

The next major step towards implementing motivation and a control system is the implementation of standard costing principles. It would involve the development of standard costs for purchased items and standard times for each operation on all parts. Without computerisation, variance analysis would be complex and time consuming. Thus computer principles need to be developed whereby access is made to the actual operational times and these are compared to the developed standard operational times and a variance analysis is achieved.

7.4. Accountability (Technique 3.)

If labour standards and actuals are to be compared by operation, it is essential to present the output of

information which promotes motivation and helps management. Although the division of the company to work centres has already been done, computer principles need to be developed which achieve reporting in this format.

7.5. Interface with H.P. 3000 and Present Manufacturing System

Cash flow problems were causing delays in the purchase of the H.P. 3000 machine and it became necessary to input the control system (in other words, the above three techniques) without the H.P. 3000 on the Altos Micro Computer: With the provision that the principles of the techniques developed could be implemented on to the 3000 when it eventually arrived.

Until that time, much of the data for the cost control project would arrive from the present manufacturing system. To implement these three techniques, it became necessary to apply resource and time to improve the present manufacturing system in certain areas, which would have the benefits of better cost information and freeing staff to provide information required.

These improvements would only be in the short term because when the H.P. 3000 system was installed, a lot of these functions could be performed by this machine. Until that time came, the Altos micro computer could

be utilised into the manufacturing system, therefore improving the quality of data for costing.

7.6. Overhead Examination

The application of an overhead examination with a view to implementing a more accurate overhead rate, would help overcome the problem of inaccurate overheads and give a fairer indication of where expenses had been incurred. However, compared to the control system (techniques 1, 2 & 3) this is of secondary importance.

7.7. Procedure for Introduction

When the project started in May 1982 and the problems facing the company were understood, the first course of action was to develop the actual costing principles for machine shop labour. The reasons for this step being that the company was falling further behind with the processing of cost data. Thus, if a computerised system could be developed which would improve the efficiency of costing, the principle developed could be put to use to process the data. It is also a natural step to operate actual costing before standard costing, because while developing the actual costing principle, some of the standard costs can be obtained by works study at the same time.

Indeed, this was the case throughout the duration of developing the actual costing principle: standard cost

data was being collated. It was decided by top management that the first machine to have its standard cost determined would be the Ace 7 guage knitting machine. This was because the machine was relatively simple compared to the others and formed a high percentage of production. Thus, with help from purchasing, assembly, machining, work study and production, cost control data would be collected which would help form a standard cost for the Ace.

The next stage of the implementation of standard costing principles would be to obtain the machining standards and build up a file of all the operations for each part, consisting of the standard set and run time for each. Once this standard file was available, it would then be possible to compare the Ace actual times with the Ace standard times.

Hopefully, achieving this would then lead on to the final stage of developing a format for presentation, thereby encouraging motivation and efficiency. Then, depending if the H.P. 3000 machine arrived in time, the above principles could then be transferred on to the machine the company would operate. If the H.P.3000 machine did not arrive in time, then the principles should be clearly documented, which would allow a computer programmer to transfer the principles. If time was available it was envisaged to examine the overhead procedure and to develop standard work centre

rates which could be used on the H.P. Also, to look into valuing the stock at standard cost, and any other benefits which could be obtained from the H.P. 3000 manufacturing system. Because it is felt important that the company should realise other benefits that could arise out of the manufacturing system, Chapter 9 looks at these benefits.

CHAPTER 8

ANALYSIS OF PRESENT DATA AND TECHNIQUE IMPLEMENTATION

8.1. Introduction

The following chapter will look at the practical work carried out at Wm Cotton Ltd, examining the introduction of the actual costing system, explaining its working and problems, how these were overcome and a summary of the system. This will be followed by a look at the development of standard costing principles and the progression into providing the analysis of the standard and actuals into an accountability format.

Lastly, other work carried out at Wm Cotton Ltd is discussed, coupled with why it was felt that this work was necessary and what long term benefits the company could glean.

8.2. Actual Costing

The design of the computerised actual Batch costing system began in July 1982. Before going on to look at this design, a description of Batch costing is repeated.

Batch costing involves the costing of a batch of 'manufactured in house parts' consisting of material and direct labour costs. The direct labour cost arises from the machine shop, by a number of operators, each operator performing an operation on to the material, which is eventually completed into a batch of finished parts. From this system the unit material and unit labour cost for each part is determined.

The aim of the computerised batch costing system is to achieve the same results, only more efficiently. Whereas with the manual system, details of each operation had to be transferred from the Batch cards (Appendix 5.8.) to the cost collection card, the details now had to be entered on to the computer. Hence, there are three distinct stages in desiging the costing system:-

1. Data Entry
2. Calculation and Print Programs
3. Recovery and Sort

8.2.1. Data Entry

Two files needed to be created to perform the costing functions, these being the actual operational file, which is the main file and gives the amount of time devoted to each operation under a particular batch number. This data went into a file known as JOBCOS DTA, and a file which gave the wage rate for a particular week which went into a file called RATE DTA.

The method of entering this data had to be uncomplicated, fast and readily available. For these reasons a system for data entry known as Datastar was chosen. The package was already on site and its reliability had already been confirmed by one of the previous Research Associates. Datastar consists of two distinct processes. The first is the design of the form known as Formgen; the next process is actual keying in of the data.

8.2.1.1. Formgen

The design of the two forms i.e. JOBCOST and RATE was done in conjunction with the management and cost accountants at Wm Cotton Ltd. They specified the required data for each form.

If reference is made to fig. 8.1. and 8.2. the layout of the two forms is given. The first 6 fields of the jobcost form is the header information, fields

JOBCOS FORM LISTING

FIELD NUMBERS

TABLE FOR BATCH COSTING (To be used in conjunction with basic programme PCDAT)

BATCH NUMBER: 1 PART NUMBER: 2 SALES ORDER NO. 3

MATERIAL TYPE: 4 MATERIAL NO: 5 MATERIAL COST: 6

QUANTITY	DATE WK/YR	OPERATION NUMBER	CLOCK NUMBER	HOURS	LABOUR COST
7	8/9	10	11/12	13	148
14	15/16	17	18/19	30	149
21	22/29	24	25/26	27	150
28	29/30	31	32/33	34	151
35	36/37	38	39/40	41	152
42	43/44	45	46/47	48	153
49	50/51	52	53/54	55	154
56	57/58	59	60/61	62	155
63	64/65	66	67/68	69	156
70	71/72	73	74/75	76	157
77	78/79	80	81/82	83	158
84	85/86	87	88/89	90	159
91	92/93	94	95/96	97	160
98	99/A0	101	102/103	104	161
105	A6/A7	108	109/110	111	162
112	B3/B4	115	115/117	118	163
119	C0/C1	122	123/124	125	164
126	C7/C8	129	130/131	132	165
133	D4/D5	136	137/138	139	166
140	E1/E2	143	144/145	146	167

FIN(147) TOTAL (168)

UNIT COST
MATERIAL LABOUR TOTAL

169 170 171

Fig. 8.1 Jobcos Form

TEMRATE FORM

RATE: TABLE OF MONTHLY RATES TO BE USED WITH MBASIC EXTENDED PROGRAMME

WEEK/YEAR NUMBER WWYY	MONTHLY RATE	MONTH NUMB
		01

FIG. 8.2. TEMRATE FORM

7 to 146 would be available to enter operational data for a particular batch which can be identified by the batch number. Fields 148-172 are allocated for calculations which are carried out in the 2nd stage of the system. The rate form contains 3 fields and simply records the wage rate for a week and month number.

8.2.1.2. Data-Star

The data would be entered on a terminal inside the cost office, which would be linked up to the Altos micro computer. Two members of the cost office staff were instructed in how to enter data.

When a Works Order was opened the cost office would be informed and the header information for that works order such as Batch number, Part number, Sales Order number, Material type, Material number and Total Material cost, were entered on to the computer. Each time an operational record was to be entered, such as the date, operation number, clock number and the hours worked, it was possible to type in the batch number of the operation. There would then be a computer search and the header information and any past operations for that batch would appear on screen. The operational details could then be entered. The rate entry was entered at the end of each month when the wage rates were known.

8.2.2. Calculations

At the end of each month, the works orders which had been completed were removed from the main file of data and their cost calculated. This was achieved by stores informing the cost office what had been completed via the Goods Received note. The cost office then entered the batch number of the completed works order and when the batch details appeared on the screen the final quantity of the batch was entered, along with a 'C' to signify that the batch was complete.

When this was completed, the basic compiled program OA Extend was evoked and run. OAExtend examined the records in the Jobcos DTA file and if the record had a 'C' in the completed flag field, this record had calculations performed upon it which determined the operational labour cost for each operation, Total Operations labour cost, Unit Material cost and Unit Labour cost. The operation labour cost was calculated by examining the date the operation was performed, obtaining the rate for that date from the Rate file and multiplying the hours worked by the relevant hourly labour rate. The value of the calculated fields was replaced into the completed works order record and these records were written in another file known as TRYCOS DTA. Thus two files now existed: Jobcos DTA which contains operational data on open works orders, and is in effect the Work-in-Progress, and Trycos DTA which were works

orders which had been completed in a particular month.

The cost office now required the print off of the completed works orders. Because this data was to be entered on to component cards which were filed in Part number order, it was beneficial to present the print off in part number order. Thus, a routine was written to do this and a basic program called ACPRINT was run to produce the print off.

An example of the data which was printed off is shown in Appendix 8.1.

8.2.3. Recovery and Sort Routines

Following the print off of the TRYCOS files, the data was archived off to floppy storage and removed from the hard disk memory of the Altos micro computer. The new JOBCOS DTA file had to have its index file recovered because the original index file was no longer valid and a routine was written to achieve this. Once this was completed the data entry phase could be restarted.

8.2.4. Operational Problems

Using the procedure mentioned above, all 1982 Actual costs for Wm Cotton were calculated. However, a couple of major problems were inherent in the system which called for an alteration. The major problems being disk storage and a change in specification.

8.2.4.1. Disk Storage

In the initial design of the system, space had been left in the JOBCOS DTA records for 20 operations per batch. The average amount of operations per batch was only 9 with some only taking 2 or 3. Thus much disk space was being wasted with storage reserved which was never used. This overhead in disc space had resulted in the JOBCOS file being divided up a number of times, which complicated the system.

8.2.4.2. Change in Specifications

Towards the end of 1982 it was decided to change the system on the shop floor from recording operational data on batch cards, to recording on time sheets . The reasons for this were discussed in section 5.5.1. The system was duly affected because whereas in the past, batch cards were received in numerical order, under the time sheets method it would not be possible to continue this because an operators' time sheet would not carry out work on batches in numerical order.

This would make a major difference to the time taken by costing personnel to process data. Because the main JOBCOS DTA file had been split in a number of places, it would mean when processing a timesheet, that batch numbers following each other on the sheet might well be in different files. Thus, it would result in exiting from one file and going into another to process data. This is time consuming and inefficient

and therefore it was decided to revise the system to overcome these problems.

8.2.5. Revised Costing System

The revised costing system not only had to overcome the two problems mentioned above, but satisfy an additional specification which was to calculate and display the number of hours worked on a machine type within a month. This could be achieved because a batch number range is unique to a machine.

To explain the workings of the revised system, an example is worked through. In order to understand the example, constant reference should be made to tables 8.1a-8.1f and fig. 8.3 which is a flow diagram for the system. The first step was to rethink the system and economise on computer space. Thus instead of reserving space for operations for a batch, it was decided only to use space when it was actually required. Therefore, two forms were designed. One would be a file just to contain operational data , (see fig. 8.5) the other would contain the incorporated header information .

The forms were again developed using formgen and the fields within each form are shown in fig. 8.4. (Opencos)and 8.5. (Batcos) . Basically, the Opencos form is the fields 1-6 and field 172 of the old Jobcos table and each record in the Batcos form

TABLE 8.1a

EXAMPLE ON DUMMY DATA TO SHOW REVISED SYSTEM

FILENAME IS BATCOS, DTA

BATCH NUMBER	PART NUMBER	DATE WK/YR	QTY	CLOCK NUMBER	OPER NUMBER	HOURS BOOKED
111111	123456	01/83	20	111/000	10	2
111111	123456	02/83	19	111/000	20	3
222222	223456	01/83	40	222/000	10	4
222222	223456	01/83	38	222/000	20	6
222222/A	223456	01/83	2	222/000	10	4
333333	333456	01/83	20	333/000	10	4
333333	333456	01/83	20	333/000	20	6
333333	333456	02/83	19	333/000	30	8
333333	333456	03/83	19	333/000	40	5
444444	444456	01/83	30	444/000	10	11
444444	444456	02/83	30	444/000	20	6
444444	444456	03/83	30	444/000	30	9
444444	444456	03/83	28	444/000	40	7
555555	555556	02/83	40	555/000	10	6
555555	555556	02/83	39	555/000	20	6

THE ABOVE DATA WOULD BE ENTERED THROUGHOUT THE MONTH USING DATASTAR

TABLE 8.1b

EXAMPLE ON DUMMY DATA TO SHOW REVISED SYSTEM

MACHINE TYPE	BATCH RANGE	NO. OF HOURS WORKED FOR JAN	CUMULATIVE TO END JAN '83
A	0 -199999	5	5
B	200000-299999	14	14
C	300000-399999	23	23
D	400000-499999	33	33
E	500000-599999	12	12
TOTAL		87	87

