Farm Business Analysis

University of Reading

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A Systematic Approach to Farm Business Analysis Without Accounts Data.

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A SYSTEMATIC APPROACH TO FARM BUSINESS ANALYSIS WITHOUT ACCOUNTS DATA

A methodology for exploratory business efficiency diagnosis, based on comparative business analysis technique using standard data and basic physical farm records; with a design format for farm business data systems

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Section 1.

PREFACE

Systems of farm business analysis have traditionally been based upon the analysis of the annual accounts.

Recent research by the Author reveals that this frequently leads to situations where:-

1. A dangerous level of inaccuracy can become unwittingly incorporated into the analysis from inadequate or improperly prepared or interpreted accounts.

and/or

2. Considerable delay occurs between the completion of the business year and the analysis of it, so that farming mispractice cannot be corrected or farming improvements brought about in a timely fashion.

These situations alone are strong grounds to stimulate the search for alternative methods of business analysis which do not depend upon the accounts. The case is strengthened by the time consuming nature of the book-keeping and accounting procedures necessary to fulfil the requirements of current analytical systems.

Examination of the main established methods of whole-farm business analysis, such as those practised by the National Agricultural Advisory Service and the majority of University Agricultural Economics Departments, reveals that a large part of existing efficiency analysis procedure is carried out without reference to the farm accounts. Other parts of the analysis for which accounts data are used are generally capable of alternative non-financial forms of solution.

These features of existing whole-farm business analysis practice have not been generally realised and so the meaningful analysis of the farm business is generally and quite wrongly assumed to be possible only through the accounts data.

This booklet describes a modified system for business analysis based upon existing methods, but involving certain new and modified concepts and procedures.* It has been developed by the Author in the Department of Agriculture at the University of Reading and tested on local farms over several years. It aims to provide a simple and effective method of business efficiency analysis which can be carried out with minimum trouble at any time of the year and without the need for reference to accounts data.

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* The Author acknowledges that the pattern of this analysis and many of the calculation procedures within it, are basically adaptations of the original concepts for whole-farm business analysis as introduced by C.H. Blagburn and subsequently consolidated and refined by A.K. Giles in the Department of Agricultural Economics at Reading University. Modification of these has been made where it represents an improvement in the simplicity and ease of carrying out and interpreting calculations and where it permits the exclusion of accounts data from the analysis.

The analysis combines those parts of established technique which do not require accounts data, with other procedures which substitute for the function of the accounts. It improves upon the logic of the traditional approach and the meaningfulness of some efficiency measurements by introducing new or modified calculations. Also by fusing certain traditional procedures for whole-farm comparative analysis with those of the more recent gross margin analysis system.

The methods outlined can be quickly and conveniently used by the advisor, or any farmer of average intelligence and enquiring mind, to evaluate past business performance and check upon future plans. It is not claimed that the system forms a complete substitute for present methods of analysis and there are occasions when reference to the accounts can provide superior data. However, using this method, considerable progress towards the understanding of the farm business and its basic deficiencies is possible, and a great saving can be made in the time spent in making traditional analysis.

The data sources used are of the utmost simplicity being mainly those for which there is already a statutory requirement for Census Return and Animal Movement purposes, namely the crop acreages and livestock numbers. Yield records, if they exist, may also be used. The only other information required concerns the standard levels of performance of comparative farms*.

The system makes a useful tool for the first exploratory analysis of a farm business and it can be supplemented by other techniques for the more refined probing of the business at a later stage. It is hoped that the adoption of this method by farmers and their advisors. together with the preparation by interested Economists of standard data to supplement that in this booklet, will lead to the more prompt and accurate control and planning of far greater numbers of farm businesses, and a considerable saving in the effort and cost of its accomplishment.

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* Some standards are published in this booklet and others are readily available from published sources or can probably be supplied upon request by local N.A.A.S. personnel or University Agricultural Economics Departments.

Section 2

THE BACKGROUND TO CURRENT FARM BUSINESS ANALYSIS SYSTEMS AND THE WEAKNESSES OF FARM ACCOUNTS AS A BASIS FOR BUSINESS ANALYSIS

The most widely used method of farm business analysis is known as Comparative Business Analysis. It is based upon:

a) The processing of simple accounts data to produce "yardsticks" of business efficiency.

b) The comparison of these "yardsticks" with standards of performance for farms of similar type.

Prior to the introduction of this system farm business analysis procedures were based upon complex accounting systems such as full cost accounting. Here any comparisons made were usually limited to the results of earlier years or theoretical targets set for the business. The considerable complexities of recording and interpretation involved, together with the limited revelations arising from the analysis did not encourage the widespread adoption of the method.

It was not until the 1930's that any significant developments took place in the concept of using simpler records and accounts in which the analysis was based upon comparisons with averages and standards derived from samples of farms, for which the causative factors of profit were isolated and measured. Even then participation in such business analysis was restricted to the relatively small numbers of farmers co-operating in the University based Farm Accounting and Costing Schemes.

Very few farmers kept accounts until 1940, but following the passing of new legislation then, which made farms taxable on the basis of profits, increasing numbers of farmers have kept accounts each year. Even so, until comparatively recently, relatively few farmers understood their accounts or could draw the essential business implications from them without professional advice.

It was only during the 1950's that readily accessable comparative data, simple analysis procedures and informed advice became available to the bulk of farmers who were not participating in the limited University Agricultural Economics Departments' Accounting and Costing Schemes. Until then the now widely used procedures for the appraisal of the farm business through the accounts did not exist. Afterwards it took several years for them to become generally known amongst farmers and even their Advisors.

Since then, however, first through the operation of the Universities' Agricultural Economics Liaison Officers and more latterly the Farm Management staffs of the N.A.A.S., the methods have been extended both in scope and the extent of their use.

Farm Business analysis procedures have mainly continued to be based firmly upon the use of the farm accounts data. In the most widely used systems, analysis involves the comparison of the farm with the results of a sample

of similar farms (or sometimes with theoretical targets for the farm or farm type). Such analyses are generally only carried out after the accounts have been processed by the farmer's accountant.

Over the years there has been much criticism of the comparative business analysis system. It has come mainly from the more theoretical element of agricultural economists. Most advisers using the system in the field have found it to be an adequate working tool introducing a logical approach to business analysis. It has proved capable of providing sound appraisals of farm business situations, providing that care is used in the preparation of data and in the interpretation of the analysis.

Latterly, the system has been extended to incorporate the gross margin analysis of component enterprises in the farm business, but to date these procedures have tended to be "tacked on" to the original system rather than forming an integral part of the analysis. They do however obviate one criticism of the system which concerns the possible masking of inefficient sectors of the business by efficient ones, which could occur within the scope of a "whole-farm" analysis.

Criticisms levelled against the system have been mainly concerned with the validity and difficulties of the comparative concept. That is, the problems which arise in comparing a particular farm with the results of a sample, as a guide to diagnosing areas of inefficiency and choosing corrective action. Other criticisms have concerned the fact that whole-farm analysis is not sufficiently penetrating of the interior of the business, and that the comparative samples themselves are deficient. Also the individual's farm results are so variable from year to year that meaningful interpretation of normal efficiency levels is difficult.

By "normalising" farm and sample results, or using theoretical comparative data, these latter criticisms can be countered. Further, the basic analytical system can be supplemented to inquire into the problems within sectors of the business as well as those problems which concern the relationship between the sectors. Most of the points concerning misinterpretation of analysis, which it has been suggested may occur, prove unlikely providing the adviser approaches the analysis in a reasonably enquiring manner and does not jump to conclusions without considering the whole of the evidence.*

Until now very little criticism has been made of the suitability of the accounts themselves as the basis for a business analysis system. The variability from year to year in a particular farm's results has been criticised, but inadequacies in other respects have tended to go unnoted.

The Author has found in his investigations of analytical systems, a number of disturbing features in accounts data which must prevent properly effective use being made of the analysis. These, together with other valid

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* Prints of a comprehensive treatise on the validity of the whole farm comparative analysis system are available on request from the Author.

criticisms of the methods used (most notably the assumption of a positive relationship between output and costs) have prompted the proposals for the revised system of business analysis which forms the basis of this booklet, and in which accounting data does not form a necessary reference point in the procedure.

The problems arising from the use of accounts data concern:-

1. Accuracy A disturbing level of unintentional inaccuracy has been found in samples of accounts investigated. In a sample of 25 accounts from general farms* examined prior to the accountant's scrutiny, but thought nevertheless by the farmer to be complete and accurate, modal discoverable inaccuracies amounted to + or - 3 per cent of the total costs and/or gross output. Sixty per cent of the accounts had this level of inaccuracy. This level represented from 10 to 50 per cent error in the farms' profits as calculated. Errors in some cases amounted to nearly one fifth of the value of output or costs and invalidated the calculated profits to the extent of several hundred per cent.

Estimates made by three accounting firms indicate that between 15 and 25 corrections of a greater value than £5 each are necessary to the entries in the books on most farms they handle. The value of the corrections to expenditure as a percentage of total expenditure vary generally from 2-5 per cent while the value of the corrections to income as a percentage of total income vary generally from 3 to 8 per cent.

In addition to such book-keeping errors, there are those arising from faulty valuation. The valuation figure, being usually from 30 per cent upwards of the value of costs or output, can with a small error have very serious effects on profits.

The Author has no quantitative information concerning such errors, but long association with farm accounts reveals a very high proportion of cases in which the initial valuations made need to be modified in the light of subsequent experience, if they are to form a reliable basis for business efficiency assessment.

