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A DEVELOPMENTAL APPRAISAL FROM THE MANAGEMENT VIEWPOINT OF THE USE OF COST-BENEFIT ANALYSIS IN IN-COMPANY TRAINING SITUATIONS

A. A. GIBB

Submitted for the degree of Doctor of Philosophy
at the University of Durham.

October 1977

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A development appraisal, from the management viewpoint of the use of cost-benefit analysis techniques in in-company training evaluations

ABSTRACT

The thesis takes the economist's concept of cost-benefit analysis and subjects it to a 'developmental appraisal', from the management viewpoint and in respect of 'in-company training'. In so doing it seeks to explore the contribution that the broad concept, when applied to training evaluation, can make to management decision making.

The thesis concludes from an appraisal of the cost-benefit concept that differences when it is applied to in-company training compared with the economists traditional 'macro' usage, merit a different label, 'investment appraisal' of training. The place of the concept in training evaluation is then explored and in use it is shown to be subject to a great many constraints. The thesis proposes that these constraints be translated as opportunities within a 'new' framework which seeks to consider training evaluation from the management viewpoint. This framework proposes a twin role for evaluation: the conventional one of feedback to the trainer and organisation; and an additional one of identification of the key 'supportive' systems needed to meet the objectives of a particular programme.

To test these roles a dichotomy is proposed between Programmed and non-Programmed training decisions, within which a classification of types of training is suggested. The investment appraisal concept is then applied to evaluations within each of these decision categories. The non-Programmed decision evaluation is conducted in an operative training situation in a rolling mill in the steel industry; the Programmed Decision evaluation is applied to a junior

operative training programme in several steel companies. The thesis concludes from the results of the experiments that a useful methodology has been devised and that the major contribution of the application of the concept in practice is the opportunity it gives both for the identification of line management contribution to the success of training and obtaining of their involvement.

A DEVELOPMENTAL APPRAISAL FROM THE MANAGEMENT VIEWPOINT
OF THE USE OF COST-BENEFIT ANALYSIS TECHNIQUES
IN IN-COMPANY TRAINING EVALUATIONS

CONTENTS

	Pages
PREFACE	i - iv
PART I -	
CHAPTER I. Developing a Framework for Understanding the Scope of Cost-Benefit Approaches in Evaluation of Training	1 - 49
CHAPTER II. An Overview of the Research Methodology	50 - 61
PART II - Non-Programmed Training Decisions	
CHAPTER III. Developing an Investment Appraisal Approach	62 - 117
PART III - Evaluating Programmed Training Decisions	
CHAPTER IV. Introduction - The Basic Objectives and the Choice of Establishments for Investigation	118 - 130
CHAPTER V. Analysis of the Significance of the Life of the Investment (Job Tenure) for Programmed Training Evaluation	131 - 170
CHAPTER VI. Evaluation of Factors Influencing the Productivity of the Training Programme	171 - 209
PART IV -	
CHAPTER VII. Summary and Conclusions	210 - 219

APPENDICES

CHAPTER III

APPENDIX 1 Results of analysis of shift records on stoppage time in the mill.

" 2 Checklist used to identify major problem areas and operative contribution to problem.

" 3 Summary of results of interviews with mill manager, assistant manager, engineers, shift managers and foremen, to isolate causes of unscheduled stoppages in various areas of the plant.

" 4 Questionnaire used in Operative Enquiry.

" 5 Report and recommendations to the management following the Enquiry among operatives in the mill.

" 6 Brief Summary of Training Action Plan.

" 7 Estimating the costs and benefits of the Programme.

" 8 The Training Programme Implemented.

" 9 Summary of time allocated to preparation and implementation of training.

" 10 Calculation of Costs and benefits, post training.

CHAPTER IV

APPENDIX 1 Major characteristics of establishments.

" 2 A description of the labour model areas in which the establishments operated.

CHAPTER V

APPENDIX 1 Tables 1 - 7.

CHAPTER VI

APPENDIX 1 Checklist for background information to be noted/obtained when visiting establishment.

" 2 Junior Operative Interview Schedule.

" 3 Tables 1 - 21.

CHAPTER VII

APPENDIX 1 Problem Solving and Investment Appraisal approach to training. A guide for the Training Officer.

A DEVELOPMENT APPRAISAL FROM THE MANAGEMENT VIEWPOINT OF THE USE OF COST BENEFIT ANALYSIS TECHNIQUES IN IN-COMPANY TRAINING EVALUATIONS

PREFACE

As the title suggests the overall objective of this thesis is to explore the relevance of cost benefit analysis to the evaluation of training. There are, however, three key phrases in the title which modify considerably this objective and therefore merit further explanation. The first is "developmental appraisal"; the second is "from the management viewpoint"; and the third is "in-company training".

The expression "developmental appraisal" emphasises that the research begins with taking a well established economic concept, i.e. cost benefit analysis and seeks to develop and appraise its value within a very specific context. "From the management viewpoint" sets the criterion for evaluation of that use, namely that it should be primarily relevant to management decision making (as opposed to trainer decision making). Finally, "in-company training" provides the context and serves to emphasise that the expression "cost benefit analysis" is being used rather outside of its traditional public sector context, a point which is recognised later when a different nomenclature is adopted. It should also be noted that although this thesis begins with an accepted economic concept it does not operate within an accepted disciplinary framework such as economics, sociology, psychology or even organisational theory but seeks to provide an integrative framework of its own drawing from a number of disciplines.

Concern with measuring the costs and benefits of training to the firm is not new - there have been several researches on this theme. The emphasis, however, in this research is placed on the value of the approach as a "live" evaluational and operational tool of the manager as well as the trainer. This in turn relates to the author's acceptance of the importance of seeking ways of increasing management involvement in training in the context of current national manpower and training policies. The definition of training used in the research is the broad one preferred by Hesseling; "Training is a systematic effort to create learning situations".(1) It thus embraces both education and development.

The thesis is divided into four parts. In Part I the derivation of the direction of the empirical work is described from a review of the research undertaken in the field of cost benefit analysis and a discussion if its relevance to evaluation studies. From this is drawn the overall framework for the research. There follows a short discussion of certain broad aspects of research methodology. Part II describes the development of an "investment appraisal" approach to training conducted in a rod and bar mill owned by the British Steel Corporation. Part III demonstrates a broader approach to the evaluation of training which is broadly derived from the cost benefit concept. The final section Part IV brings together the findings in a conclusion about the role of investment appraisals of training and their use for evaluation purposes.

The research is based on work undertaken while the author was working on a research project financed by the Iron and Steel Industry Training Board (I.S.I.T.B.). The Board are thanked for their support. This dissertation makes use of three of the papers produced by the author for the Board.(2) The research on which these papers were based was undertaken entirely by the author the only assistance being that involved in interviewing and, of course, through discussion with colleagues. Interviewers used were recruited on a casual basis and trained by the author. The research is essentially action oriented and was designed to form a basis for decision making by the I.S.I.T.B. It employs both traditional survey techniques and an action research approach.

It should be noted that the bulk of the empirical work was undertaken in 1970/71. The I.S.I.T.B. have, however, continued to provide support for development of the investment appraisal approach and many of the ideas discussed are of more recent origin. Part of the work undertaken has been published in an article in "European Training".[3] The approach outlined in Part III has also been discussed briefly by Hamblin in "Evaluation and Training".[4] Part of the literature review therefore post-dates the empirical work. The degree to which the basic thinking behind the approach was, however, developed means that it has dated little although there have been many developments in the field of evaluation research in the intervening years.

The research ought to be viewed in its historical perspective vis-a-vis the predominant thinking in the Industrial Training Boards at the time. The early 1970's were a time of great uncertainty for the Boards. The grant/levy policies which had been the basis on which they had encouraged the development of training in the industries for which they were responsible were coming under attack as no longer relevant and the Boards were under some considerable pressure to demonstrate their real impact on the effectiveness and efficiency of British industry. It is therefore no accident that at the time the I.S.I.T.B., and other Boards, were very interested in any approach that could "prove" that training pays. Their major preoccupation indeed was to undertake a number of before and after studies to, hopefully, demonstrate this point. The research work, however, points to the conclusion that the value of such studies may be limited in relation to the objectives that lay behind the initial commissioning of them and that the main value of the approaches outlined may be as a vehicle for obtaining the involvement of management.

PART I -

DEVELOPING A FRAMEWORK FOR UNDERSTANDING THE SCOPE OF COST-BENEFIT APPROACHES IN EVALUATION OF TRAINING

CHAPTER I

INTRODUCTION

The central purpose of this introductory chapter is to provide a framework within which the experimental evaluation studies described in Parts II and III can be justified and understood. The relevance of cost-benefit analysis in general and then "investment appraisal" in particular to evaluation of training is first defined and its place in the evaluation hierarchy discussed. After a review of the methodological and control problems of evaluations of this nature a framework is proposed within which the use of investment appraisal approaches might be reviewed in terms of their relevance to both manager and trainer. A major distinction is then made between Programmed and Non-Programmed decisions about training. The evaluation experiments chosen are shown to lie one in each of these categories.

DEFINING TERMS: THE MEANING OF COST BENEFIT ANALYSIS AS APPLIED TO TRAINING

Cost benefit analysis is a method of evaluating investment. The term is commonly used by economists to describe "a technique of analysis that is designed primarily to achieve the most efficient allocation of resources by taking into account all relevant costs and benefits".(1) This technique is conventionally used to evaluate investments when the product or service to be produced is not sold in a "free" market and the price is therefore not subject to the normal vagaries of supply and demand and/or in cases where the existence of external economies and diseconomies and market imperfections mean that an allocation of resources on the basis of market price alone may be inefficient.(2) It is most frequently employed therefore, to evaluate public investment expenditures - but on specific projects or activities where the problems of enumerating and measuring costs and benefits can be constrained to reasonable proportions.(3)

Many cost-benefit analyses have been undertaken in the field of education and training, (4) particularly in the 1960's when stimulus was provided by the interest and concern of governments in education and training as the residual factor in economic growth.(5) Within the strict definition of cost-benefit analysis outlined above the analytical tool can be applied to a variety of situations depending on who is viewed as bearing the cost and who is the beneficiary. The Department of Employment and Productivity Booklet on "Cost-Benefit Aspects of Manpower Re-training"(6) notes three purposes to which it might be put as follows:

... "to evaluate the costs and benefits accruing to individuals who actually undergo re-training".(7)

... " to measure costs and benefits that accrue to the economy as a whole.(8) This does not simply involve the aggregation of individual costs and benefits, since the costs that are real when seen from the point of view of the economy may involve no cost to the individual; similarly, benefits that accrue to individuals need not accrue to society."

... "to evaluate costs and benefits to the government as a result of government investment in manpower re-training."(9)

The term cost-benefit analysis is also frequently used within the context of the operations of the private company to describe the ratio between costs and benefits in a managed cost area.(10) Within the firm certain of the conditions pertaining to the economist's use of cost benefit analysis as defined above may be evident, in particular, the absence of a market price for certain of the firm's functional inputs. The training department is one such input.(11)

There are a wide variety of situations to which cost benefit analysis might be applied. It is for example possible to apply this technique to evaluate the activities of the Industrial Training Boards (I.T.B.'s). In such an analysis the costs of running an organisation such as an I.T.B. would be set against the benefits, net of any incremental costs incurred by firms, or colleges, etc. to be derived from increases in the quantity and quality of skilled manpower which could be estimated <u>not</u> to have occurred without the stimulus of the Board. It needs little reflection on this example to recognise that the problems of defining and estimating the relevant costs and benefits in this case and in most of the situations which come under the umbrella of the categories described above are many and varied.(12)

It is possible to draw a more or less clear distinction between cost benefit analysis as used in the above contexts and its use to describe the evaluation of a specific investment in training by a firm. The obvious way to differentiate the latter case is to include in the analysis only those costs and benefits incurred by the firm. A modification to this is however proposed namely that costs and benefits judged relevant by the firm to its decision making process be taken into account.(13) Thus, it would be possible, with this definition, for the firm to take into consideration the incidence of external economies or diseconomies occurring in respect of the individuals undergoing training: for example a company in launching an induction and initial training programme may wish to take into account any costs incurred by individuals in terms of job opportunities foregone during the programme or any particular benefits that accrue to them as individuals after the programme. In recognition of the distinction the nomenclature used hereafter in this research to describe cost benefit analysis in the case of the individual firm will be that of "investment appraisal". Diagram 1.1 summarises the distinctive characteristics of investment appraisal.

DIAGRAM 1.1

MAJOR DIFFERENCES: COST BENEFIT AND A STRICT DEFINITION OF INVESTMENT APPRAISAL

	TRADITIONAL COST BENEFIT ANALYSIS	INVESTMENT APPRAISAL*
A BENEFITS ANALYSED RELATE TO	INDIVIDUAL COMPANY SOCIETY GOVERNMENT	COMPANY
B RELEVANT COSTS ISOLATED RELATE TO	INDIVIDUAL COMPANY SOCIETY GOVERNMENT	COMPANY
C CIRCUMSTANCES APPLIED IN	1. EVALUATION OF NATIONAL EXPENDITURES (e.g. Education) 2. EVALUATION OF SPECIFIC PROJECTS (e.g. Government Training Centres) 3. EVALUATION OF RETURNS TO EDUCATION/TRAINING FOR INDIVIDUAL (e.g. increased earnings) 4. EVALUATION OF TRAINING /EDUCATION IN COMPANY WHERE ALL COSTS AND BENEFITS OF ALL PARTIES CONCERNED ARE IDENTIFIED	TO EVALUATE COMPANY EXPENDITURES ON EDUCATION OR TRAINING (e.g. as in physical capital)

*This does not preclude the company taking into account benefits and costs which do not relate specifically to it; but this decision will be taken from the company viewpoint and therefore presumably relates to its objectives and internal decision making process. A completely objective appraisal as in C.4 in column 1 could of course be asked for.

THE CONCEPT OF HUMAN CAPITAL

Cost benefit analysis is an economist's concept. Its use, whether in a training context or otherwise, implies that costs and benefits of an investment or investments can be quantified in money terms as a basis for decision making. It also emphasises the treatment of the resource input as an investment with the associated time stream of benefits being a function of an increase in the "output" over the "life" of the investment. The application of this concept to labour has led in turn to the development of the concept of human capital. Thus in macro economic terms investment in training can be regarded as increasing the country's human capital stock; in micro economic terms increasing the individual's skills through training might add to the value of the human assets of the company. The parallel with investment in physical capital is obvious, the major difference being that the human asset is mobile and therefore can determine its own life in a particular location. Elsewhere the parallel holds, for although the "human asset" has potentially a long life and can have added to it additional investments,certain of these may be written off over time as knowledge and skill needs change.

The development but not the origin of the economic theory of human capital owes much to the work of Gary Becker.[14] A detailed examination of this theory and its many developments[15] would not serve the objectives of this thesis which is concerned primarily with exploring the value of investment appraisal in terms of its contribution to management decision making. However, one major contribution of Becker's analysis cannot be ignored namely the central distinction that he makes between "general" and "specific" training. Training can be characterised as "specific" to the company process when it cannot be used elsewhere by the individual; it can be described as "general" when it can be used by the individual in employment with other companies and in other industries. In Becker's view this is an important distinction because (he argues) the firm will pay at least part, if not all of the costs of specific training; it will not, however, pay for general training but will impose the cost of it on the individual as he can gain the benefit by selling his newly acquired skills elsewhere.[16] This dichotomy is potentially operationally useful, as will be demonstrated in Part III, even if it is recognised in practice that any particular training programme will contain both general and specific elements.

The practical relevance of this distinction to this dissertation lies in its implication for the firm's attitude towards labour turnover.[17] If, for a moment, we assume that it is true that firms do not pay the costs of general training but pay the costs of specific training[18] then they may possibly be much more concerned about the loss of those who have been trained in skills specific to the industry (for example the range of operatives in the Steel Industry who might man the blast furnaces, rolling mills etc.) than with those trained in general skills (e.g. craftsmen who can employ these skills in a variety of industries).

The theoretical relevance of this distinction has been discussed by several writers including McCormick and Manley,[19] Lees and Chiplin,[20] Oatey,[21] Johnson,[22] Hartley[23] and Pettman.[24] These writers, however, in the main addressed themselves to the implication of the theory for the workings of the Industrial Training Act[25] and the role of the Industrial Boards within it, rather than for the individual firm or individual manager. Pettman, has moved away from the discussion within the general - specific locus towards a more dynamic view of the firm's decision making process. The decision to train, he suggests is a function of a large number of factors, including the size of firm, the levy/grant, elasticity of substitution between capital and labour, and turnover.(26) However, his framework, while relevant, is not shown to be operational and his focus is still on the firm's decision making process re. the Industrial Training Act rather than on the individual manager. The development of the discussion on the general - specific training theory and in particular the implications for the way in which the firm view labour turnover will be dealt with in more detail in Part III.

THE FIRM AS A FOCUS FOR INVESTMENT APPRAISAL OF TRAINING

It has been argued above that the situation where only the costs and benefits which the firm considers are important to its decision making process are taken into account, irrespective of whether other costs and benefits are involved, will be described as an "investment appraisal" situation. Outside of the context of testing Becker's specific - general hypothesis, the numbers of economists and others who have concerned themselves with investment appraisal have been limited. Moreover, a number of those that have been involved, have been primarily concerned with using micro-propositions (for example about the relationship of earnings differentials to training) as a basis for testing macro generalisations (for example about the returns to education in society).(27) Several other writers in a more practical vein have been concerned with advising on the classification of costs from the company "management of training" viewpoint.(28) A few have also provided generalisations on the nature of costs and benefits that will be calculated in a practical exercise without empirical demonstration.(29) The only substantial and published work in the U.K. in this area has been undertaken by a team financed by the Training Services Agency and led by Professor Brinley Thomas in collaboration with J. A. Jones of the Industrial Training Service.[30] Over two dozen individual studies were undertaken by this group between 1969 and 1975. This team's programme concentrated heavily in the initial stages on consideration of the accounting difficulties in estimating costs and benefits of industrial training programmes in companies.[31] This work has led to suggestions for the classification of costs[32] and benefits[33] and has thrown considerable light on the problems of estimating pre- and post-training performance and the possible impact of training on turnover rates in companies.[34] The emphasis of much of the work has been on historical analysis of pre- and post-training situations directing the question "does training pay?" to a variety of circumstances including operator, craft and supervisory training programmes. A model which characterizes the essential elements in this approach (although it is not drawn from this research) is shown in Diagram 1.2.

This strict accounting approach to investment appraisal was considered and rejected by the author at an early stage[35] for reasons which will be set out later. The attempt, by the Brinley Thomas team, to apply a rigorous scientific approach to investment appraisal however, has, raised a number of important issues the full significance of which will only be realised later. These however can be summarised as follows:

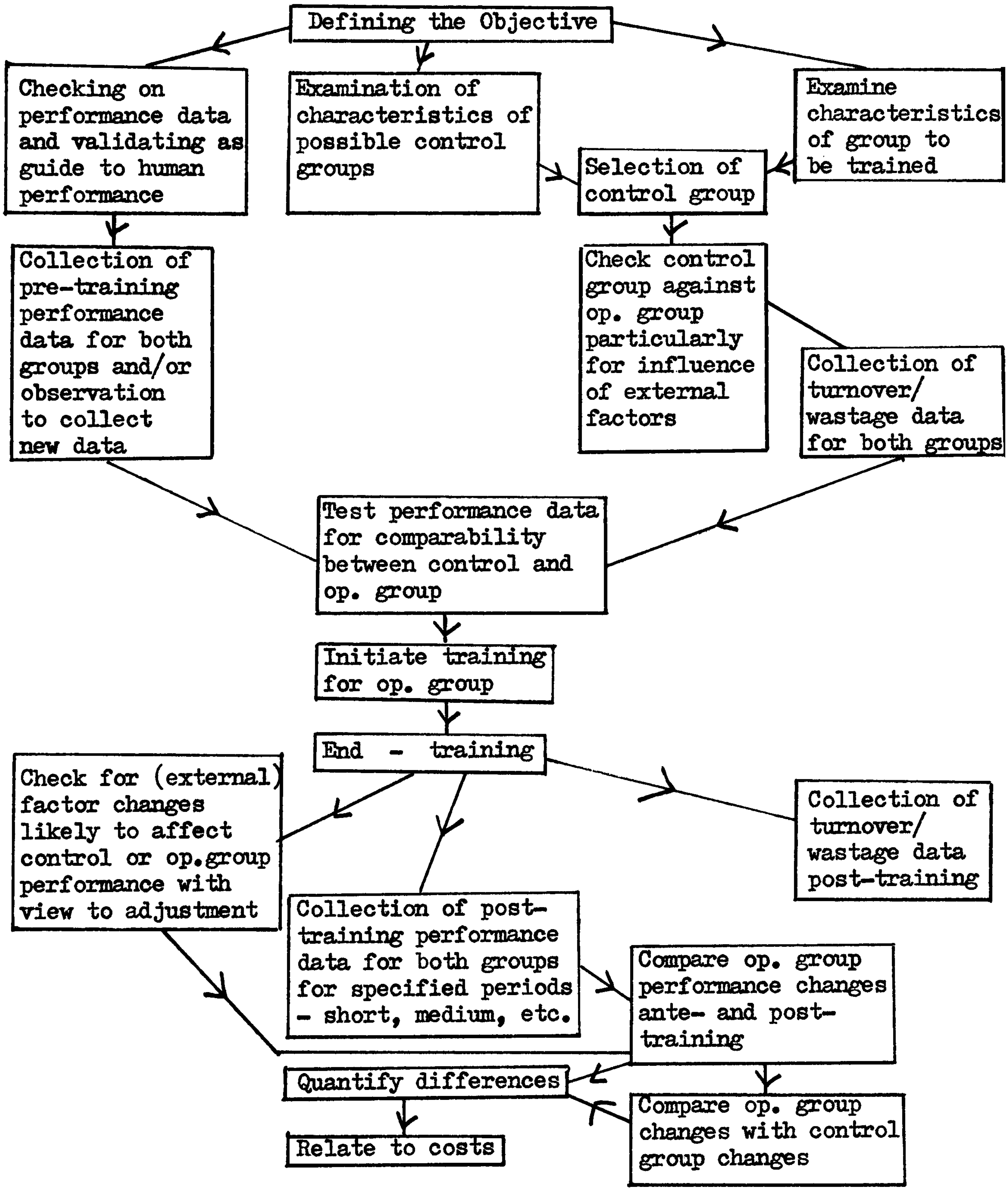
1. A cost benefit approach emphasises the change from one situation to another (Diagram 1.2). In simple terms training is generally undertaken to bring about some change in behaviour which in turn it is hoped will bring about a change in performance.[36] For

DIAGRAM 1.2

COST BENEFIT ANALYSIS OF TRAINING OF WORK GROUP OR INDIVIDUALS IN THAT GROUP

BASIC METHODOLOGY

(This looks only at the work necessary for the Cost Benefit analysis and ignores the conventional steps in preparing training programmes)



example when a formal[37] training programme is introduced into a situation where there has been no previous formal training the evaluation of the new programme must involve measurement of the marginal change in return to the new training compared with the marginal differences in costs (recognising that even informal methods of training may have costs).

2. If such evaluations are to be carried out properly then a before and after situation has to be taken and/or a matching control group must be introduced (Diagram 1.2). The failure to satisfy the latter condition may cast doubt on conclusions reached. It is possible, for example, that in the study of a clothing factory undertaken by Thomas, Jones and Moxham, where before and after measurements were taken, conditions other than the training itself may have contributed to the improvement in turnover rates after the period when training took place.[38]

3. This type of evaluation necessitates the collection of data over a period which may extend into years. In most organisations there are likely to occur within such a period a number of unforseeable but significant changes which will have some effect on behaviour and therefore on the effectiveness of the original training.

4. The ability to conduct investment appraisal analyses of this type, with before and after experiments, having sufficient laboratory precision to give creditable results, will be maximised when there is

a simple man-machine relationship.[39] This will facilitate measurements of standards such as Experienced Worker Speed and the way in which training affects learning time as measured by time taken to move to the standard. Such approaches are not, however, impossible with a well defined group.[40]

5. The real costs of training to the company are the opportunity costs,[41] which may not necessarily equal the wages of persons under training. While this is generally the case in relation to the firm's overall investment in training it has long been an acute practical problem when measuring the costs of on-the-job training.[42] For example the slack in the utilisation of the work force which can be taken up by training may mean that there is little or nor opportunity costs.[43]

6. In practice, provision has also to be made for allocating overheads to the training function in general as well as to particular programmes. A major outcome of the Thomas research has been a categorisation of costs as shown in Diagram 1.3. This takes into account the distribution of overheads.

7. The initial study indicated that the main benefits of training can be classified and measured under the headings of increased productivity and improved labour retention[44] i.e. more people staying longer with the company after training. Jones later

D I A G R A M 1.3

A SUGGESTED CLASSIFICATION OF THE COST OF TRAINING

1. Costs of initiating the training function.

2. Costs of servicing and co-ordinating the training function i.e. costs of the training department excluding (1) above.

3. The cost of fixed training capital i.e. of buildings, machinery and plant for the particular item or programme of training to take place.