FILENAME IS MTHOUR DATA

JAN 83, 5, 14, 23, 33, 12, 87

TABLE 8.1c

EXAMPLE ON DUMMY DATA TO SHOW REVISED SYSTEM

FILENAME IS OPENCOS, DTA

BATCH NUMBER	PART NUMBER	FINAL QTY	MATERIAL TYPE	MATERIAL NUMBER	MATERIAL COST	DATE	COM-MENT	IF COMP
017642	674179		STEEL	R1745	5		TR	
111111	123456	19	STEEL	6JH42	5	02/83	TR	C
222222/A	223456	2	BRASS	747H9	6	01/83	TR	C
222555	999999	50	GOLD	FU264	10	01/83	TR	C
333333	333456	19	STEEL	667H4	10	03/83	TR	C
333555	888888		DUMMY	6H974	5		TR	
444444	444456	28	STEEL	474E	6	03/83	TR	C
666669	446622	20	LEAD	627E	4		TR	

THE ABOVE DATA COULD EITHER BE ENTERED THROUGHOUT THE MONTH OR AT THE END OF THE MONTH, USING DATASTAR

TABLE 8.1d

EXAMPLE ON DUMMY DATA TO SHOW REVISED SYSTEM

MONTH NO.	DATE	HOURLY RATE
1	01/83	3.0
1	02/83	3.0
1	03/83	3.0
1	04/83	3.0
2	05/83	3.1
	06/83	3.2

FILENAME IS RATE. DTA

THE ABOVE DATA IS ENTERED AT THE END OF EACH MONTH USING DATASTAR

EXAMPLE ON DUMMY DATA TO SHOW REVISED SYSTEM

BATCH NUMBER	PART NUMBER	FIN QTY	MAT'L TYPE	MAT'L NUM	MAT COST	DATE	COM-MENT	'C'	NO. of OPS	PART NUMBER	DATE	QTY	CLK NUM	OP NUM	HRS BKD	COST	TOT LAB	UNIT LAB	UNIT MAT	TOT UNIT
111111	123456	19	STEEL	6JH42	5	02/83	TR	C	2	123456	01/83	20	111/000	10	2	6				
										123456	02/83	19	111/000	20	3	9	15	.79	.26	1.05
222222/A	223456	2	BRASS	747H9	6	01/83	TR	C	1	223456	01/83	2	222/000	10	4	12	12	6	3	9
333333	333456	19	STEEL	667H4	10	03/83	TR	C	4	333456	01/83	20	333/000	10	4	12				
										333456	01/83	20	333/000	20	6	18				
										333456	02/83	19	333/000	30	8	24				
										333456	03/83	19	333/000	40	5	15	69	3.63	.53	4.16
444444	444456	28	STEEL	474E	6	03/83	TR	C	4	444456	01/83	30	444/000	10	11	33				
										444456	03/83	30	444/000	20	6	18				
										444456	03/83	30	444/000	30	9	27				
										444456	03/83	28	444/000	40	7	21	99	3.54	.21	3.75

TABLE 8.1 (e)

Filename is merje dta

TABLE 8.1.f

EXAMPLE ON DUMMY DATA TO SHOW REVISED SYSTEM

FILENAME IS OPENCOS DTA (This now replaces original Opencos Dta.)

BATCH NUMBER	PART NUMBER	FINAL QTY	MATERIAL TYPE	MATERIAL NUMBER	MAT'L COST	DATE	COM-MENT	IF COMP
017642	674179	20	STEEL	R1745	5		TR	
333555	888888	20	DUMMY	6H974	5		TR	
666999	446622	20	LEAD	627E	4		TR	

(i)

FILENAME IS BATCOS DTA (This now replaces original Batcos Dta.)

BATCH NUMBER	PART NUMBER	DATE WK/YR	QTY	CLOCK NUMBER	OPERATION NUMBER	HRS BOOKED
222222	223456	01/83	40	222/000	10	4
222222	223456	01/83	38	222/000	20	6
555555	555556	02/83	40	555/000	10	6
555555	555556	02/83	39	555/000	20	6

(ii)

FILENAME IS NOWORK DTA (This file should be examined to see how it was formed)

BATCH NUMBER	PART NUMBER	FINAL QTY	MATERIAL TYPE	MATERIAL NUMBER	MAT'L COST	DATE WK/YR	COM_ MENT	IF COMP
222555	999999	50	GOLD	FU264	10	01/83	TR	C

(iii)

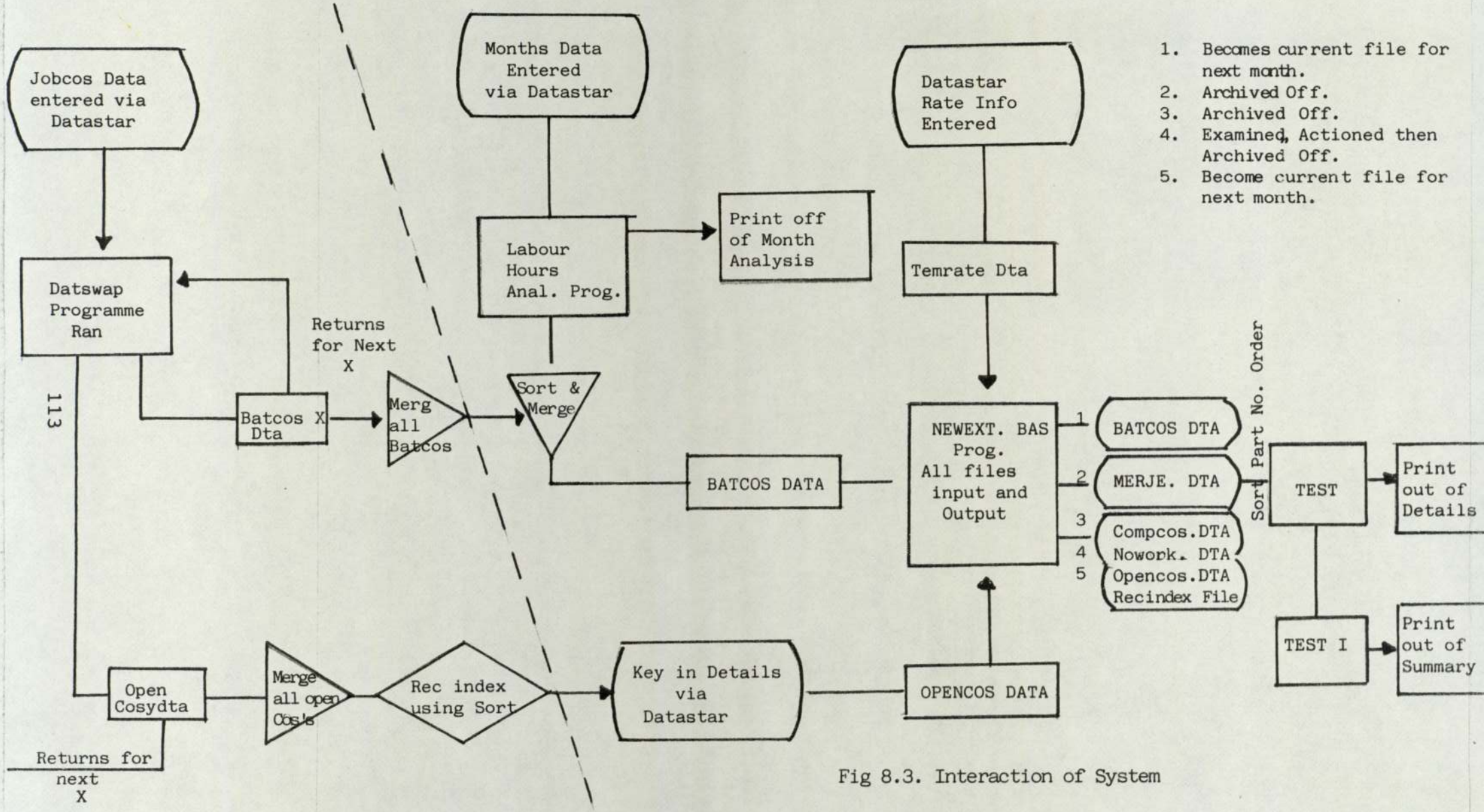


Fig 8.3. Interaction of System

OPENCOS FORM

COMPLETED BATCHES FORM

BATCH NUMBER: 1	PART NUMBER: 2	FIN. QTY: 3
MATERIAL TYPE: 4	MATERIAL NUMBER: 5	ML COST: 6
DATE: 7/8	COMMENT: 9	COMPLETED: *

FIG. 8.4 OPENCOS FORM

BATCOS FORM

FIELD NUMBERS

FORM FOR BATCH DATA ENTRY

BATCH NUMBER: 1 PART NUMBER: 2 DATE: 3/4 QUANTITY: 5

CLOCK NUMBER: 6/7 OPERATION NUMBER: 8 HOURS: 9

FIG. 8 .5 BATCOS FORM

corresponds to one line from the Jobcos table.

8.2.5.1. Example to Explain Revised Costing System

In table 8.(1)a the operational data entered for a month is shown. Thus each record would contain the batch number, part number, date, quantity, clock number of the man who performed the operation, the operation number of the parts and the hours booked to that operation, giving a record of the work carried out in a month. Once this had been completed for the month the first step in the revised system was to run the compiled basic program AMONTOT.
This program accesses this Batcos DTA file and produces a report of the labour hours worked on a machine type. An example of a print out using this program is shown in Appendix 8.2. The critical figures, in other words the hours worked for each machine type, are written to the MTHOUR. DTA file. (Table 8.1.b.).

Following the completion of this stage the next operation is to merge the data with operations that have been carried out in previous months. This data is held in exactly the same format and the two files are merged and sorted in batch number order. For simplification reasons in the worked example, it is assumed that there is no previous data, but in reality the file would be Batcoso DTA (O denotes old) and

when joined with Batcos DTA the Batcos DTA name is retained.

The Opencos DTA is a file that the cost office adds to each time it receives notification from Production Control that a works order has been opened. It carries the header information for each works order issued and throughout the month Goods Received notes are received, informing when a works order is completed. Then 'C', final quantity, and date of completion is entered on to the header record of the respective number of the batch numbers on the Goods Received notes. When the month is at an end, the file is maintained to ensure it is in batch number order. (See Table 8.1.c. to see the format of this file.)

The next stage corresponding to the calculations stage of the old costing system, is to run the compiled basic program ANEWEXTD.

ANEWEXTD operates on the Batcos DTA, Opencos DTA and Rate DTA files. It first of all extracts all the closed works order records for the month from Opencos DTA and writes them to a new file called CLOSED DTA. Opencos DTA now becomes the original file without the closed works orders.

The program then proceeds to remove records from Batcos. DTA and appends them to the corresponding

record from Closed. DTA. This new file is called MERJE DTA. (See Table 8.1.e.) Besides appending records from Batcos DTA to Closcos DTA, the costs for each operation, along with the total labour cost, unit labour cost, unit material cost and total unit cost, are calculated and also written to Merje DTA.

Once the program is completed, the next stage is to obtain a print off of Merje DTA. This is achieved by using the two basic compiled programs APRTSUMM and APRTDETS. Prior to this program run, Merje DTA is sorted into part number order using a sort routine.
APRTSUMM gives a summary of the data whereas APRTDETS gives a detailed print off. If reference is made to Appendix 8.3. and 8.4. copies of an actual summary and detailed print offs are given.

Finally, the system has to recover and prepare the data entry components for the next month's data entry. The Opencos DTA file has to have its old index file erased and a new one created. Batcos DTA is renamed BATCOS0 DTA and will be merged to next month's operational data. The latter is started afresh and data for the next month is built up as it is received by the cost office.

Table 8.1.f shows files created from the worked through example. Table 8.1.f.(iii) gives a file

called NOWORK DTA and gives details of a job which was opened and closed but had no operational data received on it. This should never happen but it is theoretically possible that such a situation could arise.

8.2.5.2. Summary

The revised system is far superior to the original system. It is "computer memory space" efficient and flexible. Although the example spoke in terms of monthly reports, weekly or even daily costs can also be obtained. This system is also extremely efficient, as one person could enter all the operational data for a week, in a day and a half. Lastly, this system is extremely compatible with a standard costing system, in that actual operational times are held in a suitable manner for comparison with standards. The technique was tested on Wm Cotton data and proved to be successful. The next stage was to implement the standard costing principles to link with this actual costing system.

8.3. Standard Costing

The implementation of standard costing principles began with the Ace 7.G machine; the reasons for this choice were given in section 7.7. Initially, the aim was to establish an overall estimated standard cost of the Ace on a stage basis (the stage basis being a distinct part of the build) and then follow

this up looking at the machining labour costs and purchasing costs in more detail as they were considered to be the problem areas. No appreciable advantage could be made in applying standard costing to assembly times until the manufacturing problems of the company were solved and shortages removed.

8.3.1. Data Collection

The collection of data ran concurrently with development of the actual costing principles and using the parts list provided by a previous research associate , listings of purchased and manufactured parts were obtained. The list of purchased items was given to Production Control and they were asked to mark the items that were high in cost. Purchasing then supplied the cost of these items, while work study supplied estimated time for the machined items, and the fitting shop foreman produced estimated assembly times, with the cost office providing the overhead rate.

8.3.1.1. Purchased Parts

To obtain the standards for the high cost purchased parts, the latest price was taken. Where the purchasing manager did not consider this realistic, a realistic standard cost was put forward. This was in some cases where he felt prudent buying could reduce the cost, or if he considered the latest cost might substantially increase.

8.3.1.2. Machining Labour Hours

As Ace production was still in its early stages, engineering change and labour learning was taking place. However, the work study engineer began an exercise of providing an estimated set and run time for every operation on all the parts that were manufactured ('in house'). This would provide the initial basis for the standard cost file and would be extremely beneficial. To determine the standard cost of each part it was assumed that the machines were being made in sets of 30, thereby obtaining the required machining labour.

8.3.1.3. Fitting Hours

The assembly times were estimated by the engineer in the Ace assembly department and these were agreed by the shop foreman. Then they were presented on a stage basis.

8.3.1.4. Overhead

The cost office provided an estimated future overhead rate.