It must be recognised that not all errors are unintentional and that a certain amount of "prudent" book-keeping and valuation occurs for taxation purposes. There may also be certain treatments of the data which are unrelated to the business situation, being taxation concessions and conventions. These things render the accounts in their taxation form unsuitable for business analysis. If the alternative of keeping a second set of accounts for business analysis is made, there is a danger that these, not being subject to the scrutiny of a professional accountant, may contain errors of a serious proportion.

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* All of these accounts were kept under the Cash Analysis system without the use of cash/bank reconciliation columns. This form is similar to the recommendations as made in the N.F.U. Farm Records & Accounts book - the most widely recommended business record book, which has been designed to fit in with current analytical systems as operated by the N.A.A.S., University Agricultural Economics Departments and certain commercial advisory divisions.

Because of the problems of accuracy the business analysis is often deferred until after the accountant has scrutinised the books and valuations and prepared his statements of Balance Sheet and Trading Account. This produces further problems:-

2. Promptness There is usually several months delay between the accountant receiving the books from the farmer and completing his investigations. Of seventeen farmers with an April 5th year end questioned on their experience with the 1964-65 accounts year:-

two had accounts completed and returned by the Accountant within 3 months of submission

two " " " " " " " " 4 "

one " " " " " " " " 5 "

three " " " " " " " " 6 "

four " " " " " " " " 8 "

one " " " " " " " " 12 "

three " " " " " " " " 15 "

one had not had the accounts completed and returned by the Accountant within 26 months of submission

For the majority of farms having a spring or summer financial year ending date, there is a sufficient interval to prevent the incorporation in the coming season's plans of improvements which are suggested by the analysis as being desirable. It may be only in the 2nd year after the costed year that improvements can be implemented, by which time the situation may have changed again so as to require different actions.

3. Detail and Pertinance The majority of those carrying out business analysis favour working from the prepared accountant's statement rather than from the account books and valuation which are time consuming to use and also difficult for anyone without a specialised accounting training to understand - particularly after being subjected to modification and correction by the Accountant.

Unfortunately, accountants' statements, while suitable for taxation purposes, tend to fall short in setting out details likely to be useful in conducting a business management analysis.

Furthermore, they are prepared with a view to legitimately minimising the farm's taxation liability rather than to indicating business set up and efficiency. For this reason, complex modification may be necessary to them, and it is often very difficult to accomplish it accurately without recourse to a detailed examination of the account books and valuations.

4. Time and Effort Another feature which tends to mitigate against the usefulness of the accounts as a basis for business control, is the considerable time spent in book-keeping. On a two-hundred and fifty acre mixed farm, a farmer records that he spends approximately 180 hours in the year on matters associated with accounting. Admittedly much of this is inescapable because of the necessity to control the financial affairs of the business and keep

tax records. However, another farmer indicates that on his 300 acre mixed farm the keeping of a separate "management appraisal only" set of account books and valuations (kept in addition to the taxation set) involves him in over 40 hours of work in the year. Furthermore, analyses which are based upon accounts tend to be more time consuming than those which are not.

It should be borne in mind that the farmer's time is probably the most scarce and valuable spent on the farm. Whether he is currently spending it well on management accounts, can only be judged in relation to the effectiveness of any alternative form of non-accounting business analysis which might be substituted.

The shortcomings in an accounts-based system of comparative business analysis, necessitate the development of a system which can function independantly of the accounts.

The potential to develop such a system can be seen by identifying the various types of business deficiencies and then investigating possible ways in which these could be revealed and measured by procedures which do not require accounts data, at least in any complete form.

Most basic farm business deficiencies are of one or both of two types; those arising from:-

1. The system and technique of farming practised - that is, the types of enterprises present, their intensity and form of management. It is possible to judge the inherent potential of any system to incur costs, produce output or make profits by applying to it standard levels of inputs, yields and prices. For example the potential yield or costs of a herd of 40 cows can be determined by multiplying the normal (standard) yields or costs for a cow by 40. A similar but more extended calculation could reveal the potential of a whole farm system. By comparing this with the potential of other farms similarly calculated, a guide to system and technique adequacy can be gained.

2. The performance level actually achieved in relation to that prescribed for the technique. The performance may fail in relation to any of five main factors:-

   a) Product prices
   b) Physical yield levels
   c) Prices paid for resources
   d) Amount of physical inputs used
   e) The timing and phasing of the programme.

   The performance level in any of these factors can be measured through extremely simply physical or financial estimates or records.

It is thus possible for a system of business analysis to be developed in which measurement of the various aspects of efficiency can be made without major recourse to the accounts. This need involve only simple physical records together with estimates of potential farming results synthesised by applying standard performance data to the farm's basic framework.

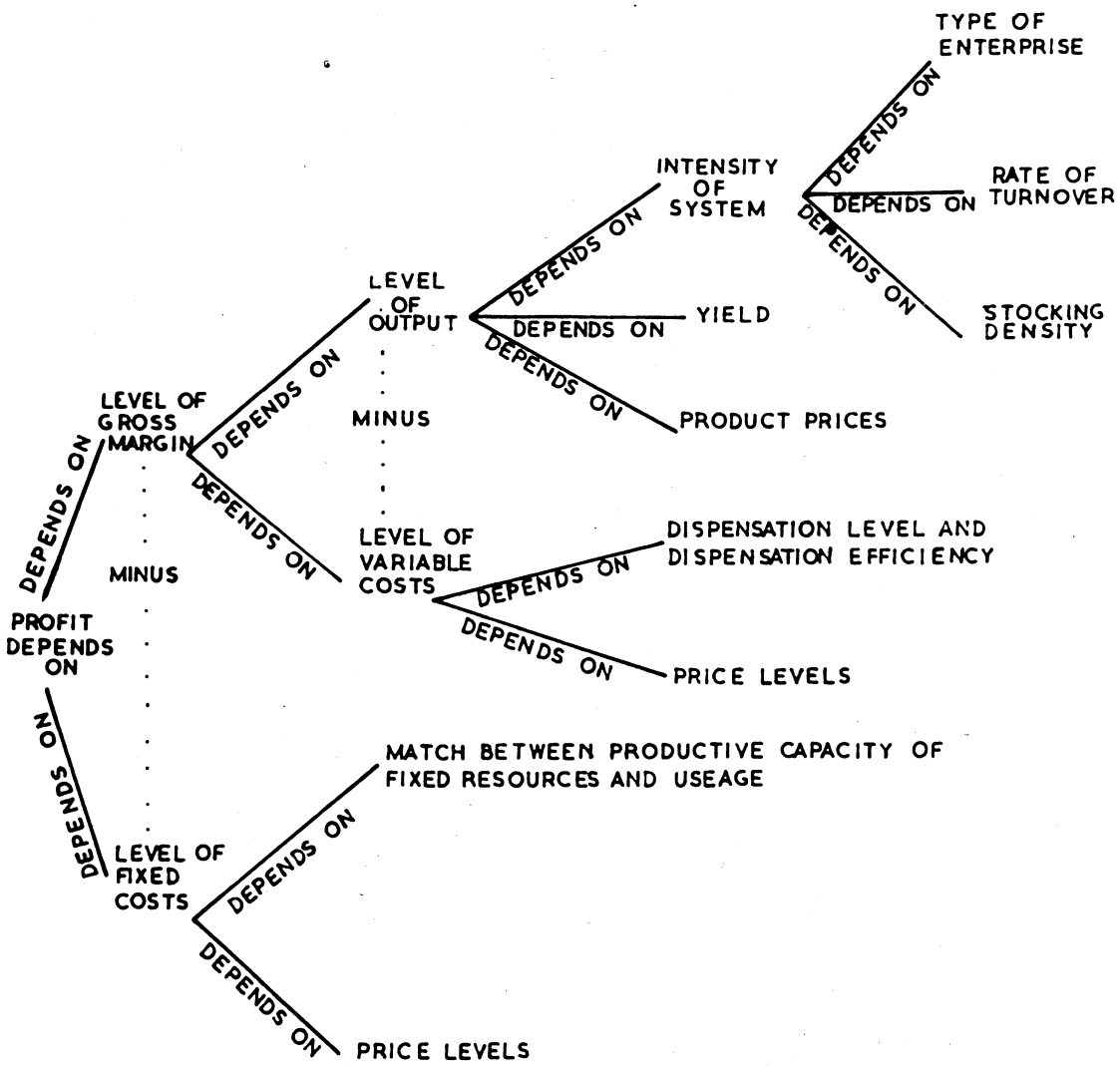
A system evolved and based upon these principles is described in Section 3. Reference to the accounts is only likely to provide the farmer or his adviser with a greater quantitative certainty in respect of two important types of information:-

1. That concerning the farm profits and solvency. This is usually the starting point from which farmers judge their success and out of which stem most desires for improvement. The majority of farmers have a fair idea of their level of profit and solvency for recent years, even if not right up-to-date. These things are calculated by the farmer's accountant as normal procedure when he prepares the annual Trading Account and Balance Sheet. But even where the farmer does not employ an accountant, the state of his bank balance and cash reserves coupled with changes in the quantity and value of the farm stocks and other assets held, usually give a fair indication of whether the position is satisfactory and whether it is improving or not.

2. A precise statement of the relative amounts spent on the various resources used and the values of the different types of output. This data is useful, but it will be demonstrated that information concerning the broad relationships involved can be calculated quite simply and with sufficient accuracy for most analytical purposes from standard data such as that used later in the text. Alternatively, the most useful part of it may possibly be recalled with sufficient accuracy from memory, or other simple non-financial records may be kept to provide the data.