4. The cost of working capital i.e. costs likely to increase with the number of trainees.

5. Costs of providing for giving of instruction i.e. relating to the decisions to give instruction.

6. Cost of giving the instruction.

7. Cost of wages of trainees net of output value.

---

identified a complete range of potential benefits (Diagram 1.4) not all of which, however, lend themselves to measurement.(45) Their importance, however, lies in the implicit recognition that training aimed at changing behaviour at one point may spark off behaviour change in a number of other directions.

8. Where the difficulties in calculating benefits are too great then it may be possible to provide a measure of the break-even level of performance that is required to justify the training, or some measure of cost effectiveness.(46)

DIAGRAM 1.4

A SUGGESTED CLASSIFICATION OF THE BENEFITS OF TRAINING

Changes brought about by training to indicate:

A. Direct changes, include changes in:

- (a) elements of performance of the company
- (b) training time
- (c) retention rates

B. Indirect changes, include changes in:

- (a) demands made on supervisors
- (b) others affected by the work of trainees
- (c) flexibility and adaptability of the work force

C. Subsequent changes, include changes in:

- (a) levels of ability (through effect of training on recruitment)
- (b) other factors affecting performance i.e. wages systems etc.

The brief review above of the work of Thomas, Jones et al dwells on the "mechanistic" side of their findings. Their overall conclusion[47] in this respect is that the greatest problem has been the isolation of results of training:

> "isolation of the results is almost impossible and is in many cases often impracticable and unprofitable".

Their conclusions as to what this means for the role of investment appraisals of training in the wider organisational sense are brought into the discussion below.

THE PLACE OF INVESTMENT APPRAISAL IN EVALUATION

Investment appraisal is one of a number of methods of evaluation of training each of which are not mutually exclusive. It is the purpose of this section to consider carefully its role in the evaluation process vis a vis other forms of evaluation with a view to gaining further understanding of the circumstances in which it might be used. Two main points for consideration can be drawn from the relevant literature:

1. the place of evaluation in the training process
2. the place of investment appraisal in evaluation.

This leads naturally to a discussion of the problems, both practical and conceptual in the use of investment appraisal as an evaluation instrument.

1. The Place of Evaluation in Training

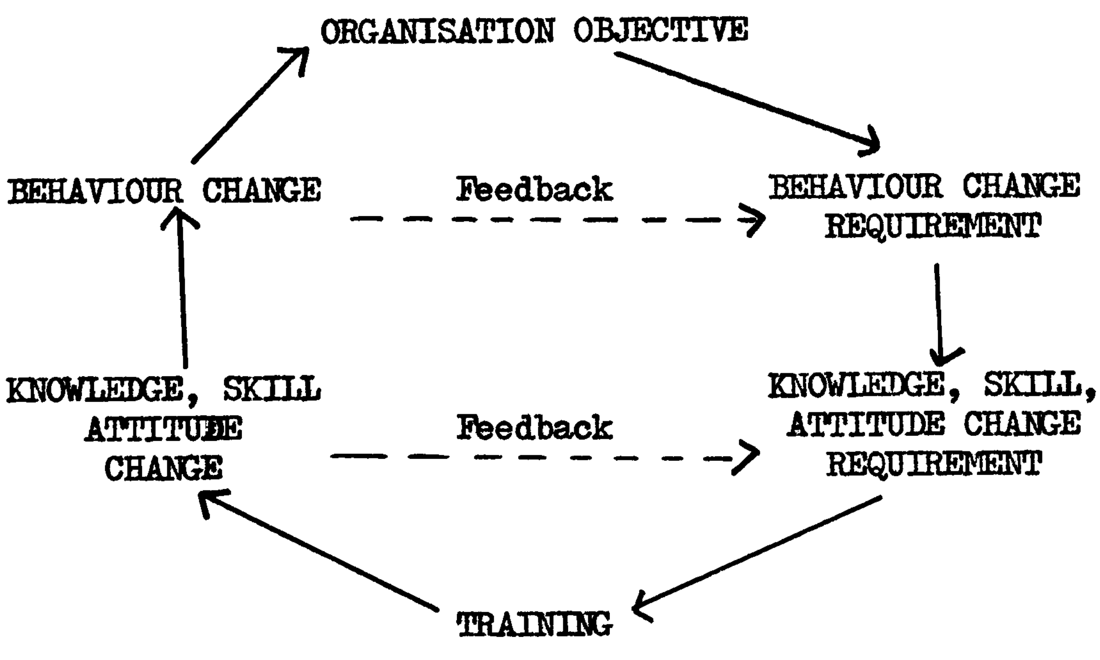
The evaluation of training is commonly seen to be measuring the overall value and worth of a particular training programme.(48) This includes, as Hamblin points out, not only assessing the value against some criteria but also considering the process by which the information is collected for this purpose.(49) The criteria used may be the financial and social objectives of the organisation or may be described as "increasing company profits"; another might be "increasing the ability of the worker to undertake a particular task". In Diagram 1.5 is presented a simple version of the training cycle in terms of its derivation from organisational objectives through behaviour needs to knowledge, skill attitude change requirements and its contribution to organisational objectives by meeting these requirements. It can also be seen from this that evaluation of the training process is likely to involve measurement over time i.e. of performance before, during and after training. The feedback nature of the flows in the diagram also underline that evaluation is concerned with control i.e. the measurement of whether objectives have been met at various stages and, if not, pointing the direction to further action.

Diagram 1.5 therefore suggests that evaluation has both a temporal and organisation-hierarchical dimension i.e. measures can be taken at different times and at different levels as effects work up the hierarchy from changes in individual knowledge to behaviour and organisational change. Not all writers on evaluation, however, emphasise the same horizons. Hesseling in his seminal work "The Strategy of Evaluation Research" concentrates substantially on the role of evaluation in the assessment of human behaviour underlining that this must have a time dimension.

> "At intermittent periods, we need measurement of the trainee's behaviour in a work situation."(50)

D I A G R A M 1.5

IMPACT OF THE TRAINING PROCESS



Recent writers in this area, however, place a great deal of emphasis on the need to combine this with measures of the degree to which the behaviour meets organisation requirements. Martin, for example, combines both temporal and hierarchical dimensions in the following description of assessment of the effectiveness of training at different stages:(51)

Stage 1. Immediate assessment during and at the end of sessions (inputs).

Stage 2. Short-term assessments at the end of a course.

Stage 3. Middle-term assessments relating to objectives beyond those specified by the course.

Stage 4. The long-term assessments related to the general efficiency and adaptability of the organisation as a whole.

This structure bears some relationship to the hierarchy implicit in the definition of validation and evaluation provided by the Department of Employment Glossary of Training Terms.(52)

"Validation .... designed to assertain whether a training programme has achieved the behavioural objectives specified."

"Evaluation .... the assessment of the total value of the training system, course or programme in social as well as in financial terms."

Warr, Bird and Rackham(53) also provide a hierarchy very similar to this defined in terms of Reaction and Outcome Valuations (Immediate, Intermediate and Ultimate). The Reaction Evaluation assesses the current and subsequent reaction of the trainee to the programme; the Immediate Evaluation checks on alterations in knowledge, skill and attitudes; the Intermediate Evaluation notes changes in behaviour; and the Ultimate Evaluation reviews the effect on the organisation. These and other hierarchies[54] all imply a continuum from the individual reaction during and after the course to an assessment of training which can be measured after the programme to a measure of behaviour change and finally some means of evaluating the long-term impact on the organisation and/or individual. This leads to recognition of the importance of training satisfying a number of distinct criteria if it is to be effective. For example the training input may be externally valid i.e. meet the needs of the organisation in content, etc. but not internally valid, because perhaps participants have been wrongly selected or the teaching is poor etc. and vice versa.[55]

The development of what amounts to definitional frameworks of evaluation has been matched by increased concern for its employment as an on-going operational tool of the training practitioner. The purpose of evaluation has, of course, always been that of feedback to the trainee, the trainer and the policy maker.[56] The emphasis in recent writings has, however, moved away from the clinical experimental viewpoint more towards the view that the main purpose of evaluation is to improve the training currently being undertaken.[57]

2. Investment Appraisal in the Evaluation Hierarchy

None of the above mentioned writers deal in detail with the role of investment appraisal approaches as such although several take cognisance of the need to evaluate training at various levels which includes the ultimate performance level. Hamblin,[58] however, has pulled together the various constructs relating to evaluation and produced the hierarchy exhibited in Diagram 1.6. Hamblin recognises that there may be a fine distinction between the Organisation and Ultimate evaluation levels. Under Organisation evaluation he suggests the inclusion of the influence of training on quality, motivation, absenteeism and turnover; and under Ultimate evaluation he suggests criteria such as survival, profit, and social and political welfare. It should be noted that both of these levels incorporate a mix of social and economic criteria.

DIAGRAM 1.6

HAMBLINS EVALUATION HIERARCHY

LEVEL 1 — Reaction Evaluation - of trainees during and after training.

LEVEL 2 — Learning Evaluation - the amount and type of learning acquired by trainees.

LEVEL 3 — Job Behaviour Evaluation - whether trainees have applied their learning on the job.

LEVEL 4* — Organisation Evaluation - effect of behaviour on functioning of the organisation. (Effect on quality, motivation, absenteeism, turnover, etc.)

LEVEL 5* — Ultimate Value - effect on overall organisation performance in cost-benefit terms. (Effect on survival, profit, welfare - social and political.)

*Investment appraisal may involve measures here. Note, however, the intrusion of non-economic objectives at these levels.

In terms of Hamblin's hierarchy, investment appraisal takes its place in levels 4 and 5. Perhaps the most important point to note at this stage is that the outcome of a training input evaluated in investment appraisal terms will be dependent upon the successful completion of earlier evaluation stages in the hierarchy.[59] Failure at any stage will adversely effect the outcome. This, however, is only one of the complications that stem from its terminal place. It follows also from this point that feedback for improvement purpose can take place at each level of the hierarchy. For example there can be feedback from one section into another during a training course at the reaction and perhaps the learning level[60] as well as feedback as to whether the programme is meeting the current needs of the organisation, at another level.[61]

PRACTICAL AND CONCEPTUAL PROBLEMS OF EVALUATION AT LEVELS 4 AND 5

The practical and conceptual problems of conducting evaluations of training at levels 4 and 5 are legend. The conclusion of Jones and Anderson concerning the difficulties of investment appraisal have been noted above.[62] Hamblin also has considerable doubts about the ability of many firms to enter evaluation at level 5 even though "they may recognise that this is the most logical place to start".[63] It is the purpose of this section to review the difficulties involved with a view to consideration either of the circumstances in which they can be overcome or the conditions in which they appear to be of less consequence. Therefore, almost by default, the situations in which investment appraisals might be used, the forms which they might take and the modifications they might have to undergo may be defined.

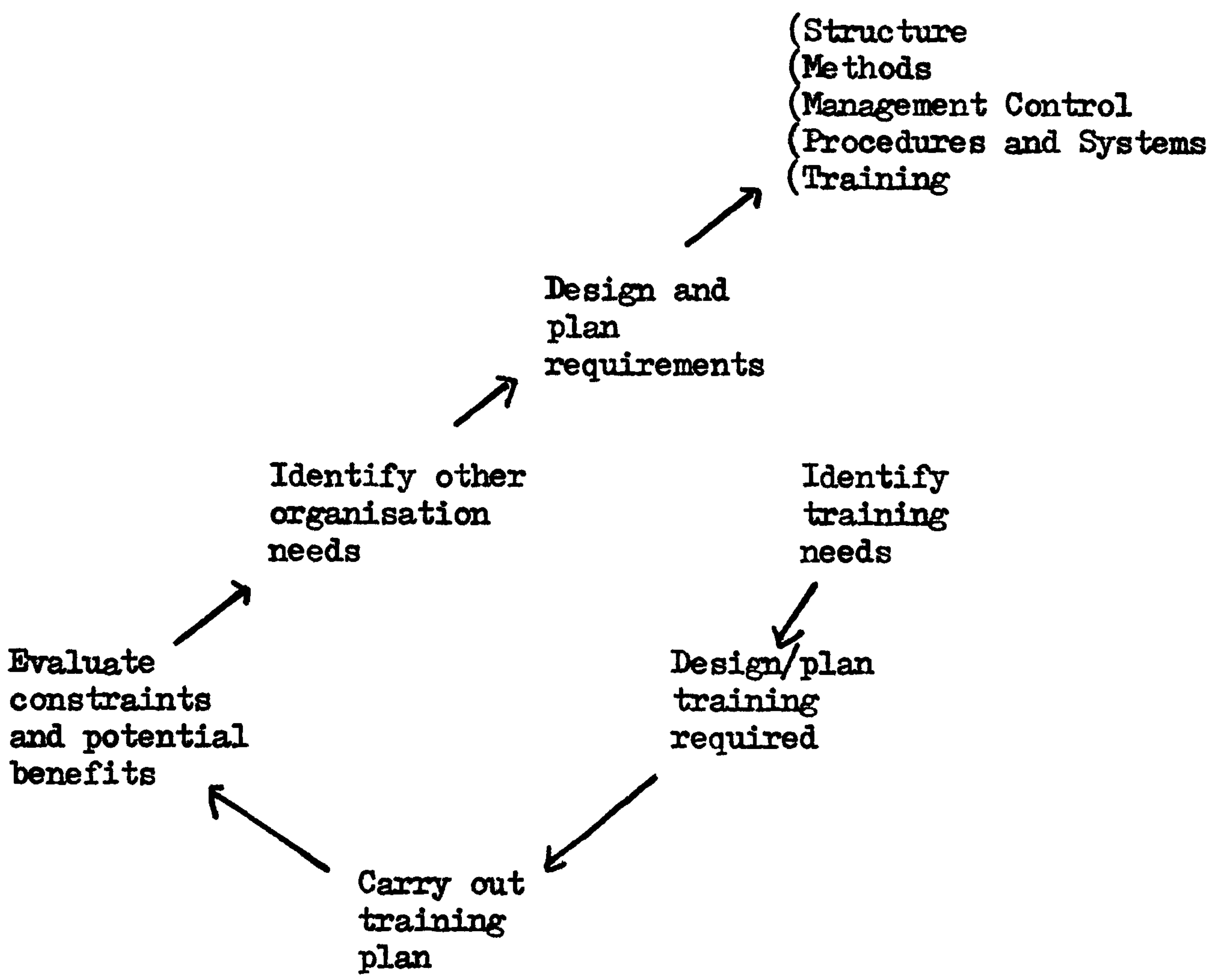
The Practical Difficulties

Perhaps the major difficulty which strikes at the heart of the utility of evaluation as a control instrument at levels 4 and 5 is the time factor involved in feedback. This will increase as one proceeds up the hierarchy of evaluation so that feedback into the system at the Ultimate level may be a matter of months and possibly years, not weeks, by which time a great many circumstances may well have changed rendering the original training objective and input obsolete or substantially amended. This would seem to place limits on the use of evaluation at this level as a control instrument. Exceptions perhaps would be circumstances where there was a simple and easily identifiable means of relating individual training to performance or where the need arose in the long term to have the occasional check that the training function in general was meeting the needs of the organisation.(64)

Major among the difficulties in obtaining feedback at the Ultimate level of evaluation are problems arising from the inflence of "other factors" in the evaluation procedure. The point is made by several authors that training is only one of a mix of factors likely to have an influence on performance. Martin,(65) for example, argues that other courses of action may achieve the same end as training and perhaps more efficiently i.e. with less use of resources. Hamblin(66) also recognises that a number of other factors may influence the effectiveness of training. One set of these may be described as directly linked with training and centre on recruitment, selection and placement policies; another set, less directly linked, might include industrial relations, management systems, bonus systems, technical systems, and information systems. The importance of the latter group of factors to evaluation is likely to increase as the hierarchical ladder is climbed. Attempts to evaluate training at the organisation performance level therefore are certain to involve consideration of these factors. Very little guidance is given in the literature however as to how these may be handled. Jones[67] recognises that "there is possibly more to be gained by removing constraints in the working environment than merely attempting to improve the training method" and proposes a cycle (Diagram 1.7) which leads after training to evaluating the constraints. As he also suggests, however, the extraneous factors likely to effect the training outcome operate at various levels of the evaluation hierarchy. Thus motivational factors influence job behaviour (level 3); changes in technology may influence levels 4 and 5. The importance of this point can be recognised in terms of the interdependance of each of the levels of Hamblin's evaluation hierarchy. It has already been noted that the effectiveness of training at each level of evaluation is dependent upon success at earlier levels.

D I A G R A M 1.7

THE TRAINING CYCLE AS INDICATOR OF ORGANISATION CONSTRAINTS



On a more technical plane there is also the problem of interdependency of human performance. This is a major practical barrier to linking performance with output. Thus an individual worker's output frequently depends on the output of workers further down the line; or, where a group works on a single process, relating output to subsets of the group or individuals within the group may present extreme difficulties.

The problem of linking human performance with output is frequently obscured by the incorporation of social objectives in the training objective.(68) Under the influence of Industrial Training Boards, the unions, and many company's own overall objectives, it is not uncommon to find strong social motivations behind certain types of programme which increase the commitment to the programme; this is particularly evident in the training of young people whether operatives, apprentice, craftsman or other grades. Social objectives are therefore subsumed into the objectives and content of the programme.

Of major practical importance also are problems relating to the role and capability of the trainer at the Organisation and Ultimate performance level of evaluation. Hamblin(69) argues that it is the role of the trainer to evaluate at each of the levels he outlines and to examine each of the links in the chain between these levels to ensure that it holds along the line. It is recognised by Hamblin, however, that because of the difficulties and the time involved the hierarchy may be abandoned after level 3 (the on-the-job behaviour level). This is indeed often likely to be the case given the limits on the status and ability of the trainer in many organisations. It has been shown above that there are many other factors influencing training effectiveness which if ignored at the performance level of evaluation are in many cases likely to render the exercise futile.

They are not, however, factors over which the trainer can normally exercise control.(70)

Finally, linked with these difficulties, are those relating to the additional skill requirements needed for evaluations at levels 4 and 5. Given the relatively underdeveloped state of the art such evaluations are generally undertaken by research or specialist teams and are still the exception rather than the rule. The number of trainers with the relevant skills is not great: level 3 evaluations if any at all, are the most that might be expected by practitioners in most companies.(71)

The Conceptual Problem

The above practical difficulties have been described by a number of authors. They serve to explain the neglect by training practitioners of evaluation of training at the Organisation and Ultimate levels. The major conceptual problem has not, however, been so fully explored: nor is it so easily explained. It can, arguably, best be revealed by means of an exploration of the possible contributions to the organisation of evaluations at levels 4 and 5.

Put at its strongest it can be argued that evaluation at the Ultimate level provides training with its major, if not sole, relevance in organisational terms. In relation to the dichotomy suggested by Ivor Davies(72) between efficiency and effectiveness in training it can even be suggested that the links between Hamblin's evaluation levels 1, 2 and 3, are concerned primarily with training efficiency and that those between levels 3, 4 and 5, with training effectiveness. The absence or disintegration of links in the middle of the chain can therefore have several major adverse consequences. Chief of these is that the training function may become isolated from organisation needs. This for example can be seen as a particular issue now facing the Industrial Training Boards. As external agents they have been able to influence considerably the level of resources, manning, and status of the training function in a large number of organisations.(73) They have, no doubt, in the main fulfilled their original promise to increase the quality and quantity of training.(74) Having created the system, their main problem is to encourage the effective interface and integration with other management systems.

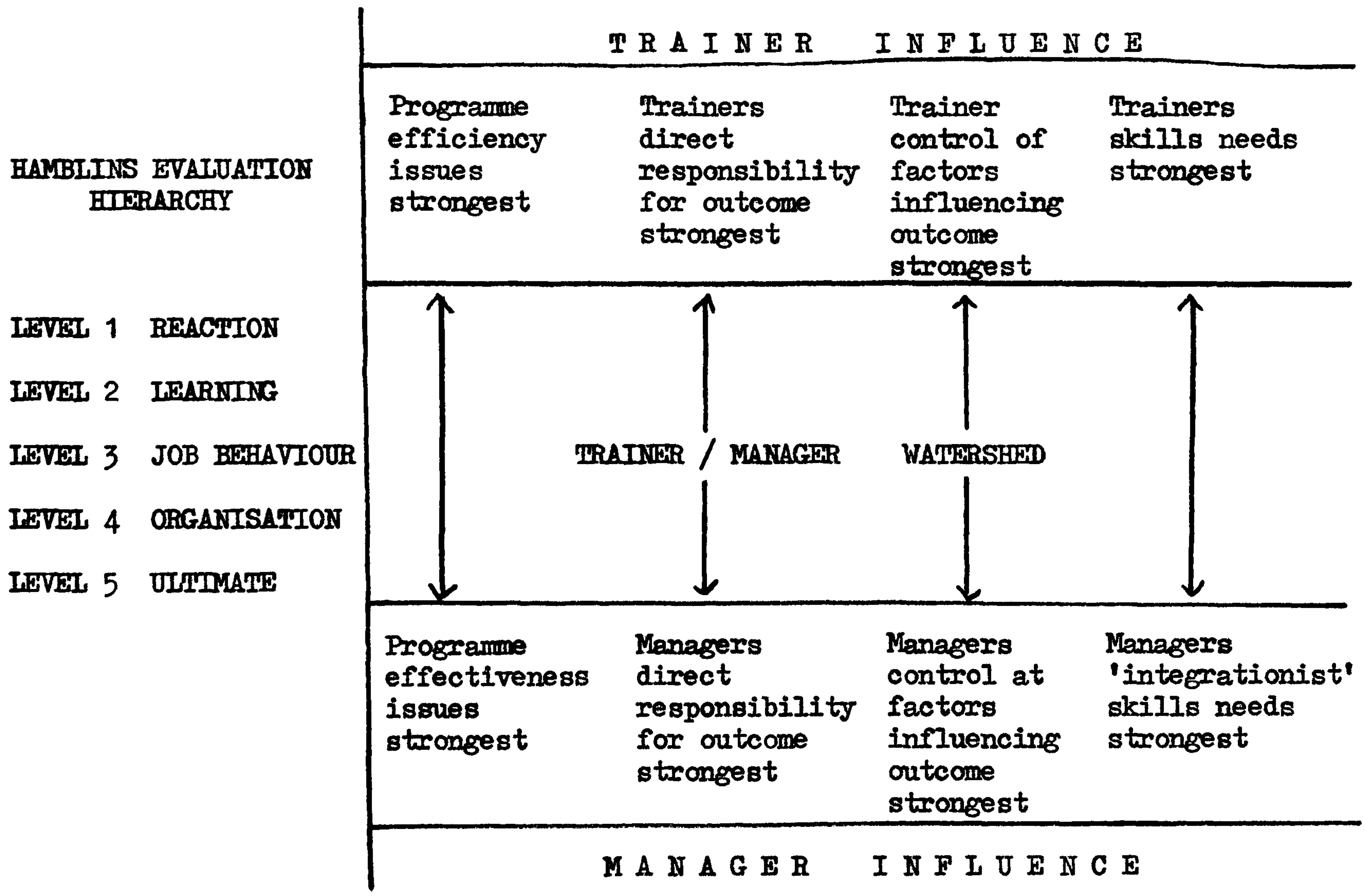
Hamblin(75) has argued, in this respect, that "evaluation of training (in moderation) can help to remove training from its isolation and so galvanise it to more effective action". It is clear from this that he recognises that the scope for management involvement lies in the relationship of training to organisational objectives for which the manager is responsible. Abandonment of evaluation at or before level 3 (behaviour) is likely to emasculate this hope. Without the integrating role of evaluations at the higher levels in the hierarchy it is likely that several of the perennial problems which face trainers are likely to persist, for example the difficulty in getting line management involvement in training as opposed to commitment in principle.(76) It is also in linking training with performance, that the trainer might expect to integrate most with management and therefore be more likely to influence management expectations of him.

It is clear, however, that the outcome of evaluations at levels 4 and 5 may depend not on the trainer, but on the "integrationist" skills of the manager in developing the optimum circumstances for training to be successful. It is after all the line manager who is responsible for "integration" of the "sub-systems" to achieve organisational effectiveness. This is most clearly revealed when considering the use of evaluation as a control instrument.

As has been mentioned earlier the trainer's ability to control the situation diminishes as the evaluation ladder is climbed. It is not only his ability to control, however, that declines but also his responsibility. He is not finally responsible for job behaviour and certainly has no overall responsibility for controlling organisation performance improvement. He has on the other hand a clear responsibility for ensuring that trainees learn what they are supposed to learn. It is proposed therefore that there is a watershed area between trainer and management influence at or around Hamblin's evaluation level 3 (Diagram 1.8). Beyond level 3, it is the management influence that predominantly determines whether training objectives are met.

DIAGRAM 1.8

TRAINER AND MANAGER INFLUENCES IN EVALUATION



Commitment of management in terms of decision making and active involvement in ensuring training effectiveness however raises the problem of the degree to which a sufficient respectability in any laboratory design to provide "scientific evaluation" can be retained. Intervention of trainer and manager jointly in the factors revealed to be influencing the programme effectiveness itself may lead to specific changes being made outside the training situation the exact impact of which may be unforseeable. Moreover there are likely in the pre-training situation to be factors which have been unforseen in the initial analysis which may become important later and which, it has been argued, the trainer or manager ought to become involved with.(77) Thus the Catch 22 of the "use of evaluation as a control instrument" is that if evaluation can be used to develop management control of training and it is seen as the right and proper function of management at levels 4 and 5 then it is also likely to involve trainers in dynamic change situations which may help them to realise new opportunities but will made it seemingly impossible for them to evaluate their activity in the strict laboratory control sense unless the evaluation is structured as a research situation.