8.3.1.5. Estimated Standard Cost of the Ace

The result of the data collection is an estimated standard cost of the Ace by stage, which is further sub-divided into purchased cost, machining cost, fitting cost and overhead. (See Appendix 8.5)
This can be used as a target cost for the

Ace and the starting point for the more detailed analysis of the machining and purchased costs.

8.3.2. Machining Labour Hours Variance Analysis

A substantial file of standard times for each operation now existed. The logical step seemed to be a comparison of these times with the actual times that were being recorded on the Altos micro computer. Thus the manual standards file was transferred on to the Altos by means of a program called SOPDATA BAS The data entered being the part number, operation number, place where operation should be performed, setting up time and machining time. This file was known as OPERATIN DTA and entries were stored in part number order.

The next stage involved making a copy of the Ace data in Batcos DTA and storing this data also in part number order, under the file name known as ACEJAN DTA. The two files i.e. Operation DTA and ACEJAN DTA were then bounced off each other with a program known as SPRTVAR2 BAS. The result of this program was a print off giving a labour variance analysis for the Ace parts made in Jan. Appendix 8.6. presents this information with the details given in part number and then operation number order.

8.4. Accountability

Having analysed actuals results against standards,

the system should be taken one stage further and present this information in a format which would promote accountability. It was decided that a format which summarized the performance of an individual, then a workcentre would provide the motivation needed. The reasons for this decision were argued in Chapter 3.

The presentation of data in this format was achieved with the Basic compiled program SPRTWKCT an example of the program's output is shown in Appendix 8.7.

This output informs operators, their supervisor's and management, how well the personnel are performing in relation to the standards set. It is contended that these implemented principles and data presented in this format, would greatly aid Wm Cotton's cost control, especially as these programs can be run on a daily or weekly basis, although it should be pointed out that there were limitations to the results.

8.5. Limitations

The biggest limitation stems from the accuracy of the standard costs data. The derivation of the standards had been estimated by a work study engineer who based his estimates on his experience. There had been no scientific approach or conventional work study methods to determine the standards and for these reasons such standards would always be open to question.

To fully obtain the advantages of standard costings, there should be confidence in these standards which would require standards accurately determined and obtainable.

Another serious limitation was the amount of unavailable data due to engineering change in the Ace. As new parts were continually being designed, it was essential to continually produce standard times for these operations. This was not taking place, which resulted in many actual operations taking place that standards did not exist for. In SPRTWKCT such operations were printed on to a separate file for analysis at a later date.

The recording of actual data also caused limitations within the system and on many actual operations part numbers and/or operation numbers were not entered. This meant that a comparison against standards could not be performed. Thus, it was essential to promote these ideas onto the shop floor and ensure that the data was recorded by the operators.

However, in spite of these limitations the principles of the control system were developed and proved to work, but although it was realised that there were inefficiences in the computer programs, this was not as important as obtaining the principles. When the above work was completed in November, 1983 the H.P.

system had only just arrived, thus the decision was taken to document the principles and leave them with Wm Cotton, so that they could implement these principles on the H.P. system themselves.

8.6. Preparation of Data

Besides implementing the cost control system, it was necessary to prepare data to be entered onto the H.P. system when it did arrive, not only for the Ace but for the Intarsia. The exercise of preparing data could be made more effective by carrying out this exercise in specific areas where the company required information. Two such areas were the Ace and Intarsia purchased parts. The company needed an up-to-date cost for both these items, to see if they were accurately setting their selling price.

8.6.1. Ace Purchase Costs

Although the purchase price for the ace had been estimated in the standard costing exercise outlined in section 8.3.1.5., this estimate had been based on the list of most expensive items originating from production control. It was to be expected that omissions would be made fromthis list and engineering change had meant that the estimate was inaccurate and out of date. Thus, in November 1983, a suite of programs were written which accessed the file on the Ace parts used in the previous research associates' work, wrote the purchased parts to another file and

then the latest cost of each item was obtained from the costing office.

Other purchased items, for example subcontract and castings were not on this file, but the casting costs were held on another file (see section 8.7.2.) where subcontract costs were entered. The result of the exercise was a printout of all purchased parts used on the Ace in part number order, displaying part number, description, Quantity/machine, cost/per, and extended cost which the purchasing manager agreed could be used as standard cost. The total of the parts used on the Ace 7g was totalled up to give an accurate purchased parts cost of the Ace 7g machine. This exercise would be of value when the H.P. machine was delivered, because it would allow data to be entered easily. The limitation of the exercise stems from the age of some of the costs, although the Ace is a relatively recent machine, some of the fastenings and common parts to other machines were early 1970 costs, which would undervalue the machine costs. However, it should be stressed that these are low cost items and do not make any appreciable difference to the final cost.

8.6.2. Intarsia Purchased Costs

Once this exercise was completed on the Ace, a similar exercise was repeated on the Intarsia purchased costs. Again a suite of programs were

written to enter costs for Intarsia cams, stock castings, subcontract and purchased parts.
As with the Ace, Intarsia castings already existed on file (see Section 8.7.2.). Once the data was entered, a print off was produced. This would improve data entry speed on to the Hewlett Packard machine. The information also revealed that the cost of parts was more expensive than the original estimates had assumed.
The limitations again concerned the age of some of the costs especially the stock castings. These were castings purchased in the early 1970's, now considerably undervalued, thereby undervaluing the cost of the whole machine.

8.7. Improvement in Manufacturing System

As mentioned in Chapter 6, in order for costing to be efficient, there must be an efficient means for recording and informing the costing department what was taking place in the production process. Although it was hoped that such a system could be implemented after the arrival of the H.P. 3000, the delayed ordering of this facility meant it was necessary to improve some of the existing manufacturing systems using the Altos microcomputer. The purpose of such action was threefold.

Firstly, to show management what a computer was capable of doing, thereby helping to build confidence in

computer aided production and finance systems. Secondly, by improving these systems, better data would be produced for the costing department, hence, improving the costing function, and lastly, by developing such systems, personnel would gain time to concentrate on solving problems, thereby providing capacity to improve control.

The areas that were examined were in production control (shortage analysis and casting order generation) and purchasing, (a purchase committment report).

8.7.1. Shortages Analysis

When purchasing orders were raised, production control was informed, resulting in a substantial amount of data being accumulated, which was of no value to the production control department, unless it was sorted into stage build areas, thereby allowing production control to analyse what had been entered for a specific stage, allowing follow up action to take place to ensure the part arrived.

Thus a suite of programs were developed to enter, sort and print the data allowing this to take place, This exercise gave production control personnel better control in ensuring the shortages would arrive on time.

8.7.2. Casting Order Generation

Another area where it was felt computerisation would greatly help the manufacturing system and demonstrate the flexibility and enhancement of such a facility, was in the ordering of castings for Ace and Intarsia machines.

Once a production schedule had been decided for a specified time period, the ordering of castings could begin to take place. Developing programs which made use of lead time data, the quantity of castings on each machine, the required amount of machines to be built and their 'due by date', made it possible to obtain a list by supplier of the casting number, quantity for order, and required by date. A copy of this order list could be furnished to the supplier, who could take steps to supply the goods when they were required. Such a process could be repeated at the beginning of each time period.

Such a system is a simplistic MRP system which demonstrated to the management that once the data was on the computer memory, (in other words, the casting file) all that was required was to enter the required amount of machines to be built, and the due by date. Then a good working report could be produced, saving time, while being of value to the company.

Once the H.P. system was installed, this system

would be taken over by the softwear provided.

8.7.3. Purchase Committment

The final piece of softwear developed and proved to be of immense value to top management at the company, was the purchase committment report.

This arose from the need by top management to know how much cash had been committed on purchased items and when, in order to plan cash flow.

Again it was necessary to develop programs which would allow data to be entered and produce a report which informed how much cash was committed, in other words when it was due and to what product groups it should go. This facility would be provided by the H.P. system and again it gave management an insight into the sort of reports that they could expect from a computerised integrated system.

8.8. Summary

The work and principles developed at Wm Cotton will be of benefit to the company. The actual costing system providesthe company with all its 1982 costs, and when time is available, and the principles are introduced onto the H.P. 3000, system, it will enhance the accounting system provided by this machine.

The areas where it will significantly improve the

accounting systems is in motivation, and although the H.P. does provide a variance analysis, it is contended that the labour variance analysis outlined in the accountability section (8.4.), will achieve this motivational impact. This being because it has the facility to look at open works order and analyse at an operational level, the variances. Whereas the H.P. in its materials management form can only analyse at part level, (this being a culmination of operations) and therefore cannot break down into the reasons for the variance.

It is realised that there are limitation to these principles, the chief problem being the validity of the standard data. To put this right it would be necessary to provide resource in the short term to obtain accurate and meaningful standards. This then, would be beneficial in the long term.

Lastly, other work completed at Wm Cotton (although not directly linked to the costing function), will demonstrate to the management, further uses of computer technology, providing an insight into the integrated computer system; the accounting function of which is fully explained in Chapter 9.

CHAPTER 9

THE ACCOUNTING FUNCTION WITHIN MRP II

9.1. Introduction

When computing was first introduced into manufacturing companies in the early 1950's, its prime use was as a 'glorified calculator'. (52). Today, it can provide manufacturing industry with an effective integrated manufacturing system, which "incorporated information from manufacturing, marketing engineering and finance into a total operations plan." (53).

This development began with the initial impact of the computer on the financial accounting function and provided the accountant with a means of generating financial and management reports, financial modelling, ledger maintenance and preparing and using budgets. Weeks points out that this success was not only due to obvious reasons, for instance fast processing speeds and easily understandable logic, but because the introduction of this new technology was "generally under the control of the accounting function and the change to a computer did not directly affect other parts of the business" (55). Thus a new system could be introduced without the problems of reconciling conflicting user requirements.

As processing costs continued to drop, the growth in

computer systems spread into the production and inventory control areas, and what started out as computerised stock control systems, developed into M.R.P. (Materials Requirement Planning) packages which were capable of controlling, procuring and managing work in process material. There were problems of initiating these early integrated systems and indeed there were many failures and successes associated with their implementation. However, today MRP is an accepted tool for the production manager and has evolved into MRP II (Manufacturing Resource Planning).

MRP II takes the integrated aspect a stage further, with the areas of application moving from finance and production and incorporating data from a number of departments. Further, by making use of on line transactions, decision makers in all departments, at all levels, are able to work from the same set of numbers, thereby providing a closed loop manufacturing system.

The purpose of this system aptly put by Weeks is "to plan and control the resources, priorities and performance, to deliver the right products to the right customers at the right time at the right price". (56). To achieve this aim requires good management working from sound data. Within manufacturing resource planning each department supplies data which may be used by other departments, each having their own

objectives, which if met, will help meet Weeks' definition of the manufacturing system.

Table 9.1. gives a summary of the tasks each department should carry out at Wm Cotton in order to supply correct data to management. In the remainder of this chapter the costing department's essential objectives are examined which are to produce product costing information, value inventory and to work closely with the Operations Management system in producing variance analysis and various management reports.

This will be achieved by looking at these objectives in turn and concluding if an MRP system will provide all this data. However, firstly, the original manual manufacturing system at Wm Cotton and the data required to produce the costing objective, will be stated.

9.2. Cost Management System

If reference is made to the original diagram of Wm Cotton's manufacturing system, (Fig. 5.5.) it can be seen that the costing function required data from a number of sources, in order to complete its product costing and inventory accounting functions. Data arrived from production control, the shop floor, production engineering and the stock control department. This data should then have been collated and analysed

TABLE 9.1 THE FUNCTION OF INDIVIDUAL DEPARTMENTS IN AN INTEGRATED MANUFACTURING SYSTEM

DEPARTMENT	INFORMATION SYSTEM CLASSIFICATION	TASKS OF DEPARTMENTS
DRAWING OFFICE PRODUCTION ENGINEERING WORK STUDY	ENGINEERING DATA MANAGEMENT SYSTEM	1. How a product is manufactured i.e. routing file 2. What makes up a product i.e. Bill of Materials & Product Structure 3. Informs where a product is manufactured i.e. workcentre 4. Keepsfiles up to date by on line transactions
MANAGEMENT BOARD MARKETING	MANUFACTURING MANAGEMENT PLANNING SYSTEM	1. Provide master production schedule 2. Detailed specification of customer order 3. Updates master production schedule
STORES PURCHASING PRODUCTION CONTROL	INVENTORY MANAGEMENT SYSTEM	1. Provide accurate stock levels by on line tranactions & perp invent. 2. Detail requirements of purchased and manufactured components, giving quantities, order and due by dates i.e. MRP 3. Issues purchase and works orders 4. Amends MRP run
WORK STUDY PRODUCTION PLANNING COSTING	OPERATIONS MANAGEMENT SYSTEM	1. Informs on capacity details i.e. routing file 2. Controls W.I.P queues 3. Collects data for analysis i.e. scrap, times, etc 4. Works with costing to produce work centre and operator efficiency
COSTING	COST MANAGEMENT SYSTEM	1. Provides std and current product costs i.e. BOM, product structure and routing file. 2. Inventory accounting i.e. product costs and inventory levels 3. Variance analysis 4. W.I.P valuations

to produce product costs and thereby inventory valuations. However, for reasons mentioned in Chapter 6., this process was lacking in essential areas. It is contended that with the correct application of a computerised manufacturing system, the integrated approach would go further towards supplying Wm Cotton with the data required for Product costing, Inventory Accounting and Operational analysis.

In order to produce this data, it is essential for certain files to be set up and via integration, costing has access to these files. This integration and required files, are shown in Fig. 9.1. However, this diagram does not specify the actual data in each file, as this will vary from company to company.