Many farmers have in the past been prevented from making business appraisals by the fact that they do not have up-to-date accounts in a useable form. Alternatively they may fail to understand their Accountant's statements, or the accounts material may be with their accountants for too long a time to be of contemporary value. Irrespective of whether their financial position is critical or not, most will benefit from carrying out the analysis which is suggested in Sections 3 and 4 of this booklet. The system requires the minimum recourse to farm records. Details of crop acreages and average livestock numbers are the main requirements, and the reference tables of standards given, enable the necessary calculations for completing the business analysis to be quickly made. Conclusions regarding business and organisational deficiencies may be drawn and suggestions for improvements should be self-evident.

DERIVATION NETWORK DIAGRAM - ILLUSTRATING THE INTERDEPENDANCIES PRODUCING BUSINESS PROFIT.



STRONG LINKS EXIST BETWEEN THE LEVELS OF INTENSITY AND YIELD AND THE LEVEL OF VARIABLE COSTS. ALSO BETWEEN INTENSITY OF FARMING AND THE LEVEL OF FIXED COSTS.

Section 3

A PROCEDURE FOR BUSINESS ANALYSIS WITHOUT ACCOUNTS

The Nature of Business Deficiencies

The diagram illustrates the principle factors which contribute to business viability. The global factors appear to the left and the more detailed contributory factors to the right. The most influential factors tend to appear towards the top of the diagram and the least influential towards the bottom. Individual circumstances may, of course, vary this general order.

OUTPUT is obviously a very important determinant of profits. Despite the enormous increases in farm production achieved in recent years, the most common farm business deficiency is still inadequate output. It is only possible to judge whether the output of a farm is suitable by relating it to the costs necessary to achieve it. Thus any appraisal of output level must simultaneously be tempered by costs evaluation.

It is helpful to consider the components of output for each may involve a differing level of cost to achieve a marginal advance. The output of the farm is the product of three factors. They are:-

1. Intensity factors. These are:-

a) The types of the farm enterprises present, (that is, whether they are of high output character, e.g. milk cows, potatoes, or sugar beet, or low output character, e.g. store cattle, sheep, cereals, etc.).

b) The livestock acreage and/or housing/yarding accommodation available in relation to the number of animals kept, (that is, stocking density) together with the acreage of productive crops grown in any year in relation to total farm acreage.

c) The rapidity of turnover (e.g. whether fat cattle are produced in one year or two or whether one or two crops are grown on a field in a year).

These three factors, when related to farm size together constitute what the economist terms the intensity of the farm.

2. The level of yields achieved, e.g. milk gallons per cow, cwts. of cereals grain per acre.

3. The prices obtained for the products of the farm, e.g. s. d. per gallon of milk, s. d. per cwt. of cereal grain.

Any one or more of these various factors may be responsible for an inadequate output and profits, and the first task of analysis should be to discover whether any weakness exists in respect of any one of them or the combination in which they occur.

The analysis of accounts data by economists has demonstrated that farms with a high performance in product price or yield are likely to be more profitable than those with just high intensity. This situation is put into a

Table I

EFFECT OF MODIFICATIONS TO INTENSITY, YIELD, PRODUCT PRICES AND COSTS ON BUDGETED PROFITS AND RETURNS TO INVESTMENT (DAIRY, POULTRY AND CEREAL FARM)

	Current £ p.a.	If 25% greater intensity £ p.a.	If 25% greater yields £ p.a.	If 25% better product price £ p.a.	If 25% lower costs levels £ p.a.
Fixed Costs					
Rent	4	4			
Regular labour	12	12	At original level	At original level	At original level
Machinery depreciation	4	4.5			
Non-machinery repairs	2	2			
Miscellaneous	2	2.5			
	24	25	24	24	24
Variable costs					
Feed	20	25	22		
Seed	3	4	3.5		
Fertilizer	4	5	5		
Casual Labour	1	3	1.5		
Machinery repairs	5	6	5		
Miscellaneous	3	4	3		
	£36	£47	£40	£38	£21
Output	£66	£82.5	£82.5	£82.5	£55
Profit margin	£6	£10.5	£18.5	£20.5	£10
Production Costs as % of product income	91	87	78	75	82
Average Annual Investment per acre	£72	£86.5	£74	£73	£65
Profit as % of A.A. Investment	8.3	12.1	25.0	28.1	15.4

practical perspective by by budgets constructed for a farm in S. England, which relate to the impact on profits of increasing intensity, yield, and product price and reducing costs.

The farm is of just over 100 acres in size and carries a dairy herd of about 30 cows and followers, some poultry and about 20-30 acres of cereals.

The Budgets for increasing the intensity are related to increasing the stocking density, reducing replacement numbers reared, and the incorporation of some cash roots into the system.

Yields could be improved by improved fertiliser and feeding practices, new strains of seeds and revised seasonal production policies for the herd and flock.

Product prices could be improved by changes in cereal variety and seasonal production policies for the stock.

Costs could be reduced by prudent dispensation policies and changes in feeding practice in particular.

The table indicates the interrelationships which exist between Intensity and the level of both Fixed and Variable Costs and Investment level. For yield and product price level advances, the relationship is mainly with Variable Costs. This tends to make advancement policies based on improved yields and product prices more profitable and producing a better interest on investment than those based on Intensity increases. They may not however be so easy to implement, which explains the Intensity orientated approach of most farmers to the solution of profit maximisation problems in recent years.

It is worth noting that marginal increases in intensity such as those arising from marginal increases in stocking density and turnover rate are likely to provide a greater business advantage than those which involve major changes to the Fixed Costs pattern of the business such as certain enterprise substitutions.

Measurement of the Intensity of Production

A useful overall measure of the suitability of a farm's intensity level may be calculated using standard enterprise gross margin data derived from the study of the average performances of farms. These figures are the "standard gross margins" per acre or per animal, of crops or stock enterprises, and represent the gross margin which might be expected under normal average conditions from a typical farm. The suggested gross margin standards, which are based on limited investigations by the Author, are generally substantiated by published data for the S. England from University Agricultural Economics Departments. The standards are shown in the third column of the accompanying "Standard data form and calculation sheet", e.g. dairy cows £70 per head, wheat and barley £30 per acre, (see Table II).

The procedure involved, in calculating farm intensity, which may be carried out if desired in the blank spaces of columns 2 and 4 of the standard data form and calculation sheet, is as follows. Write down the average

STANDARD DATA FORM AND CALCULATION SHEET

Table II

(1) Enterprise	(2) Farm Statistics	(3) Standard Gross Margin per year £	(4) Calc. Std. Gross Margin for farm. £. (2) x (3)	(5) Standard Livestock Unit Equivs.	(6) Calc. Livestock Unit equiv. on farm (2) x (5)
	Average nos. carried throughout normal year.*	per head			
LIVESTOCK					
Dairy cows		70		1	
Cattle over 2 yrs. old		15		0.8	
Cattle 1-2 yrs. old		15		0.6	
Cattle up to 1 yr. old		15		0.4	
Barley fed beef		20		0.7	
Ewes plus followers up to 6 months		5		0.2	
Sheep over 6 months		2		0.1	
Sows		17		0.5	
Store & fattening pigs		6		0.25	
Laying hens (p.100)		10		0.02	
Growing pullets (p.100)		25		0.008	
Total Livestock	-	-		-	
CROPS	normal acreage	per acre			
Sale crops					
Cereals		30			
Potatoes		70			
Sugar Beet		48			
Grass Seed		25			
Total Sale Crops					
Conc. Feed Crops					
Bulky " "					
Total useable farm acreage					

* Nos. carried are not the same as nos. produced, e.g. 100 baconers might be produced in a year, but this might represent an average of only 50 carried throughout the year.

numbers of each class of stock carried throughout a normal year (col.2). Multiply them by the appropriate "standard gross margin" per animal shown in column 3 and enter the product in column 4. When totalled, this represents the value of gross margin which might normally be expected from this number and combination of animals on a farm, providing that their performance is similar to the usual results in the area.

Similarly for crops, the acreage of sale crops of each type normally grown on the farm is entered in column 2. This is then multiplied by the "standard gross margin per acre for sale crops" of column 3 and the product entered in column 4. When this section of the column is totalled it represents the value of gross margin which might normally be expected from this acreage and combination of sale crops. Note that forage crop acreages and gross margins are not involved in this calculation as their gross margin is an indivisible part of the margin attributed to livestock and is covered therein.

It is possible to insert in column 3 suitable standard gross margin figures for any other enterprises not covered on the form.*

The total livestock standard gross margins and total crop standard gross margins of column 4 are added together, and the result divided by the total useable farm acreage (cash crop plus forage crop acreages). This produces the standard gross margin per acre of the farm. This can then be compared with the standard gross margins normally achieved by commercially successful farms of a size and type similar to that being investigated. Such standards might be as follows in Table III, but more detailed standards for any local area can probably be provided on request by the nearest University Agricultural Economics Department or N.A.A.S. Officer.

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* The gross margin of an enterprise is calculated as the value of its production (sold plus used on the farm) adjusted for valuation changes, minus purchases of livestock, if any, and other variable costs. Variable costs for crop enterprises consist of the value of seed, fertiliser, spray, contract work, casual labour, fuel, equipment repairs and small sundries purchased.

Variable costs for animal enterprises consist of concentrated foods (purchased and home grown) purchased bulk foods, the variable costs of forage crops used, fuel, equipment repairs, veterinary and medicines, services, fees and small sundries purchased.

It will be noted that overhead and other fixed charges such as rents and rates, regular wages and equipment depreciation are not allocated to specific enterprises.