TOWARDS A MANAGEMENT CONTROL VIEW OF EVALUATION

The above dilemma has not been fully explored by most writers on evaluation. Hamblin, in recognising it, argues that when starting out on a strategy for evaluation of training at level 5, such a strategy might become a strategy for management rather than training.(78) Marrow, Bowers and Seashore(79) and Hutton(80) are quoted as examples of this "systematic attempt to change the pattern of management in a company". On the other hand the Brinley Thomas/ Jones research seems largely to avoid this issue by dealing with the exercise mainly from the viewpoint of the trainer concerned with evaluating a certain input and "selling" the results to the management. For example, in a later article Jones and Anderson,[81] in dealing with the issue of obtaining management acceptance of training recognise the limitations of post-event monetary cost benefit evaluations by concluding "proof must be acceptable to the decision maker". From this they go on to suggest that the results of training may be expressed in "subjective value" terms, perhaps other than in money, but related to the perceptions of management in the organisations: they then go on to suggest a hierarchy of such values. This view, of finding the right 'currency' in which to sell training to management, does not mean that they neglect the need to recognise the dependency of training on other factors in the organisation which may be beyond the influence of the trainer. But it is significant that in the training evaluation cycle described in Diagram 1.7, Jones showed how the training programme leads, <u>after it has been carried out</u>, to identification of the constraints and opportunities which need to be acted upon.[82]

This research does not accept the view that evaluations beginning at level 5, must necessarily be seen as an overall strategy for management rather than training, nor does it on the other hand, accept the view that cost benefit evaluations are about 'selling' training to management. It instead seeks to treat some of the constraints as opportunities in demonstrating that:

(a) it is evaluations at the Organisation and Ultimate levels that demonstrate the "systems" interdependency of training for its effectiveness on other parts of the organisation.

and (b) that training can only achieve satisfactory integration by management involvement.

It is therefore proposed in this research than an evaluation instrument's prime purpose at these levels might be twofold:

(i) TO DEMONSTRATE WHETHER TRAINING IS WORTHWHILE OR HAS VALUE IN TERMS OF ORGANISATIONAL OBJECTIVES,

and equally importantly

(ii) TO BE OF USE AS AN INTEGRATING CONTROL SYSTEM DEVICE TO AVOID THE FRAGMENTATION THAT CAN OCCUR WHEN AN ACTIVITY BECOMES DIVORCED FROM ORGANISATION OBJECTIVES.[83] THIS TO BE ACHIEVED BY DEMONSTRATING AS PART OF THE EVALUATION THE DEPENDENCE OF TRAINING EFFECTIVENESS ON OTHER SYSTEMS IN THE ORGANISATION AND BY SO DOING INFLUENCE MANAGEMENT COMMITMENT AND ATTITUDES.

DEVELOPING A FRAMEWORK FOR TESTING THE RELEVANCE OF INVESTMENT APPRAISAL EVALUATION

The object of this research therefore, becomes to explore how the investment appraisal concept can be used to further the role of both manager and trainer in the "management of training". This penultimate section aims therefore at providing a new framework for approaching this issue which in turn will lay down the guidelines within which the evaluation experiments in Parts II and III were conducted.

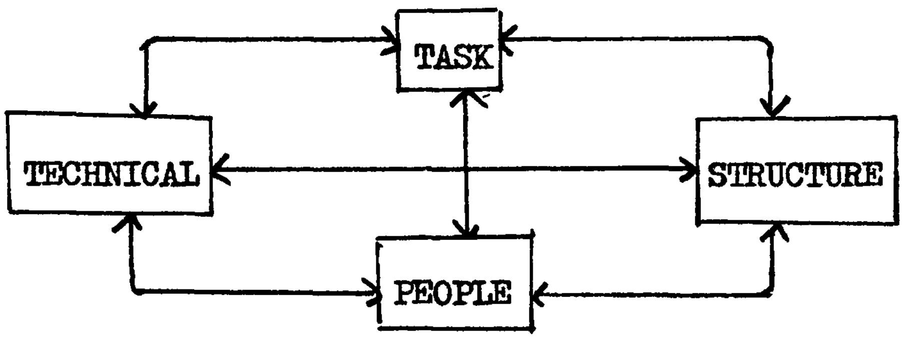
In view of the above objectives it seems essential in constructing this framework to start from a perception of the manager's decision-making role in training (and therefore in training evaluation) rather than to view his behaviour as a constraint on the "scientific" evaluation approach.

The conclusion to the previous section emphasised the interdependency of training with other components of the organisation and stressed the responsibility of the manager rather than the trainer for integration. This underlines the view of training as only one part of the total organisational system.

There are many ways in which this organisation system can be described and each is almost certainly an over-simplication.[84] One of the simplest and yet most revealing is that used by Leavitt[85] and shown in Diagram 1.9 below. It can be argued that this framework is of particular relevance because it is generally presented as

D I A G R A M 1.9

THE LEAVITT FRAMEWORK FOR ANALYSIS OF CHANGE



a means of representing strategies for organisation change where: Task refers to the organisation production of goods and services; Structure, the organisation planning and work procedures; Technology, the production engineering and systems; and People represents the human relations aspect of the organisation. All four variables overlap and each may be the major source of any particular change. Training is, of course, a means within the People element of bringing about change or helping the organisation cope with change. The manager of change is faced with taking decisions involving frequently the interaction of all four components. Fortunately, not all decisions he faces are novel. In this respect, Simon[86] has provided a useful breakdown of decisions between those which are "Programmed" and those which are "Non-Programmed". The former are described as routine and repetitive while the latter are unique in the sense that the form in which they present themselves has usually not been met before (Diagram 1.10). Thus, within the People element in the Leavitt framework above "Programmed" decisions might involve decisions about routine promotions, appraisals, redundancies, payment systems etc. while Non-Programmed decisions might involve the settling of interpersonal or group conflicts, the selection from existing personnel of a special team for a new venture etc.

D I A G R A M 1.10

A CLASSIFICATION OF DECISION TYPES*

Programmed	Non-Programmed
Routine, repetative The organisation develops specific procedures for handling them.	One-shot, ill structured, novel, policy decisions. Handled by general problem processes

*Taken from H. A. Simon. The Shape of Automation for Men and Management. London. Harper and Row. 1965.

The dichotomy can equally be applied to training and the implications for evaluation explored. Programmed training decisions will represent regular commitments which are likely to be repeated. Induction training (training to cover introduction to the organisation and its environment) and Initial training (training for the first, or next job) probably provide the best examples of this although any general training course, regularly repeated, and to which the organisation has a commitment, might also be included in this category. Induction and Initial training in particular have been a prime focus of attention of most Industrial Training Boards which has helped to confirm them in many companies as a standardised commitment. As such they may be readily administered and clearly 'owned' by the training department.

Non-Programmed training decisions in contrast will call for unique responses to unique situations. It is suggested that training in this decision category might be grouped into three main types: training to remedy deficiencies in human behaviour which are causing problems (to be defined as Maintenance Training); training which is related to particular changes in the organisation structure or technology which have associated behaviour change needs (to be defined as Change Training); and any other 'one-off' training and development input which is not clearly related to organisation maintenance and/or change needs. Training decisions in this Non-Programmed category are less likely to lend themselves to autonomous ownership and administration by the training department. The implications for training of the Programmed/Non-Programmed distinction are summarised in Diagram 1.11.

The importance of the dichotomy for the two prime objectives suggested for evaluation outlined above (page 28) can now be considered, particularly in relation to the potential for investment appraisal.

The first proposed evaluation objective was:

'to demonstrate that training is worthwhile or has value in terms of organisational objectives'

While both Programmed and Non-Programmed training decisions will, hopefully, be linked with organisation objectives, the manner in

D I A G R A M 1.11

A SUGGESTED CLASSIFICATION OF TRAINING DECISION TYPES

	Programmed Training Decisions	Non-Programmed Training Decisions
WHERE STARTS	Likely to start with people component to deal with regular problems.	Could start with straight people problem but more likely to involve a number of interactions between structure/task/technical components.
EASE OF ADMINI-STRATION	Training situation well defined lends itself to <u>regular</u> administration.	Not well defined training situation. Does not lend itself to <u>regular</u> administration.
OWNERSHIP	Lends itself to ownership by training department.	Problem ownership is clearly the managers.
DEGREE OF STANDARD-ISATION	High concern with a set of standardised behaviour requirements and set of knowledge and skills.	Difficult to define behaviour requirements. May be a unique set for the occasion.
EXAMPLES	Examples include: Induction and Initial Training and standard development type programmes e.g. supervisory courses.	Examples include: Maintenance (of behaviour standards) training; Training for change; Individual development programmes.

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which this arises and the nature of the linkage may be different.

Programmed training decisions will relate to overall organisation objectives - it is unlikely that such training would survive on a regular basis unless there was this perceived link. The relationship is, however, likely to be on a broader basis than is the case with Non-Programmed training, and less likely to be tied in with specific organisation performance deficiencies. This together with the longer planning horizon associated with the regular commitment will mean that Programmed training is frequently likely to embrace a number of objectives, social as well as economic reflecting in turn the mix of these in the overall objectives of the organisation. It has already been noted that such objectives are likely to be influenced by the Industrial Training Board recommendations which are more easily applied to regular committed situations and which themselves will embrace wider industry and national criteria. The intrusion of such criteria will, however, make it more difficult to arrive at quantitative performance evaluation indicators of the investment appraisal type although there will be certain situations (for example, in initial training) where there are clear man-machine relationships which facilitate quantitative measurement of training outcomes. The Brinley Thomas work has, however, demonstrated that in the absence of direct productivity measures other specific key indicators can be fruitfully studied - for example the effect of training on the life of the investment (labour turnover).[87] The longer planning horizon will certainly facilitate the setting up of 'scientific' evaluation measures, quantitative and qualitative.

It, 'a priori', can be argued that the opportunity for quantitative measurement may arise more frequently in Non-Programmed training decisions because the need for Maintenance and Change training will frequently arise directly from organisational performance deficiencies or hoped-for improvements. Paradoxically in such situations, however, there is likely to be less scope for 'scientific methodology' in the traditional cost benefit sense because of management urgency for action. In particular, such is the inter-dependency of people, task, structure and technology factors in most problem/change situations[88] that one hundred per cent scientific evaluation is unlikely to be practical without control groups which may be difficult to set up in 'pressure' circumstances. Such groups can perhaps more easily be negotiated in respect of Programmed training decisions.

The proposed second prime evaluation objective was

> "to be of use as an integrating control system device to aviod the fragmentation that can occur when an activity becomes divorced from organisation objectives. This to be achieved by demonstrating as part of the evaluation the dependence of training effectiveness on other systems in the organisation and by so doing influence management commitment and attitudes."

It is possible to argue that there will be key differences between Programmed and Non-Programmed training decisions in respect of the use of evaluation as 'an integrating control device'.

Because they are repeated regularly the careful evaluation of Programmed training decisions post-hoc, may well be worthwhile for control purposes. It has been recognised above that it will frequently be difficult to provide feedback in terms of complete quantitative criteria: because of the regular commitment, however, it will be particularly important to identify any partial quantitative criteria that might be used. On the other hand feedback post-hoc from most Non-Programmed training decisions may have limited control value because of the one-off nature of the intervention. Such feedbacks may be justified, however, on the grounds that it is desirable to demonstrate to managers the 'value of training' or that there is a need to identify general lessons that may be learned for such exercises which might be put to use in future cases. The arguments in terms of the ease with which evaluations of the investment appraisal type might be undertaken are summarised in Diagram 1.12.

DIAGRAM 1.12

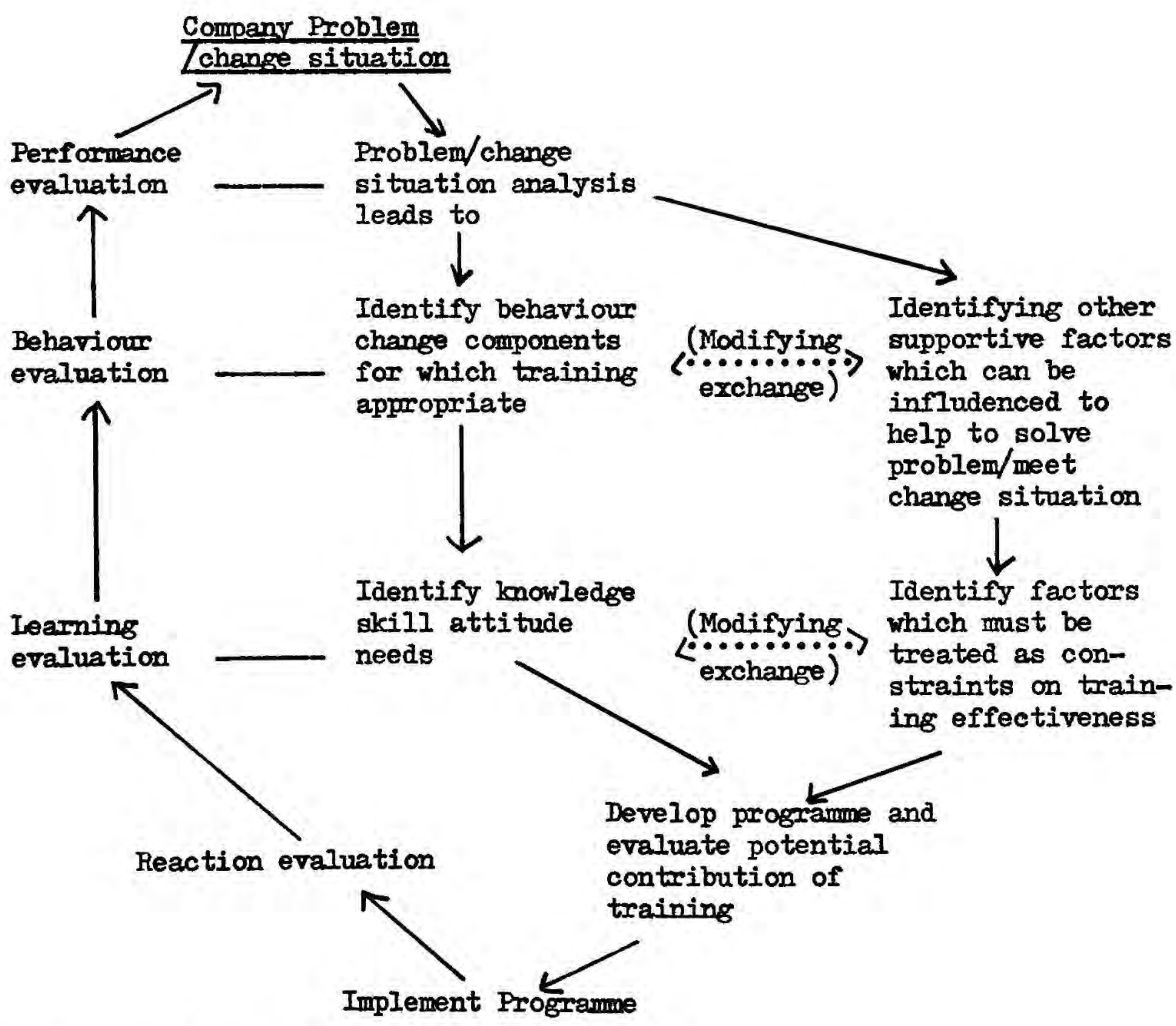
TRAINING DECISION TYPES AND PERFORMANCE EVALUATION CRITERIA

	Programmed Training Decisions (Regular)			Non-Programmed Training Decisions (One-off)		
	INDUCTION	INITIAL	DEVELOPMENT	MAINTENANCE	CHANGE	DEVELOPMENT
Training Types Definition.	Training to cover introduction to organisation and its environment.	Training for first job or new job.	Other Training organised on regular basis.	Training to maintain the standard of performance of individuals or groups (i.e. to remedy deficiencies.	Training to cope with forseen organisation or technical changes.	Other Training not regularly based.
Ease of association of organisation performance criteria.	Difficult can be related to induction crisis as measured by labour turnover.	Difficult but possible where simple man-machine relation holds.	Extremely Difficult	Easier depending largely on ability to define standards of performance.	Moderately Difficult because is generally linked with other changes.	Relevance may be difficult to establish as is frequently likely to be individual rather than organisation oriented.
Evaluation methodology needed.	Where changes made-need control group to measure change against.	Where changes made-before/after measurement plus control group depending upon circumstances.	Possibly needs detailed behaviourally oriented measures.	Before and after control group rarely possible in practice because of time pressure to solve problem.	Control group necessary. But likely to find because of time pressure.	Possibly needs detailed behaviourally oriented measures.
Value of historical feedback as control.	High because is a regular programme.	High because a regular programme.	High because a regular programme.	Low because it is one-off. Training investment is unique.	Low because is one-off.	Low because is one-off.

It has been argued above that an essential part of the 'evaluation for control purposes' objective is that of 'demonstrating as part of the evaluation the dependence of training effectiveness on other systems in the organisation and by so doing influencing management commitments and attitudes'. In both Programmed and Non-Programmed training decisions there are likely to be a wide range of systems influences lying outside of training which impinge on the ultimate objective. In both cases it is argued that it is important to evaluate the organisational dependency of training but with a different temporal emphasis. Diagram 1.13 provides a framework for

D I A G R A M   1.13

NON-PROGRAMMED (ONE-OFF) TRAINING DECISIONS
- THE TRAINING/EVALUATION PROCESS



(———) Represents post training feedback
(·······) Represents discussion and interaction pre-training

consideration of this point in respect of Non-Programmed training decisions. It shows an expanded version of the training process and evaluation cycle as in Diagram 1.5 with the exception that the unique one-off characteristic of such decisions dictates the importance of undertaking a pre-training identification of training effectiveness supportive factors. These will be derived from the analysis of the problem or change situation: they may be categorised into those that can be altered to support the training situation (opportunities) and those that cannot and will have to be treated as constraints on training effectiveness. The nature of these supportive opportunities and constraints will vary with the problem or change situation as will be demonstrated in Parts II and III of this thesis. This pre-training exercise can also be viewed as identifying the relative weight of contribution that training is likely to bring to the solution of the problem compared with other factors. If, for example, the overall objective can be defined in quantitative terms and the relative weight of training in terms of its potential contribution to the problem solution or change objective (compared with other factors) is high then it might be possible through this exercise to show that training will help to 'solve' the problem and result in measurable benefits.

If, however, the weight of training is low relative to other factors then management may decide that training is not worthwhile unless other action is taken in association with or instead of it. Either way the emphasis is on pre-training evaluation of training potential. It is argued that this may have several benefits:

(a) it gives the opportunity to involve management in evaluating the potential training contribution compared with other actions

(b) it gives the opportunity to modify the training in the light of supportive opportunities and constraints

and (c) it ensures that a proper pre-training investment appraisal is attempted.

The last benefit derives particular significance from the earlier argument that post-training evaluations in one-off training situations may be of limited value. The parallel here with physical capital investment appraisals is clear - the emphasis is on sound pre-investment appraisal in order to help improve management decision making.

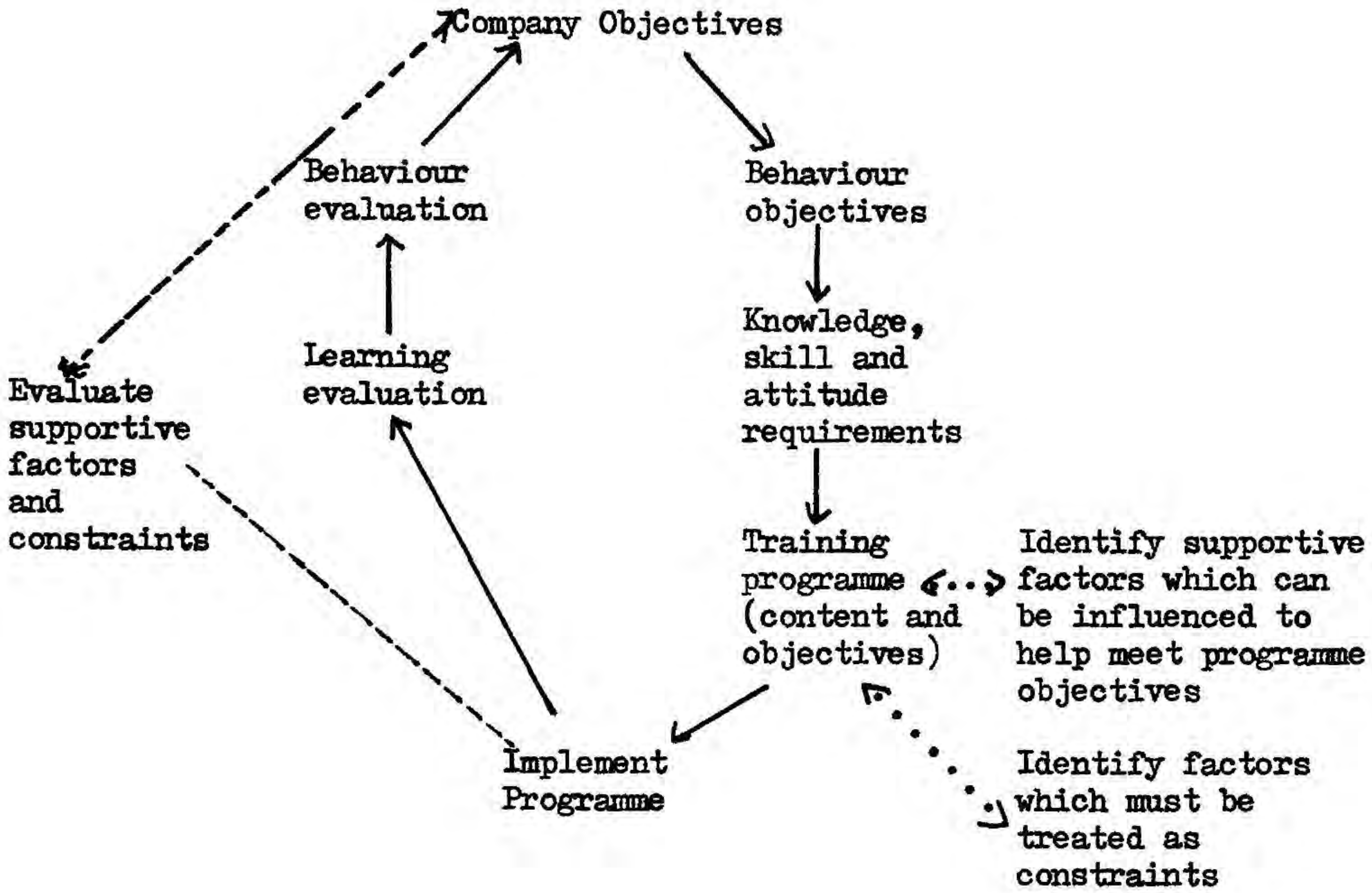
In Programmed training decisions it has been recognised that in many cases it will not be possible to link the programme with performance deficiencies or required changes. This together with the point that the programme is not derived from specific problem analysis or change needs but more broadly from company objectives has two major implications. In the first place it will commonly be much more difficult to weight the training contribution to objectives in the manner described above. The inability to produce a pre-training weighting of potential contribution to objectives does not however obviate the need for a pre-evaluation of effectiveness conditions. But the second major implication is that the opportunity for this pre-evaluation of supportive factors and constraints arises when the training programme has been prepared bearing in mind that this is a 'committed' decision. The pre-evaluation nevertheless may take on added importance in "Programmed" training for a number of reasons. Chief of these relates to the degree to which such training may become isolated from organisation objectives.(89) A tendency to isolation may be encouraged by the ease with which decisions of this nature lend themselves to complete delegation by management to the training sub-system and become administratively easily routinised. Thus induction and initial programme systems may develop stereo type patterns with an input and output emphasis and a consequent concentration on issues of efficiency based on an input-output ratio.[90] Isolation in itself may be partly a result of the difficulty that there is in linking 'tightly' such programmes with general organisational goals which are subject to change over time. The significance of such change may be overlooked. Finally, it is clear that in the absence of continuous questioning about effectiveness in the organisational context isolation of a training department undertaking Programmed training decisions for management may lead to the adoption of norms and objectives from outside the organisation, for example under the influence of external agencies such as Training Boards, which may be only indirectly in line with organisational goals.[91]

Evaluation of pre-training effectiveness conditions (both supports and constraints) will therefore certainly be desirable prior to the taking of Programmed training decisions. But in this situation, it has been shown above that post-hoc evaluations of existing programmes are likely to be of value because of their recurrent nature. Indeed such evaluations may be desirable on a regular basis to guard against possible "drift" from organisational goals. The organisation effectiveness questions which may be asked will of course be particular to the programme. Diagram 1.14 shows the training evaluation cycle for Programmed Training.