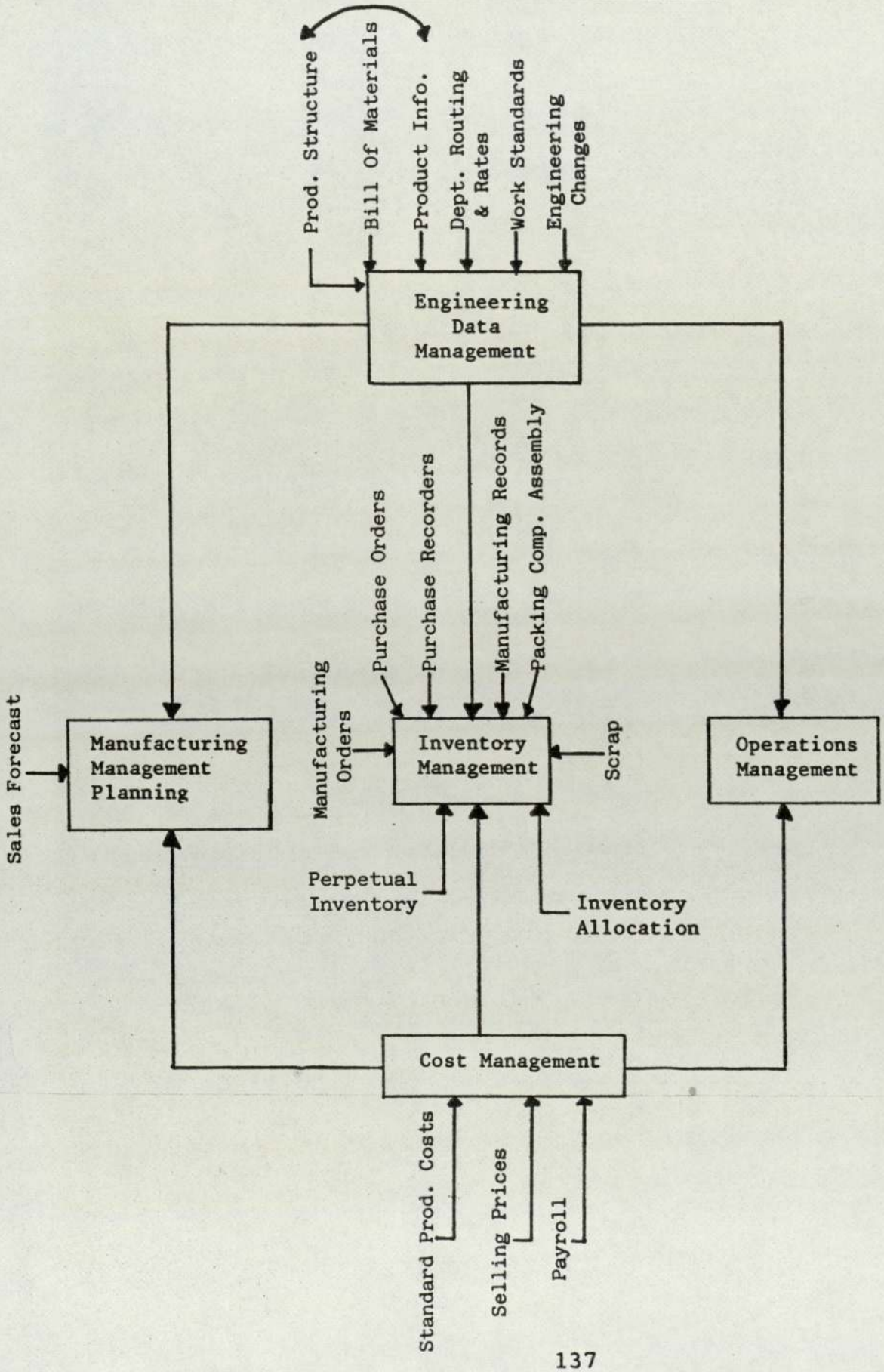
9.2.1. Product Costing

One of the essential features of Manufacturing Resource Planning, is its product costing capabilities. This can be done in a variety of ways, but the two usual methods are standing costing and current costing.

9.2.1.1. Standard Product Costing

The standard product costing function relies heavily on the data supplied by engineering data management, which provides the bill of materials and product structure file. The product structure file contains the part numbers of the component parts of each item

Fig. 9.1 INFORMATION INPUTS



which are held level by level and can be cross referenced to a Routing file, giving details of how component parts are converted and/or assembled to make the finished product. By imploding the bill of materials, it is possible to roll up all the component costs of a product by accessing the standard material, labour and overhead costs for that item. An example of a costs indented Bill of Materials is shown in table 9.2. giving the material labour and overhead costs.

9.2.1.1.1. Material Cost

Calculating standard material cost requires a procedure which starts at the lowest level in the bill and rolls up or 'implodes' material cost, level by level, until the top level item is reached. Standard quantity is extended by standard cost and the result is summed to give the total standard material cost for the item being manufactured.

9.2.1.1.2. Labour and Overhead Costs

Labour and overhead costs are incurred at each stage of manufacture when one item is fabricated from another, or a number of parts are assembled together. The information required is held on two files:

1) The Routing File
2) The Workcentre File

The routing file contains a numbered sequence of the manufacturing operations and the standard times for

each operation in a specified work centre. The workcentre file holds the labour and overhead recovery rates. The extension of the rate and the time gives the standard labour and overhead cost for the operation.

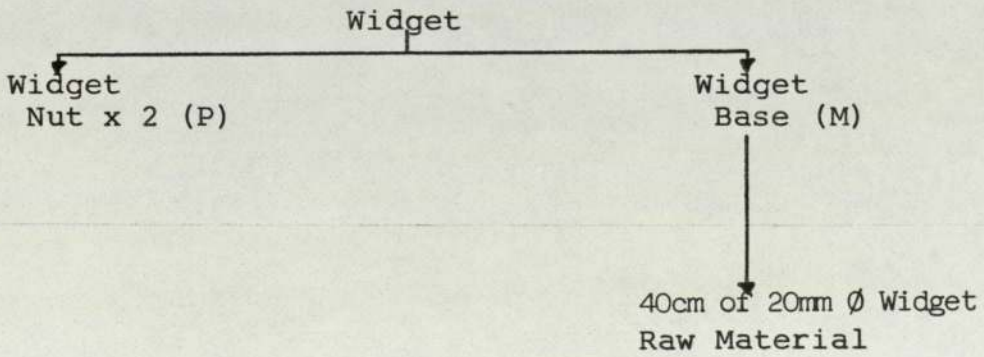
Once the basic data on standard costing has been entered, which are Bill of Material, Product Structure and Routing File, the accountant has only to add material cost for purchased parts and the labour and overhead work centre rates before the system is able to calculate standard product costs.

In order to explain the procedure for standard product costing, a simple example is worked through.

9.2.1.2. Example of Standard Product Costing

Suppose the cost of a widget is required whose bill of materials is as shown in fig. 9.2.

Fig. 9.2. Bill of Materials for a Widget



The bill of materials informs the computer if a

component is manufactured or purchased, the quantity of the component, plus the unit of measure with the cost per unit. The computer working through the BOM level by level, records the cost for a level and cumulative cost, for all the previous levels until the top level is reached. The procedure for costing the widget is now worked through, beginning with table 9.2. which shows the possible standard cost fields for a component.

Table 9.2. Cost Fields in Standard Product Costing

	Material	Labour	O'Head	Total
Cumulative	4	5	6	21
This Level	1	2	3	

The initial step is to determine the lowest level raw material cost, which in this case is the 20mm Ø widget raw material. From the Bill of materials this is shown to be a purchased item and in field 1 the cost per unit is measured. (See Table 9.3.)

Table 9.3. Cost of Widget Raw Material

	Material	Labour	O'Head	Total
Cumulative	-	-	-	40
This Level	40/Metre	-	-	

The next step is the manufacture of the widget base. From the bill of material and product structure files, it can be seen that one base uses 40cm of widget raw material. Thus the material cost for this level is 40 x 0.4 = £16 and is stored in field 1 of 'this level material'. The BOM also informs the computer that the part is fabricated and to divert to the routing files to obtain the operation job times. These are extended by the labour and overhead rates in the workcentre file and accumulated to give the labour and overhead costs. The accumulated time is one hour, the labour rate £3 an hour and overhead rate £9 an hour, giving a labour cost of £3 and an overhead cost of £9. (See Table 9.4.).

Table 9.4. Cost of Widget Base

	Material	Labour	O'Head	Total
Cumulative	-	-	-	28
This Level	16	3	9	

Finally, in constructing a widget, two widget nuts are assembled to a widget base. The raw material cost for the widget nuts are again obtained from the BOM data base. The cost is £6 each. (See Table 9.5.)

Table 9.5. Purchased Cost of Widget Nut

	Material	Labour	O'Head	Total
Cumulative	-	-	-	6
This Level	6/1	-	-	

In attaching these nuts to the base, the standard labour time is 15 minutes, again from the workcentre file the rates for labour and overhead are obtained, (for instance, £4 an hour for labour and £8 an hour for overhead). Giving a labour cost of £1 and £2 for overhead. Thus, the standard product costing for the widget would be as shown in table 9.6.

Table 9.6. Widget Cost

	Material	Labour	O'Head	Total
Cumulative	16	3	9	43
This Level	12	1	2	

Using this system it becomes possible for the accountant to specify a part number (for example the part number of the widget) and produce an indented cost bill of material for that item. It is feasable to manipulate the data to produce other reports, for instance, giving prime cost (material + labour) which in this example would be £32. It will enable the

accountant to ask 'what if' questions by adjusting material costs and labour and overhead rates. Indeed, standard product costing would be a distinct advantage to Wm Cotton, as once the initial data is set up and actual costs were in the vicinity of standard costs, they could be used in pricing decisions, spares pricing, stock valuations, make or buy decisions. This data would also be available to managers at the 'touch of a button' if a terminal was available due to the interaction of data.

9.2.1.3. Current Product Costing

The process of current costing is similar to standard costing and where there is a facility to store a standard cost of a part, there is usually a corresponding facility to store an actual/current cost. However, the degree of sophistication and detail the current costs can be stored at, largely depends upon the package purchased.

In some packages it may be possible to record actual data at operational level on the system (57), whereas on others it may be necessary to record actual operation labour costs using a method outside the system (58), entering total costs for a part after they have been accumulated. In this latter case it is necessary to run an actual costing system or buy additional softwear with an interface.

This is the case with the system purchased by Wm Cotton - they will require a system to record their actual labour costs on an operational basis. The principles of such a system were developed and discussed in detail in Chapter 8. This system could be adapted to the package purchased by Wm Cotton and thereby allow a meaningful variance analysis to be obtained.

9.2.2. Variance Analysis and Operational Performance

It has been contended on numerous occasions that one of the keys to controlling manufacturing costs is the comparison of standard and actual costs at operational level, and the presentation of the variances in a format which encourages accountability, thereby producing the necessary action. It is therefore of great importance that Wm Cotton operate a system which is capable of this. If this is not the case and a system is maintained which only allows accumulated actual costs for manufactured parts to be entered into the current cost fields, then it will not be possible to perform an up to date labour variance analysis on open orders. This is because under an accumulated cost situation it is necessary to wait for an order to be closed and variances can then only be examined at part level. To counter this problem the detailed actual time data would come from the shop floor but entered onto the system on line, thereby informing production planning what operations have been completed and allowing valuation of total work

in progress at actual cost immediately, besides giving the important facility of allowing operational variance. Such a report would be a vast improvement to the situation presently existing at the company.

Material variance analysis can be achieved by comparing the current costs of material from the current cost file and the actual quantities issued from stores against the standard costs and standard quantities which are held on the BOM data base. Overhead variances can be obtained in a manner similar to the labour variances, although there is no guarantee as to their effectiveness, because under or over absorption might be taking place.

Another advantage of holding current and standard costs on the data base is the reduction in the time consuming aspect of issuing new standards which can be achieved by using the roll over facility.

9.2.2.1. Roll Over

One of the major critisms levelled at standard costing is the annual process of issuing new standards (59). Having current costs on the data base allows this process to be made easier, one possibility being rolling over all the latest material costs and updating new labour and overhead rates. Thus the whole process of setting new standards could be completed in a relatively short time. It could also be a matter of choice how frequently the standard data bases are

reviewed and new levels set.

9.2.3. Inventory Accounting

Another major area where a manufacuring system would provide the management accountant at Wm Cotton Ltd with major benefits, is in the inventory accounting function. Wm Cottn's stock valuations are resource and time consuming and open to questionable accuracy. With a computerised manufacturing system, the product costs and quantities in stock are held on a data base, the physical calculation of stock inventory (cost x qty) can be achieved in a relatively short time.

Using the principles of integration, various departments are involved with supplying the data for the valuation. The stores enter on line transaction data and provided discipline is maintained, should produce an accurate quantity figure. Costs are obtained using the product costing system and can be received at standard or current, thereby allowing the valuation at either, depending upon the policy chosen.

The process of performing the valuation takes little time and is possible in an overnight run. Thus it becomes possible to value the stock on a number of occasions throughout the year. Manipulation of data is easy and it would be possible to value stock in

a number of different ways, for instance, high cost order, or stocking location, or by product line. This allows inventory management to see where the costly items are located and how this relates to the various product lines.

9.3. Conclusions

An integrated manufacturing system would provide Wm Cotton with the majority of its required cost accounting data. It would enable them to carry out stock valuations and product cost at both standard and current costs. These could be performed with greater accuracy and less resource than is now required, allowing the accountant more time to interpret the results. The operational performance depends upon the package chosen and the one Wm Cotton Ltd is installing lacks labour variance level and therefore the system requires the additional actual costing facilities discussed previously.

Another criticism in line with the opinion of Bowers (60), is that whereas "financial and tax considerations may require cost data based on full absorption costing, while management decisions may require variable cost data".

It might well be, as Bowers points out, that because these systems are heavily production orientated, they have not yet been fully utilized by accountants.