Table 3 TARGET STANDARD GROSS MARGINS PER ACRE FOR COMMERCIALLY SUCCESSFUL FARMS

	FARMING SYSTEM			
	Mainly Dairy	Mainly Arable	Mixed	Extensive
	£ p.a.	£ p.a.	£ p.a.	£ p.a.
50 to 150 acres	50	40	35	-
150 to 300 acres	40	35	30	20
300 acres and over	35	30	25	15

While the achievement of the above standard gross margins does not necessarily guarantee financial success, the vast majority of farmers achieving these levels are commercially successful. The achievement of these standards should not prevent the farmer examining possibilities for further intensification. It is merely an indication that the farm is likely to be of sufficient intensity to be economically viable.

In some cases the farm's standard gross margin target may not be achieved. This will be for one or more of three reasons:-

1. The enterprises of the farm are preponderantly those types producing lower gross margins, e.g. store cattle rather than cows, or cereals rather than cash roots.

2. There is insufficient density of animals and sale crop acreage for the size of farm.

3. Turnover rates are too extended.

Suitability of the farm set-up in respect of these factors must thus be examined. A mechanism for this is described:-

Choice of enterprises

The relationships between the normal gross margins per acre of the various sale crops is shown in column 3 of Table II and the potential of each to add to the farm total gross margin is readily apparent. The gross margins for livestock are more complex to compare. It cannot easily be done on a headage basis, which is the form in which they are shown in Column 3, and so gross margins per head must be converted to gross margins per acre. Taking typical land requirements, for livestock on farms in S. England, the standard gross margins per acre for the grazing animal enterprises are as follows:-

Cows	£40	
Cattle over 2 years	£10	
Cattle 1 - 2 years	£12	
Cattle under 1 year	£18	
Ewes and followers to weaning	£10	(£25 if creep stocking)
Sheep over 6 months	£12	(£20 if intensive stocking)

By comparing the enterprise gross margins expressed on a per acre basis, those normally giving the highest levels of gross margin per acre are clearly revealed.

While net profit levels are not always completely relative to gross margin levels (because of the fixed costs of production, some of which are specific to certain enterprises) there is, nevertheless, a distinct correlation. Hence, rearranging the emphasis placed on the various enterprises so as to maximise the incorporation of those with the highest gross margins per acre will usually maximise farming profits. If such changes are contemplated, they should always be preceded by a thorough budgetary examination on the particular farm to ascertain that they are sound policy. Any enterprise run at much above or below average efficiency may prove to be more or less valuable to the farm economy than is suggested by the table of standard gross margins. Furthermore, the recombination of enterprise themselves may have a different gross margin structure with a changed level or balance of incorporation in the farm system.

Stocking Intensity

The overall stocking intensity of the farm can be judged from the level of the calculated total livestock gross margin. However, it is greatly affected by the presence of non-land using livestock enterprises like barley-beef, pigs and poultry.

Whether the non-land using livestock are present in sufficient numbers can only be judged by relating their standard requirements for space, labour (and possibly capital) to what is available for their use.

Standards useful for this purpose are:-

	Floor area reqs.p.animal	Av.lab./reqs.p. animal p.day (smallish units)	Peak variable capital* reqs. p. animal
Barley fed beef	35 sq.ft.	4 mins. p. beast p. day	£54
Sows	"	6 mins. p. sow p. day	£54
Fattening pigs	6 - 9 sq.ft. pen + 3 sq.ft. dunging	2 mins. p. pig p. day	£10-£15
Laying Hens (In batteries (1 per cage).	1½-2 sq.ft.p.bird)	10 to 15 mins.p.100 p.day	£1
Laying Hens (in deep litter	3-3½ sq.ft.p.bird)		
Broilers	0.8 sq.ft.p.bird	3 mins. p.100 p.day	£0.3

* excludes capital in equipment

As these are enterprises which can be added to or contracted almost at will, a high incidence contributing to high farm intensity must not be allowed to mask any basic deficiency in the population density of the land using livestock. Thus, the intensity of grazing animals upon the land must be measured. This is most usefully calculated in terms of the numbers of grazing animals (i.e. grazing cattle and sheep) carried by the acreage of bulky forage crops grown and used (i.e. grazing, hay, silage, kale, turnips, etc.).

As the different classes of grazing livestock eat different amounts of food, it is necessary to convert them all to one common type of animal - usually their "cow equivalent" or, as it is more usually termed, their "livestock unit equivalent". A commonly used conversion scale is that printed in column 5 of Table II, the "Standard data form and calculation sheet". The farm's stocking in livestock unit equivalents may be calculated by multiplying average livestock numbers shown in column (2) by the appropriate standards in column (5). The answer may be inserted in column (6).

The total acreage of forage crops grown, together with the addition of an appropriate acreage allowance for purchased bulk forage (e.g. for purchased hay - one ton is taken as equivalent to ½ acre) is divided by the number of grazing cattle and sheep livestock units. A stocking intensity in excess of one such livestock unit per 1.6 acres of forage crops usually signifies a sufficiently heavy stocking policy to produce viable results.

Turnover Rate - an examination of the length of production periods and speed of production rate should be made.

For example

	Target
Calving interval	365 days
Litters per sow per year	2
Weeks to fat (barley beef animal)	50
Weeks to fat porkers 125 lbs.	18
Weeks to fat baconers	26
Weeks to fat heavy hoggs	30
Weeks to fat broilers	$6\frac{1}{2}$

The extent of double cropping of land may also be examined.

Of even greater importance than the intensity factors in their effect on farm profits, are the factors of yield level and the prices achieved for the farm products.

Yields

Yield levels are closely correlated with net profits. This is because good yields only involve the application of increased levels of certain resources, such as the production part of rations fed, or fertilisers or seed costs. The other costs including overheads and fixed charges such as rents, machinery overheads, possibly wages and maintenance ration foodstuffs tend to be unaffected.

The adequacy of crop yields is usually best judged in terms of the quantity produced per acre grown. In compiling crop yields care is necessary, for experience shows that the farmer's first overall estimate of his yields is invariably higher than the true average when worked out. Obviously the level of satisfactory crop yields varies from area to area, but minimal comparative standards which will usually contribute to properly profitable farming are:-

Cereals	30 cwts. per acre
Sugar beet	12 tons per acre
Potatoes (main crop)	9 tons per acre
Mangolds	25 tons per acre
Turnips and Swedes	18 tons per acre
Hay	40 cwts. per acre per main cut
Silage	6 tons per acre per main cut
Grazing	0.6 Livestock Unit Equivalents grazed per acre per year

Similarly for livestock:-

Cows	More than 850 galls. per year
	Less than 380 day calving index
Fattening cattle	2 lb. live weight gain per day
Ewes	135 per cent lambing
Lambs	2 lb. live weight gain per week
Sows	15 piglets weaned per sow per year
Fattening pigs	weaner to pork wt. 1.2lb. live weight gain per day
	weaner to bacon wt. 1.3 lb. live weight gain per day
	weaner to heavy hogg 1.5lb. live weight gain per day
Laying hens	17½ doz. eggs per layer housed per year

With livestock, it is more difficult to judge the minimal acceptable level of yield than with crops, for a greater proportion of production costs can be expanded or contracted according to yield level. Also if the stocking density and turnover rate are high enough, they can produce adequate yields per acre to enable good profits to be made, despite quite low yields per animal.

Prices

There is a most direct relationship between the farmer's performance in selling as judged by the prices of the products he sells, and his profits. No guide as to what constitutes a satisfactory price can be given. Indeed, the margin between a good price and a poor price may not be very great, but it is a margin that is reflected in direct and almost equal amount by changes to the profit. The satisfactoriness of product prices thus must be judged in relation to the prevailing market prices for the quality being offered.

Care is necessary not to confuse intended low prices (as when coupled to a low cost system, e.g. summer milk production) with those which arise from poor marketing timing, poor placement in the market or inferior quality. Some examination of past experience on the farm may do much to improve future selling results.

Any major form of inadequacy in the nature and value of farm production should be apparent if the foregoing calculations and assessments have been made. The first ideas for correction or the improvement of the farming system may now begin to form. However, no attempt to crystallise these should be attempted until the analysis has been taken further and the economy of resource use examined, for production and cost policies are closely inter-dependent and neither can be considered in isolation.

Costs

Importance of cost levels

Generally cost levels are less significant in determining profits than the level and value of production achieved. All costs put together usually come to less value in total than the farm production. Furthermore, the levels

of only certain cost items can be subjected to increase or decrease as a direct result of the farmer's care and methods of dispensation. Those which can, are known as variable costs, such as the feed, seed and fertiliser bills, and repair charges. They account in total for about sixty per cent of all farming costs. Thus, even if the farmer uses twenty-five per cent too much of them it detracts from his profits only to the same extent as fifteen per cent under-production.

The remaining farming costs are basically fixed in nature, and are mainly, but not entirely overheads such as the rents and rates, machinery depreciation and the regular wages bill. In absolute level they have less potential for modification by the farmer's policies, and then only in the long term. Their incidence in the total production costs of any farm product is influenced by the amount the farmer can employ them. If they are fully employed, they present a smaller charge against each item produced than if they are under-employed.

Judging efficiency in costs

In deciding the efficiency with which the farm resources are used, it is customary and useful to draw the distinction between costs of a "variable" and "fixed" nature.

Resource utilisation analysis proceeds first by an examination of the variable costs, for these have the most obvious link with profitability. They can be subjected to control, expansion or contraction, as a group they represent the biggest part of total production costs, and individually some are of very substantial size. They have a great influence on performance levels. They thus constitute a key-stone to farm efficiency.