DIAGRAM 1.14

PROGRAMMED (REGULAR) TRAINING DECISIONS

- THE TRAINING/EVALUATION PROCESS



——— represents post-training feedback

...... represents discussion and interaction pre-training

A SUMMARY OF THE ARGUMENT LEADING TO THE CHOICE OF EXPERIMENTS

The main aim of this Chapter has been to explore the potential for the development and use of company cost benefit, or the investment appraisal concept as it has been renamed, as a technique in training evaluation. It has been demonstrated that the economist's concept of human capital can be useful in the in-company situation as well as in aggregative or macro situations where it is more commonly used. Its importance was seen to lie in the focus it places on the link between training and company performance through the effect on output and job tenure. The work reviewed in this field has demonstrated clearly the techniques needed and the conditions under which successful links between training and output are likely to be established.

Investment appraisal has been shown to have a place at the top of the evaluation hierarchy as defined by Hamblin and other writers. Within the evaluation framework it has been possible to explore the many practical difficulties that are associated with evaluations at the performance level including: the time factor involved in feedback; the intrusion of other factors which effect purity of results; the interdependence of human performance in organisations; the incorporation of social objectives in training, and the limits of the skills and responsibilities of the trainer. This led to the conclusion that the technique of investment appraisal as applied in its purest "scientific evaluation" form may be of very limited value.

In true cost benefit style the difficulties (costs) can only be assessed against the rewards (benefits) and it has been argued that there may be many dangers in not attempting evaluations at this level. These mainly centre on the possible divorce of training from organisational effectiveness criteria. The important conclusion from this discussion was that the evaluation process should not be aimed solely at measuring the "value" of training but equally might be used as a management/trainer integration and control device by stressing the dependency of successful training on other activities in the organisation.

In assessing how and where performance linked approaches and investment appraisal in particular might best be used for evaluation in this 'new' respect the emphasis was laid on considering the manager's decision making role in respect of training. Two types of training programme related to management decisions were isolated, Programmed (regular) and Non-Programmed (one-off). Within this framework it was found possible to categorise different types of training and to explore the potential for use of performance or investment appraisal evaluation within these typologies. By undertaking this exploration within a framework of management decision categories it was possible to demonstrate, outside of the technical parameters of feasibility, that post-hoc evaluations may have limited significance in one-off situations and that there was therefore a particular need for a thorough pre-training investment appraisal. In terms of the second role found for evaluation i.e. that of an integration and control device, it was argued that this had considerable importance in both types of training decisions whether or not there was available "hard" performance criteria for investment appraisal.

The empirical work described in Parts II and III seeks to demonstrate the typology for evaluations within the categories Non-Programmed and Programmed training decisions as described above. The research took place within the U.K. iron and steel industry and was concentrated on operator training. This concentration on operators was a constraint imposed by the nature of the Iron and Steel Industry Training Board contract: it was perhaps fortuitous in that it enabled a start to be made at a level commonly regarded as easier for performance type evaluations.

The two experiments may therefore be briefly described as follows:

- PART II - Non-Programmed Training Decisions

An attempt to develop and test a methodology for investment appraisal of operator training. This was to address itself directly to several of the difficulties described above as facing such evaluations but was to attempt to treat them as opportunities. The situation chosen therefore was a "live" situation rather than that of a retrospective analysis; it was an attempt to link operator training directly with performance indicators in quantitative terms; it was to eschew the "simple" choice of working with individual man/machine relationships but to concentrate on the not untypical situation in the Iron and Steel Industry of operatives working as a team; it was to endeavour to involve management in the decision making process; and finally it was to attempt to make explicit the "supportive" circumstances upon which training effectiveness depended.

In terms of the framework described in Diagram 1.12 above it centred on a Non-Programmed management decision concerning an acute management problem and considered as its prime aim the effect of training directly on performance rather than through the life of the human asset.

- PART III - Programmed Training Decision

An attempt to develop an evaluative methodology for a committed regular programme of junior operative training in the Iron and Steel Industry as broadly encouraged by the I.S.I.T.B. This type of programme had induction and initial training components, incorporated social objectives and was not likely to lend itself easily to evaluation in strict performance terms. The major "straight" investment appraisal technique that could be used was the effect of training on the life of the investment. An attempt was also made to build a broader organisation performance-based evaluative approach by taking into the evaluation, as a major part, certain organisational supportive factors which were felt to be key to the effectiveness of the programme.

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CHAPTER II

AN OVERVIEW OF RESEARCH METHODOLOGY

The two empirical studies contained in Parts II and III contrast sharply in the research methodologies used reflecting the very different situations tackled. The research methods will be described in detail in the respective sections. It is the purpose here, however, to provide an overview of the typology of the research which serves to place it in its academic context. There are three reasons for doing this. Firstly, the work was not initiated by the researcher but by an external client, the I.S.I.T.B. and was to be developed if possible to serve a practical purpose. Second, the approach used in Part II has a number of points in common with what is designated by behavioural scientists as action research, aspects of which are controversial.(1) Finally, it could be asserted that the study described in Part III is "evaluation research" (in the sociological not the training sense), a form of research which has sometimes been subject to some criticism.(2) A discussion of action research, to which all these points are related, provides the vehicle for dealing with them in the remainder of this Chapter.

Action research is essentially a problem solving model replicating the steps of scientific enquiry in an open-to-change situation.(3) French has defined it as:

> "...the process of systematically collecting research data about an on-going system relative to some objective, goal or need of that system; feeding these data back into the system; taking action by altering selected variables within the system based both on the data and on hypotheses; and evaluating the results by collecting more data."(4)

This form of research may therefore serve several communities,[5] including the sponsoring community with its practical concern for problem solution and the social science community with its obligations to work within an adequate conceptual framework or frameworks.[6] It is therefore the nature of the collaboration with the client and the degree to which it can claim social science respectability as a research methodology that are the two central issues.

The Nature of Collaboration with the Client

It is possible here to make a distinction between: A. the influence on the research because it is being undertaken <u>for</u> a client and B. the influence on the research because it is being undertaken <u>with</u> a client.[7]

A. Research for the Client

The existence of a client, as opposed to a provider of research funds, is a necessary but not sufficient condition for action research. It is a condition shared for example with applied research[8] on the one hand and consultancy[9] on the other. Its importance, however, lies in the degree to which it constrains the objectives of the research, namely, how specific the goals and objectives set by the client become and how narrow his expectations.[10] The setting of very specific goals leaves the researcher with little opportunity to explore the situation which has led to such objectives and consult with the client on this; it may severely limit his ability to choose what he sees as relevant conceptual frameworks. In these circumstances what is being bought and sold is the pure "scientific methodology".[11]

The empirical studies contained in this dissertation were commissioned by a client, the I.S.I.T.B. The Board is not a research organisation and it had the specific objective of using the results either to build into its recommendations to the industry on operative training or to use to meets its objectives in some other way. The terms of reference, insofar as they related to the work discussed here[12] were very general; the initial constraints placed on the objectives were that the studies should embrace considerations of "wastage of operatives training programmes" and "an estimation of the possibilities for the use of cost benefit analysis of operator training".[13] The evolution of the detailed objectives was of course monitored by a liaison panel of the Board but this left the author the freedom to construct the conceptual framework described in Chapter I.

There is one further complication. The work on investment appraisal of training described in Part II was aimed at developing a methodology which could be used by Board and/or company staff. There was, however, by the nature of the project another client, namely the management of the plant within which the experiment took place. This client had no tightly defined goals;[14] neither at this point did the researcher. The specific goals gradually evolved in a manner described in Part II.

The evaluation of the "committed regular" programme of junior operative training described in Part III comes into a different category. The aim here was to develop a methodology and provide research evidence on the evaluation of programmes in the first instance <u>for the I.S.I.T.B.</u> - not for the firms. Information was to be fed back through the Board to the companies.

B. <u>Research with the Client</u>

It seems generally accepted that action research means the joint involvement of researcher and client in facilitating change.[15] Perhaps because the number of academic practitioners and consequently the number of published cases are limited[16] it is difficult to find detailed agreement on the ground rules. This makes it arduous to describe all the agreed "sufficient" conditions for there to be valid action research. It is clear also that there are areas of considerable disagreement about certain of the rules of the game. While there is general agreement that the effort should be collaborative there are disagreements as to whether this means full collaboration at each stage of the problem solving process[17] including: joint problem diagnosis;[18] joint planning of action;[19] joint data collection;[20] joint participation in decision making;[21] and joint evaluation. The principle of "full" collaboration also has implications for the timing of interventions e.g. ought the researcher to be there full-time during each stage?[22] It also begs the question of whether there should be "equal sharing" at each stage. Is for example, the researcher to share his concepts with the manager.[23] Gouldner,[24] in this context suggests only that the researcher should work with the sponsor to identify assumptions underlying preferences and formulate a series of hypothesis about what must exist for the favoured idea to work.

Clearly different styles are currently admissible. These range from the consultancy model, where the researcher acts as an expert but with some consultation, to an engineering model,[25] where the sponsor initiates surveys with largely determined terms of reference, to Schein's process consultation model[26] with the sponsor not necessarily being aware of the problem. There is, however, a certain measure of agreement that consultancy approaches can be differentiated from action research by the absence of collaboration, the concentration on prescription with a package in mind tied in with a defined objective in turn built into a tight business contract.[27]

At the other extreme more rigorous data-based research may become eligible if it forms a deliberate pressure for change.[28] Implicit in the concept of sharing between client and researcher is that some learning must take place on both sides[29] although it is not structured as a learning situation solely for one or other of the collaborators.

The research described in Part II has several of the characteristics referred to above. The exercise involved considerable <u>interaction</u> with the management and personnel of the company. The problem was owned by the management and defined and recognised as a result of discussion between management and researcher. The results of the work were disseminated at some but not all the stages and at certain points the direction of the next stage was jointly determined. Decisions had of necessity to be taken by the management before certain parts of the process could be implemented and there was clearly built into the work a strategy for getting it utilised.[30] Initially, there was a bias towards the relationship between manager and researcher being consultative rather than collaborative, with the researcher maintaining in the earlier stages the typical academic "low profile".[31] The fact that the sponsor (the I.S.I.T.B.) was outside of the organisation, and was demanding a generalisable product (see below) was partly responsible for this. Also of importance, however, was the need to build up credibility slowly with the management and not to put the project at risk: the collaberative element steadily increased, however, during the project.

The empirical work which constitutes Part III was much more removed from the action situation. The objectives and planning of the research were not derived in consultation with the companies visited.[32] The relationship in the firms was therefore more that of the conventional researcher collecting data within a conceptual and analytical framework derived independantly. It was recognised, however, that the research might have important policy implications for the firms (as well as for the I.S.I.T.B.) but the feedback process was to be ultimately through the recommendations of the Board. The fact that this was the nature of the feedback process had some important implications for the methodology of the research.

<u>The Nature of the Research Methodology</u>

Action research embodies the scientific problem solving model of:(33)

- diagnosis
- data gathering
- feedback to client group
- data discussion and work by client group
- action planning
- action

The model is employed on an iterative or cyclical basis.

It thus embraces both an approach to problem solving (a model) and a problem solving process (a series of activities and events).(34) It is dynamic - its dynamism stemming from the iterative process within each problem and the recognition that the research may move from one problem to another.(35) The acceptance of this definition immediately enables several differences from the conventional academic research model to be noted. The first is embodied in French's distinction between field study and field experiment:(36) the former uses the selection of subjects and the measurement of existing conditions in the field as a method of determining correlations; the latter "manipulates conditions to determine causal relationships". The dynamic nature of the latter approach, embracing as it does the willingness to introduce change at each stage of the process may mean also that it is extremely difficult to maintain adherence to a controlled experiment typology.[37] Even the ability to manipulate some variables while holding others constant may be threatened by practical difficulties.[38] Clearly linked with this problem of control is the degree to which objectivity may be threatened by involvement and/or the researcher manipulated by the client.[39] The conditions under which objectivity is destroyed by the circumstances are difficult to define given the many difficulties there are in defining objectivity in the more conventional form of academic social science research.[40] The key issues linked with this question of objectivity and perhaps more fruitful to pursue are whether the research embraces a "social experiment"[41] and whether it is capable of generalisation.[42] Without the former the pretence to research is abandoned; without the latter it becomes devoid of meaning outside of a very specific context.[43]

The development of an investment appraisal approach to training in Part II was a problem solving exercise but aimed at developing a generalisable problem solving approach for those concerned with the "people" part of the organisation structure.[44] As well as being a "process" it can therefore claim to be an "approach". An attempt was made to manipulate certain variables in a diagnosed situation while controlling others. But this meant that opportunities to provoke change by feeding back into the system all the data at each stage were foregone: this moves the work one major step away from the action research model described above although it still retains other components in common. It did, however, enable a classic before and after experiment to be made.[45]

The evaluation experiment in Part III had none of the action research components described above. It used the classical "after-only" design with a matching control group. This had the major advantages that it avoided the problem of changes occurring over time (disturbing the control variables) and also the problems that are sometimes experienced when measures beforehand affect measures afterwards.(46) The main challenge to the validity of the approach in the context of the above discussion, stems from whether it can be classed as "evaluation research". Clark(47) describes the normal evaluation programme as follows:

"- examining the objectives of the enterprise or the selected sub-part
- identifying the goals of the units selected
- establishing specific criteria against which success can be measured and devising specific measures
- carrying out a research study on the selected unit to measure performance
- comparing the actual performance against the goals previously established
- reporting the discrepancy between the desired and the actual performance"

He states that such a programme will not include a change strategy and will be highly particularist in its results.

The model used indeed matches that described by Clark but with a few very significant exceptions. The framework for evaluation (the goals) was not specifically laid down by the organisation but was derived from consideration of a broader concept of the link between evaluation and organisation performance. Thus while there was no "dynamic" attempt to evaluate the "crucial process underlying success or failure",(48) there was a static picture taken of these. This enabled indirect feedback (through the Board) into the organisation for consideration of change. Moreover, it was envisaged that the approach used (supported or otherwise by the results) could be developed for use in other situations and make a distinctive contribution in this respect.

<u>Conclusion</u>

The research described in Parts II and II therefore falls into no single camp be it of the classical or action school. It can, however, be seen to have components that embrace both. While no judgement can be made on the academic respectibility and validity of the empirical research methods used without consideration of these in detail this Chaper has tried to demonstrate that at a general typological level the work has a legitimate and interesting context.

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PART II -

NON-PROGRAMMED TRAINING DECISIONS

CHAPTER III

DEVELOPING AN INVESTMENT APPRAISAL APPROACH

INTRODUCTION

The case study described below aimed to satisfy three major objectives.

(i) To apply the principles of the training evaluation process in a Non-Programmed training decision situation as described in Chapter I (see also Diagram 1.13): these principles were to be applied in the form of an investment appraisal approach. The key factors involved would be:

(a) Clear identification of the potential contribution of training to a problem solution.

(b) The clear isolation of the inter-dependancy of training on other factors.

(c) The presentation of (a) and (b) above in the form of a pre-training investment appraisal as a basis for management decision making.

(ii) To develop, if possible, a generalisable methodology of value to training practitioners in other situations.

(iii) To identify the constraints and opportunities associated with training investment appraisals of this nature with a view to understanding how and where they limit (or otherwise) the opportunity for wider application.

CONCEPTUAL AND METHODOLOGICAL FRAMEWORK

The broad conceptual framework for the approach has been described in Part I. This section describes the more detailed conceptual and operational framework within which the empirical investigation was constructed.

- The Systems Approach

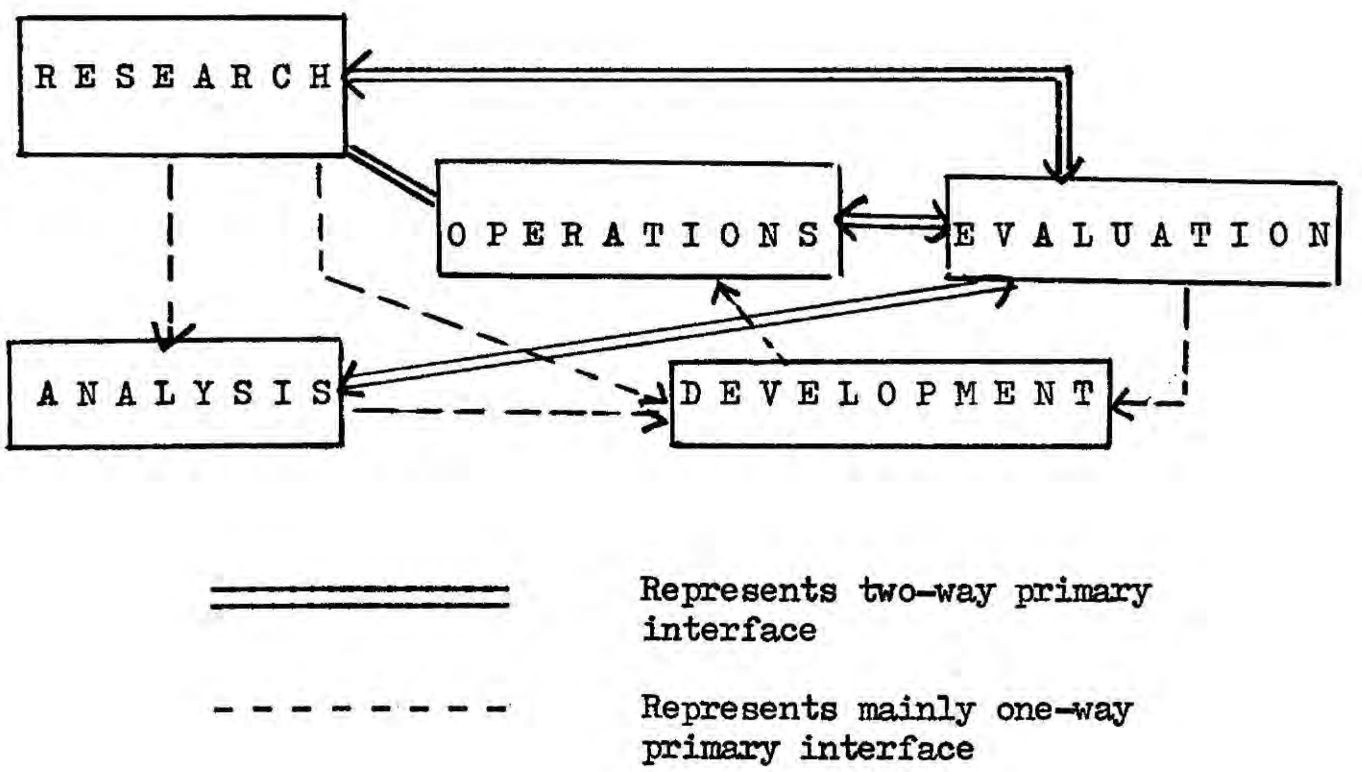
In Part I particular emphasis was placed on the view of training as part of a total organisational system. This view provided the initial starting point for the approach described in this chapter and therefore merits some expansion. From a systems view-point the organisation is seen as having a "mission" which embodies its specific objectives.(1) Training is a sub-system which is part of that organisation and exists to bring about behaviour change to meet objectives. The systems view serves to emphasise the dependency of training effectiveness on its links with other sub-system in achieving organisation goals and focuses attention on the manner in which it interfaces with other systems in the related environment.(2) Training has such interfaces with the personnel system (through recruitment selection and concern with absenteeism and payment systems) with management services (through work study and other human engineering work), with the operating system itself (in providing induction, initial, maintainence, change and development training for those in the operating system), with other support systems including quality control, costing and production planning and with environmental systems such as the bodies that develop training technology and those that influence manpower planning.

Warren has, however, agreed that within the training function itself there are a number of further sub-systems.(3) These he describes as Research, Analysis, Development, Operations and Evaluations. They interface with each other as demonstrated in Diagram 3.1 with functions defined as follows:

- Research:- Provides data to the rest of the training sub-system to improve organisation. Also trains the rest of the training sub-system.
- Analysis:- Identifies training needs and costs of meeting them.
- Development:- Designs and produces training actions.
- Operations:- Administers training action.
- Evaluation:- Evaluates training performance, training programme effectiveness and systems efficiency.

DIAGRAM 3.1

WARREN'S TRAINING SUB-SYSTEMS : MAJOR INTERFACES



Warren's view of training conditioned the whole approach described below by emphasising training systems inter-dependency in each component part. It is, however, in his hands, essentially a static concept used to describe the key factors in the effectiveness of training departments and the constraints operating on them in terms of levels of competence, capability (resourcing) and accountability.[4] But there seemed little reason why his systems representation should not be used as a basis for an approach to a dynamic situation. Warren's view was therefore developed and expanded as a framework, represented in Diagram 3.2 to describe the functions, interfaces and outputs of each of the sub-systems. Most of Warren's ideas have been incorporated in this Diagram but a number of others have been added to highlight key dependency aspects deemed relevant to the proposed investigation. It was found that the sub-systems could be transformed into stages that might be used to progress the work in the company and are shown as such in Diagram 3.3. Within each stage are inserted the key "tasks" which emerged from the study. The tasks resulted from the application of the problem solving paradigm described in Diagram 3.4. This problem solving approach was pursued throughout and follows the action research model as defined by French[5] and discussed fully in Chapter 2. The link which evolved between the systems framework and the problem solving model is described in the conclusion to this Chapter.

- The Detailed Methodology

There remains outstanding the question of the data collection methods used in conducting the various enquiries described below. As befits an "action" based approach a mix of formal and informal methods were employed. The development and content of these methods

D I A G R A M 3.2

DEVELOPMENT OF WARREN'S FRAMEWORK

FUNCTIONS, INPUTS AND OUTPUTS OF TRAINING SUB-SYSTEMS

SUB-SYSTEM	PRIMARY FUNCTIONS	PRIMARY INPUTS FROM	PRIMARY OUTPUTS TO
RESEARCH	- Provides external data to training sub-system - Provides training for training sub-system	- From environment (current research) - From management services (techniques) - From operations system (learning about behaviour change)	- To environment (results) - To evaluation) - development) - operations) (techniques) - analysis)
ANALYSIS	- Identifies performance and behaviour requirements - Analyses tasks - Identifies supportive conditions - Identifies sources of subject expertise	- From research or techniques - From evaluation on adequacy of analysis - From production interface (managers, etc.) - From management services	- To development (objectives and content of programme) - To evaluation (criteria)
DEVELOPMENT	- Designs and produces training actions (subject, teachers, techniques, methods)	- From analysis (setting objectives) - From research (techniques) - From evaluation (reaction evaluation) - From technical experts (internal and external to company)	- To operators (action programme)
OPERATIONS	- Administers training actions - Schedules and arranges facilities - Maintains day to day training systems	- From development (content, etc.) - From evaluation (reaction) - From research (training)	- To company personnel (trainees) - To evaluation) - research) (information)
EVALUATION	- Monitors training performance - Monitors training effectiveness - Monitors training efficiency - Feedback	- From research (techniques) - From operations (data) - From analysis (criteria)	- Feedback to all systems

D I A G R A M 3.3

THE DYNAMIC SYSTEMS FRAMEWORK AND THE KEY TASKS

STAGE 1 - RESEARCH	(a)	Development of overall[1] rationale for approach (investment appraisal)
	(b)	Development of systems[2]/problem solving framework
STAGE 2 - ANALYSIS	(a)	Of organisation performance and problems
	(b)	Of key areas of behaviour change requirement
	(c)	Of training needs and their relevance to behaviour change requirements
	(d)	Of relevant supportive conditions
STAGE 3 - DEVELOPMENT	(a)	Of training programme
	(b)	Of estimates of costs and benefits
	(c)	Of potential evaluation and monitoring system
	(d)	Of necessary supportive conditions
STAGE 4 - OPERATIONS	(a)	Implementation of programme
	(b)	Control of costs
STAGE 5 - EVALUATION	(a)	Evaluation of costs and benefits
	(b)	Evaluation of changes in supportive conditions

(1) Described in Part I, Chapter I.

(2) Described in introduction to Part II, Chapter III.

D I A G R A M 3.4

THE PROBLEM SOLVING PARADIGM

1. Recognition of problem existence.

2. Definition of problem.

3. Analysis of causes.

4. Measurement of factors of importance.

5. Generation of possible solutions if known or: framing of hypothesis to test deeper.

6. Evaluation of alternative solutions proposed.

7. Development of plan based on best solution.

8. Implementation of plan/solution.

9. Monitoring and evaluation.

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is described in detail as and where appropriate in the text. They include:

- Initial checklists used to identify problem areas: they are described in Appendix 1.
- More formal interview schedules piloted and developed for certain detailed parts of the inquiry shown in Appendix 4.
- Formal reports to the management, used as a means for giving and asking for information in a systematic manner, contained in Appendix 5.

The Appendices also show the detailed methodology used for the calculation of costs and benefits. No formal picture can, however, be given of the process of continuous communication with managers, engineers, foremen and operatives during the course of the investigation.

- Selecting the Case Study Situation

It was hoped that any model developed as a result of the experiment might be used in other situations by training practitioners in the industry and in the I.S.I.T.B. Equally important, if it was to be considered capable of generalisation, it had to be developed in a "typical" iron and steel industry process. The characteristic of such a process would be that it emphasised the group inter-dependency of the work force in production performance: it would therefore be difficult if not impossible to separate out the contribution of any single worker.