However, the important point is that in order for these systems to be of use, the accountant must understand the principles of the production systems, grasp Materials Requirement Planning and influence the systems so that required information becomes available and specified.

CHAPTER 10

PROJECT DISCUSSION

The initial terms of reference for the project were to implement a standard costing system which was to be part of a materials management package supplied by Hewlett Packard on an HP/3000. The main purpose of this package was to provide Wm Cotton Ltd with effective Material Requirement Planning, thereby producing a Production and Inventory Control System. This would overcome the problems which existed at the company and were pointed out in Chapter 2.

The hardware and software for the project was originally due to arrive at the start of the project (May 1982). However, because of cash flow problems at the company, the equipment did not arrive until December 1983 - which was four months before the project was due to terminate. The purpose of the original objective was to provide an effective control system, in other words, comparing standards with actuals and taking action. However, it became apparent after researching into the outputs of the proposed materials management package, that whereas it was capable of providing production and inventory control, it lacked significantly in using cost information to provide motivation and hence cost control.

Although there was a facility to hold actual cost, this was at end cost and without additional software, no means of collecting and processing the actual operation costs in the manufacture of parts was available. Whereas this would cause no problems when dealing with purchased parts and assembly times, because they only contained a final cost i.e. the purchased price or time, it would create difficulties when dealing with the manufactured items. These contained a number of operations in their production and to record their costs would require additional softwear.

Thus the project now developed into assessing the viability of the existing actual costing system, and developing standard costing principles, which would allow a link up with the actual costs data, to analyse and present the information in a format which would encourage work force motivation and cost control.

To assess the existing actual costing system, an initial period was spent researching into the manufacturing system and observing how this influenced the data which the costing system required. (Chapter 5). To compliment this exercise, reading was carried out into management accounting (Chapter 1) and its techniques (Chapter 4), production and inventory control, and the impact of computerised MRP and MRP II systems on the management accounting system (Chapters 5 and 9).

The summary of this literature survey was presented in Chapter 3. It became apparent from this reading, and talking to company staff that the existing actual costing system for manufactured items had some major failings. These were discussed (Chapter 6) and it was concluded that the system was resource and time consuming. Thus the project developed into providing the principles for an alternative actual costing system which could be switched onto the Hewlett Packard machine at a later date.

The development of this system was discussed in Chapter 8, which looked at the practical work carried out in the project. The development of the standard costing principles were thus explained and limitations of these standards were pointed out, culminating in the arguement that although the company was under short term pressure, it was essential to provide resource to obtain accurate standards, thereby contributing towards the effective control system. Labour variance was then developed in a format which was convivial towards motivation, pointing out that a reporting analysis by operator and work centre, would be superior to the H.P. format supplying variances at completed part level.

The other main aim of the practical work was to demonstrate to Wm Cotton management the benefits of computer technology by mini projects into:-

purchase committment, shortage analysis by stage, casting orders, Ace and Intarsia purchased costs. This had the added advantages of producing useful data for the eventual implementation of MM/3000 and helping the company achieve short term aims.

Lastly, the benefits of the integrated computerised manufacturing system to the company were summarized, with particular emphases on the accounting function. This was dealt with in Chapter 9, pointing out how product costing, stock valuations and operational analysis could all be performed.

Besides the project being of value to the company, it has also been of immense value to the author, giving an understanding of costing systems, management accounting techniques, production and inventory control (MRP) and the data which is required by management to operate a computerised integrated manufacturing system (MRPII) with particular reference to the finance function.

CHAPTER 11

CONCLUSIONS

1. The company faced a number of problems and on the financial side these included:-

   (i) No means of quantifying efficiency in terms of what could be achieved in relation to actual performance.

   (ii) Stock taking was both resource and time consuming and far too complicated.

   (iii) Actual costing was not used to motivate the work force and this too had many associated problems which meant the system which existed at the start of this project was inappropriate.

2. The introduction of a standard costing system would supply a control system and help to overcome some of these problems. However, in order for it to be successful it required parallel management accounting techniques (for instance, actual and responsibility costing) and an efficient manufacturing system due to a heavy reliance on data from this funtion.

3. A manufacturing system was being supplied on a H.P.3000 machine in the form of a materials

management package. Although this package would provide stock taking, operational analysis and product costing capabilities, it has been contended throughout this thesis that there are limitations to this system which would significantly reduce its motivational impact.

4. The motivational aspect is one of the most important factors when supplying a control system, for if workers at all levels are not correctly motivated then a control system cannot work.

5. Motivation can be supplied by having realistic targets for people to obtain, personnel should be held responsible for achieving these targets and there should be an efficient reporting system informing them of their performance.

6. The limitations to the H.P. 3000 materials management system lay in its inability to record actual costs at operational level, which meant variance analysis could only be carried out at piece part level. This was not a major problem for purchased or assembled parts but was for manufactured parts due to the number of operations contained.

7. It was at manufactured part level where inroads could be made in cost reduction, due to the company being a manufacturing plant with most influence in this area.

8. The time delay between incurring costs and having them

analysed should be as short as possible. A daily analysis would be ideal, but a weekly one would be acceptable. This would be achieved using less resource with a computerised system, the principles having been outlined.

9. In order for standard costing to be effective, it is necessary to have a reliable standard cost file known as the Routing File. This contains a description of the operations which go to make up a part and a standard time for each operation. It is important for this file to be accurate, up-to-date with a provision for new parts, and accounts for all parts used in manufacturing.

10. The actual costing system which existed at the start of this project was inappropriate and it is recommended that a system is maintained which is similar to the principles in Chapter 8. This not only allows for product costing, but allows the actuals to be used with the standards to provide the motivational aspect.

11. The company would benefit by reassessing its overhead procedure. The one currently in use is inaccurate, as it has the same rate for the machine shop and for fitting. This understates the cost of a machine which is machine intensive and overstates the cost of one that is fitting labour intensive.

12. The company should also be prepared to adopt a marginal costing procedure to assess its most profitable line and see how far it can drop its prices when spare capacity is available and it is undergoing strong competition.

APPENDIX 2 (1)

DETAILS ON COMPANY PRODUCTS

PRODUCT NAME	FULL FASHION MACHINE CHARACTERISTICS INTARSIA	V-BED KNITTING MACHINE CHARACTERISTICS ACE	ROTARY WEAVING MACHINES ORBIT
No. of Parts	10,500	3,500	1,000
Ratio of manu. to Bought	2:1	2:1	2:1
Build character-istics	stage built on static site	built on floatline	manuf. at Blackburn site
Options & Variations	no. of knitting hds. knitting width knitting guage attachments	knitting guage presser foot attachments	
Build Programme	To customer order/ forecasting	To customer order/ forecast	
Selling Price	Upwards of £200,000	£25,000 Ace £45,000 R,A,	
Lead Time	4-9 months	8-10 weeks	
Model Types	INTARSIA CLASSIQUE	ACE R.A.	
COMMENT	Frequent rebuilds & refurbishments		Some parts manuf. in Loughbor-ough

APPENDIX 2(2)

PROJECT AREAS ON THE TEACHING COMPANY SCHEME BETWEEN THE UNIVERSITY OF ASTON AND WM COTTON LIMITED

Stage 1

1. Classification and coding of components
2. Capacity Planning
3. Inventory Control

Stage 2

1. Materials Requirement Planning
2. Cam Design
3. Standard Costing

APPENDIX 4(1)

DEFINITIONS OF THE ELEMENTS OF COST

4 (1) 1 Direct Material Cost

The cost of raw materials and components for manufacturing, processing or assembly into the finished product or unit. They are normally recorded on a parts list or bill of material in compliance with the specification of the product.

4 (1) 2 Indirect Material Cost

Materials which cannot be identified in the final product including certain packing supplies, plating materials, paint, oils and compounds.

4 (1) 3 Direct Labour

The cost of labour used to convert or process the raw material, to assemble components, or to provide a product or service. This cost is the product of the time taken for the operation and the rate paid per unit of time.

4 (1) 4 Indirect Labour

Indirect labour comprised all wages and salaries not charged as direct labour. This category will

therefore include clerical, supervisory, managerial, store keeping, material handling, cleaning, maintenance, sales and similar labour costs. Lost time, vacations and training.

4 (1) 5 Direct Expenses

In some industries, expenses can be attributable directly to the product and they can be charged thereto as incurred. Examples of this type of expense are - insurance, transportation, import duty, rentals and design services.

4 (1) 6 Indirect Expenses

Included in this category are establishment costs including rent and rates, depreciation, travel and entertainment, tools, power, water, gas and similar utilities. Also stationery, employee fringe benefits such as pensions, National Insurance contributions and all other charges/ services.

4 (1) 7 Sub-Contract Costs

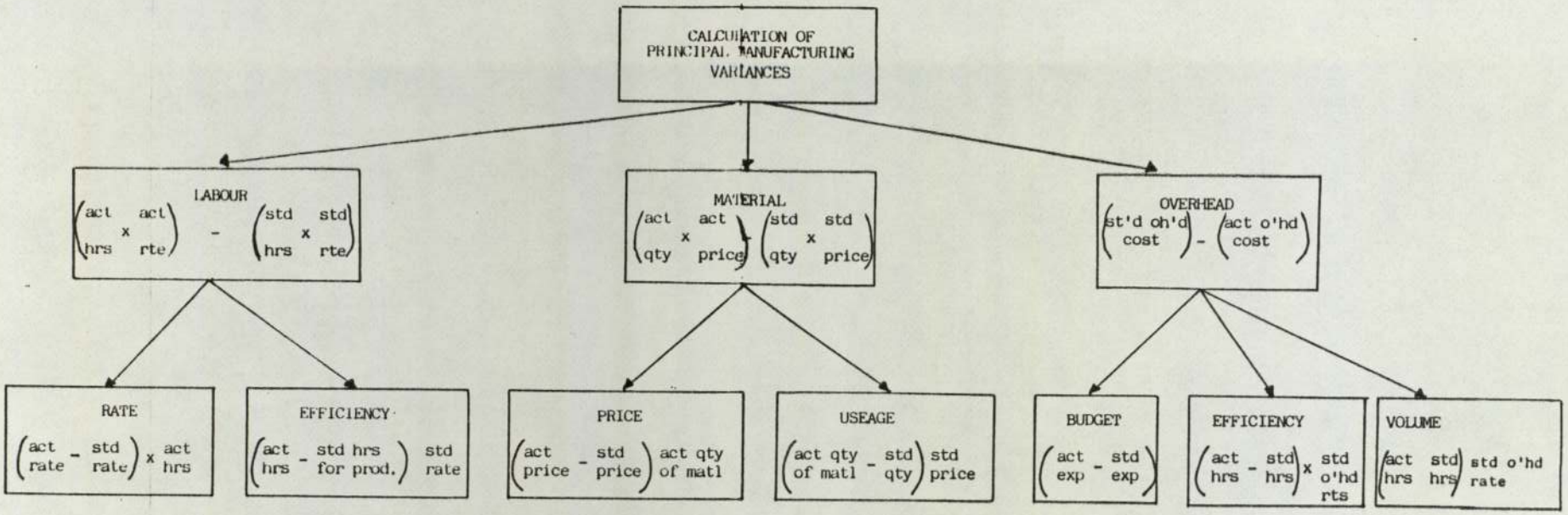
Sub-contract costs can normally be identified with a specific product or service, and can be charged directly thereto.

Two definitions of sub-contracts are in common use:

a) All work placed with outside suppliers to designs peculiar to the main contracter for

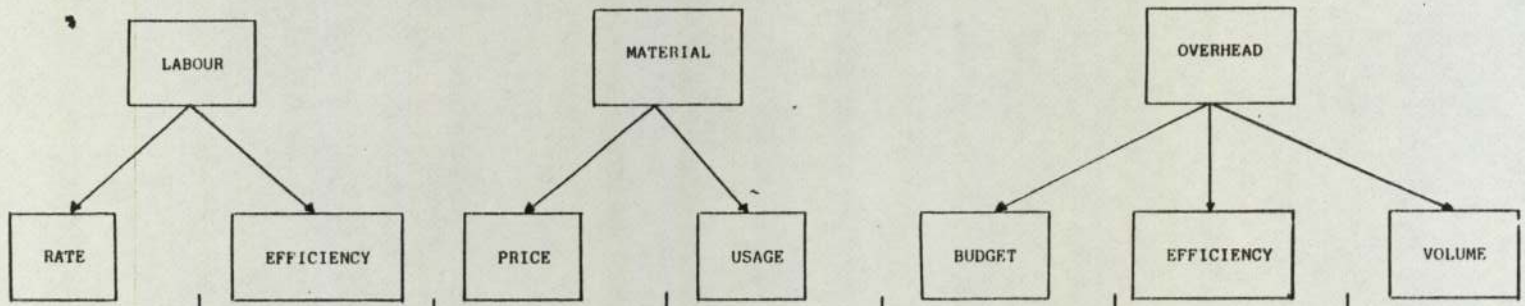
economic reasons, or to augment the existing manufacturing facilities.

b) Work for which facilities exist within the main contracting company but which, by reason of shortage of capacity, is placed with outside supply sources.



APPENDIX 4 (2) CALCULATION OF PRINCIPAL MANUFACTURING VARIANCES

APPENDIX 4(3) POSSIBLE REASONS FOR MANUFACTURING VARIANCES



RATE

a) Changes in basic wage rate.

b) Employing a man of a grade different from the one laid down as the standard grade for the job.

c) Where an overtime allowance is included in the std rate but an excessive ammount of overtime is worked.

EFFICIENCY

a) Use of std Employees.

b) Failure to obtain best results from employees.

PRICE

a) Change in Price

b) Failure to buy in quantities anticipated.

c) Not taking discounts.

d) Failure to purchase std quality which results in a different price.