Food Usage

By far the most important variable cost on most stock-keeping farms is that for foods, representing anything from one quarter to one half of all farming costs. It may be much higher on specialised pig or poultry units.

There are two aspects of efficient feeding to be examined, that of using the bulk foods and that of using the concentrate foods. A useful measure of bulk-food utilisation (forage acres required per livestock unit of grazing cattle and sheep) has already been described. It should be interpreted in relation to the level of concentrate feeds also used and the resulting yields.

In assessing the efficiency of concentrate feeding the first step is to ascertain the quantity of concentrate foods fed, both home grown and purchased. This may necessitate reference to the merchant's invoices or perhaps the information is available in the granary book or enterprise food store records if kept. Whatever method is adopted it is necessary to calculate the total quantity used within a 10 per cent accuracy or better.

The weight of concentrates fed is then converted to crop acreages in terms of the farm's average yield of cereals per acre*, and the resultant

*This is preferable to the more normal practice of allowing 1 acre for each ton of concentrate food purchased.

acreage added to that of the forage crops grown and purchased. This produces what the economist calls the "adjusted feed acres" of the farm. This is then divided by the total number of livestock units of all types on the farm (calculated as outlined earlier in column (6) of the standard data form - Table II.

The resulting "feed acres used per livestock unit" must be interpreted in relation to forage (bulk) crop utilisation and the yields achieved.

In general, a figure of not more than 2.5 feed acres per livestock unit indicates economically successful overall feeding practices.

It will be appreciated that the above calculation is a fairly approximate measure of efficiency and certainty is greatly improved if the quantity of concentrate foods consumed by each of the major concentrate food using enterprises is known. In interpreting these, the following standards present some guide as to whether concentrates are being extravigantly fed.

Dairy cows

	Herd Annual Average Milk Yield per Cow		
	700 gall.	900 gall.	1,100 gall.
Maximum cwt. of conc. foods per cow	15	28	40

Autumn calving herds may be expected to use more concentrates than spring calving herds. The contribution to the ration from bulk foods also affects acceptable concentrate feeding levels, as does the quality of the concentrate feeds.

Barley fed beef

Maximum of 33 cwts. concentrates per animal produced.

Pigs

Heavy Hoggs - Maximum of $8\frac{1}{2}$ cwts. of concentrates per pig fattened.

Baconers - Maximum of $6\frac{1}{2}$ cwts. per pig fattened.

Porkers (140 lb. l.wt.) Maximum of 4 cwts. per pig fattened.

Laying Hens

100 lbs. per bird per year (more for heavy breeds)
$6\frac{1}{2}$ lbs. per dozen eggs (" " " ")

It will be appreciated that factors other than feeding practice affect feed conversion efficiency - the breed and strain of animal, type of accommodation, season of the year, incidence of mortality, etc. These must be taken into account in interpreting the consumption levels.

The remaining variable costs of major importance are fertiliser and seed bills, fuel and repair costs, plant and animal health protection costs and some miscellaneous items.

Fertiliser Usage

Few, if any, farmers have reached diminishing returns to their fertiliser applications. It is thus unlikely that any farmer need fear he is applying too much. However, he may not be applying enough, or he may be applying the wrong sort of fertiliser. For example, many farmers are applying phosphate to soils in which they have built up adequate reserves over the years.

As a first broad indication of sub-optimal fertiliser applications, any farmer with the minimal yields and stocking density capacities recommended who is spending less than £5 per acre over the useable farm acreage (excluding rough grazing) is probably using insufficient. In round terms costs may be calculated, taking the standard of 25s. per cwt. for compounds and 15s.0d. per cwt. for straight nitrogenous fertilisers. Obviously the level of application necessary will depend on the type and level of cropping and stocking. Six pounds an acre might be inadequate on a cash roots farm and two pounds an acre too much on a hill sheep or extensively grazed cattle farm. However, there is generally little to fear that over-optimal dressings are being given unless there are obvious problems such as cereals lodging or an inability of the livestock to consume and utilise the forage grown. Analysis should concentrate on seeing that enough fertiliser is given and that it is of the right sorts. In this matter of securing optimal dressings "hit and miss" changes of policy are not to be advised, for the benefits of costs savings are small in comparison with the losses that can arise from reduced crop yields. It is most sensible to have soil analysis made and the N.A.A.S. and many fertiliser companies and merchants will undertake it free of charge.

A similar policy should apply in relation to seed costs. Here what is only a very minor section of farm costs (usually less than 5 per cent) can have an enormous effect on yields. Hence, the level of expense must be related to the production achieved. It can be that the repeated use of low cost and home grown seeds is amongst the worst investments the farmer can make.

The efficiency with which the farmer spends on equipment repairs and animal and plant protection can really only be subjectively appraised. It appears, however, that as farming becomes more intensive and as costs and investments rise, so it becomes more important to avoid failures in achieving the necessary output. Thus, money spent on precautions against failure should never be recklessly cut down.

Fixed costs

These are composed of such charges as the rents, rates, fees and subscriptions, insurances, machinery depreciation, regular wages and other farm overheads.

Achieving economy in their use is mainly through the scale and yield of the business. The greater these are, the less the fixed costs are represented in the costs make-up of each item produced.

Concerning the true fixed charges such as rents, rates, fees and subscriptions etc., there is little the farmer can do other than to ensure that the output

Table IV

STANDARD LABOUR AND TRACTOR REQUIREMENT DATA AND CALCULATION SHEET

(1) Enterprise	(2) Farm Statistics	(3) Standard man day* requirements per year	(4) Calc.std.man day reqs. of livestock & crops (2) x (3)	(5) Standard tractor day* requirements per year	(6) Calc.Std.tractor day requirements of livestock and crops (2) x (5)
	Normal Av. No.	per animal		per animal	
Cows (parlour)		11		1	
Cows (cowshed)		15		1	
Suckling cows		2		1	
Bulls		3		1	
Cattle over 2 years		3		0.6	
Cattle 1-2 years		3		0.6	
Cattle under 1 year		3		0.4	
Ewes and rams		1		0.1	
Sheep over 6 months		0.3		0.1	
Sows		4.5		0.3	
Boars		2		0.3	
Store and fatt. pigs		1.5		0.06	
Laying hens		0.2		0.005	
Growing chicks		0.1		0.002	
	Normal acreage	per acre		per acre	
Cereals (combined)		2		1.25	
Potatoes		18		3.5	
Sugar Beet		14		3.5	
Brassicas for sale		25		2.0	
Mangolds, swedes		13		3.5	
Herbage seed		1.5		1	
Kale cut and carted		9		5.0	
Kale folded		2		1.5	
Fallow		1		1	
Hay (p.cwt)		1.5		1	
Silage (p. cwt)		1.5		1	
Grazing		0.3		0.25	
Total					

* An eight hour day

of the business is appropriate to them. It is, therefore, not very productive to try to measure their utilisation.

However, for the other fixed resources such as the regular labour and machinery, good organisation can enable them to become more productive in themselves. Hence, analysis of the efficiency with which they are used is pertinent to problems of improving the farm business. The importance is obvious, for labour and machinery fixed charges (i.e. depreciation and insurances, etc.), together account for something like 35 to 40 per cent of all farming costs.

The efficiency measures which are suggested for these factors involve the comparison of the farm's theoretical labour and tractor requirements with the quantity of labour and tractor power actually available.

In Table IV standard labour and tractor requirements for various types of farm stock and crops are given (columns 3 and 5) and these may be multiplied by the farm's normal average livestock numbers and crop acreages shown in (column 2) to give the standard labour requirements (column 4) and standard tractor requirements (column 6) of the farm system.

These are then related to the number of workers averaged over the year, and the number of working tractors (excluding reserve or belt-work machines).

When allowance is made for farm work which cannot be directly attributed to the crops or stock, seasonal slacknesses and pressures, time off, holidays etc. on the normal efficiently run arable farm an average performance per worker of 250 standard man days and 150 standard tractor days per tractor should be achieved. On livestock farms the labour performance should be about 20 per cent better (i.e. 300 std. men days per man).

Where poor utillsation occurs further study may be made of contributory factors such as:-

Uneven seasonal work requirements leaving slack periods of the year
Uneconomically sized or badly laid out enterprises
Inadequate equipment
Poor organisation and supervision of workers and machines and the use of bad methods.

There is frequently some association between extravagance with tractor power and the total extent of mechanisation on the farm. Thus, if tractor utilisation appears poor, some subjective appraisal is often worthwhile of the adequacy or over adequacy of all the farm equipment.

Several years experimentation with the system of analysis reveals that it is capable of diagnosing many of the weaknesses in farm businesses. It is however a relatively superficial method and it must be recognised that the existence of reliable accounting data may help in the refinement of problems indicated by the technique, and in the budgeting of improvements. Thus it does not necessarily displace the keeping of accounts for business analysis purposes.

A word of caution is necessary to those who will use the system. In certain parts the analytical procedures do not penetrate the economy of enterprises or sectors of the business, only measuring success through the results achieved from the business as an integrated whole. While this is the ultimate criterion of efficiency, care is necessary to see that success in certain aspects or sectors of the farm business is not masking inefficiency elsewhere.

Also, in using the forms of analysis suggested, any tendency to act upon evidence from an isolated efficiency measure without further consideration, should be resisted. No one sector of the business can be divorced from the others. Resource use and production are so interlinked that sound appraisal can only be made in the light of reviewing all the efficiency measures simultaneously.

It may well be that following the exploratory analysis of the business as outlined, a more detailed examination of the component sectors may be desirable. For this to be accomplished with maximum effectiveness and minimum effort an examination format must exist.