The need to meet the basic criteria directed the search for a suitable situation to basic steel industry processes located in the North East of England. Contacts were already established with the steel industry in the region both at the training and management level. Enquiries were therefore made about the existence of problem areas within production departments. As a result of these enquiries a short-list was drawn up and investigated further to enable a preliminary assessment of the nature and extent of problems, in particular the degree to which they seemed to be linked with behaviour rather than with purely technical matters. Also extremely important was the attitude of the management towards co-operation in the experiment. Consideration of these factors led to a final choice being made to attempt the project in a rod and bar mill at the British Steel Corporation Lackenby Works on Teesside.

- Mill Description and Manning

The rolling mill involved in the experiment was a continuous rod mill producing a merchant bar and coil rod from 35' long by $3\frac{1}{2}$" billets. The mill was run on a three shift system. The organisation and manning of the mill is shown in Diagram 3.5. There was no

DIAGRAM 3.5

ROD MILL - ORGANISATION AND SHIFT MANNING

MILL MANAGER

MILL ENGINEER — ASSISTANT MANAGER — ASSISTANT MANAGER

DAY FOREMAN

SHIFT MANNING(1)
(3 Shifts)

SHIFT MANAGER

Roller

Finisher

Rougher

Reel operators

Furnace charge operator

Spare hand operators (two)

Burner bundlers (two)

Test end youth

Spare hand

Main pulpit operator

Furnace attendant

In addition there was a mill recorder and a billet stocktaker.

(1) The ranking shows relative earnings status.

- - - - Represents possible promotion alternatives.

straight-forward promotion line as is common in many steel industry processes. The Diagram indicates, for example that the reel operator can go into the main pulpit as a speed operator, to the furnance as a furnace attendant or to the mill floor as a rougher. The relative earnings status of operatives in the mill is roughly indicated in the Diagram. Job descriptions for all the operator jobs in the mill were available: but, apart from training for bottom jobs, no systematic training was carried out. The training officer was largely involved in giving advice on the mill floor if and when required.

THE CASE STUDY

The case study represents an action research situation. It is therefore characterised by an attempt to develop a generalisable methodology while at the same time affecting change in an organisation.(6) There are consequently two outputs: a methodology; and an evaluation of change. This makes for difficulty in description. A complete description of the methodology used, followed by a case study to illustrate the use of the methodology would facilitate clear demonstration. It would, however, give the misleading impression that the methodology was invented prior to the application rather than being evolved from it, which is the true nature of the case. To relate the case study, describing events as they happened, on the other hand, would be a better approximation to the truth but would make for difficulty in digestion and perhaps understanding. A middle way is therefore proposed namely to describe the analysis step-by-step as it proceeded through the various stages as outlined in Diagram 3.3.

STAGE ONE - Research

The research element in training, in the sense that Warren[7] meant it, is concerned with designing and improving the technology of training as well as the conceptual framework within which it takes place. In this sense the research stage has already been described in terms of the development of the management decision-making framework for investment appraisal evaluation as described in part I of Chapter I and the systems framework used for the model in practice as described in the introduction to this Chapter. It thus conditioned the approach to all the other stages.

STAGE TWO - Analysis

- Analysis of Organisation Performance

A number of difficulties confront the would-be analyst of organisation performance problems. These have been documented by several authors.[8] Major among these is the diversity, complexity and differing importance of various problems that surround the production interface. The listing of such problems and the weighting of their relative importance is particularly difficult in the absence of clear criteria. It is not uncommon for the problem analyst to be confronted with a hotch-potch of interdependent 'problems' some of which represent either 'cause' or 'effect'.[9] In this respect a useful definition of a problem which has been proposed is that of a 'deviation from an accepted standard of performance'.[10] It can be argued that all problems represent such deviations even though standards of performance in many situations may be more implicit than explicit. The establishment of a standard provides the criteria against which might be measured the size and nature of the problem.

Thus in the rod mill situation the initial effort was directed towards seeking to establish what standards of production performance were required to be maintained and where there were deviations or 'problems'. From there it was hoped to identify how behaviour was related to 'problems' and what changes in behaviour were required, particularly at the operative level. Thus it was hoped to define eventually what contribution if any training might potentially make to solving problems. It was also hoped to define what conditions were needed for this training to be effective and thus, hopefully to relate training objectives directly to any revealed deficiency in performance where relevant. At this stage it was not anticipated that a completely definitive quantative training objective might be reached by these means. It was indeed hoped rather to achieve perhaps less than this in deriving indicators which in the managers' view might more or less be confidently associated with performance.

The search for 'standards' demanded systematic collection of written and oral data to determine:

(a) What measures of performance there were, potentially or in practice, for various parts of the plant and for the plant as a whole. It was recognised that this might include information that was not regarded as useful for conventional management control purposes. It was also recognised that such data might or might not be available and might or might not be used by the management for definition and control of standards. In many companies standards are implicit rather than explicit.*

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* In such situations it is nevertheless an excellent discipline to ask 'under what conditions would there not be a problem' in order to define standards.

(b) How the plant had measured up to standards of performance (explicit or implicit) over a recent time period and which were the key areas (recognised) of deficiency.

(c) In which parts of the plant, operatives exercised an important influence on plant performance and the extent and nature of this influence compared with technical and other factors. It was felt that this would enable areas of deficiency to be ranked alongside operator influence thus identifying any key areas of deficiency where operator influence was also regarded as high.

(d) What quantitative standards of performance existed or could be derived for individual jobs, elements of jobs or groups of jobs and whether these standards could be derived for the whole plant and/or for which parts of the plant. This represented the final analytical condition for establishing the feasibility of an investment appraisal approach - namely the potential for quantification of costs and benefits. It was recognised that in group working conditions it would probably not be possible to derive quantitative measures of performance for the whole job of any individual; but it was considered possible that the impact of certain elements of an individual's job or a combination of elements of a number of jobs on performance might be measured. A job element is here defined as a number of actions which need to be closely co-ordinated to achieve part or whole of a group or individual task.(12)

In summary it was hoped, through the process described above, to define key areas where operator performance was important to production results (compared with technical and other factors), to match this with results of analysis of the plant's major problems and in these matched areas to ascertain whether operative performance could be measured or related more or less confidently to certain indicators translateable into output terms.

- Major Initial Problems

The process of analysis involved continuous dialogue with the management, technical staff and operatives, initially through exploratory interviews, and afterwards using a questionnaire checklist derived from an analysis of plant performance. Initial discussions with the mill manager, assistant manager, foreman and mill engineer were designed to establish: what major problems there were in the mill; what factors were important in achieving optimum efficiency; what action had been taken to overcome problems and improve efficiency; to what extent training was thought to be important in relation to problems of efficiency and how it interfaced with other aspects of man management; and what standards of performance were expected in the mill as a whole or in parts of the mill related to this. Questions were also asked about the availability of production and man-power data.

From these early interviews it was possible to establish that:

- production in the mill was well below that which management desired and had been for some time.
- this was felt to be related as much to the performance of personnel in the mill as to technical or other factors.

- if there was any training need for operatives it was thought to relate all along the line and not just in the bottom jobs where, traditionally, training had been concentrated.
- there would be problems in the introduction of any operative training especially for more senior operatives because:
  - (i) attitudes of senior operatives were such that it was thought they believed themselves to be beyond any training need and would resist any attempt at training them.
  - (ii) management was reluctant to interrupt shifts for training purposes largely because of the substantial costs involved.

- The Search for Standards

There were no obvious performance standards for mill operations on an individual worker basis. The mill as a whole, however, had standards of expected shift output and yields from given inputs of steel based largely on past performance. Shift reports were set out in such a way as to indicate what standards were reached and to state explanations for any deviation from these standards. This data was amalgamated into weekly reports which gave very much less detail than the shift reports themselves.

There was also data available relating to shift manpower in the form of report cards setting out conventional personnel and job movement information. Further investigation undertaken in the company personnel record office revealed that there was no labour turnover data produced for the mill separately - only for several associated mills together. Analysis of the record cards available in the plant however revealed that labour turnover was only significant in the lower, relatively unskilled jobs. Absenteeism, however, was fairly high which put a premium on the ability of operatives to work efficiently at one or two jobs above them in the promotion ladders.

In considering what standards were available and in analysing mill performance in relation to these it was obviously necessary to settle on a particular time period. In general it was recognised that the time period over which observations might be taken would depend on the number of observations needed to establish with reasonable confidence that the data represents all conditions affecting the works, given that almost no data will be free from abnormalities such as shutdowns, raw materials supply failure, random technical influences, etc. The number of observations and therefore the time period would also be affected by the nature and length of the process and by the period over which control and other data in the works is collected.

Taking these factors into account the shift reports were examined over a period of one year and revealed the following significant facts:

(i) There were substantial product changes in the mill. This meant that large adjustments were needed to move from one product to another and these adjustments were marked by step functions in shift output. After a change there would be a steady improvement for several shifts until a relative plateau was reached, the low initial output obviously relating to the problem of setting up the mill. This provided a first clue for further investigation.

Shift report data was presented in such a way as to differentiate between scheduled stoppages on the plant for roll changing, etc. and unscheduled stoppages of one kind and another. These unscheduled stoppages could be analysed by the cause of the stoppage and/or the area of the plant in which the stoppage occurred. The headings under which this information was summarised are given in Diagram 3.6. The shift reports were compiled by the mill recorder. Enquiry about the status and role of the mill recorder revealed that some recorders were not fully familiar with the operations of the mill. Consequently much of the recorded stoppage time was that indicated by roller, rougher or finisher.

D I A G R A M 3.6

MAJOR HEADINGS FOR DATA ANALYSIS
(show mill location and/or cause)

ROTARY SHEARS	FURNACE
REPEATER COBBLES	MECHANICAL
STAND COBBLES	REELS
Q BAR SHEAR	CONVEYORS
BAD STEEL	COOLING BED APRON
ROD SWITCHES	MATERIAL AND BENT BAR
HOOK CARRIER	ELECTRICAL

MISCELLANEOUS

(ii) Mill costs were controlled on a standard costing system. Standards were set for rolling rod and bar based on a time utilisation factor. This factor was derived from a total number of manning hours available for a week in the plant minus allowance for scheduled roll changes, meal times and unscheduled stoppages. Standard rolling costs and times were applied to standard raw material (billet) costs with standard yield for any billet tonnage throughput. Data was available showing times budgeted for stoppages both scheduled and unscheduled as well as other factors to be compared with budgeted times such as the yield and rolling rate.

(iii) Given the availability of billets to roll, it was clear that the major factor affecting the ability of the plant to operate near output standards was the maximisation of effective rolling time by minimising the amount of stoppage time on the plant. Next to this in importance was the maximisation of yield from a given billet throughput from the furnace: yield would be low if there was a high percentage of breakdowns or failure to pass raw material through stand (cobbles) which led to the steel being reduced to scrap.

- Analysis of Data

An analysis was made of the total unscheduled stoppages in various parts of the mill as in Diagram 3.6 and results set against the budgeted figures. This analysis was undertaken over a period of just less than twelve months. The tables in Appendix 1 show the results of this analysis. For the purposes of the calculation a distinction was made between periods when bar was rolled and other periods when coiled rod was rolled, because the problems involved in rolling bar and rod are somewhat different. Throughout the twelve month period taken there were twenty-one weeks when coiled rod was rolled and twenty-five weeks when bar was rolled. Two weeks when both rod and bar were rolled were ignored.

The most obvious fact to emerge from the analysis was that stand cobbles* accounted for about one-third of the stoppage time in relation to both bar and rod rolling even though the bar did not go through all the finishing stands on the mill. In the case of both bar and rod the figure was greatly in excess of budget (see Appendix 1). This excess however was rather smaller than in relation to mechanical stoppages which accounted for just over one quarter of the time lost in the period and grossly exceeded the budget estimate. Other stoppages were much less important although in some cases there were large variances over the budgeted figures.

- Analysis of Key Areas of Behaviour Change Requirement

In initial discussions with management about this data it was pointed out that stoppages classified under mechanical failure were exaggerated because it was felt that the information fed upwards from the mill floor attempted to disguise the number of hours lost by operative error. It was also revealed that the budgeted hours lost were based on part performance rather than on any technical standard.

The next stage was to ascertain what factors were important in causing lost output and in particular where the areas where operator performance was viewed as being important as opposed to other

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*A cobble occurs when the rod or bar fails to go through the rolls either jamming in the rolls or being thrown aside.

factors. The rollers, mill foreman, the assistant managers, the manager and the mill guide engineer were therefore asked to comment on the factors likely to lie behind the unscheduled stoppages listed under the headings given in Diagram 3.6. After all the factors were listed they were asked to comment on each in terms of the scope for operative error in causing the unscheduled stoppage: they were also asked to ascribe a relative percentage importance to these factors. The checklist used in this constitutes Appendix 2. Under each heading a varying number of technical and mechanical factors were mentioned and noted. A brief summary of the replies are given in Appendix 3.

In general operative performance was considered, by all interviewed, to be only a small factor (accounting for 15% or less of time lost) in stoppages relating to the "rotary shears", "reels", "rod switches", "cooling bank apron", "hook carriers", and "Q bar shears". In the case of stand cobbles and repeater cobbles all those interviewed were unanimous that poor operator performance was between 90 and 100 percent responsible for stoppages either directly or indirectly through failure to check for notice and correct faults. A decision was therefore made to concentrate on the problem of stand cobbles.

The process of interviews with all senior personnel in the mill based on a common checklist was itself of importance as a means of focussing the attention of the management on the problem identification and analysis. It also served as a vehicle for reaching a consensus on the problem areas most likely to be affected by operatives. It thus represented the first major step in obtaining involvement of management in the project.

- Analysis of Behaviour Change Needs and the Relevance of Training to Them

There was a sharp distinction between validating that operative performance could in some way be related to plant performance and measurable standards and determining whether training had any role to play in improving performance. Problems in deficiency of performance in key areas (in the plant or in jobs) might for example have resulted from a variety of factors other than training (poor supervision, inadequate remuneration),[13] etc. Further discussions were therefore held with foremen and management to ascertain: what factors might be important in the poor performance of operatives in these areas; which operatives had duties and responsibilities in these areas; and what were these duties and responsibilities.

In general, no clear picture emerged as to the important factors in poor performance. It was, however, evident that problems were partly related to the frequent changes in product mix which seemed to place a premium on the ability of operatives to adjust to changes accurately and quickly. The operatives principally responsible for making these changes were the senior operators on each shift. There was considerable doubt, expressed by management and others, as to whether poor performance in these duties was the result of inadequate knowledge or skills or whether it was application, not skill, that was missing. It was therefore decided to conduct an enquiry into the skills and knowledge of key operatives in this area and the operation of factors influencing the application of their knowledge and skill. The enquiry that was set up had four main purposes:

(a) To establish knowledge and skills related to the key job elements in the problem areas.

(b) To establish what performance (behaviour) standards were required to do the job or job elements in these areas.

(c) To establish what other factors might be important in relation to sub-standard performance and what weight they carried.

(d) To establish whether the knowledge and skills of relevant personnel were up to the required standards and if not, what were the deficiencies that could be met by training.

The total duties and responsibilities of the top operators in the several shifts had been outlined clearly in job descriptions written some time previously. But it was obvious that it was certain elements of these jobs that were important in relation to performance in the areas chosen for further investigation and not the whole job. A list of factors judged to be important in the prevention of cobbles was therefore drawn up, each item of which had implications for the diagnostic abilities and knowledge of operatives and the application of these abilities in undertaking certain key elements of their jobs. These factors are shown in Diagram 3.7. No clear picture could, however, be obtained from discussions with management as to what standard of performance in these areas was adequate.

In consultation with the management it was therefore proposed that all the senior mill floor operators should be interviewed about the factors outlined in Diagram 3.7. These were the roller, finisher, rougher and the operator who stood in for the rougher or finisher when they were ill or absent on each shift. Two questionnaires were then developed, designed to ascertain:

- the levels of knowledge and diagnostic skill of operatives
- the practice and use of this knowledge and skill

DIAGRAM 3.7

IMPORTANT FACTORS IN THE PREVENTION OF COBBLES

- The diagnosing of front ends of cobbles after they have occurred to ascertain the correct cause of the cobble which can then be remedied.
- Knowledge of the correct procedures for setting up the stand and starting the mill again after the cobble has occurred.
- Knowledge of guide setting and location.
- Knowledge and practice in the setting of roll height.
- Knowledge and practice in the setting of twisters.
- Knowledge and practice in the setting of roll cross.
- Knowledge and practice in balancing the loops in the repeater.
- Knowledge and practice in the preservation of the correct balance throughout the mill and the climination of pull and push.
- Knowledge and practice about the elimination of finning of the rod or bar.

- how the operatives saw their own duties and responsibilities in the problem areas and in key parts of their jobs
- whether the operatives themselves felt that they had problems either of training or of any other nature.

Under this last item the opportunity was taken to provide a framework within which the operators' comments on the mill's problems could be compared with those of management.

Both questionnaires were drawn up with management and checked several times as to content. A brief model answer was also prepared for each question, verified by management and foremen. These model answers were not, however, in most cases treated by the interviewer as the correct answer against which to assess the reply of the operatives because it was suspected that there might be practices that management was not aware of or did not condone but which in fact were as good as those in the "book". All the questions were treated as open ended and the operative encouraged to say as much as he thought relevant. The management was, however, asked to indicate what standards were expected from the replies. Each manager consulted felt that the top operatives in the mill should be able to answer the questions without any difficulty although the less senior of the operatives might have difficulty with some. The proposed enquiry was also discussed with union representatives and approved and all the operatives interviewed, which included four of the senior operatives from each shift were reassured that the report of the enquiry would preserve their anonymity. The questionnaires used are shown in Appendix 4.

Questionnaire 'A' was designed to check on the diagnostic abilities of the operators in relation to cobbles. Examples of sections that had cobbled in the mill were collected until it was believed that a representative sample was obtained and with the help of the mill foreman and training officer information was prepared on:

1. Why the cobble had occurred (what went wrong with the section that caused it to cobble).
2. What had caused the cobble (what factors had resulted in the section being the shape that it was).
3. Where the cobble had occurred (which stand it had cobbled in).
4. What action might be taken after the cobble occurred to sort out the problem and get the mill started again.

5. Which of the cobbles could have been prevented and how.
6. Who is responsible for taking action after the cobble.

These six points became the basis for questions related to each exhibit. Points 1, 2, and 3 were turned into questions which checked the operative's ability to diagnose correctly: Points 4, 5 and 6 became questions designed to build up a body of information about practice in handling cobble situations. In this context further questions were asked about responsibilities for action in general, and specifically in relation to the roller, finisher and rougher.

Questionnaire 'B' was designed to test knowledge and established practice about the adjustment of the plant to prevent cobbles. Questions were drawn up relating to the factors affecting the propensity of the section to cobble. These questions were graded according to difficulty. The aim of this questionnaire was:

- To isolate factors affecting cobbles or the prevention of cobbles.
- To obtain the operative's view of the problems of the mill to compare with those of management.
- To ask the operatives about their own perception of their strengths and weaknesses.
- To find out what was checked and by whom in the mill.

The results of the enquiry were presented to the management in the document contained in Appendix 5. The report represented the second major step in the process of communications with management. It presented the detailed results from the questionnaires, feedback operator comments as the reasons for production losses in the mill, pointed out admitted deficiencies in operator knowledge and skill and brought to the attention of management a number of practices in the mill which were not established procedures but nevertheless seemed to work and were relevant to the problem. Perhaps, most importantly, however, the report in the conclusions (page 137) posed a number of questions for management to answer, both specific and general, technical and organisational.

- The Relevant Supportive Conditions

From an early stage in the analysis (prior to the detailed enquiry among operatives) it became clear that the problems were mainly the result of frequent changes in the product mix. The original aim of the management had been to produce three weeks of bar and three weeks of rod in rota: in practice production was related to the vagaries of the market. There were problems therefore associated with the need to change the rolls frequently as well as to alter roll speeds and set the guides. All this seemed to place a premium on the ability of the operative to adjust to changes accurately and quickly. It was clear, therefore, that if product mix policy was changed improvements could be expected in mill performance irrespective of major changes in operative behaviour.

During the early stages of the analysis it became clear that the role of the shift manager in providing advice and guidance to the operatives on the mill floor had been neglected. In discussions with management their reaction was that shift managers ought to play a role in this respect but that the majority of managers probably could not do so because they lacked the ability themselves to handle the detailed production situations involved. It was decided therefore initially to incorporate shift managers into the detailed enquiry described above (this was not, in fact, done at this particular time because of the need to press ahead with the operative enquiry). It nevertheless served as an example of the way in which the enquiry could have been broadened. A similar case could have been made out for investigating maintenance problems in detail but this again was beyond the scope of the enquiry at this point.

The discussions with the management following the detailed enquiry however centred on a number of other factors namely:

- the adequacy of certain practices in the mill
- the possibility or desirability of standardising certain procedures
- the desirability of clarifying responsibilities or certain duties which appeared to be unclear
- the possibility of management action in certain respects other than formal training

The management were therefore asked to decide in a number of cases what was and what was not the deficiency and what was and what was not an acceptable practice (see page 37 of the report to the management - Appendix 5). Management answers to certain of these questions provided the trainer with some further direction in developing a training plan. Others, however, pointed to the need to improve certain equipment in the plant in order to ensure that the correct practice was carried out e.g. the hickey block, to be used for setting roll height was often not used because it was not marked clearly and th e correct pattern piece to go with it could not be found. On another plain, discussions concerning the roller's responsibility for the shift were of obvious importance, in particular:

- his role in cobble diagnosis and the degree to which he could delegate this

- his relations with the main pulpit operator (was the main pulpit operator responsible to the roller?)
- his responsibility for training

These points had implications for the training to be given to the roller and for the type of training needed.

Another factor discussed was the influence of the promotion line on training. The splitting of the line (Diagram 3.1) led to problems in seeking replacements for the rougher and the training of suitable replacements. The reel operator for example was expected to know three key jobs. The influence of pay differentials was of critical importance here. It had been clear in interviews with senior operatives that there were problems in encouraging the best young men to work on the mill floor, where conditions were dirty and dangerous, because of the relatively high status of the furnace attendant's job (Diagram 3.1). This job it appeared, had earlier been further down the line (in terms of pay) and in fact had been undertaken by two men, one at the front and one at the back of the furnace. A partial productivity agreement had been made replacing the man at the back of the furnace by a T.V. camera. The wage re-adjustment under this agreement had <u>not</u>, however, been extended to the senior mill operatives with the result that their relative earnings status had been diminished.

<u>STAGE THREE - Development</u>

<u>- Development of a Training Programme</u>

The major conclusion of the enquiry was that there were obvious deficiencies in knowledge and skill in certain areas which pointed to a need for training (pages 36-37 in Appendix 5). These were detailed in the report along with the levels of operative at which training should be aimed. Management answers to certain of the questions posed in the report provided some further direction in developing a training plan. As a result of the enquiry and subsequent discussion of the results with management, an action programme for training of the top operatives in the mill was drawn up with the objective of diminishing the unscheduled stoppages resulting from stand cobbles. The basic outline of the programme which was to take place both on and off-the-job is contained in Appendix 6.

- Estimating Costs and Benefits

Before any final decision was taken about training, estimates had to be made of the costs and benefits associated with the programme. The training action programme was therefore costed in terms of analysis, development and implementation costs. The benefits represented the potential revenue to be obtained by closing the performance gap.

Potentially the most difficult abstract problem in making these estimates was the calculation of the time period over which benefits might flow and costs would be incurred. In general the length of the time stream of benefits from particular training to be undertaken in the immediate future will depend partly on labour turnover in the jobs affected: if turnover is significant it will have to be taken into account.[14] Judgement might also have to be made as to whether the impact of the training scheme may diminish over time.

It was recognised that the validity of making quantitative estimates over time would be affected by changes in other factors in the future. Thus, particularly in estimating benefits, the possibility of such changes affecting the data would have to be noted. All the factors outlined in Stage Two (d) above represented uncertainties in estimating the benefits from the training investment.

It was recognised that this process of estimating costs and benefits was not a substitute for the validation of knowledge and skill imparted through the training nor for on-the-job assessments procedures. The methods used for validating the training are described in Appendix 8.

(i) Estimating Cost of Training

Turning quantitative indicators of performance into estimates of financial benefits is a procedure which varies with the nature of the indicators chosen. No overall generalisation can therefore be made. This is not the case in measuring costs of training. Proper and accurate measurements of the costs of training were needed if an investment appraisal was to be attempted. An attempt was therefore made to embody a number of principles into the calculation of costs, as follows:

(a) They should, as far as possible, be real opportunity costs. The opportunity costs of time and effort spent on training are the returns to be derived from the time/efforts spent on doing something else(15) e.g. the opportunity cost of taking a man off his shift for interview or training is the value lost because of his lack of contribution to the output of the shift during that time. The calculation of opportunity cost, however, is particularly difficult in relation to management and supervisory time. On occasion it is possible to argue that the opportunity cost of questionning a manager or supervisor is nil if he has slack time available.(16) Similarly, if there is a spare hand employed on the shift to fill in for absentees then the opportunity cost of taking an operative off the shift for an hour for training, if not always nil, (because the spare hand may be unable to do the job as well as the operative replaced) may be much less than the cost of taking the operative off the job without replacement. It can be seen from this discussion that the conventional approach of calculating costs by estimating the relevant part of wages and salaries in relation to time spent could be very misleading. The opportunity cost of taking a top mill operative off the plant for a short period may be several thousand pounds worth of production.