USAGE

a) Sub std material.

b) Carelessness.

c) Pilferage.

d) Wastage.

e) Quality of material is used other than specified.

f) Non std material mixture.

BUDGET

a) Change in Price.

b) Changes in efficiency in using services.

c) Lack of control in spending.

d) Increases in the cost of some external services.

EFFICIENCY

As labour efficiency.

VOLUME

Consideration of Factors which bring about idle time or overtime. i.e.:

(1) Machine Breakdown.
(2) Labour Troubles.
(3) Power Failures.
(4) Inefficient Planning.
(5) Shortages.

APPENDIX 4(4)

COMMONLY USED METHODS OF OVERHEAD ABSORBPTION

1. Direct labour hour rate = $\frac{\text{Total overhead of cost centre}}{\text{Direct labour hours}}$

2. Machine hour rate = $\frac{\text{Total overhead of cost centre}}{\text{Machine Hours}}$

3. Direct materials percentage rate = $\frac{\text{Total overhead of cost centre} \times 100}{\text{Direct materials cost}}$

4. Direct wages percentage rate = $\frac{\text{Total overhead of cost centre} \times 100}{\text{Direct wages cost}}$

5. Prime cost percentage rate = $\frac{\text{Total overhead of cost centre} \times 100}{\text{Prime Cost}}$

6. Cost unit rate = $\frac{\text{Total overhead of cost centre}}{\text{Cost units produced}}$

STOCK RECORD CARD REF. S/R 2

PART NUMBER BIN NUMBER

QTY SOLD	FREE STOCK	DATE	BATCH/FRAME or SALES No.	STAGE/UNIT SUB. ASSY. No.	QUANTITY		STOCK
					INWARD	OUTWARD	

Appendix 5(1) Stock Record Card

This Order No.

C 2026

Copy for

PURCHASE MASTER FILE

Quantity	Description	Req. No.	Code	
	Delivery			
	Deliver to			

Appendix 5 (2) Purchasing Order

ADVICE NOTE No. 754

CITY ENGINEERING SERVICES

156 MAIDSTONE ROAD, LEICESTER LE2 0UB TEL: 0533 530958

INVOICE TO:

WM COTTON GROUP LTD
P.O.BOX 9
~~BELTON ROAD~~
LOUGHBOROUGH
LEICS

DELIVERED TO:

WM. COTTON DIVISION

OUR REF:	YOUR ORDER No:	INVOICE/TAXPOINT DATE:	TYPE OF SUPPLY:
	C 29973	19-12-83	DELIVER

BIN No.	QTY	DESCRIPTION	PRICE	RATE	T
	10	EW 3/4 THRUST RACE			
		R.H. (E 7720)			
	20	½" D. TUBULAR BOW LINK			
		CUETTED TYPE.			
		(R.H. 46930)			
		(POST ORDER)			

"DAYSPEED"
FOR THE BEST IN SERVICE

CARRIAGE PACKING
TOTAL
VAT @ %
AMOUNT DUE £

CONDITIONS OF SALE AVAILA

VAT REG. No. 355 3240 70

Appendix 5 (3) Example of an Advice Note

		ORDER ROUTING				
		DATE	PART No.	PART DESCRIPTION	BATCH No.	DATE FOR COMPLETION
	W.C.F.44A.	COMPLETION DATE	QUANTITY	MATERIAL	ISSUE	

Appendix 5 (4) Material Requisition

DAILY GOODS RECEIPT SHEET

SHEET N° 577 DATE 21 DEC

BATCH ISSUE DATE	COMPL WEEK	PART N°	BATCH N°	QTY REQ'N	QTY REC'D	SHORTAGE INFORMATION	QTY TO STOCK	ACTUAL STOCK	BIN LOCATION
		WUQSF 0620	C 29944	400	400	3/8" X 1 1/4" WHT. SKT. CAP SCREW.	400	400	A 171
		WUQSF 0612	C 30235	200	200	3/8" X 3/4" — " —	200	200	A 171
		WUQSF 0708	C 29946	200	200	7/16" X 1/2" — " —	200	200	A 120
		WUQSF 0707	C 30004	100	100	7/16" X 7/16" — " —	100	100	A 171
		WUQSF 0504	C 30061	600	600	5/16" X 1/4" — " —	600	600	A. 118
		FUQSF 0306	C 30077	300	400	3/16" X 3/8" BSF. — " —	400	400	A 55
		AUQSF 0208	C 30233	1000	1000	2BA X 1/2" — " —	1000	1000	A 116.
		AUQSF 0205	— " —	600	400	2BA X 5/16" — " —	400	400	A 227
		AUQSF 0204	— " —	500	500	2BA X 1/4" — " —	500	500	A 115
		WUC 0524	C 30236	400	400	5/16" X 1 1/2" WHT. SKT. HD. CAP. SCREW.	400	400	A 3.
		WUC 0512	— " —	200	200	5/16" X 3/4" — " —	200	202	A 179
		WUC 0416	— " —	400	400	1/4" X 1" — " —	400	600	A 179
		WUC 0628	C 30221	400	300	3/8" X 1 3/4" — " —	300	430	A 4
		WUC 0624	C 30222	400	300	3/8" X 1 1/2" — " —	300	341	A 3.
		WUC 0414	C 30235	400	400	1/4" X 7/8" — " —	400	400	NO LOC. A179

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Appendix 5 (5) Goods Received Note

	PURCHASE REQUISITION	RAISED BY	R 64750

MAXIMUM ITEMS 4

ITEM No.	PART No.	QUAN.	DESCRIPTION	ACCOUNTS CODE	DUE DATE	SUPPLIER	PRICE	ORDER No.

OUTSTANDING PURCHASE ORDERS			
ITEM No.	ORDER Nos.	QUANTITY	DUE DATE

NORMAL MONTHLY USAGE	STOCK	REQUIREMENTS
DATE	INSPECTOR	AUTHORISED BY

W.C.F.2.

Appendix 5 (6) Purchase Requisition

	87/101022	PINION GEAR.	
Date for Completion	Quantity	Material EN32 16 ø X 10 LG.	Issue

Start Week	M/c No.	Op.No.	M/c Group	Operation	Tools	Set Up Sm
		10	11 G4	FACE.C/DRILL,DRILL & REAM 8ØH8 P/O.		30.0
		20	11 G4	FACE TO LG. & DEBURR.		30.0
		30	S/GON	CUT TEETH & DEBURR.		
		40	80 HT	CASE HARDEN AS DRG.		
		50	P/S	CHEM.BLACK.		
				STORES.		

W.C.F.30.

CLOCK NO.__________ OPERATOR______________ WEEK ENDING______________

PLANNED PRODUCTIVE OPERATIONS

Batch No.	Part No.	Op. No.	Qty	Date	Time On	Time Off	Hrs. Mns Time Taken	Dec.Hrs Total Time	Remarks
						TOTAL			

Appendix 5 (8) (i) Form Showing Completion of Planned Productive Operations

CLOCK NO: ___________

UNPLANNED PRODUCTIVE OPERATIONS

Frame No. Batch No.	Part No.	Toy	Date	Time On	Time Off	Hrs/Mn Time Taken	Dec.Hrs Total Hrs.	Remarks
					TOTAL			

Appendix 5 (8) (ii) Form Showing How Unplanned Productive Operations Completed.

CLK. No. _____ OPERATOR _____ DATE _____

CODED OPERATIONS

Cost Code	Date	Time On	Time Off	Hrs. Min Time Taken	Dec. Hrs Total Time	Details	Sign
			TOTAL				

Appendix 5 (8) (iii) Form Showing How Coded Operations Completed

Date	Part No.	Part Description	Batch/Frame	Sta

Target Week	Quantity	Material	Issue	Total Hc Hrs.

	Op. No.	M/c Group	Operation	Tools	Set Up Sm	Prod. Sm

Appendix 5 (9)(i) Production Card

NO PAYMENT PASS OUT CARD

AUTHORISED PASS OUT CARD DATE _____

EMPLOYEES NAME _____ CLOCK No. _____

TIME OUT _____ TIME IN _____ TOTAL TIME _____

NO PAYMENT SIGNED _____

W.C.F. 42

Appendix 5 (9) (ii) Overheads Costs

CODED CARD

CODE _____/_____

DIVISION 4_____

MACHINE TYPE No._____
(EXPERIMENTAL ONLY)

QUANTITY	STD TIME	
	SET	PROD

DETAILS

BATCH/FRAME

PART/STAGE

SIGNED_____
(ISSUE)

SIGNED_____
(RESPONSIBILITY)

W.C.F.40.

Appendix 5 (9) (iii) Coded Operations

UTILISATION. WEEK Nº: 1 WEEK END: 6.10.83

FRAME.	CARRIED FORWARD HOURS	126 SKNEK.	133 CAMS.	152 PAINT	161 SUB/ASSY.	162 PANEL.	163 INSIDE.	164 PILOT.	165 STRIP.	166 MISC.	171 CARCASS.	172 SPLICE.	173 RIB/HELIX	174 FINISH.	175 ATTACH.	177 STR.	178 ELEC.	TOTAL HOURS BOOKED
MICHEL						29				31	8					4	8	75.
SERVICE SALES						5	39	1							14		46	105
4009				12			[illegible]	1		2					10	1	10	39
4010				4			6											10
4011				4	5	2	10			57	32	49	52		43	6	38	298
4012				7			7	2			25	2				5		48
3537							31	35			13	13				4	2	98
3[illegible]8					4							12		31	31	15	12	105
1555				31	46		[illegible]	23			18	46	40	61	45	3	34	371
1203					26		29			54	5	23		139	27	46	34	383
2713					8										8			16
2810																	3	3
2760																	18	18
3AA[illegible]																2		2
3[illegible]0																4		4
0226																3		3
1683											18							18
TAL				58	89	31	149	62		144	119	145	92	231	178	93	205	1596
ERHEAD				4	3		5			2	5	1					12	32
LKNESS												8				31		39
TAL LOCKED				62	92	31	154	62		146	124	154	92	231	178	124	217	1667
IRECT ARK-U				4	3	1	5	2		5	4	5	2	8	6	4	7	55

Appendix 5 (10) Form Showing How Total Assembly Time Allocated to a Machine

PURCHASING COST ANALYSIS

W/ENDING _____

Order No.	Supplier	MX NO	Part No. Or Description	Quantity Ordered	Current Price	Date Of Previous Order	Qty. Of Previous Order	Previous Price	Variation Shown As % + -	Total Value Of New Order	Whe Use

Appendix (11) Purchase Cost Analysis Form

TABLE TO GIVE UNIT COST OF A BATCH

JANETB\JOB2053 PARTNUMBER	BATCHNUMBER	FINQTY	DATE	MATERIALTYPE	MATERIALNUM	LABUNIT COST	MATUNIT COST
	210376/	4	2 82	CASTING		24.182	0.000
E248	211599/	11	2 82		5049/10512	3.425	2.750
E415	211681/	8	2 82		5049/10512	3.465	2.521
E540	207361/	6	7 82	CASTING		6.486	17.600
E920	210391/	29	3 82		5342/10823	4.800	0.350
12499	212107/	200	7 82		CASTING	0.129	0.125
18062	212313/	1530	7 82		5140/11732	0.102	0.002
18272	211810/	30	2 82		5040/10142	0.408	0.024
14281	211846/	20	4 82	FIN/PT		0.928	0.000
21532	211908/	400	6 82		5957/11871	0.435	0.029
21533	211754/	400	8 82		5957/11871	0.523	0.034
21584	212070/	2	4 82		5479/12193	2.753	0.083
23395	210828/	32	54 82		5351/11289	3.214	0.010
27049	211852/	20	2 82		5042/10020	0.585	0.022
28638	210479/	20	54 82		5042/10030	1.081	0.054
28839	211778/	32	54 82		5140/11710	0.875	0.020
29125	211506/	22	54 82	CASTING		2.749	1.473
30057	211956/	1330	54 82	MOD		0.006	0.000
30058	211992/	700	5 82		5040/10142	0.101	0.003
30062	211920/	23	6 82		5140/11711	0.277	0.013
31923	211914/	2	7 82	CASTING	31292	17.211	0.905
31997	210352/	4	2 82	CASTING		4.359	0.494
32645	211140/	10	2 82	CASTING		4.774	0.186
34520	211941/	17	54 82		5040/10122	3.205	0.457
36326	210690/	11	3 82		5045/10301	3.747	0.207
45737	212042/	198	4 82		5040/10154	0.275	0.888
45738	211726/	96	7 82		5049/10522	0.425	0.001
45989	211725/	93	7 82		5049/10522	0.415	0.001
47589	211949/	36	54 82	MODIFY		1.089	0.000
48129	211640/	37	54 82		5371/11213	1.546	3.054
48130	211641/	48	7 82		5371/11213	1.750	0.701
60050	212306/	80	8 82			0.757	0.000
60119	211776/	300	6 82			0.993	0.000
60170	211724/	182	7 82		5957/11872	1.077	0.028
60287	211443/	302	7 82		5957/11871	1.077	0.047
62040	211627/	16	7 82	CASTING		2.680	1.500
80049	210563/	20	54 82	CASTING		3.645	0.350
80107	211994/	3	54 82	MODIFY		7.650	0.000
81307	211926/	183	54 82	MODIFY		0.878	0.000
81329	212059/	35	8 82		5040/10133	0.424	0.052
81283	212080/	54	8 82			0.187	0.000
81346	209457/	10	2 82	CASTING		3.223	0.112
81351	210891/	3	7 82			3.043	0.000
81396	207332/	27	8 82	CASTING		8.627	4.056
81440	211839/	6	3 82		CASTING	10.968	2.690
81446	211840/	6	54 82		5040/10126	0.787	0.039
81448	211841/	7	54 82		5140/11701	0.857	0.101
82047	211809/	32	4 82			0.298	0.000
82154	210686/	4	54 82	CASTING		9.453	5.620