In Section 4 of this booklet a methodology for identifying key factors for study is outlined, together with an approach to data provision tailored to the needs of the individual farm.

Section 4

THE DESIGN OF A FARM BUSINESS DATA SYSTEM

For the purposes of properly effective business efficiency analysis and the planning of improvements it is essential to have a sound basic farm recording scheme. This need not necessarily be of a comprehensive nature.

Few farmers keep records beyond those which they are statutorily obliged to maintain. There is a minority who tend to the opposite extreme, often overdocumenting the farm. In so doing they may confuse the real issues of management and operation which arise, or promote a situation where sufficient time is never available for the analysis and interpretation of the extensive records kept.

A middle course is necessary, in which the time spent in documentation and analysis is not excessive and where the task is adapted to the unskilled clerical efforts which occur on most farms. For this the subject matter recorded must be entirely relevant to the problems at issue and the form of the records and analysis simple, easy to keep and interpret.

A simple method has been developed to assist the farmer or his advisor in selecting those subjects which it is most useful to record and for designing an appropriate recording and analytical procedure. This system has been tested and evaluated in records and analytical systems developed for the Poultry Division of the Ministry of Agriculture, Fisheries and Food*, for the University of Reading farms, and for other commercial farms and ancillary trading companies mainly in S. England.

There are three aspects to the production of a satisfactory data system:-

1) Selection of the subject matter for documentation
2) Choice of the form of documentation, recording method and analytical procedure
3) Installation, maintenance and use of the system.

SELECTION OF SUBJECT MATTER

If a farm data system is to be effectively used it must generally be simple. The time and clerical skills available do not usually permit otherwise. It can thus usually be concerned only with a limited range of facts. Care is necessary in the selection of the subject matter to confine it to that which is most pertinent to the operational and planning decisions which may arise.

As the first step to ensuring the relevance of the data, it is best to define those factors which are of prime importance in determining the farming results. This can be done through the mechanics of two simple decision tools - recently developed at Reading University - the DERIVATION NETWORK AND THE RANKING BUDGET OR TEST.

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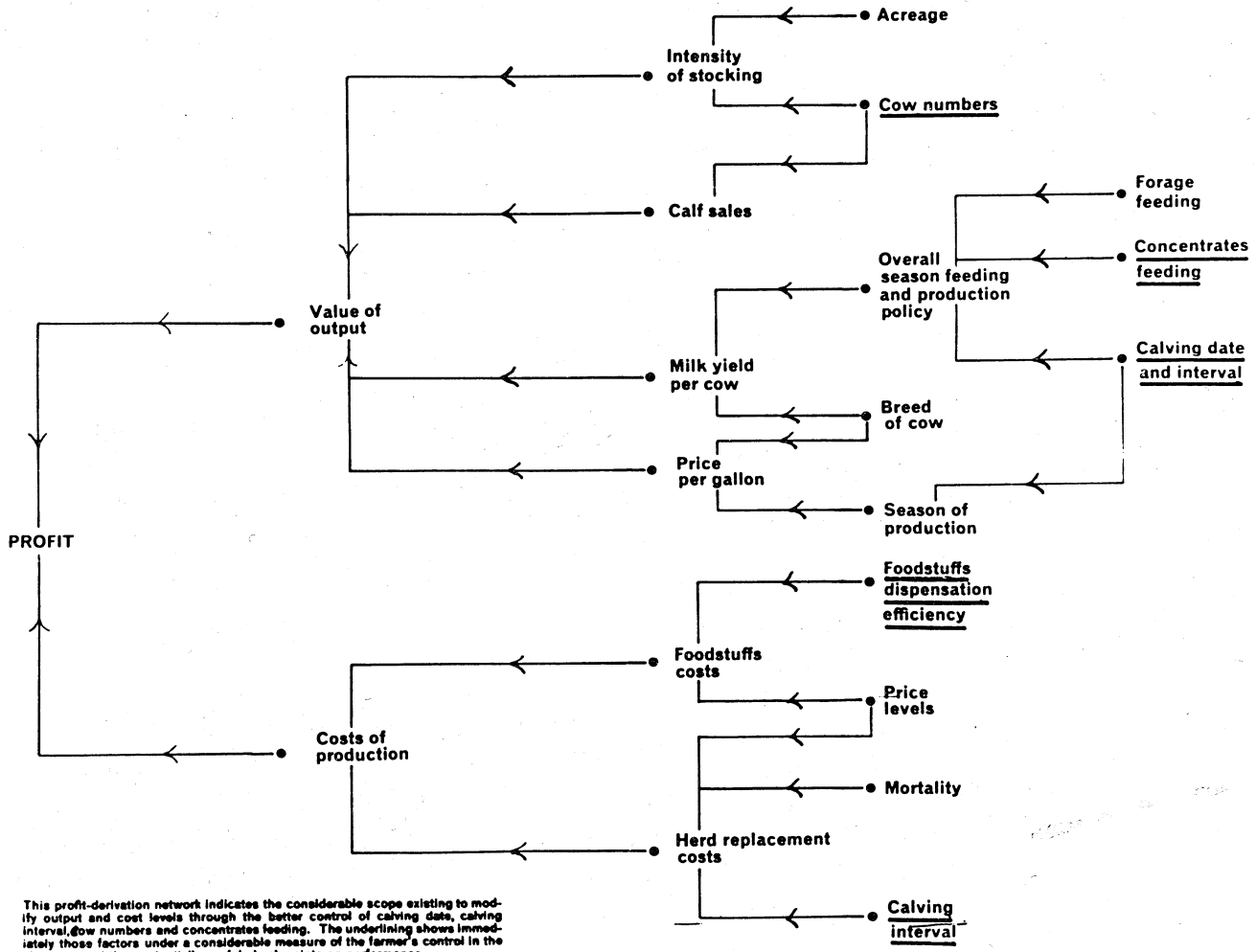
*See "Business Control in Poultry Keeping". Bulletin 191, M.A.F.F. Pub H.M.S.O. 1967.

PROFIT DERIVATION NETWORK - APPLIED TO DAIRY HERD ECONOMY



This profit-derivation network indicates the considerable scope existing to modify output and cost levels through the better control of calving date, calving interval, cow numbers and concentrates feeding. The underlining shows immediately those factors under a considerable measure of the farmer's control in the short run and thus potentially useful check-points on performance.

The Derivation Network is a diagramatic method of portraying the various factors in a situation so that their relationship to each other and to the end point is illustrated. It operates from left to right and top to bottom.

On the left of the diagram the main or global end-point or objective is stated and the factors which promote this situation are shown in stages of increasing detail moving to the right across the diagram. In so far as is possible, the more important factors tend to be ordered towards the top of the diagram, and the less important ones towards the bottom.

An example is given in the accompanying diagram of a Derivation Network applied to the isolation and selection of factors for incorporation in a data recording system for a dairy herd. The various factors which contribute to herd profits are shown so that the dependancies between them are clear. For example the diagram shows that the profit depends on 2 main factors, the output and the costs. Taking the output, this depends on four factors, intensity of stocking, calf sales, milk yield and price per gallon. Milk yield in turn depends on breed and production policy. Production policy is composed of forage feeding, concentrate feeding, season of calving and calving interval.

Not all factors shown in the Derivation Network will:-

a) Contribute equally to the end point
b) Are equally amenable to control
c) Can be recorded as easily, accurately or meaningfully
d) Need the same level of data to facilitate sound decisions.

Management must decide on which factors to concentrate its attention. It must decide whether it will be useful to know about items which it cannot control e.g. chance mortality. Such information may be useful in alerting management to the extent of deviations from plans. On the other hand management may feel that it has no use for data which does not facilitate better control.

Underlined on the Derivation Network are those factors which the farmer may select as being worth the effort of recording and analysis. It may not be possible to incorporate all of them in the data system and hence further selection is necessary. This is based primarily on the relative capacities of the factors to influence the end results. The process of selection can be approached through the mechanism of the Ranking Budget or Test.

In this, the various factors are ranked in order of their capacity to affect the end point. Such a ranking may be carried out subjectively and importance of each factor stated relatively e.g. very important, important, not so important, unimportant. Alternatively, as in the Ranking Budget which follows, the ranking is based upon financial calculations showing the impact on profits of a 10 per cent improvement in the level of application of each factor. This particular Ranking Budget illustrates the effect of a 10 per cent improvement in factor performances in a dairy herd of 30 cows on a 48 acre holding currently producing a profit of £1,200 per year. It is apparent that the price per gallon for milk and milk yield per cow are capable of producing the most significant effects upon the herd economy.

FACTOR RANKING BUDGET Illustrating the capacity of dairy herd management factors to affect profits.

Factor		Achieved Results	10 per cent improvement	Increase to herd profits
No. of cows on 48 acres		30	33	156
Annual milk yield p.cow	(galls)	810	891	224
Price per gall. milk	(s. d.)	2.11	3.2½	354
Conc. food per cow	(cwt.)	30	27	135

It may not be equally feasible to modify each of the factors by the suggested 10 per cent. On some this improvement could be achieved without difficulty (e.g. number of cows on acreage). On others it might be problematical (e.g. price per gallon of milk). Thus in making the final selection for the data system the possibilities of achieving the targets set in the Ranking Budget are weighed up.

An alternative approach is to base the Ranking Budget from the outset on the likely attainable standard for each factor. While this may appear to cut out an unnecessary stage of the previous procedure, the resulting Ranking Budget does not truly indicate the scope that each factor can present, for limits on scope have been placed at the outset. It has been shown many times that when the scope of a difficult to ammend factor is revealed, the attempt which the farmer is prepared to make to achieve the target is greatly influenced.