(b) They should be only marginal costs i.e. only those that could be directly associated with the particular training undertaken.(17) This neglects training overheads related to the upkeep and administration of the fixed training facilities for operatives which may indirectly supply support for the cost-benefit experiment. There was, however, no estimated increase in the training overhead brought about by this additional activity. Direct participation in the exercise by a member of the central training staff would of course have had to be included.

Normally, if a strict application of marginal criteria is used then the costs of the existing training would have to be subtracted from the costs of the new scheme introduced. In this case this issue was ignored because the training was being directed to the solution of a problem and therefore almost by definition was a "new event".

(c) All relevant marginal costs should be calculated including the costs of analysis, interviews, setting up data collection systems arising from the need to arrive at performance data and monitoring systems. These include the costs of management, supervisors, technical staff and operatives who provided assistance or were involved at any time in the experiment.

(d) The cost ought to include an estimate for maintenance training costs which will be a function of turnover of personnel resulting in the need to provide occasional training to keep up the standard. Such costs become relevant in relation to the life of the investment and will vary according to this life.

The application of the above principles to the pre-training estimation of costs is described in detail in Appendix 7. The costs of the training programme were calculated as X + Y (+ Z) where:

X = the cost of the analysis

Y = the cost of drawing up, organising and implementing the training programme

and Z = the cost of maintaining the standard (estimated over six years)

These costs totalled £700 + £905 (+ £1,295) = £1,605 + (£1,295).

(ii) Estimating the Benefits of Training

It was recognised that the criteria that might be used in detail to convert estimated potential performance changes into monetary terms for purposes of estimating a rate of return on the training investment, might vary with the performance indicators chosen. In the case of the rodmill the training objective was expressed in terms of reducing stoppage time in the mill to standard. Thus the opportunity cost principle could be applied i.e. the cost of the mill being down was the revenue foregone expressed as £(A + B).

Where A = the gross revenue contribution from bar/rod that would have been rolled but which cobbled in the process minus the scrap value of cobbled material.

Where B = The added value that would have been produced by the mill in the normal running time available (if there had not been cobbles) minus any expenses that vary directly with tonnage (but excluding tonnage bonus which was paid anyway) and minus any contribution from alternative use of variable resources.

It was recognised that the concept of revenue foregone which was to be used to calculate B would be absolutely valid only if the mill was operating at or near capacity. This was the case at the time of the calculation and seemed likely at the time to be the case in the foreseeable future. If this was not the case than B could be abandoned and an additional factor C introduced where:

C = all the incremental costs incurred in running the mill for longer periods of time e.g. overtime payments, power, higher maintenance charges, etc. in order to make good the deficiency caused by unscheduled down times.

Using these definitions (at 1971 prices) the total estimated cost of unscheduled down time resulting from stand cobbles was estimated at £470 per hour for rod and £452 per hour for bar. The detailed calculations are shown in Appendix 7. The estimated returns to be gained from reducing stand cobbles alone to time budgeted for, over 1 year, was £31,479 which discounted back at 15%* was £26,757 in the first year.

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*The then current (1971) required rate of return in the steel industry.

(iii) The Cost Benefit Ratio

The total training objective was aimed at a saving in present pounds of £26,757 in the first year compared with estimated costs of just over £1,600 (assuming no maintenance training costs in the first year). This represents a yield of over 1,600 percent. The size of the potential estimated yield was so great in the short run that no serious attempt was made to calculate returns over a longer period. In relation to the estimates of costs and benefits there was an element of uncertainty about the outcome. It was therefore for the management to weight this uncertainty in the light of the evidence from the enquiry and the financial estimates before approving expenditure on the programme. Once the targets were accepted as realistic by the management it could be pointed out that only four hours of down time had to be saved for the training to be successful in terms of yielding a return of over ten percent.

- Development of Evaluation and Monitoring Systems

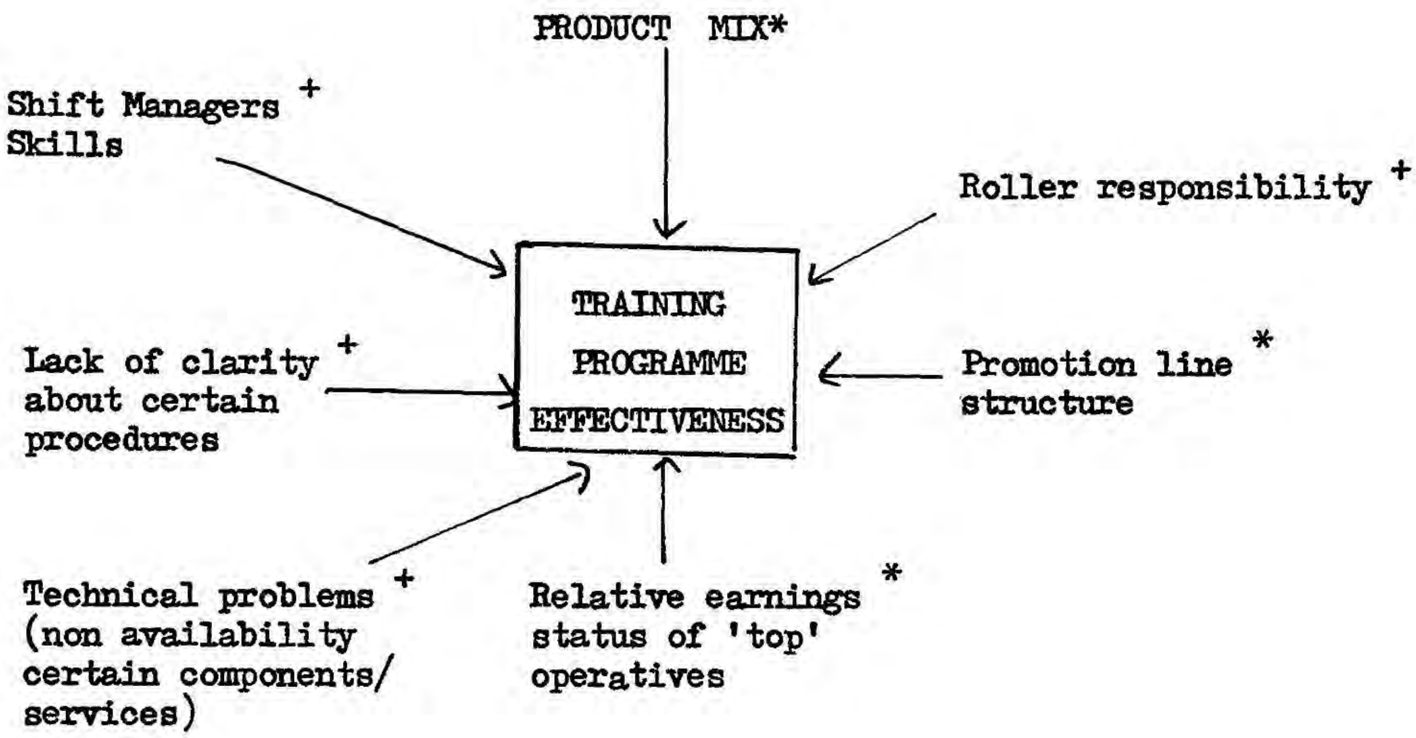
It was envisaged that, subject to changes in supportive conditions being not too substantial (see below) the training would be evaluated in terms of a reduction in the number of stoppage hours over the period of a year following the completion of the training. The performance in this year would be compared with that of the period prior to the training. The shift records and reports could be used for this monitoring process in the same way as they were used for the analysis of the problem. The procedure for monitoring the standard of training is described in Appendix 8. In order to monitor carefully the costs of the training programme it was agreed that a diary of training associated with the action plan was to be kept by the mill's training officer.

- The Development of Supportive Conditions

The main supportive factors potentially influencing operative training effectiveness in relation to the defined training objective were identified above. In the light of the model for Non-Programmed training demonstrated in Diagram 1.13 in Chapter 1 these factors were discussed with management with a view to identifying those which would have to be treated as constraints and those which management was prepared to adjust. Certain of the Factors were obviously more important than others in terms of their potential effect on the training outcome. The factor deemed most important was the frequent changes in product mix. It was clear, however, in discussions with management that it would not be possible in the short run to alter the basic policy of operating the mill flexibly in relation to orders. It was similarly deemed not possible to make immediate changes in the structure of the promotion line. Discussion of a number of ways in which the effect of the existing structure on operative effectiveness in respect of the training objective could ameliorated led the management agreeing to take action to try and isolate those operators in the line below the rougher who stood in for him in the mill if the reel operator refused to take the job. These personnel would then be trained. It was also possible to clarify the responsibilities of the roller in relation to the pulpit (speed) operator. It was agreed that management action could be taken to establish procedures in the event of certain interruptions in the mill relating to various types of stand cobbles as a basis for the training programme and that certain minor changes in equipment, brought to attention by the survey, would be made. It seemed, however, from discussions that there was little that could be done about the relative earnings status of the roller and furnace man although this example was taken as a pointer to the danger of partial productivity agreements. Nor, as has been indicated above was it possible - in the then immediately foreseeable future to do anything about the training of shift managers - although the impact of this on the problem was not considered major. Diagram 3.8 summarises the supportive constraints and opportunities.

D I A G R A M 3.8

KEY SUPPORTIVE CONDITIONS INFLUENCING TRAINING PROGRAMME EFFECTIVENESS



* constraints

\+ opportunities for associated change

All the factors identified in the Diagram were likely to influence to some degree the ability to 'scientifically' relate pre-training performance to post-training performance. It was discussed and agreed with the management, however, that none of the supportive conditions, other than a major product mix change itself was likely to make a significant impact on pre- and post-training comparisons. It was at this stage, foreseen that there would be changes in the shift working patterns which would give maintenance men on the shift more time and would therefore be expected to reduce the time lost through mechanical stoppages. It was considered that this was unlikely to have any substantial effect on the incidence of stand cobbles resulting from causes other than mechanical.

STAGE FOUR - Operations

- Implementing the Programme

The training programme was implemented sometime after the researcher had left the company. The details of the programme and its implementation in practice were nevertheless a product of continued discussions between the mill management, the mill training officer, the I.S.I.T.B. and the researcher. The report in Appendix 5 was presented to the management in early 1971 and it was hoped that action would be taken following the report by March of that year. The implementation of the training programme does not however begin until the end of 1971 for two major reasons: firstly, as anticipated, there were a number of difficulties in implementation stemming from the fact that the operatives at which the programme was aimed had all been with the company for a considerable number of years and regarded themselves as fully experienced; secondly, there were problems in finding the resources and skills necessary for organising and supervising effective on-the-job training. The Iron and Steel Industry Training Board were therefore invited, at the initiative of management, to help the implementation. Discussions on this did not, however, reach a practical nature until the end of the year and detailed agreement was not reached until 6th January, 1972.

Because of the delay in implementation it was considered that there may in the intervening period have been certain changes in technology, product mix, etc. which would make it difficult to associate the claimed potential benefits from training described in the original analysis, with any post training changes almost a year later. It therefore became necessary to re-establish that there was still a production problem of sufficient size to justify training activity. A preliminary analysis of the production shift reports for a period of thirteen weeks up to 10th January, 1972 indicated that time lost due to stand cobbles was at least as serious as that reported earlier. Subsequent training activity was therefore pursued in the confidence that there was still a problem to be solved. This was later verified by the collection of information on the same basis as in the earlier analysis for the period beginning April, 1971 through to end February, 1972. This data indicated that during this period there were eleven rolling weeks of straight bar eight of coiled rod and twenty seven seeks in which both straight bar and coiled rod were rolled. Altogether there was an excess of variance of time lost over budget at all points on the rolling line of three hundred and fourteen hours of which over fifty five hours was due to stand cobbles. It was therefore clear that there was still considerable scope for reducing time lost in the mill.

The training programme is described in Appendix 8. It consisted of a number of off-the-job courses for rollers and other senior operatives which took place over a period of eight weeks up to mid April, 1972. These covered instructional techniques, cobble diagnosis and prevention, basic rod mill practice including practical work on guide setting and pass changing. Shift workers were taken off their shift and put on days for the duration of the course they attended.

Using the background knowledge collected during the analysis, at-the-job training was introduced. The roller of each crew was encouraged to identify, on an individual basis, the particular needs of operatives not only in relation to his own job but to jobs above him. This provided an effective way of training the roller himself. Training based on this system continued for several months.

- Control of Costs

Appendix 8 itemises the time devoted to preparation and implementation of the training. Fortuitously (from the training viewpoint) at the time of the off-the-job training there was a shortage of orders and the course could be held on the days on which production would not be scheduled. Since operatives were paid for these non rolling days there was no real opportunity cost associated with the training programme. (Nevertheless an apportionment of wages and salaries was made to the costs of training - see below.) The time utilised by a number of the I.S.I.T.B. staff was also logged during this period.

The time taken by the roller in implementing systematic at-the-job training was not however logged because it was designated by the management that this was part of the roller's job which should be built into his routine.

STAGE FIVE - Evaluation

- Evaluating Costs and Benefits

The detailed calculation of costs and benefits is shown in Appendix 10. As indicated above the real opportunity costs associated with the implementation of the training programmes were low because training was carried out when the mill was down because of shortage of orders and no charge was incorporated for the roller's time involved in at-the-job training. The total costs of training were therefore X + Y where:

X = the costs of analysis, research and interviewing. These totalled £700 and were equal to those incorporated in the estimate because this part of the estimate was already based on hard facts. (i.e. the research and analysis had of course taken place prior to the estimation of the costs of training)

and Y = the cost of implementing the training programme.

The times estimated to be devoted to the training programme (contained in Appendix 9) were given to the company cost accountant. He provided the overall figure of £669 on this basis. To this was added the cost of the time of a member of Board staff, although the company did not actually pay anything for the service. This was assessed at £550 over the period January to April, 1972. There were no consumable expenses in providing the training except chalk.

The total cost of preparing and implementing the training was therefore estimated at £1,219.

Therefore X + Y = £1,919 = the total cost of training.

The benefits were estimated by measuring improvements in mill utilisation between the two periods April, 1971 to February, 1972 (pre-training) and April, 1972 to March, 1973 (post-training). This compared a period of forty six rolling weeks with a period of forty five rolling weeks (see Tables 1 and 2 in Appendix 10). The comparison was undertaken on an individual shift basis in order to take into account the fact that a slightly different number of weeks was worked and within these weeks a different number of shifts. The breakdown into shifts also enabled comparison, pre- and post-training, to be made for each product category.

Tables 1 and 2 in Appendix 9 indicate the change in time lost between the two periods for the rodmill as a whole. This showed that overall there was a considerable improvement between the periods and, secondly, that variances from budget improved considerably and in the case of straight bar rolling became positive.

Of the overall improvement of 277 hours in actual time lost in the mill between the two periods, 180 hours or almost two-thirds of this improvement was obtained by the reduction in time lost because of stand cobbles. Overall there was a favourable variance in relation to budget in the period 1972/1973 compared with an adverse variance in 1971/72. Although the mix of work in terms of weeks devoted solely to bar rolling, solely to rod rolling and mixed rod and bar rolling was different a comparison of average individual shift performance reveals that:

(a) On straight bar rolling an average of 35 minutes a shift was saved between the two periods.

(b) On coiled rod rolling 11 minutes a shift was saved.

(c) In weeks when both straight bar and coil rod were being rolled there was a saving of 8 minutes a shift.

Therefore in terms of stand cobbles alone the 180 hours saved at the estimated 1971 costs of down time in the mill of £470 for bar and £452 for rod per hour represented a saving of £77,055. This compared with an originally estimated saving of just under £27,000.

<u>- Evaluating Changes in Supportive Conditions</u>

It was clear from the post-training analysis that a considerable part of the improvement in the second period over the first was due to changes in certain supportive conditions - in particular changes in product mix which were not foreseen (page 96). For example there were more weeks when both straight bar and coiled rod were rolled in the same week in the period 1971/72 than in the later period. Longer runs on certain products would be expected to give a lower incidence of stand cobbles. The management indicated, however, that the incidence of technical change between the two periods was not considerable. There were indeed several technical changes immediately after the original study, including the standardisation of billets size, the cessation of three-strand rolling and a change in the shift system. But most of these events occurred before or at the beginning of the second pre-training control period (April, 1971 to February, 1972). The management were unable to indicate major factors which could significantly account for differences in performance between these two periods.

The change in the product mix was, however, obviously important. It was clear, however, that even in the weeks when both rod and bar were rolled there was a noteable improvement in utilisation of 8 minutes per shift. In these weeks obviously the economies to be gained from longer runs at bar and rod would not pertain. Therefore it was assumed that this 8 minutes per shift represented the minimum improvement that could be more positively associated with the influence of training. Applying this minimum to bar rolling and coiled rod rolling in the second period a saving of approximately 32 hours and 22 hours respectively could be calculated. When this was added to the saving in weeks when mixed bar and rod were rolled (17 hours) and valued on the basis demonstrated in Appendix 6, the benefit from improved utilisation could be calculated at £34,070. This total benefit from greater utilisation between the two periods was calculated (see Appendix 10) by taking the value of the time saved per shift between the two periods and relating this to the pattern of bar and rod rolling in the second period.

Conclusion to Case Study

Overall it would appear that training accomplished by the mill management and the I.S.I.T.B. had helped to contribute a significant improvement to performance. Actual costs were £1,219. Benefits that could be minimally associated with training were calculated at £28,960.

In summary therefore the methodological process described in the case study revealed that:

(i) There were key areas of the plant where short-fall in performance occurred in the top jobs. Training had hitherto been concentrated on bottom jobs.

(ii) In certain key areas deviation from standards were virtually wholly within the responsibility of top operatives.

(iii) Because of this it was possible to relate behaviour change requirements and, moreover, training needs to a quantitative performance criteria.

(iv) The implementation of the training could be strongly associated with substantial improvements in the output performance of the plant.

(v) Although a number of problems were identified only one was followed through. It would have been possible, however, to present to management a list of possible areas for further action in several other parts of the plant and perhaps to estimate costs and potential benefits for these.

In practical terms the case study demonstrates several major differences from conventional training analysis methodology.[18] These are:

- The work did not begin with analysis of particular jobs in order to determine training needs but with analysis of plant performance as a whole.
- It did not accept the lack of standards or indeed necessarily any existing standards but sought to establish standards for training purposes. In other situations it may well be that the performance data required or used for control purposes is different from that required for training purposes. In these circumstances the analyst would have to ascertain whether other data was available for collection which met his needs or set up a system to collect it.
- The approach enabled the clarification of areas of real training needs in relation to plant performance and enabled priorities to be established.
- It led to concentration for training purposes on key elements of the operative job rather than on the whole job itself.
- It revealed at an early stage of the investigation the problems relating to the interfaces of training when other factors likely to influence its effectiveness.
- It involved management continuously (at each stage) so that the training function became clearly linked in the managers mind with problems of efficiency.
- It was possible to estimate the returns to training in monetary terms. It can be argued that this is important because it presents the manager with the full implications of a decision not to train in terms

with which he is familiar. It might therefore have encouraged him to undertake training in circumstances where the costs were high (if the benefits were also very high).

Set against these differences which are arguably advantages of the approach, are some obvious limitations:

- The approach accepted as a training objective, short run quantitative indicators related to plant performance. It did not reveal needs that may be associated with longer term objectives nor did it incorporate into it training inputs which were required to meet other company objectives.
- It was restricted to training needs that could in some way be directly related to plant performance i.e. where a direct influence could be seen to be established. This would seem to be a potential restriction on its usefulness in terms of it being more likely to be of value in an approach to shop-floor worker training than to supervisory or management training.
- It did not result in the description of total training needs for an individual or groups of individuals but concentrated on certain elements of their jobs. It could not therefore be described as a substitute for conventional training methodology.
- It is also not a substitute for other conventional validation procedures.[19] In the case study the potential quantitative targets could only be met

if the training input was itself validated i.e. there remained the need to check that skills and a knowledge of top operatives were improved after training.

- It would not appear to be suitable for evaluation of off-the-job programmes which are not specific to the needs of the plant. For example it could not be applied to general management programmes and other general introductory programmes for adults or youths recruited to the organisation.

GENERAL CONCLUSIONS

On a different plain the results of the exercise may be reviewed in terms of their contribution towards meeting the objectives outlined at the beginning of this chapter.

Objective number (1) was that the case study would attempt to apply the principles developed in relation to Non-Programmed training decisions in the form of an investment appraisal approach in order to:

(a) Clearly identify the potential contribution of training to a problem solution

(b) Clearly isolate the interdependency of training on other factors

(c) Present the results of the above in the form of a pre-training investment appraisal to the manager

It can be argued in respect of this objective that the case study represents a successful application of an investment appraisal methodology as applied to a "Non-Programmed" maintenance training situation. Objectives (a) and (b) above were met by linking a "staged" systems approach to training with a problem analysis as shown in Diagram 3.9. This facilitated in the analysis stage the selection of a problem where a clear identification of the potential contribution of training could be made and the interdependency of training on other factors clearly assessed. The case involved the meeting of Objective (c) above in the form of a presentation of a pre-training investment appraisal for consideration of management. It was further possible to follow the project through the Operations and Evaluation Stages to the final problem solution situation.

Objective (ii) was:

> "To develop, if possible, a generalisable methodology of value to training practitioners in other situations".

In respect of fulfilling this objective it can be claimed that a general Problem solving/systems methodology has been derived which could be generalised to other situations using the framework described in Diagram 3.9.

Objective (iii) involved:

> "Identifying the constraints and opportunities associated with training investment appraisals of this nature with a view to understanding how and where they limit (or otherwise) the opportunity for wider application".

In respect of this objective the success of the methodology in terms of its ability to link training clearly with performance in an organisation can be seen to depend largely on three factors:

(i) The ability to isolate areas within the plant which are highly dependent on individual or group operator performance.

DIAGRAM 3.9

THE SYSTEMS STAGES AND THE PROBLEM SOLVING MODEL

SYSTEMS STAGE | **PROBLEM PARADIEM**

ANALYSIS

(a) Of organisation performance and problems

(b) Of behaviour requirements

(c) Of training needs

(d) Of supportive conditions

Identify implicit/explicit production performance standards

Identify major problems (deviations)

Rank problems in priority | Measure Problems | Rank problems in terms of direct dependence on human operator performance

Select Problem

Identify Causes

Identify relevant personnel and direct behaviour deficiencies (key job elements) | Identify other deficiencies likely to be necessary supportive conditions for training

Identify causes where direct behaviour deficiencies important

Establish whether training needs | Establish necessary supportive conditions

Establish solutions which depend on training

DEVELOPMENT

(a) Of training programme

(b) Of costs and benefits

(c) Of evaluation and monitoring system

(d) Of supportive conditions

Develop training Programme | Develop necessary supportive conditions (opportunities and constraints)

Establish potential for quantitative evaluation (pre-investment appraisal)

Training (Go/No-go decision)

Set up training system and controls

OPERATIONS

(a) Implementation of programme

(b) Control of costs

Implement training programme | Implement supportive conditions (where possible)

EVALUATION

(a) Of costs and benefits

(b) Of supportive conditions

Calculate Costs | Calculate Benefits | Review changes in supportive conditions

Evaluate Programme

(ii) That these coincidently are areas where there are major problems and/or opportunities for improvement.

(iii) That these are areas where data is available sufficient to enable quantification.

It was clearly fortunate in the case study that an important issue could be directly related to operator behaviour which in turn could be directly influenced by training. These are necessary conditions for building up a clear investment appraisal of training for consideration of management prior to the training development and operations stage.

In reality it is evident that in many cases one or more of these conditions may not hold. This does not destroy the validity of the approach but means that on a number of occasions the deviation from standard (problem) may not be quantifiable or that the problem solution depends more on 'supportive' factors than on behaviour change to be brought about by training. In other situations, identifiable and desired behaviour changes may not lend themselves to influence by training. Nevertheless it is evident that the approach could still be used by the training adviser to identify possible training opportunities and to rank them in terms of their importance as a contributor to the solution of production performance problems. These opportunities may not only relate to operatives. A problem analysis may reveal behaviour change and training requirements at all levels.