Appendix 8(1)

Example of Print of Actual Cost Data under Original System

ANALYSIS OF HOURS WORKED PER MONTH

13/06/83

1.	0 NOS	MIXTURE	0.00
2.	AE/ET	100000-119999	206.00
3.	AEF/ETF	120000-129999	0.00
4.	SALES SP. F/F	140000-149999	0.00
5.	SALES SP S/A	150000-159999	0.00
6.	F/FT	160000-169999	0.00
7.	R.A.	170000-179999	14.00
8.	SALES SP R.A.	180000-189999	15.00
9.	AUTO RID CUFF	190000-199999	60.00
10.	CRP	200000-239999	174.00
11.	INTARSIA	240000-249999	0.00
12.	GEMINI	260000-279999	0.00
13.	SUB CONTRACT	300000-309999	35.00
14.	FIOSTJ/1/S	400000-409999	166.00
15.	ACE	450000-459999	14.00
16.	EURO	460000-469999	0.00
17.	SALES SP REEP	480000-489999	0.00
18.	SALES SP ALEM	490000-499999	0.00
19.	ORBIT	500000-509999	0.00
20.	SALES SP ORBIT	590000-599999	0.00
		TOTAL	684.00

Appendix 8 (2) Example of an Analysis of Hours Worked per Month

17/06/83

TABLE TO GIVE A SUMMARY OF COST INFORMATION

PARTNUMBER	BATCHNUMBER	FQTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST	MATERIAL UNITCOST	LABOUR UNITCOST
111111	100001/	46	STEEL	RAHGT	Test run	03/83	20.00	0.43	6.37
222222	100002/	8	STEEL	SERWQ	Test run	03/83	5.00	0.63	22.84
777777	100009/	100	STEEL	HYTRI	Test run	03/83	39.00	0.39	0.38
888888	100010/	100	STEEL	RTYUIO	Test run	03/83	39.00	0.39	0.69
697891	112463/	50	STEEL	ONE	Test run	03/83	15.00	0.30	0.76
147859	112564/	24	STEEL	ONE	Test run	03/83	20.00	0.83	1.18
100014	176917/	14	STEEL	GTE	Test run	03/83	20.00	1.43	3.15
147231	185684/	40	STEEL	HWE	Test run	03/83	20.00	0.50	1.18
140198	199652/	80	STEEL	HYT	Test run	03/83	20.00	0.25	2.36
333333	200003/	98	STEEL	STREA	Test run	03/83	50.00	0.51	1.32
999999	200009/	20	STEEL	RTYUIO	Test run	03/83	19.00	0.95	0.79
159836	200014/	100	STEEL	WDERT	Test run	03/83	59.00	0.59	1.13
012589	211574/	55	STEEL	TQP	Test run	03/83	26.00	0.47	3.95
357951	217421/	55	STEEL	TQP	Test run	03/83	26.00	0.47	0.86
254139	219874/	10	STEEL	FTQ	Test run	03/83	5.00	0.50	2.52
145789	300001/	14	STEEL	RETWQ	Test run	03/83	15.00	1.07	1.13
444444	300004/	18	STEEL	KIOPE	Test run	03/83	10.00	0.56	5.23
159836	314764/	10	STEEL	RAOP123	Test run	03/83	5.00	0.50	2.84
555555	400001/	30	BRASS	14POI	Test run	03/83	39.00	1.30	6.72
147963	400003/	25	STEEL	JULOP	Test run	03/83	19.00	0.76	2.52
159820	400004/	45	STEEL	JULOP	Test run	03/83	40.00	0.89	1.40
666666	400006/	40	BRASS	14POI	Test run	03/83	53.00	1.33	2.84
147320	400015/	25	STEEL	HTRYU	Test run	03/83	20.00	0.80	1.51
249789	400016/	12	BRASS	DERTW	Test run	03/83	14.00	1.17	1.31
125879	411721/	12	STEEL	UEY	Test run	03/83	20.00	1.67	3.68

Appendix 8 (3) Example of a Print Out of a Summary of Cost Information under Revised System.

TABLE TO GIVE DETAILED COST INFORMATION

Appendix 8 (4) Example of Print of Detailed Listing of Cost Information under Revised System

PAGE 1

13/06/83

MATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
100001/	111111	46	STEEL	RNGT	Test run	03/83	20.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
111111	02/83	47	159/852	20	14.00	44.10
111111	01/83	50	147/852	60	20.00	63.00
111111	01/83	48	159/753	30	11.00	34.65
111111	01/83	49	124/487	50	27.00	85.05
111111	01/83	49	159/753	40	16.00	50.40
111111	01/83	50	123/123	10	5.00	15.75
						292.95

MATERIAL UNIT COST= $0.43
LABOUR UNIT COST= $6.37

MATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
100002/	222222	8	STEEL	SERVO	Test run	03/83	5.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
222222	02/83	9	159/632	20	2.00	6.30
222222	02/83	10	879/654	10	10.00	31.50
222222	02/83	10	159/632	50	11.00	34.65
222222	02/83	10	159/632	40	15.00	47.25
222222	02/83	10	159/632	30	20.00	63.00
						182.70

MATERIAL UNIT COST= $0.63
LABOUR UNIT COST= $22.84

MATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
100003/	777777	100	STEEL	MTRI	Test run	03/83	39.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
777777	03/83	100	111/222	10	12.00	37.80
						37.80

MATERIAL UNIT COST= $0.39
LABOUR UNIT COST= $0.38

TABLE TO GIVE DETAILED COST INFORMATION

MATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
100010/	888888	100	STEEL	RTYUIO	Test run	03/83	39.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
888888	03/83	100	111/222	10	12.00	37.80
888888	03/83	100	111/585	30	5.00	15.75
888888	03/83	100	148/478	20	5.00	15.75
						69.30

MATERIAL UNIT COST= $0.39
LABOUR UNIT COST= $0.69

MATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
112463/	657891	50	STEEL	ONE	Test run	03/83	15.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
657891	01/83	50	148/956	10	2.00	6.30
657891	01/83	50	148/956	30	5.00	15.75
657891	01/83	50	148/956	20	5.00	15.75
						37.80

MATERIAL UNIT COST= $0.30
LABOUR UNIT COST= $0.76

MATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
112564/	147859	24	STEEL	ONE	Test run	03/83	20.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
147859	01/83	25	145/985	10	2.00	6.30
147859	01/83	25	159/630	20	5.00	15.75
147859	01/83	25	159/630	10	2.00	6.30
						28.35

MATERIAL UNIT COST= $0.83
LABOUR UNIT COST= $1.18

MATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
174917/	100014	14	STEEL	CTE	Test run	03/83	20.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
100014	01/83	25	159/478	10	14.00	44.10

(Continued from previos page restarting at the place where page full.)

MATERIALNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALRUN	COMMENT	DATE	ML COST
185484/	147231	40	STEEL	HWE	Test run	03/83	20.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
						44.10

MATERIAL UNIT COST= $1.43
LABOUR UNIT COST= $3.15

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
147231	03/83	40	145/236	10	15.00	47.25
						47.25

MATERIAL UNIT COST= $0.50
LABOUR UNIT COST= $1.18

MATERIALNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALRUN	COMMENT	DATE	ML COST
199652/	140198	80	STEEL	HYT	Test run	03/83	20.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
140198	02/83	80	124/568	10	12.00	37.80
140198	02/83	80	124/568	50	12.00	37.80
140198	02/83	80	124/568	40	12.00	37.80
140198	02/83	80	124/568	30	12.00	37.80
140198	02/83	80	124/568	20	12.00	37.80
						189.00

MATERIAL UNIT COST= $0.25
LABOUR UNIT COST= $2.36

MATERIALNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALRUN	COMMENT	DATE	ML COST
200003/	333333	98	STEEL	STREA	Test run	03/83	50.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
333333	01/83	100	159/632	10	10.00	31.50
333333	01/83	100	159/632	30	5.00	15.75
333333	01/83	100	159/741	20	26.00	81.90

Appendix 8 (4) (cont.)

(Continued from previos page restarting at the place where page full.)

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MACHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
200097/	999999	20	STEEL	RTYUIO	Test run	03/83	19.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
						129.15

MATERIAL UNIT COST= $0.51
LABOUR UNIT COST= $1.32

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
999999	03/83	20	249/521	10	5.00	15.75
						15.75

MATERIAL UNIT COST= $0.95
LABOUR UNIT COST= $0.79

MACHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
200014/	159837	100	STEEL	WDERT	Test run	03/83	59.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
159837	02/83	100	143/682	10	12.00	37.80
159837	02/83	100	143/682	30	12.00	37.80
159837	02/83	100	147/682	20	12.00	37.80
						113.40

MATERIAL UNIT COST= $0.59
LABOUR UNIT COST= $1.13

MACHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
211574/	012589	55	STEEL	TOP	Test run	03/83	26.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
012589	02/83	55	124/124	10	12.00	37.80
012589	02/83	55	124/125	30	21.00	66.15
012589	02/83	55	124/125	20	36.00	113.40
						217.35

MATERIAL UNIT COST= $0.47
LABOUR UNIT COST= $3.95

Appendix 8 (4) (Cont.)

TABLE TO GIVE DETAILED COST INFORMATION

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13/06/83

MATCH/ORDER	PARTNUMBER	QTY	MAT'L TYPE	MATERIAL NUM	COMMENT	DATE	ML COST
217421/	357951	55	STEEL	TOP	Test run	03/83	26.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
357951	02/83	55	124/125	10	5.00	15.75
357951	02/83	55	124/125	30	5.00	15.75
357951	02/83	55	124/125	10	5.00	15.75
						47.25

MATERIAL UNIT COST= $0.47
LABOUR UNIT COST= $0.86

MATCH/ORDER	PARTNUMBER	QTY	MAT'L TYPE	MATERIAL NUM	COMMENT	DATE	ML COST
219874/	254139	10	STEEL	FTO	Test run	03/83	5.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
254139	02/83	10	124/159	10	2.00	6.30
254139	02/83	10	124/159	20	6.00	18.90
						25.20

MATERIAL UNIT COST= $0.50
LABOUR UNIT COST= $2.52

MATCH/ORDER	PARTNUMBER	QTY	MAT'L TYPE	MATERIAL NUM	COMMENT	DATE	ML COST
300001/	145789	14	STEEL	RETWO	Test run	03/83	15.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
145789	12/83	14	145/623	10	5.00	15.75
						15.75

MATERIAL UNIT COST= $1.07
LABOUR UNIT COST= $1.13

MATCH/ORDER	PARTNUMBER	QTY	MAT'L TYPE	MATERIAL NUM	COMMENT	DATE	ML COST
300004/	444444	18	STEEL	XIOPE	Test run	03/83	10.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
444444	01/83	20	159/147	40	5.00	15.75
444444	01/83	20	159/142	50	5.00	15.75
444444	01/83	19	158/236	30	8.00	25.20
444444	01/83	19	158/236	20	2.00	6.30

(Continued from previos page restarting at the place where page full.)

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
444444	01/83	20	159/852	10	10.00	31.50
						94.50

MATERIAL UNIT COST= $0.56
LABOUR UNIT COST= $5.25

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
314744/ .	159836	10	STEEL	RAW123	Test run	03/83	5.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
159836	02/83	10	124/159	10	2.00	6.30
159836	02/83	10	124/157	30	5.00	15.75
159836	02/83	10	124/159	20	2.00	6.30
						28.35

MATERIAL UNIT COST= $0.50
LABOUR UNIT COST= $2.84

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
400001/	555555	30	BRASS	14*01	Test run	03/83	39.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
55555	01/83	30	123/159	40	2.00	6.30
55555	01/83	30	123/236	10	25.00	78.75
55555	01/83	30	123/236	60	12.00	37.80
55555	01/83	30	123/159	50	25.00	78.75
						201.60

MATERIAL UNIT COST= $1.30
LABOUR UNIT COST= $6.72

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
400003/	147963	25	STEEL	JUMP	Test run	03/83	19.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
145782	02/83	25	147/962	10	20.00	63.00

Appendix 8 (4) (Cont.)

(Continued from previos page restarting at the place where page full.)

13/06/83

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
						63.00

MATERIAL UNIT COST= $0.76
LABOUR UNIT COST= $2.52

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
400004/	159820	45	STEEL	JULIP	Test run	03/83	40.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
159820	02/83	45	147/146	10	20.00	63.00
						63.00

MATERIAL UNIT COST= $0.89
LABOUR UNIT COST= $1.40

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
400006/	666666	40	BRASS	14F01	Test run	03/83	53.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
666666	02/83	40	159/264	20	12.00	37.80
666666	02/83	40	159/264	10	12.00	37.80
666666	02/83	40	159/264	30	12.00	37.80
						113.40

MATERIAL UNIT COST= $1.33
LABOUR UNIT COST= $2.84

BATCHNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
400015/	147520	25	STEEL	HTRYU	Test run	03/83	20.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
147520	01/83	25	147/963	10	12.00	37.80
						37.80

MATERIAL UNIT COST= $0.80
LABOUR UNIT COST= $1.51

Appendix 8 (4) (Cont.)

TABLE TO GIVE DETAILED COST INFORMATION

PAGE 8

13/06/83

MATERIALNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
400016/	245789	12	BRASS	BERTW	Test run	03/83	14.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
245789	10/83	12	147/963	10	5.00	15.75
						15.75

MATERIAL UNIT COST= $1.17
LABOUR UNIT COST= $1.31

MATERIALNUMBER	PARTNUMBER	QTY	MAT'LTYPE	MATERIALNUM	COMMENT	DATE	ML COST
411721/	125879	12	STEEL	UEY	Test run	03/83	20.00

PARTNUMBER	DATE	QTY	CLK-NUM	OP'ION	HOURS	L'COST
125879	03/83	12	123/456	10	12.00	37.80
125879	03/83	12	123/489	20	2.00	6.30
						44.10

MATERIAL UNIT COST= $1.67
LABOUR UNIT COST= $3.68

Appendix 8 (4) (Cont.)