The construction of a Derivation Network and Ranking Budget should assist management in selecting those factors which should form the core of the data system. The next step is the design of an appropriate analytical and recording procedure.

ANALYTICAL AND RECORDING PROCEDURES AND DOCUMENTATION

Records have no value unless they are used. They will not be used unless they have a function and are reliable and relevant.

Function

The ultimate purpose of managerial records is to facilitate current decisions and assist the future planning and control of the unit. Records are used to determine current or past results and this data is used to review achievement and so give guidance on current and future problems. Each record must be designed to fulfil such precise functions from the outset if it is to provide complete and adequate data of the type required, without, at the same time, bring superfluous in certain aspects.

Reliability

To be reliable data must be accurate. An inaccurate record may be worse than no record at all, for unwittingly appraisals may be made and decisions taken on false evidence. If a record is known to be of limited accuracy

procedure can be cautious, but where an inaccurate record is accepted as valid evidence, wrong conclusions will be drawn. Thus effort should be made to create accurate records, but where accuracy is not possible it must be clearly recognised and the records subsequently interpreted with great care and not pressed to fine limits over important decisions.

Not all records need to be accurate to the same degree. Greater accuracy is necessary where the relationships involved are very critical to productivity and profit, and where there are fine tolerances to making the correct choice. Frequently an acceptance of limited accuracy may be forced on management where problems of precise measurement are difficult or where great urgency is involved.

Accuracy alone is not sufficient to ensure that data will form a sound basis for decisions. The data must also be representative of the pattern of events under review, and so expressed that its interpretation is straightforward. Often it must be supplemented by information indicating circumstances which may have influenced the results.

Relevance

If records are to be of use they must obviously be relevant to the problem under review. However, the structure and emphasis within any business is constantly changing, and with it new problems crop up and new evidence is required to first measure and then solve them. It is thus problematical to know what should be recorded, and what may safely be omitted.

This uncertainty is one of the greatest stumbling blocks to achieving efficient recording systems. Invariably conscientious managers, working on the principle of being prepared, record too much data in the expectation that it may one day prove useful. Often a body of data, indigestible even with modern sorting methods may accumulate. Time is not found for analysis because it had no specific purpose from the outset. If at some late date the information can be used then invariably it is found to be lacking in some respect because it was never systematically recorded, with definite objective in view.

In designing comprehensive records systems, the value of spot-check records as substitutes for more laborious longer term records should not be overlooked. Despite their inherent disadvantage of possible unrepresentativeness, they may be useful for the many tactical problems arising in a normal farm business, for which data of precise accuracy is not vital. But for policy decisions which may involve costly and irrevocable changes, longer term and more fully comprehensive records are usually necessary. Nevertheless it is well to remember that major policy decisions rarely arise overnight. So long as a sound basic recording programme exists, there is usually sufficient time to institute an adequate supplementary record scheme after the first warnings of trouble

This situation emphasises the main deficiency of any recording system which relies too much on short-term records as the supplement for an inadequate basic recording scheme. Here faults are often not realised until they are well established and so measurement and control action can only be implemented at a late stage. With a more adequate basic recording system there is earlier

diagnosis of problems which can be evaluated and corrected before they have a serious effect on business efficiency and profits.

The adequate recording system, although entailing more effort in recording and analysis, thus provides the opportunity to keep the business operating at optimum efficiency within controllable circumstances.

In practice it has proved problematical to ensure that recording schemes possess the features of reliability and relevance referred to. Until now no formal procedure has existed to assist the manager or his adviser in the compilation of schemes, or even individual records. Many have been created (rather than designed) on a trial and error basis in the belief that by the very act of recording some cogent facts will emerge.

A Design System

Basic to good design is the concept that recording and analysis are two closely interlinked operations in one process. They produce evidence which illuminates circumstances and quantifies the issues involved so that sound decisions may be taken.

Design procedure should thus start by enquiring into the precise nature of the problem which the recording and analysis system is to illuminate and quantify. The evidence required to illuminate the situation, and the form in which this evidence shall be expressed are next decided. Only then is the method of recording and analysis decided, and it is designed specifically to facilitate the accurate evaluation of the facts required.

Only on very rare occasions would a record be instituted without a precise objective in mind from the outset. It is usually wasteful of effort to keep records just because "they may produce some useful information". If this is felt to be the case, there must be some reason for it which can be evaluated by close questioning. Such possibilities should be defined and if they are reasonable a record can be designed in which they form a specific objective. Very rarely does the casual record turn up a fact or relationship of a type which could not have been foreseen by an intelligent approach. It is up to management to foresee what a record can show and then to design it so that it measures the fact properly - that is, completely in all its aspects yet without wastage.

A system which may be followed in building up a sound recording and analysis technique is outlined on the Design Questionnaire. The designer works within sections from left to right of the page and moving from top to bottom.

Stage I The objective - (A)

At the outset the designer must consider the farming purpose for which information is required. To this end he must consider the ultimate objective. This is stated (A-1) and then subsequently justified (A-2, 3 and 4).

The stating of the objective must be carefully done. It must represent the ultimate objective and not some interim or partial objective. Thereby

DESIGN QUESTIONNAIRE FOR:- RECORDING AND ANALYSIS SYSTEMS AND DOCUMENTS

Answers should be entered working within section headings from left to right of page and moving from top to bottom.

COLUMN NUMBER			
(1)	(2)	(3)	(4)
FACTS OF PROPOSED SCHEME	JUSTIFICATION	ALTERNATIVES & MODIFICATIONS FOR CONSIDERATION	FEATURES FINALLY SELECTED FOR INCORPORATION
(A) ULTIMATE OBJECTIVE OF farm scheme?	Is this a good objective and and why?	What other objectives might be achieved instead or at the same time? (State their value)	What final objective is desirable?
(B) CIRCUMSTANCES (changes or repercussions) INVOLVED in adoption of selected objective	Why these circumstances?	What other circumstances might arise and why?	Final selection of circumstances
(C) EVIDENCE (FACTS) required to illuminate slected considerations	Why these facts?	What other facts could throw useful light on the considerations?	What facts are desirable?
(D) FORM in which evidence (facts) to be expressed	Why this form?	What alternative form? (state advantages and disadvantages in terms of ease of calculation and meaningfulness)	Selected form of expression
(E) SOURCE of facts	Why this source?	What other sources possible? (State advantages and disadvantages)	Selected sources of facts
(F) METHOD AND DOCUMENTATION of recording, analysis and future estimations Description	**Why** is it done this way? (State advantages and disadvantages) **Could it with advantage:-** Be simpler \ in content / to complete Be more detailed \ in content / to complete Incorporate better checks on accuracy Be more revealing. Be modified or adapted to provide greater or lesser integration between the business of recording, checking, analysis, appraisal and forward estimation Be arranged in some more economical manner Be arranged in some more revealing manner Be more representative	How else could it be done? State how modifications might be incorporated	What should be done?

Continued

Continued

COLUMN NUMBER			
(1)	(2)	(3)	(4)
FACTS OF PROPOSED SCHEME	JUSTIFICATION	ALTERNATIVES & MODIFICATIONS FOR CONSIDERATION	FEATURES FINALLY SELECTED FOR INCORPORATION
(G) PLACE Where is it done? (*a*) Recording (*b*) Checking (*c*) Summation, appraisals and future estimations	Why is it done there? (State advantages and disadvantages)	Where else could it be done? (State advantages and disadvantages)	Where should it be done?
(H) TIME When is it done? (State preceding and succeeding jobs) (*a*) Recording (*b*) Checking (*c*) Summation, appraisals and future estimations	Why is it done then? (State advantages and disadvantages)	When else could it be done? State advantages and disadvantages)	When should it be done?
(I) PERSONNEL Who does it? (*a*) Recording (*b*) Checking (*c*) Summation, appraisals and future estimations	Why that person(s) ? (State advantages and disadvantages)	Who also could do it? (State advantages and disadvantages)	Who should do it?
(J) INTEGRATION and SUMMARY OF SELECTED SYSTEM What is the system of recording and/or appraisal?	State advantages and disadvantages of this system. Does this fully cover the requirements for the objective finally selected? If not why not?	If the system does not fully cover the requirements for the objective finally chosen (A) What further modifications might be desirable? (B) How might such modifications be incorporated?	What final system should be used?

Because of the need to conserve printed space, the room left for answers is restricted. Persons adopting the system are recommended to increase answer space several fold.

there is less risk of subsequently recording superfluous data, and more important, of not recording enough data.

As an illustration of the care necessary in the stating of the objective, a farmer wishing to determine whether to keep first year or first and second laying hens stated his objective simply as to find out which birds produced more eggs. When he came to make his decision he was of course grossly under-documented on important factors affecting his decision. To make a sensible decision he required information on gradings, seasonality of lay, mortalities, food consumption, rearing requirements, space and accommodation use, etc. This situation could have been avoided if the ultimate objective of a possible change in the ages of the laying stock kept had been stated from the start.

Stage II Circumstances for Consideration - (B)

If any objective is to be achieved certain upsets of present arrangements within the business are likely. All of the various effects and repercussions must be defined (B-1) and carefully checked as being a complete list (B-2, 3 and 4). This is necessary for two reasons:-

(a) So that all aspects of change on which data may be required are recognised.

(b) So that the desirability of the ultimate objective can be re-assessed and re-affirmed before proceeding further.