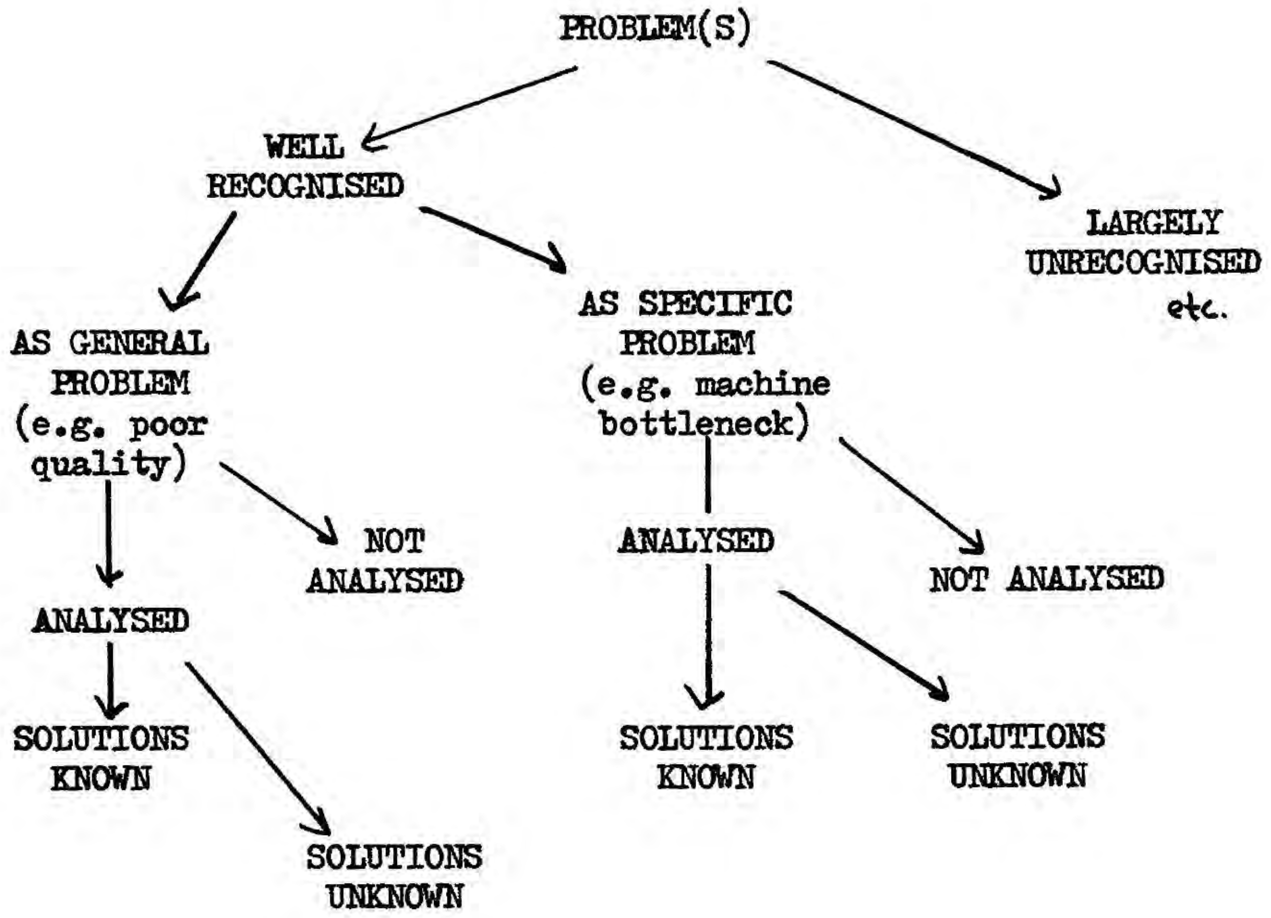
Alternative uses of the approach may be more than acceptable if they are judged against the criteria underlying the initial attempt to develop an investment appraisal methodology. The argument from the Training Board viewpoint was that the demonstration that training can be treated as an investment and can provide pay-offs will motivate management to make better use of training resources. This however assumes that the "currency" in which management evaluates training is monetary. This need not be the case. It was evident in the case study that a major factor motivating the management in support of the training programme was the continuous involvement in the analysis and development of the work, rather than any potential values that could be attached. Indeed it could be argued that the investment appraisal calculation was regarded as rather "academic" by the management. In sum, it was the concern of the trainer and analyst for the solution of production problems that led to the close identification of management with the project.

In this respect it was management's perception of the importance of the problem that carried weight rather than the sheer bulk of the analysis, although undoubtedly there was interaction between the two. Situations will undoubtedly arise where the problem is not perceived by management and the weight of analysis is discounted. It might therefore be important in the preliminary analysis to concentrate on those problems which management perceive clearly, rank highly and have already analysed rather than those that seem to be objectively important.(20) In this respect the author has constructed a whole hierarchy of problem perception/diagnosis in any organisation which may look something like the network in Diagram 3.10: the analyst may wish to start someway down this network.

In relation to some of the conceptual difficulties described in Part I the case study had demonstrated that it is possible to begin an evaluation at Ultimate level 5 and work through it while concentrating on the "direct" training element in the problem solution. Thus an involvement in a total "management of change" exercise can

D I A G R A M 3.10

THE PROBLEM HIERARCHY



be avoided (if so desired) by pre-selection of those problems which seem to be capable of clear influence by training at the level of competence of the trainer. It is clear, however, that even within a limited "training" context the trainer by his interaction with management in the problem diagnosis and in particular his attempt to highlight the "supportive" conditons upon which training depends for success is instituting a limited 'management of change' process.(21) Indeed it has been argued above that it is from this process and not necessarily from the reults of the exercise that he establishes credibility.

This point can be underlined succinctly by comparing the various stages in the methodology used in the case study with the six phases of the organisational change process couched in terms of management stimulus and reaction and drawn up by Greiner as a result of his research.[22] The methodology is shown in Diagram 3.11 to fit comfortably into Greiner's categories.

DIAGRAM 3.11

THE MATCHING OF THE INVESTMENT APPRAISAL APPROACH AND THE ORGANISATIONAL CHANGE PROCESS

Greiners 'Phases of Organisational Change'		Investment Appraisal Model
PHASE I:	Stimulus - Pressure on management Reaction - Arousal	Discussion of implicit/explicit production performance standards
PHASE II:	Stimulus - Outsider interaction Reaction - Some re-orientation of decision maker	Identification and ranking of problems by process of interaction by trainer and manager. The clarification of areas where direct influence of behaviour clear
PHASE III:	Stimulus - Diagnosis of problem Reaction - (Full) recognition of problem	Analysis of causes of selected problem(s). Identification of direct behaviour deficiencies and 'supportive' conditions. Testing for training needs
PHASE IV:	Stimulus - Invention of solutions Reaction - Commitment to implementation (seeing problem in a new light)	Development and costing of training programmes and programmes of supportive action. Pre-investment appraisal study presented for management showing costs and benefits
PHASE V:	Stimulus - Experiment with 'new' solutions Reaction - Search for preliminary testing of results	Implement programmes and monitor
PHASE VI:	Stimulus - Reinforcement from positive operations and results Reaction - Acceptance of practices	Feedback post-hoc from training experiment. Acceptance of contributory role of training to problem solving

The description of the change process above serves to highlight the very proactive role of the training function in the methodology. This is particularly evident in the "analysis stage": the conventional role of the trainer is to be reactive to the line manager in undertaking training needs analysis but <u>not</u> to undertake a total analysis in order to define the relevance of training. The approach in the case study therefore meant that there was abnormal interface with the managers and technical staff as well as with operatives and other departments during the preliminary analysis. This has implications for the behaviour requirements and the knowledge and skills of training advisers. For example the effectiveness of the trainer in such an approach will depend very much on his ability to use resources in the organisation and to communicate easily with other parts of the organisation which might help in the process of problem recognition, definition and solution. Among those likely to be of assistance are: workstudy and human engineering personnel; accountancy and wages analysis staff (for costs and bonus rates/systems); industrial relations personnel; union representatives; maintenance and technical staff; quality control staff; production planning and control staff; line management; supervision as well as operatives. The ability to interface with these personnel may not be just a function of the personal abilities of the trainer but also the way in which the training function is perceived in the organisation and, more specifically, whether the manager perceives the trainer as legitimately playing the role of the problem consultant. The manager may see the training adviser as someone dealing solely with specific types of off-the-job or on-the-job skills training. He may not consider him capable of analysing in depth more complex at-the-job learning problems or, more commonly, the manager may not regard the problem as one relevant to the training. Certain barriers are also likely to arise because of the way in which the information analysis may provide threats to persons in the organisation by destroying myths or calling to question so called neutral sources of information. Without going further into these problems than the individual case study has permitted it is evident that the approach may depend for its success on the development of the training adviser as a process consultant.(23) Indeed the methodology has been written up and used as a basis for training programmes for advisers of various training boards along these lines. The abilities associated with the approach can be identified as follows:

(a) Ability to recognise, interpret, analyse and use, for communication, management control information, particularly production control information.

(b) Ability to interact with senior executives:

(i) socially

(ii) in handling meetings

(iii) in conducting face to face interviews as part of the problem analysis

(iv) ability to devise fact-finding interviews with management and shop floor employees

(v) ability to collate and systematically analyse data

(vi) ability to understand the process of management development

(vii) ability to understand work study and method study techniques (the derivation of standards)

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12. Similar to Annet and Duncan's definition of an operation which will have 'an identifiable input .... on output or response and possibly response feedback ....".

    See Annet, J. and Duncan, K. D. 'Task Analysis for Training'. in 'Manpower Research' Edt. Wilson, N. A. B. English Universities Press Ltd. 1969.

13. Mager, R. F. and Pipe, Peter. op.cit. Part III.

14. See discussion in Chapter V.

15. Garbutt, Douglas 'Training Costs'. Gee and Co. 1969. p. 29.

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17. Woodward, Nicholas. 'The Economic Evaluation of Supervisor Training'. Journal of European Training 4.3 1975 p. 139.

18. As such it broadens the concept of the 'Sheffield System' as described in Davies, Ivor K. 'The Organisation of Training'. McGraw-Hill. 1973. Chapter 4.

19. For a description of some of these see Davies, Ivor K. ibid. Chapter 11.

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PART III

EVALUATING PROGRAMMED TRAINING DECISIONS

CHAPTER IV

INTRODUCTION - THE BASIC OBJECTIVES AND THE CHOICE OF ESTABLISHMENTS FOR INVESTIGATION

INTRODUCTION

The objective of Part III is to explore the relevance in practice of the investment appraisal concept of evaluation to Programmed Training decisions. Programmed Training decisions were defined in Chapter I as those which were routine, were likely to be repeated over time and which the organisation had developed specific procedures for handling. They were thus likely to lend themselves to a well defined training situation embodying regular administration. They were likely to be concerned with a set of standardised behaviour requirements and a well defined set of knowledge and skills. Such programmes it was argued would lend themselves easily to "ownership" by the training department. They would conventionally embrace induction, initial training and standard development type training courses.

The argument developed in Part I indicated that there would be several major limitations to a strict investment appraisal approach applied to such programmes. These limitations centred mainly on the difficulty involved in relating broad based programmes incorporating components covering a wide range of individual, organisational and social objectives to "hard" measures of organisation performance. It was, however, argued in Part I that it was important to seek such measures where possible and that it was extremely important to attempt an 'ultimate level' evaluation of such broad based programmes for two major reasons:

1. They were likely to be repeated regularly over time and therefore feedback over time would be important for future decisions.

and 2. It is these kinds of programmes that lend themselves to "complete ownership and administration" of the training department. This situation may lead to isolation of the programme from the influence of the changing needs of the organisation and of its line managers over time.

These two factors also provide the basic justification for the twin roles that have been allotted to evaluation in this thesis:

- That of a feedback mechanism;

and, equally important,

- That of defining the necessary interface of training with other systems in the organisation (necessary that is in terms of training making a successful contribution to organisation performance). By doing this it is hoped to focus on the decisions that line management need to take in order to integrate training into the organisation.

The research described in Chapters V and VI below attempts to relate the above roles to a Programmed Training decision in the Iron and Steel Industry. The programme chosen was the Junior Operatives Induction and Initial Programme as laid down for the industry, in the form of a model, by the I.S.I.T.B.[1] This added an extra dimension of interest to the evaluation as certain of the parameters of the programme were the product of the I.S.I.T.B. recommendations and not solely reflecting the company objectives. Thus an interesting point is raised about the way in which the company absorbs the Board recommendations into its own objectives and the source of the criteria that might be used for determining whether the training is being successfully carried out. Under the Board model firms were encouraged to place all junior operatives through a programme of further education, vocational education and training, together with at-the-job training in the form of rotation between various departments in the works. This programme was given to junior operatives recruited at age 15, 16 or 17 while in a supernumerary capacity. It had several unique characteristics. First, it was not only an induction programme but also set out to be a complete introductory training process. Second, it was given to young people with little or no experience outside of the industry or indeed of the industry itself. Third, it frequently incorporated several broad social objectives relating to the welfare of the individual and perhaps of the local or regional communities. These characteristics place the programme model firmly in the category of Induction and Initial Training. They also make very difficult the application of an investment appraisal approach to evaluation or indeed any evaluation at the Ultimate level.

In respect of the investment appraisal approach it was argued in Part I that the return from any training investment will be a function of:

(a) The life of the investment

and (b) The productivity of the investment over its life.

There is some evidence to suggest that in respect of Induction and Initial training programmes the life of the investment may be an important determinant of the returns: this was shown to be the case in the Brinley Thomas research.(2) It will almost certainly always be relevant to evaluations of induction and initial training programmes because of the higher labour turnover rates associated with the entry of new personnel into an organisation and/or new jobs.(3) Measurement of the life of the investment may provide a major source of "hard" data for evaluation. Chapter V therefore explores more fully the relevance of the inter-relationship of training and turnover to evaluation and tests the relationship in a number of companies operating junior training programmes.

It was clear, "a priori", from examination of the I.S.I.T.B. Junior Operative Training Model that measurement of the 'productivity' of the training investment in the model in terms of 'hard' performance data would be extremely difficult if not impossible. This was, however, recognised in Part I to be a difficulty generally to be associated with Programmed Training decisions. Nevertheless it is feasible to attempt to evaluate the supportive circumstances relating to the training investment on the assumption that if these circumstances are 'right' then the conditions for achieving maximum productivity are established. The model for Programmed Training outlined in Diagram 1.14 in Part I, while describing the conventional feedback loop from company objectives through to training programme implementation and back, sought in this respect to emphasise that a programme might be subject to influences "external" to it but which might nevertheless have a major impact on its effectiveness and efficiency. Chapter VI therefore concentrates on developing a very basic systems model which might be used as a tool for "evaluating" programmed training in this manner. Its use in practice in evaluation of the junior operative training programme is then described.

The approach described in Chapters V and VI gains added importance from the fact that, as mentioned briefly earlier, it throws light on a further issue which although not central to this research, is of considerable general interest, namely the way in which Industrial Training Boards influence decisions about training in companies. All the schemes adopted by the firms in the sample were drawn from the I.S.I.T.B. model. This model was, in each company examined, monitored by a training committee composed of high level management, training and personnel staff. While the training model might be supported by the organisation in this way, in practice its effective implementation will always depend on the motivation of middle management and supervision who are frequently in a critical position in terms of influencing the 'supportive' conditions for a programme. Their attitudes to the programme and the way in which these are reflected in their actions provides an important focus for the role of evaluation as defined in this thesis. This point is dealt with in more detail in Chapter VI.

THE SELECTION OF COMPANIES FOR STUDY

In terms of developing and testing a model to explore the phenomena described above a single organisation might have sufficed. It was, however, clear that the I.S.I.T.B. model of junior operative training was designed to be applied widely throughout the industry in a more or less standardised form. Moreover it was felt that in measuring the interaction between training and wastage rates some account should be taken of different local labour market situations. Finally, it seemed that in terms of measuring basic factors influencing the effectiveness of the programmes it might be possible to conduct an "aggregative" study which would have a far greater impact on thinking within the industry.

It was initially decided therefore to obtain a list of establishments in which junior operative training programmes either met or approached the I.S.I.T.B.'s recommended model. A number of establishments apparently meeting the above criteria were selected after an examination of the various I.S.I.T.B. returns for a large number of companies over a number of years. It was decided that the companies chosen should satisfy basically the following criteria:

1. They should represent different types of labour market area although it was recognised that this was not a variable whose influence could be isolated out and controlled.
2. That they should have been operating junior operative training programmes for at least five years: this would ensure that there would be junior operatives who had been through the training programme and were working in the organisation.
3. That the size of the establishment and the scope of its junior operative intake be sufficient to make an exercise statistically worthwhile.
4. That there should be company records available sufficient to give data about junior operatives over the time period of the training programme.

Analysis of I.S.I.T.B. records and subsequent discussions with company representatives in respect of these further criteria narrowed a list of companies down to seven which were finally selected. A brief description of these works is given in Appendix 1. Of the seven establishments four were in different parts of the Midlands and North Midlands, one was in the North East, and two were in Scotland. Strict application of the criteria for inclusion, particularly the conformity to the I.S.I.T.B. model and the Board 'rating', virtually limited the study to these seven establishments although it was hoped originally to take one establishment from each of the British Steel Corporation regions. In practice, each of the works had their particular idiosyncrasies: major aspects of the company organisation of the programme and any idiosyncrasies are pointed out in Diagram 4.1. While the timing of the programmes varies, as does the emphasis on certain components, all the basic components of the I.S.I.T.B. model are there of which the main ones are: batch intakes of school leavers; day release for general education and City Guilds at the local technical college; some periods spent on training in the company training centre; a period of at-the-job training usually supernumerary and possibly involving rotation.

A preliminary analysis of the circumstances relating to general operative training in the seven companies selected (See Chapter V p. 143) revealed one very interesting feature which became fundamental to the research methodology adopted, namely that all the organisations recruited large numbers of other junior operatives additional to those incorporated into the Junior Operative Training Programme. This factor became important because it introduced the possibility of selecting and using a control group of non-trainees (to be known as Direct Entrants) in support of any detailed methodology selected. These Direct Entrants were recruited into the works to fill gaps in manning resulting from those who left the organisation out of the junior operative trainee intake and to support any other manning requirements. It also became apparent that in all the organisations there was a limited number of junior operatives that could be taken into the programme at any one time. Thus supply of this form of training was below demand.

DIAGRAM 4.1.

Summary of Junior Operative Training Programme

	ESTABLISHMENTS 1.	2.	3.	4.	5.	6.	7.
Time of intake	2 intakes at August and Easter.	2 intakes, September and Easter.	3 intakes in September, January & April. Each intake is split into 2 groups.	2 main intakes in August and January.	2 intakes - Summer and Easter.	Main intakes in July, January & Easter.	2 intakes, June/July and December.
Characteristics of intake	15 year olds.	15 year olds ideally, with some 16 year olds.	15 years 6 months to 17 years 9 months.	15 or 16 year olds - Few 17 year olds are taken on.	15 year olds only.	Mainly 15 year olds but other ages recruited.	15 year olds only.
LOCATION Technical College	Day release for City & Guilds (C. & G. for August intake only.	Day release for C. & G. for September intake only.	C. & G. 8 weeks. 1 week at a time over 16 weeks. Interspersed with weeks in the training centre and at the job.	Day release for C. & G.	Day release for C. & G.	Day release for C. & G.	Day release for Social Studies.
Training Centre	One week induction then five weeks in the Centre. Plus two weeks refresher in in April for the August intake. The April intake do C. & G. in the Centre.	3 days induction. Then 12 weeks in the Centre. The Easter intake do C. & G. in the Centre.	1 weeks induction then 4 weeks in the Centre interspersed with weeks at the technical college.	1 week in 5 during the year at the Centre.	1 week induction. No other training centre course. 16 year olds go onto shiftwork.Recently, however Tech.course split - half day at the tech. half day at the Centre.	1 week induction 2 weeks junior skills and introductory works course. After ten weeks at the job back to the Centre for 1-3 weeks for more theory.The Centre used for half days to provide background to job rotation.	1 day induction. 2 x ½ days a week at Centre for approximately 20 weeks to do C. & G.
At the job or on the job	4 months in steel making and mills departments in rotation. At-the-job instruction by variety of people. Always supernumerary.	3 months each in blast furnace melting shops and mills. At-the-job training. Supernumerary.	3 weeks at the job, supernumerary in the mills only.	For 15 year olds the 4 out of 5 weeks remaining are spent on a day job.	In connection with the particular job on which the operative is placed.	10 weeks 'plant practice' - job rotation in single department. Then after break for theory 5-6 weeks attachments to particular areas with classroom supplementing this.	When not at Tech or Centre boys are moved round departments every 6 weeks. Usually visit 3 departments. Supernumerary - learn jobs.
How long Programme run in its present form.	In present broad form since 1964.	In present form since Easter 1965. Before that - day release and a fortnight's course.	In present form since October 4th 1965.	In present form since 1965. Before that C. & G. was given in the works.	In present form since 1965. Before that C. & G. was in the Centre.	In operation with little alteration for 5 or 6 years.	In present form since August 1968. Prior to this trainees had 2 days a week in the Centre for C. & G. and no tech.

THE COLLECTION OF DATA ON THE LABOUR MARKET AREA

It is recognised that turnover rates are influenced by external environmental factors such as the availability of alternative job opportunities in a particular area. While no attempt was to be made to study these influences in detail it was thought desirable to collect, as background, information on the nature of the labour market within which the establishments operated. Enquiries were made of the regional and local offices of the Department of Employment[4] to obtain the following information about male employees:

(i) The size of the local labour market within five miles radius of the works (or roughly in the relevant employment exchange areas).

(ii) The pattern of employment by industry order in these areas; and the relevant size of the establishment and its degree of dominance of the labour market.

(iii) The present level and rate of employment and vacancies and the broad pattern of unemployment rates and vacancies over the years for which any establishment wastage data might be collected (since the beginning of the training programme).

(iv) Any information on particular peculiarities of the labour market in the vicinity of the plant e.g. what was known about travel to work patterns etc.

(v) Any particular problems experienced by employment officers in finding employment for the young people in the area and the major employment opportunities for school leavers and under-eighteen year olds.

Full details of the information collected and analysed are contained in Appendix II. Diagram 4.2, however, contains a summary of the information obtained. This reveals the degree of comparability between various pairs of the establishments selected. Establishments 1 and 2 are located in major industrial conurbation in a low unemployment area where alternative job opportunities were plentiful. Plants 3 and 4 were located in industrial areas where there were unemployment problems but where there were alternative job opportunities available if not in the immediate locale. Establishments 5 and 6 were not located in industrial conurbations but in townships which provided a substantial basic labour force, where employment opportunities outside of the steel industry were not great and where other steel industry establishments were making demands on the local labour market and where there was no great unemployment problem. Establishment 7 cannot be matched with any others in that it is a plant located in an otherwise rural area smaller in terms of employment than any of the others and with few alternative job opportunities.

CONCLUSION

This chapter has sought to introduce the basic framework for the empirical study of evaluation of a Programmed Training decision in the Iron and Steel industry. It has been shown that in general these types of decisions will not lend themselves easily to "hard" data evaluations of the investment appraisal type. It has been argued, however, that within the objectives set for evaluation in this thesis Programmed decisions place a special emphasis on exploring the basic systems interfaces of the programme and the support (or lack of it) that they give.

DIAGRAM 4.2

Summary of Major Characteristics of the Labour Market in the Vicinity of Establishments

	Employment Size (of which junior operatives in brackets)	Immediate Labour Market Size	Company Size Mix in Area	Industrial Pattern 3 largest male employing industries	Current Local unemployment (Jan. 1970)	Range '64-'69
Establishment 1	1,900 (60)	22,000 but with near catchment area of 93,000	Several other large establishments but they do not dominate the labour market. Competing for labour with small companies	Iron & Steel, vehicles, engineering	2-3%	0.8(June) 2.8(Jan.)
Establishment 2	1,900 (60)	23,000 but with near catchment area of 100,000	"	Vehicles, Iron & Steel engineering	Around 2%	0.3(June) to 2.0(Jan.)
Establishment 3	5,600 (192)	24,000 but with near catchment area of 95,000	Establishment dominates immediately local area but a variety of altern. steel, employment not far away	Engineering Iron & Steel Transport	Around 8%	3.8(June 9.5(Jan.)
Establishment 4	1,900 (145)	23,000 but near much larger catchment area	Establishment dominates immediately local area but to a slightly smaller degree than in 3 above	Iron & Steel Engineering Construction	Around 6%	2.3(June) to 6.1(Jan.)
Establishment 5	4,000 (100)	19,000 but labour recruited from a variety of nearby small towns & villages within 10 miles radius	Steel works dominates local labour market. Rest of local employment (Male)opportunities in light manufacturing	Iron & Steel and variety of others	2-3%	0.8(June) to 3.1(Jan.)
Establishment 6	7,000 (200)	35,000 with smaller recruitment of labour from surrounding villages	Large steel works dominate labour market. Rest of local employment opportunities in light manufacturing	Iron & Steel Construction Transport	2-3%	0.9(June) to 2.8(Jan.)
Establishment 7	1,300 (40)	4,000 but recruitment from surrounding villages	Steel works completely dominates local labour market. A few alternative light manufacturing job opportunities	Iron & Steel and a wide variety of others	3-4%	2.7(June) to 6.3(Jan.)

The initial criteria used in selecting locations for the empirical development and testing of the approach has been outlined. The junior operative induction and initial training programme as recommended by the I.S.I.T.B. is the focus, and the process by which companies were selected for the empirical study has been described. Application of the investment appraisal concept to this type of programme has revealed two possible approaches which will be described in Chapters V and VI respectively namely:

(a) Analysis of the significance of the life of the investment (job tenure) for training evaluation

and (b) An analysis of the factors deemed likely to influence the productivity of the investment.

REFERENCES - CHAPTER IV

1. See 'Recommendations for the Training of Operatives 1967-68'. Iron and Steel Industry Training Board.

2. Thomas B. op.cit.

3. See 'Labour Turnover'. Clothing E.D.C., N.E.D.O. 1968.

4. The relevant Department of Employment and Productivity regional offices were all contacted with a standard letter asking for information as on Page of the text. All co-operated mainly by sending local employment and unemployment data.