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8	Stage 9	Stage 10	Stage 11	Stage 12	Stage 13
B'out Parts	495	313	400	1127	750	177	5700	365	1240				217
Raw Material	49	19	71	261	72	16	-	88	-				
LABOUR													
(1) Machining	324	110	132	810	110	57	6	57	35	28			
(2) Assembly	148	85	85	564	54	54	148	85	54	49	22	44	
(3) O'head	826	341	380	2405	287	194	270	249	156	44	38	177	
Total Cost	1842	868	1068	5167	1273	498	6124	844	1485	77	60	221	217

Total Cost = £19,744

Appendix 8.5 Estimated Standard Cost of the Ace Machine in £'s

PAGE

05/09/73

APPENDIX 8.6

Labour Variance Analysis for Ace Parts Made in January

PARTNUMBER	OPE'N NUM	BATCH NUM	STD SET UP TIME (MINS)	STD MCH TIME MINS	QTY	STD LAB HRS/BT	ACT LAB HRS/BT	VARIANCE	AS A P'CT	DEGREE OF VARIANCE 10 100
87/101088	50	1451894/	90	4.00	28	3.37	9.92	-6.55	194	**********
87/101088	60	1431894/	60	4.00	28	2.57	8.75	-5.88	204	**********
87/101088	70	1451894/	60	2.00	30	2.00	2.25	-0.25	12	*
87/121074	80	1452006/	30	0.50	90	1.25	3.00	-1.75	139	**********
87/121077	10	1452272/	30	1.75	20	1.08	3.00	-1.92	176	**********
87/121077	20	1452272/	30	0.75	20	0.75	1.50	-0.75	99	**********
87/122068	30	1452544/	90	1.25	104	3.67	6.67	-3.00	81	*********
87/122068	40	1451518/	90	1.25	28	2.08	2.83	-0.75	35	****
87/122068	50	1451518/	30	0.50	90	1.25	1.17	0.08	-5	
87/122068	60	1452544/	30	0.50	104	1.37	1.25	0.12	-8	
87/122069	10	1452257/	30	2.25	30	1.63	6.25	-4.63	284	**********
87/122069	20	1452257/	30	2.25	15	1.06	2.67	-1.61	150	**********
87/122069	50	1452257/	30	0.50	30	0.75	1.00	-0.25	32	***
87/124164	50	1452921/	30	0.50	300	3.00	4.33	-1.33	49	****
87/124165	30	1452482/	60	1.50	40	2.00	3.42	-1.42	70	*******
87/124165	40	1452482/	90	2.50	40	3.17	4.00	-0.83	25	***
87/124165	50	1452482/	90	1.50	40	2.50	4.00	-1.50	59	******
87/124176	20	1453103/	60	2.00	50	2.67	3.75	-1.08	40	****
87/124176	30	1453103/	90	3.00	50	4.00	5.00	-1.00	24	**
87/124176	40	1453634/	90	3.00	25	2.75	2.58	0.17	-5	
87/124178	30	1453634/	90	3.00	15	2.25	1.50	0.75	-32	
87/124177	20	1453104/	60	2.00	50	2.67	3.75	-1.08	40	****
87/124177	30	1453104/	90	3.00	50	4.00	5.00	-1.00	24	**
87/124178	50	1452874/	50	2.00	150	2.67	4.50	-1.83	68	*******
87/124178	50	1452874/	60	2.00		1.00	3.25	-2.25	224	**********
87/124179	50	1452876/	60	2.00	25	1.83	3.00	-1.17	63	******
87/125102	60	1451852/	30	1.50	70	2.25	5.50	-3.25	143	**********
87/125102	70	1451952/	20	0.50	70	0.32	1.00	-0.08	8	
87/125102	90	1451952/	30	2.50	70	3.42	1.00	2.42	-70	
87/125103	90	1451842/	30	2.50	50	2.58	1.25	1.33	-51	
87/125110	10	1452916/	30	6.00	30	3.50	9.92	-6.42	182	**********
87/125110	30	1452916/	30	3.00	30	2.00	3.00	-1.00	49	*****
87/125110	60	1452264/	30	3.00	40	2.50	1.33	1.17	-46	
87/125126	20	1453857/	60	5.00	28	3.90	13.00	-9.10	232	**********
87/125137	10	1453858/	60	5.00	30	3.50	7.83	-4.33	123	**********
87/125137	20	1453858/	60	3.00	30	2.50	6.25	-3.75	149	**********
87/125137	30	1453858/	30	3.00	30	2.00	3.50	-1.50	74	********
87/126029	10	1453833/	30	2.00	40	1.83	3.00	-1.17	63	******
87/126029	15	1453833/	30	2.50	40	2.17	4.25	-2.08	95	**********
87/126031	10	1452254/	60	6.84	44	5.65	13.67	-8.02	141	**********
87/126031	20	1452254/	60	4.84	44	4.55	7.50	-2.95	64	******
87/126031	20	1452254/	60	4.84	10	1.81	1.50	0.31	-16	
87/126031	30	1452254/	30	2.00	48	2.65	2.67	-0.02	0	

WORK CENTRE LABOUR VARIANCE ANALYSIS FOR ACE PARTS MADE IN JAN

APPENDIX 8.7

Work Centre Labour Variance Analysis for Ace Parts Made in January

WORK CENT	OPTR NUM	STD CENT	PARTNUMBER	OPN NUM	BATCHNUM	STD SETUP	STDMC EACH	QTY	STDHOURS	ACTHOURS	VARIANCE	PCT	Deg var 0-100
121	003	121	187/126091	20	452254/	60.00	4.84	44	4.55	7.50	-2.95	64	******
121	003	121	187/165122	10	452359/	30.00	2.25	50	2.38	4.00	-1.63	67	*******
121	003	121	187/165122	20	452359/	30.00	1.75	50	1.96	4.17	-2.21	112	**********
121	003	121	187/475129	30	454078/	90.00	10.00	29	6.33	9.00	-2.67	41	****
121	003	121	187/491036	30	454030/	60.00	4.30	62	5.44	9.42	-3.98	72	*******
121	003	134	187/812021	30	452156/	90.00	4.00	90	7.50	10.00	-2.50	32	***
					TOTALS FOR OPERATOR 003				28.16	44.09	-15.93	57	******
121	004	121	187/122069	10	452257/	30.00	2.25	30	1.63	6.25	-4.63	284	**********
121	004	121	187/125113	30	452916/	30.00	3.00	30	2.00	3.00	-1.00	49	*****
121	004	121	187/125113	10	452916/	30.00	6.00	30	3.50	9.92	-6.42	182	**********
121	004	121	187/126091	20	452254/	60.00	4.84	10	1.81	1.50	0.31	-16	
121	004	121	187/444041	80	453002/	60.00	4.00	50	4.33	11.00	-6.67	153	**********
121	004	121	187/444047	90	453020/	90.00	5.00	70	7.33	20.00	-12.67	172	**********
					TOTALS FOR OPERATOR 004				20.60	51.67	-31.07	151	**********
121	005	121	187/126097	70	452705/	30.00	2.75	20	1.42	2.00	-0.58	40	****
121	005	121	187/131181	10	453917/	30.00	1.00	60	1.50	1.50	0.00	0	
					TOTALS FOR OPERATOR 005				2.92	3.50	-0.58	20	**
121	006	121	187/101088	70	451894/	60.00	2.00	30	2.00	2.25	-0.25	12	*
121	006	121	187/434024	20	453856/	90.00	6.00	30	4.50	5.42	-0.92	19	**
121	006	121	187/474062	40	452038/	60.00	1.00	30	1.50	2.00	-0.50	32	***
121	006	121	187/474062	30	452038/	60.00	2.00	30	2.00	7.75	-5.75	287	**********
121	006	121	187/474062	40	454029/	60.00	1.00	30	1.50	3.25	-1.75	116	**********
121	006	121	187/474062	30	454029/	60.00	2.00	30	2.00	5.00	-3.00	149	**********
121	006	121	187/475129	30	454078/	90.00	10.00	4	2.17	2.25	-0.08	3	
121	006	134	187/812021	40	452156/	90.00	5.00	18	3.00	5.75	-2.75	91	*********
121	006	134	187/812021	40	452156/1	90.00	5.00	38	4.67	9.25	-4.58	97	**********
121	006	134	187/812021	30	452156/1	90.00	4.00	38	4.03	8.50	-4.47	110	**********
121	006	134	187/812021	40	452156/	90.00	5.00	32	4.17	8.83	-4.66	111	**********
					TOTALS FOR OPERATOR 006				31.53	60.25	-28.72	91	*********
121	007	121	187/122069	20	452257/	30.00	2.25	15	1.06	2.67	-1.61	150	**********
121	007	121	187/125137	10	453358/	60.00	5.00	30	3.50	7.83	-4.33	123	**********
121	007	121	187/125137	20	453358/	60.00	3.00	30	2.50	6.25	-3.75	149	**********

WORK CENTRE LABOUR VARIANCE ANALYSIS FOR ACE PARTS MADE IN JAN

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APPENDIX 8.7

WORK CENT	OPER NUM	STD CENT	PARTNUMBER	OP'N NUM	BATCHNUM	STD SETUP	STDMC EACH	QTY	STDHOURS	ACTHOURS	VAR-ANCE	PCT	Deg var 0-100
121	007	121	187/144051	10	452260/	30.00	3.00	50	3.00	5.42	-2.42	80	********
121	007	121	187/172107	20	453567/	60.00	1.00	30	1.50	2.67	-1.17	77	********
121	007	121	187/172107	30	453567/	60.00	2.00	30	2.00	1.67	0.33	-16	
121	007	121	187/172107	40	453567/	30.00	1.00	30	1.00	3.00	-2.00	199	**********
					TOTALS FOR OPERATOR 007				22.46	50.68	-28.22	126	**********
121	008	123	187/393010	20	451979/	60.00	1.00	40	1.67	2.00	-0.33	19	**
121	008	121	187/422071	30	454092/	60.00	1.50	21	1.53	1.50	0.03	-1	
121	008	121	187/422071	20	454092/	60.00	3.00	21	2.05	2.50	-0.45	21	**
121	008	121	187/423003	20	454134/	30.00	7.00	28	4.77	8.50	-3.73	77	********
121	008	121	187/447049	40	454023/	30.00	1.50	37	1.43	2.50	-1.08	74	********
121	008	121	187/447049	30	454023/	30.00	2.00	37	1.73	2.50	-0.77	43	****
121	008	121	187/474008	5	454093/	60.00	2.00	45	2.50	2.50	0.00	0	
121	008	121	187/491013	40	452522/	60.00	2.00	45	2.50	2.50	0.00	0	
121	008	121	187/492064	20	453833/	60.00	3.00	40	3.00	4.33	-1.33	43	****
121	008	121	187/496005	30	454083/	60.00	2.00	18	1.60	1.75	-0.15	8	
121	008	121	187/496005	20	454083/	60.00	3.00	18	1.90	2.50	-0.60	31	***
					TOTALS FOR OPERATOR 008				24.67	33.08	-8.41	34	***
121	009	121	187/125136	20	453357/	60.00	6.00	29	3.90	13.00	-9.10	232	**********
121	009	121	187/172081	40	451825/	60.00	6.00	30	4.00	9.50	-5.50	137	**********
121	009	121	187/475129	50	452518/	90.00	15.00	30	9.00	12.00	-3.00	32	***
					TOTALS FOR OPERATOR 009				16.90	34.50	-17.60	104	**********
121	010	121	187/151094	10	453420/	30.00	2.25	60	2.75	6.00	-3.25	117	**********
121	010	121	187/151094	20	453420/	30.00	1.75	60	2.25	6.00	-3.75	166	**********
121	010	121	187/196012	10	453498/	30.00	3.25	120	7.00	5.50	1.50	-20	
121	010	121	187/196012	10	453990/	30.00	3.25	200	11.33	12.17	-0.84	6	
					TOTALS FOR OPERATOR 010				23.33	29.67	-6.34	27	***
121	011	121	187/165036	10	452928/	30.00	1.75	120	4.00	4.50	-0.50	12	*
121	011	121	187/165036	20	452928/	30.00	1.25	120	3.00	4.50	-1.50	49	*****
121	011	121	187/171129	10	452912/	30.00	2.25	60	2.75	2.75	0.00	0	

WORK CENTRE LABOUR VARIANCE ANALYSIS FOR ACE PARTS MADE IN JAN

WORK CENT	OPER NUM	STD CENT	PARTNUMBER	OP'N NUM	BATCHNUM	STD SETUP	STDMC EACH	QTY	STDHOURS	ACTHOURS	VARIANCE	PCT	Deg var 0-100
121	012	121	87/126029	10	453833/	30.00	2.00	40	1.83	3.00	-1.17	63	******
121	012	121	87/126029	15	453833/	30.00	2.50	40	2.17	4.25	-2.08	95	**********
121	012	121	87/163034	10	453819/	30.00	1.75	40	1.67	2.00	-0.33	19	**
121	012	121	87/163034	20	453819/	30.00	0.75	40	1.00	1.00	0.00	0	
121	012	121	87/165126	10	452917/	30.00	1.25	30	1.13	2.75	-1.63	143	**********
121	012	121	87/165126	20	452917/	30.00	0.75	30	0.88	0.75	0.13	-13	
					TOTALS FOR OPERATOR 012				10.92	19.25	-8.33	76	********

SUMMARY FOR WORKCENTRE 121

STD HOURS	ACT HOURS	VARIANCE	PCT	DEG OF VAR
192.49	339.94	-147.45	77	********

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