The type of considerations which would have come to light in this analysis would have been that there would be changes to:-

egg sales - arising from changes in total yield and yield per bird, gradings and seasonality of production.
cull sales - arising from changes to annual and seasonal culling rates, carcase weights and grades.
food charges - arising from the differing levels of food consumption and types of ration for first and second year layers and young stock being reared.
labour requirements - arising from the different seasonal and total requirements with a modified rearing programme.
equipment required and used - arising from changes in adult flock culling practice, and changes in the numbers of birds reared and different seasonality of production.

Stage III Evidence (facts) required - (C)

In order that sound decisions relating to the above objectives and considerations can be taken, certain types of evidence will be necessary. The nature of this evidence must be established (C-1, 2, 3 and 4)

In the example quoted it might be:-

relative annual and seasonal: - egg yields
egg gradings
culling rates
culling prices

(relative annual and seasonal:-)

culling prices
mortalities
food consumption
resource requirements of layers and replacement stock e.g. labour, accommodation, capital
alternative costs of rearing and buying replacements
etc., etc.

From such evidence the value of the objective can eventually be weighed.

Stage IV Form of expressing evidence - (D)

The same evidence may frequently be expressed in different ways and through different calculated relationships. The most pertinent and reliable method must be selected (D-1, 2, 3 and 4).

In the above example, relative egg yields might be expressed on the basis of hen housed performance (eggs laid ÷ birds housed), or average annual performance, (eggs laid ÷ average number of birds). Because the problem is one of substituting one form of production for another in which the initial bird numbers are the most accurately known guide to flock size, the hen housed performance figure is probably the more useful. It is also both simpler to calculate and comprehend in this situation.

Stage V Source of facts - (E)

It is not always necessary to keep records in order to get useful and usable data. Standard data is being disseminated throughout agriculture in increasing quantities each year and management should not ignore its existence and usefulness for providing information on certain types of problem. Care must be taken that the best data available is used particularly where the penalty for inaccuracy is considerable (E-1,2, 3 and 4).

In the example it may be reasoned that standard data on the relative egg yields of first and second year laying stock might be inadequate for the decision to be made because yields vary greatly with individual farm practice. However, using standard data on relative food consumption might be more acceptable, being less ubject to variation by individual management and carrying a smaller penalty on inaccuracy.

Stage VI Method of collection and analysing and documentation - (F)

The designer by now knows precisely what he requires the recording and analysis system to tell him, and he must set about devising the way in which the information will be collected. Here certain principles must be observed:-

The records must deal with measurable quantities, for example, point-of-lay birds must be defined as those of say 20 weeks of age, rather than some indeterminate maturity judgement. Thus each item to be recorded must have clearly defined beginning and end points and be capable of expression in quantitative terminology. To this end instructions must be clear and should

be adequate to cover any eventuality which may occur leaving as little as possible to the initiative of the enumerator. This is important not only for accuracy but for the interpretability of the records when the evidence is analysed.

Human error can easily mar the efficacy of a record. Its likelihood is minimised where:-

1) The record is interesting. A link with the final objective, and the knowledge that the record is used helps to maintain interest. The incorporation of sub-totals and running totals completed by the enumerator establishes this link as well as assisting accuracy.

2) The documentation is agreeable. Over-complexity must be avoided and the records should be simple, precise and progressive. Instructions, though adequate, should not be overlengthy or difficult to grasp.

Presentation is important. Avoids records -

(a) on flimsy paper easily holed by pencil or pen
(b) with inadequate space for writing data and comments
(c) requiring the manipulation and sorting of data on several sheets of similar paper.
(d) on which headings and data have to be re-written
(e) on which totals are added horizontally.

Speed and accuracy of recording and analysis are assisted if they can be carried out on the same document. This may not always be possible. The environment for recording may be such that only memory jogging notes can be made there, or perhaps the initial recording system involves the use of film or sound tape techniques. In such cases transposition of the original records is required in the office.

However thoughtfully records have been designed errors will still occur. It is imperative that they are picked up quickly before they are lost in cumulative totals and averages but where they may still invalidate the evidence. Thus a regular mechanism for checking and, where possible, cross-checking must be built-in.

There are other points worthy of note in the design and layout of the system. Each item and each stage must be clearly identifiable. The use of colour print, coloured paper or coloured writing materials for different years, units, stages of analysis or types of records can save much time in searching for particular items, and minimise the likelihood of entries being made in or extracted from the wrong place.

All records should contain adequate space for the insertion of comments concerning special circumstances affecting the data being recorded. These are often invaluable in the subsequent interpretation of data.

The above points should be incorporated in the method of recording and analysis chosen and in the documentation thereof. (F-1, 2, 3 and 4). However, before bringing the system into operation it remains to consider the administrative machinery of recording and analysis concerning:-

Where it will be done (location or place)
When and how often it will done (time)
By whom it will be done (personnel).

Stage VII Location - (G)

Frequently the place where an event happens is the best place at which to record it, for location serves as a stimulus to memory. Unfortunately, however, the environmental conditions there may not be ideal and hence errors crop up due to the physical discomfort of the enumerator or irritation through noise, stress, etc. Frequently the best policy is to complete only memory jogging notes on location, the full details being recorded subsequently in the office. Final analysis is always done in the office.

Stage VIII Time - (H)

It is when non-specialised recording and analysis staff are used, that most problems of timing occur. Recording and analysis are best done at set times and dates, preferably when there is a relaxation from pressures which may detract from good work. As a last job of the day it may be skimped because the worker is tired or wishes to get home. As a first job the information is either not available or possibly not clearly remembered from the previous day. Also the worker may be unsettled and anxious to start his other duties, his mind being on them rather than yesterday's details.

Generally some period towards the end of the day is best, providing adequate time is set aside for it, as part of the regular routine.

The ideal frequency of recording and analysis will vary, and should be greater where:-

1. There is more to remember
2. Where up-to-date progress control is required.

The greater the extent to which recording and analysis can be carried out at the same time the better and more useful the results will be.

Stage IX Personnel - (I)

Initial recording is best done by the person involved or his immediate supervisor. However, where information in the records is not for general disclosure it is necessary to detail selected staff to this job.

Analysis, often being of a different nature from recording and requiring different skills is probably best done by office staff or, in smaller businesses, the management itself. If the material being recorded is suitable there are considerable advantages in allowing the workstaff to analyse the data as well as complete the records. This can produce a great stimulus to interest and accuracy.

Whatever the divisions of labour in recording and analysis, it is important that a clear line of responsibility exists throughout.

Stage X Co-ordination

From the foregoing considerations the form and mechanism of a good recording and analysis system or single record document can be constructed. The last step is to review the proposals and justify that they are indeed the best (J-1, 2, 3, and 4). They may then be instituted.

THE WELL KEPT, WELL USED AND WELL MAINTAINED SYSTEM

Certain recommendations should be observed when introducing a records system, for it is little use designing good records unless they are kept well and subsequently used intelligently.

Almost the most important factor in good recording is the co-operation and interest of those responsible. Time devoted to securing these ends is time well spent. It may be achieved in several ways.

Keeping staff in the picture

A knowledge and understanding of the purpose of the records stimulates care and interest. This attitude is enhanced if the project is initially discussed and if subsequently (where feasible) the information extracted and conclusions drawn are communicated to those recording and doing the job. If records are seen to be used and have a useful purpose, they are usually well kept and presented.

Instruction and supervision

No one can do their job well unless adequately instructed. This is a feature so frequently almost entirely neglected when a recording system is started, and it is not surprising that many records become a muddle, especially where different stages of recording and analysis are handled by different people.

Initially clear instruction and some supervision must be given and subsequently all work must be checked for error arising out of:-

(a) carelessness
(b) misunderstanding

Such deficiencies can then be put right by modifications to the form of the record, perhaps by making it self-checking, or by revised instructions or discipline.

Controlling errors

Records should be written up and handed in at shortish intervals, as a precaution against lapses of memory so common where there is any delay in documenting the facts. The records must be checked immediately, as errors must be noticed quickly. If not, the task of sorting out mistakes increases. The longer the time between collection and checking the less likely it is that errors will be found. Mistakes must be taken up directly with those

responsible and they should be made to make the necessary corrections, and not merely to "advise" on them. There must always be a clear line of responsibility throughout the process of recording and analysis.

Analysing and interpreting records:-

The information in records is usually summarised and on this are based the management's decisions. It might thus appear sensible to record only summary detail, and in certain cases this could be a useful suggestion and could lead to great savings in time and effort.

However, it must be remembered that summaries are comprised of many individual figures and these may vary considerably. Without knowing the range of variation it may be impossible to draw a sound conclusion.

Thus in making summaries a close and apparent link with the original data must be maintained. For this reason, the good summary should include not only totals, sub-totals and averages, but also details of the circumstances which may have influenced the results and the range of results which has occurred.

There is no one prescribed procedure for analysing and summarising data, but the analyst or person taking decisions must be aware of the dangers inherent in unqualified data, however accurately it is prepared, and the attendant need for supplementary information.

A useful procedure of questioning to use in interpreting data is:-

1. What facts does the data appear to present?
2. Is this a legitimate conclusion or could it be a misconception arising out of:-

   a) Certain dominant facts in the data masking others?
   b) An insufficient body or duration of data giving a biased effect?
   c) Mistakes in recording or analysis?

3. Are all the necessary qualifications made concerning the data and circumstances ruling at that time?
4. Have events changed, or are they likely to change by the time action based on the decisions comes about?
5. What is the limit to which the data may be safely used?

If this questioning can be answered satisfactorily, a manager is in a sound position to make sensible decisions, which are the ultimate goal of all recording and analysis schemes.

DIAGRAM ILLUSTRATING THE FUNDAMENTALS OF THE GOOD DATA SYSTEM