PART III

EVALUATING PROGRAMMED TRAINING DECISIONS

CHAPTER V

ANALYSIS OF THE SIGNIFICANCE OF THE LIFE OF THE INVESTMENT (JOB TENURE) FOR PROGRAMMED TRAINING EVALUATIONS

INTRODUCTION

This Chapter focuses on the possible importance of labour turnover to the return on the training investment, particularly in respect of Programmed Training decisions. Put simply, if training is an investment in human capital from which a company expects a return over a number of years then, should a trained worker leave, the asset has to be written off and a fresh investment may be necessary. This point is relevant to all training decisions. It takes on particular significance in respect of Programmed Training decisions, however, because it may be the only "hard" criteria for evaluation that can be applied. In practical terms, moreover, certain Programmed Training decisions will lend themselves easily to evaluation of wastage through labour turnover because they involve "blocks" of people; this may particularly be the case with Induction and Initial training programme where there are administrative economies involved in dealing with a group of people at one time. It has been argued in Chapter I and elsewhere that basic Induction and Development programmes, and even Initial training programmes when they are not highly job specific, will otherwise be extremely difficult to evaluate directly in organisation performance terms for two major reasons: first, because they are not generally geared closely to the performance of a discreet set of tasks; and second, because they frequently incorporate a number of objectives relating to individual and social needs which can be traced back only indirectly to a company performance criteria.

Within the Programmed Training context the Chapter first seeks to provide a framework for exploring the inter-relationship of training with labour turnover and then describes its use in the empirical investigation. The basic question to be pursued is how "wastage" effects the costs and potential benefits of the training programme.*

It is possible, however, to take several views of this question. In the first instance turnover can be regarded as independent of training: it is simply accepted that the "mechanics" of the calculation of the costs and benefits associated with training may be affected by labour turnover. It has, however, been pointed out by a number of writers that training may itself influence turnover either positively or negatively.(1) Secondly, therefore, if this argument is acceptable then there is a case for considering the influence of training on turnover as part of the evaluation.(2) Finally, and particularly in respect of our treatment of evaluation as an instrument to influence management decision making, it may be possible to demonstrate that, whether or not turnover is treated as independent of training, turnover rates have relevance for a number of basic management decisions(3) including the objectives, timing and content of an introductory training programme.

The three issues that serve as a focus for this Chapter are therefore:

(A) Labour turnover and its direct implications for calculating costs and benefits of a training programme.

(B) The inter-relationship of training and labour wastage.

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* The expression "wastage" is used in preference to turnover whenever losses out of a training programme are being discussed.

(C) The significance of wastage for decisions taken by the company about the timing and content of the programme in the light of its objectives.

(A) Labour Turnover and its direct effect on training costs and benefits

The simple statement that the length of stay of the ex-trainee with the company will determine the period over which the investment in training can obtain a return is an over-simplication. In the first place the training may be relevant to the worker's task for only a limited amount of time in the company: he may change his job or the job itself may become different and/or more complex.[4] Assuming that a period of "relevance of training" could be defined then it would be possible to sum the total number of relevant man months of productive work following a training programme for those who stayed right throughout the period and for those who contributed some productive work but who left during the period. Thus the real cost of the programme per man month would be as follows:

$$\frac{X}{AB+C}$$

where X = the total costs of the programme

A = the total period in months over which training investment is relevant

B = number of ex-trainees who stayed for the full relevant period post training

C = the sum total of productive man months contributed by those who left

This expression therefore gives the total cost of the training programme per productive man month and would be a suitable figure to compare with benefits. This, however, is still theoretically inadequate in that it ignores the point emphasised in the discussion of cost-benefit analysis in Chapter I that the relevant costs of training are the marginal costs (on the assumption that some form of training, perhaps very informal, existed before the implementation of the particular programme under examination).(5) In practice, however, unless one formal programme is replacing another, then the calculation of marginal costs will be extremely difficult and involved and are unlikely to appeal to the decision maker.

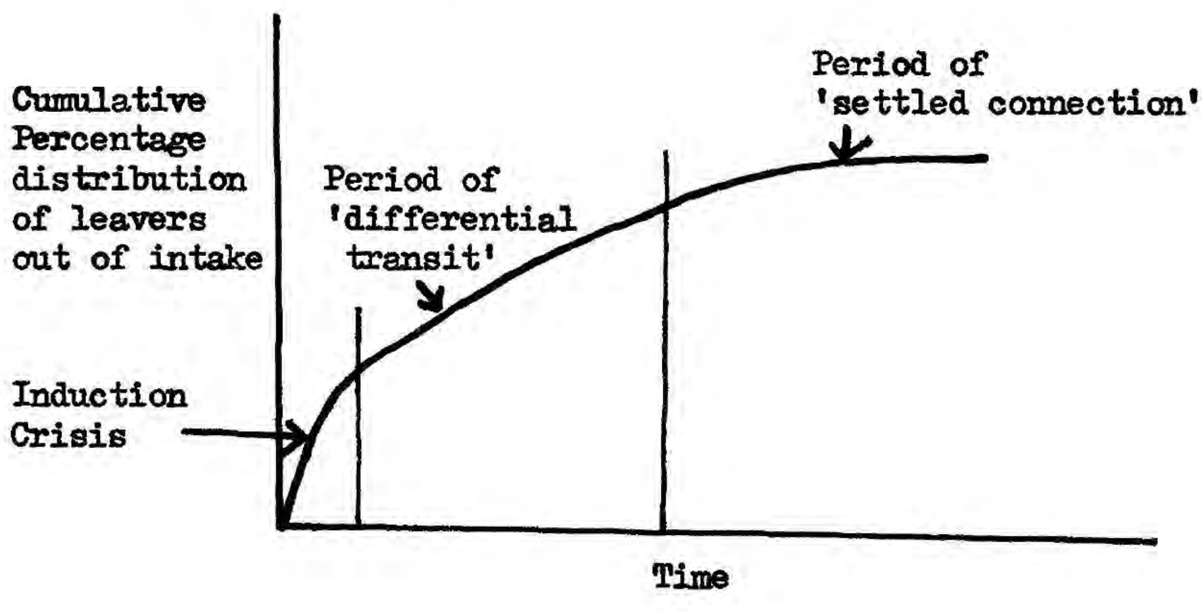
The above expression, however, poses a more direct practical problem namely that of determining the length of period over which the training is relevant. For the decision maker the issue might be avoided if it was possible to provide an estimate of the expected "long life" workers produced. This may be a particularly relevant calculation where the programme is long and where the majority of those who are going to leave do so within a short time.

In this respect it is worthwhile reviewing what is known about the shape of survival curves of newly recruited personnel: this will be of particular relevance to the junior operative induction and initial training programme which is to be evaluated.

There have been a large number of studies of patterns of turnover rate of new recruits to organisations.(6) The exact shape of any distribution of wastage out of a given intake has been disputed(7) but it is clear that the amount of wastage decreases as the length of service increases(8) and that wastage tends to decline with the age of the worker: here the evidence is more conclusive.(9) It is recognised that for any given intake the distribution of those that leave out of it will be skewed towards the early leavers: a high proportion who leave will go within one to three months of joining the establishment or even in a shorter period. This is the period of the "induction crisis" when employees who are of the drifting type leave following an initial adverse reaction between the establishment and the individual.(10) After this it has been argued, there follows a period of "differential transit" which may last several years when those who have survived the induction crisis learn more about the establishment - sufficient to made judgement on whether they wish to continue in their job there.(11) Of those who stay after this it is argued that there follows a period of "settled connection" during which they become converted into hard-core employees.(12) Thus the shape of the distribution of leavers out of a given intake may be as in Diagram 5.1, below. If distributions of leavers are indeed shaped like this then "a priori" it may be both useful and possible to obtain a measure of the cost of producing a "potential hard-core" employee.

DIAGRAM 5.1

THE LABOUR TURNOVER PROCESS - THE TAVISTOCK MODEL



It is possible that the calculation of the "hard-core employees" cost, however, is not the relevant one for decision making. For example, the organisation may have as its objective the supply of a certain number of employees through an induction and initial training programme and will recruit with this in mind. Given this target then the real cost of the drop-outs during the induction and differential transit period will be the "replacement cost". This cost will be the current and future costs of putting another trainee through the programme. The value of examining the shape of survival curves of training intakes for this decision process is that it will enable an estimate of "wastage" to be obtained and built into the initial target of the programme, i.e. the replacement costs will be built into the initial costs on the basis of the forecast of the programme eventually producing the desired number of "hard-core employees" needed by the organisation.

(B) The Interaction of training with labour turnover

So far it has been assumed that training is independent of labour turnover and that the major significance of the relationship rests on the implication that turnover has for the cost of producing trained personnel with a productive life. A number of writers have, however, argued that there is a positive interaction between training and employee tenure.(13) More specifically it can be argued that training and education may have a role to play in lowering the number of drop-outs at various stages of the turnover process. A good induction scheme may for example help to combat the adverse affects of the initial interaction between the individual which a number of writers have pointed out(14) thus decreasing the number of drop-outs at this stage. Training may also help to increase the predictability of job relationships, uncertainty about which, it has been argued in a number of studies, might lead to labour turnover.(15) It is further argued that job and process knowledge given during the transitional period, will encourage more of the intake to accommodate themselves to the working environment, for it has been shown that when recruits misunderstand the nature of the job then turnover may increase.(16) The direction of the relationship however is by no means clearly one-way. It is, for example, possible to argue that the greater the level of education given to the employee, the greater the conflict between the job and his self image which may increase his propensity to leave.(17)

The argument in the form stated simply above ignores a large number of job satisfaction and other factors bearing on the individuals propensity to leave the company.(18) Some may relate to the organisation's characteristics, some to the make-up of the individual and some to the opportunities and nature of the environment external to the company. And there is by no means agreement among academic writers on the relative importance of these factors although there is now a considerable literature, some of which will be reviewed in Chapter VI. At this point it is merely necessary to note that the training department might need to concern itself with the most obvious of these factors if its work is not to be undone - for example, training may have to be planned to ensure there is utilisation of skills taught. For without this, it can be argued that training will itself merely increase frustration and lead to higher wastage.

It can be concluded from this brief review that training may in certain circumstances contribute to the reduction of labour wastage and thus may have associated benefits to be measured in this respect. Seen in this light training could be regarded as a preventative cost, that is it may be a cost which can contribute to a reduction in the costs of labour turnover. Such costs have been well documented(19) and include the costs of advertising and work of the Employment Department in recruiting labour, temporary loss of output, other costs associated with the employment of raw labour, i.e. higher incidence of tool and machine breakages, greater number of accidents and proportion of scrap and bad work. It should be noted that these are the direct replacement costs of labour for the company as a whole.

(C) Significance of wastage for decisions on timing, content and objectives of programme

In general terms the role of training within the establishment can be described as maintaining, developing and adequately replacing (when necessary) manpower resources. It follows from this that knowledge of wastage rates will be needed if training departments are to gear themselves to the role of maintaining an adequately trained labour force.[20] Leaving aside for the moment the hypothesis that training may affect labour turnover there are obvious implications to be drawn from what has been learned about the shape of survival curves for decisions about the timing of training. For example it can be argued that to use resources in training new intakes in a variety of job specific skills before they have overcome the "induction crisis" may be an ill-advised investment. Depending on the length of the programme many trainees may go without ever completing any productive work in the establishment. In similar vein it can also be argued that expenditure on development of all round job knowledge during the "differential transit" period should also be viewed carefully. It is thus possible to argue that the bulk of certain types of training investment be left until after the "induction" and later in the "differential transit" periods so that they may be placed in persons with a lower probability of leaving thus minimising the possible loss to the company.

The significance of labour turnover for the training decision may vary with a number of other factors. Chief among these is the degree to which the skills of the labour force being trained are specific to the firm or industry and consequently to what degree already-skilled replacement labour can be recruited from other companies or industries. The distinction between "specific" company or industry skills and "general" skills which are applicable in a number of companies and industries was discussed in Chapter I.[21] Depending on the relative difficulties in recruiting personnel and the relative costs of training them it can be argued that the company will be more concerned about the loss of "specific" than "general" workers because they cannot be recruited directly into the plant whereas those with general skills can be bought in.

The significance of this dichotomy can, however, only be understood in the light of the objectives of the company. It has been noted earlier that programmed training, particularly at the induction and initial level, may incorporate objectives which only indirectly relate to the performance of the company. Thus a programme may incorporate "welfare" elements which aim at developing the individual and meeting his needs, may incorporate social elements relating to the needs of the local or national society and may incorporate elements relating to the needs of the industry as a whole. This latter point in particular has become important through the influence of the Industrial Training Boards and their emphasis on ensuring an adequate supply of trained labour to the industry.[22] Thus a programme's objectives may incorporate the following beneficiaries:

- The firm
- The individual
- The industry
- Society (local, regional and national)

Benefits will not necessarily be exclusive to any of these categories:

part of a programme which provides benefits to the individual may also provide benefits to the firm/industry and society. It is in this respect that the arguments advanced by Becker(23) and discussed in Chapter I became of theoretical importance. He argued that the benefits of specific training will be taken by the firm because the worker cannot "sell" his skills outside the industry whereas benefits of general training may be sold by the worker to other companies and industries. Research evidence on this has been inconclusive(24) and it is not an issue that is of major practical importance to management decision making in the context of this research. However from the viewpoint of evaluating the significance of labour turnover in relation to the objectives of a training programme it may be operationally useful to try to distinguish between the benefits from educational or training inputs which accrue mainly to one party as opposed to the other. Thus an attempt could be made to separate out the degree to which a given input of education and training was "specific" to the firm and/or industry (i.e. is of little use outside of the firm/industry). The value of such an analysis may lie in the emphasis it places on consideration of what the real objectives of the programme are. If, for example, a firm engaged in "specific" training is doing this as part of an organised national effort (perhaps organised by an I.T.B.) to increase the supply of "specific" skills to the industry as a whole, and particularly also if it is in an area where other companies in the same industry employing the same skills are also located and thus share a local market for labour then it may be less concerned with the issue of labour turnover than a company which is training purely for its own specific needs and/or situated in a remote location where there is no opportunity for recruiting "specific" trained personnel from other sources.

THE APPROACH TO THE COMPANIES

The above argument has demonstrated that labour turnover or wastage may be relevant to the training decision in a number of ways. Firstly, in general terms it will affect the "output" of the programme in terms of productive potential measured in terms of available productive man months. It has been demonstrated that the shape of the distribution of labour turnover out of a given intake may be such that it might be used as a predictive guide as to the number of productive employees to be produced by a programme. It has also been argued that training itself may affect the shape of that curve. And finally, it has been shown that the significance of labour turnover for the training decision will depend not only on the "specificity" of the training incorporated in the programme but, linked with this, the degree to which the programme seeks to provide benefits to the individual, the industry and society as a whole.

In the light of these conclusions the decision was made to adopt as objectives for the empirical work:

1. Analysis of the shape of the distributions of wastage out of junior operative programmes and their significance for costs and potential benefits.
2. The testing of the effect of the training programme on turnover.
3. Exploration of the significance of the findings in the light of possible timing, content and objectives of the programme in the companies.

These objectives eschew the building of a model theoretical or otherwise to 'explain' the relationship between training and wastage. This would be outside the requirements of this chapter which are eventually to explore the consequences of a determined course of management action, namely Programmed junior operate training. The methodology described below therefore calls upon the work of those concerned with the broader issue of manpower planning and labour renewal process(25) for certain of the 'mechanics' of the approach without exploring in depth the relevance of the models in this field. Thus it cannot claim to be a closed 'systems model' set up to feed-back to management the overall consequences of its actions but seeks only to highlight the importance of certain major factors relevant to decision making in this area.

- The Methodology

The method of selection of companies for investigation has been described in Chapter IV. The companies selected were those that had been running junior operative training programmes on broadly similar lines for a number of years - sufficient to allow an exploration of what had happened to junior operative trainees after they moved into the works following the programme. As a basis for the turnover analysis it was necessary to check the state of company records in relation to the periods since the junior operative training scheme commenced, and in particular, to ascertain whether it was possible to separately trace junior operatives in the companies' personnel records.

Preliminary investigation in the companies revealed that information was obtainable from the personnel cards (dead and live files) of the various establishments on the date of starting, date of birth, first department and/or occupation of the trainee. Data was also available on date of leaving although here it was much more difficult to trace movements in and out of the company and dates associated with this. At this stage, however, it became clear that there were large numbers of junior operatives taken into the respective companies who had not been through the junior operative programme. Enquiries as to the reasons for this revealed that in most companies such recruitment was necessary to keep up the manning and make up for wastage: these personnel could not be trained because they were recruited not in batches as were operatives destined to be trainees but continuously throughout the year as and when the need arose. It was also evident that in most companies the training department could not cope with training the numbers involved. At this point in time a decision was made to explore in principle the possibility of using these "direct entrants" as a control group for the "ex-trainees". It was thought that this might help to overcome one mjaor obstacle, which had hitherto seemed insurmountable, namely to find a basis on which the effect of training on wastage rates might be tested. For this process of testing by control group it had to be demonstrated that there were no major differences between direct entrants and ex-trainees which might serve to provide an obvious explanation for differences in propensity to stay with the company. Comparative evidence on the age, previous experience and education of direct entrants and ex-trainees was collected and is discussed in Chapter VI. Evidence was also sought as to whether the company itself operated strict selection criteria for trainees which might make them a distinctly different 'set' from "direct entrants". This is also discussed in Chapter VI. The findings from this analysis indicated that there appeared to be few significant differences between the direct entrants and ex-trainees other than that the former were slightly older and on average had had a little more job experience. Only two of the companies attempted selection tests and in practice these were found to be not strictly operated (see page 194).

On the basis that information would be obtained for both junior operative trainees (J.O.T.s.) and junior operative direct entrants (J.O.D.s) a search was made within each company to determine the date of entry, date of leaving and age of all JOTS and JODS who joined the works during the period of operation of the training scheme. This period ranged from five to nine years in the various establishments (see Diagram 4.1 in Chapter IV). As can be imagined great difficulty was encountered in extracting information from some of the records. The process was generally as follows:

1. Obtain lists of all junior operative trainees since the inception of the programme.
2. Check in the company "live" files to ascertain whether they were still with the company. Extract from the card the date of joining the company and whether they had any time left and returned (noting dates).
3. For those ex-trainees who could not be traced, to go through the file of "dead" cards to check for date of leaving.

Direct entrants (JODS) were much more difficult to trace. In a number of cases the data had to be collected by a complete sweep of the live and dead record cards. In others because junior operative entrants (whether or not they were trainees) were separately noted it was possible to trace the data more easily. It was finally possible to obtain complete information for five of the companies investigated. In establishments four and seven it was not possible to distinguish from the personnel records which operatives had had training and which had gone straight into the works. Nor was it easily possible to obtain information on the date of leaving of those operatives who had left the works some time ago.

- <u>Method of Presentation of Data</u>

The literature on turnover data analysis is considerable.[26] Several methods of turnover analsis were considered in the light of the needs of the research. These included:

(a) Variations on the crude turnover rate

(b) A measure of half life (the time it takes to reduce a particular intake by one half)

(c) A labour stability index

(d) A simple cohort method measuring the distribution of dropouts out of any particular intake

(a) <u>Crude Turnover Rate</u>

The simplest method of computing labour turnover, known as the "Rochester Method"[27] can be described as:

$$T = \frac{S}{W} \times 100$$

Where S equals the total number of separations for a period

Where W equals the average number of workers working each day of the period

and Where T equals percent labour turnover

For W one can use average numbers employed <u>not</u> average attendance as the latter will reflect absenteeism.

Separations would include:

(a) Decisions to leave by the worker

(b) Discharges

(c) Layoffs

(d) Miscellaneous - deaths, disability, pension retirements, etc.

The major weakness of this definition is that it is not a measure of labour force stability. For example, a turnover of 100 percent could be:

(i) A complete discharge or replacement of the whole labour force

or (ii) A change-over of part of the labour force more than once e.g. 5 percent of the labour force changing over twenty times.

Thus the index tells us nothing about the stability of the labour force even in a firm with a constant labour force.(28)

(b) <u>The Half-line Method</u>

H. Silcock quotes Professor D. G. Champernowne as suggesting that the "Median of the distribution of leavers might provide the required alternative".(29) This is the time taken for a batch of entrants to be reduced to one half of their original size. This index has the advantage that it abstracts from trends up and down in the labour force which may effect the turnover rate.

(c) <u>Labour Stability Index</u>

Bowey proposes an index of the labour stability variety which is called Accumulative Length of Service Index. "The idea is to consider the present labour force not only in terms of how many members of it were here a year ago but also two years ago, three years ago, forty years ago, etc."(30) The index is derived by measuring the length of stay of the present labour force and will gave a profile of whether the labour force is substantially long-term, recent or split between the two.

(d) <u>The Simple Cohort Method</u>

The method advocated by Silcock is that of the simple cohort namely the distribution of leavers from a given intake into the labour force by length of stay e.g. how many entrants into the company between January and March are left in June and September and December, etc. This is a particularly appealing method where the researcher wishes to analyse the length of stay of a particular batch of intake.(31)

The lesson to be drawn from this brief review of different methods of measurement of labour turnover is that the index has to be derived to meet the particular needs of the situation. In practice therefore a number of different measures of turnover in respect of JOTS and JODS were taken based mainly however on the cohort method. These included:

(i) A simple measure of the numbers out of each year's intake that were still with the establishment. This enabled a rough measure to be made of the time it took to get down to a "hard core" of employees and gave a guide as to the size of this hard-core.

(ii) Accumulative length of stay distribution of leavers from each years intake. This demonstrated the shape of the distribution of leavers.

(iii) A measure of the number of leavers within the first year.

(iv) A measure of the rate of fallout from the intake during the first eighteen months and a separate measure of the rate out of the remainder during the second eighteen months of tenure.

(v) Estimates of stayers out of intakes of every one hundred junior operatives over the first month, three months, six months and twelve months periods.

(vi) Estimates of the numbers leaving and returning to the works.

Several of these indices were calculated separately for junior operative trainees and junior operative direct entrants and comparisons were made.

The detailed data relates mainly to four or five establishments. In one case, establishment four, it was not possible from the records available to distinguish between trainees and direct entrants. Length of stay distributions have therefore been prepared separately for this establishment.

The Summary Tables presented in the text and Appendices to this Chapter are generally in percentage terms although an attempt has been made in most cases to give the figure for the total "population" of operatives considered. The figures shown for example in Table 5.1 for the annual intake of junior operative trainees and direct entry into the companies demonstrate clearly that care must be taken in commenting on individual annual percentage figures. In the first place, the intakes of junior operatives whether trainees or direct entry, fluctuate considerably from year to year within a works. Secondly, the numbers recruited vary between establishments. Thirdly, the ratio of junior operative trainees to direct entry varies substantially both from year to year within an establishment and between establishments. Finally, the numbers are often small so that the difference in percentage terms which looks significant from one year to the next may mean a difference of only one or two persons.

The number of trainees taken on in each year seemed to be a function largely of the number of training places available i.e. (of physical constraints) and the number of potential candidates

TABLE 5.1

Intake of Junior Operative Trainees and Direct Entry into the Establishments 1962/68*

YEAR	ESTABLISHMENT 1 JOT	1 JOD	2 JOT	2 JOD	3 JOT	3 JOD	5 JOT	5 JOD	6 JOT	6 JOD	7 JOT	7 JOD
1962	32	47	25	22	-	-	44	46	-	-	-	-
1963	30	20	27	38	-	-	41	46	124	87	-	-
1964	38	53	30	40	-	-	68	58	92	94	-	-
1965	41	65	62	24	17	27	56	78	116	90	25	33
1966	26	44	46	25	63	82	60	53	97	117	21	26
1967	14	80	34	16	76	49	62	37	72	83	14	25
1968	17	64	20	12	48	49	73	56	93	135	18	18

*In certain establishments data was only collected for later years as the junior operative trainee scheme was not in operation in 1962.

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available (supply constraints). The numbers recruited obviously in a broad sense related to demand for junior operatives. While it might be argued that this annual demand figure might be difficult to predict, such was the level of intake of direct entrants in each case that this does not appear to be a reasonable explanation for the short-falls. Training and personnel managers were asked why they took on the number of trainees that they did and their replies failed to reveal any great awareness of total demand (usually the reply was in terms of training places available or supply constraints).

The fact that the number of junior operative direct entry varies more widely from year to year than the intake of trainees in some establishments almost certainly reflects the fact that the numbers of direct entry recruited were partly a function of the wastage of junior operative trainees and ex-trainees (i.e. they were replacements).

Differences between the distribution of ex-trainee and ex-direct entrant leavers over time (Table 5.3) were tested using a t-test for two independant samples. The t-test was used because of its suitability for small samples. Only a one-tailed test was used the hypothesis being that trainees would have lower leaving rates over the period tested than direct entrants. The test was at the 0.5 level of significance the number of degrees of freedom varying with the number of observations used per establishment.

RESULTS OF THE ANALYSIS

TRAINING LOSS AND PRODUCTIVE LENGTH OF STAY OF JUNIOR OPERATIVE TRAINEES

It is clear that in all the companies for which data was available the crude loss of junior operatives through wastage was very high. Junior operative trainees were no exception (Table 5.2.). While there were fluctuations from year to year and individual differences between establishments, in most of the establishments, by the time the ex-junior operative had completed a year as an adult, less than on average one-third of operatives remained and in some cases fewer than one-quarter. Establishments 6 and 7 were exceptions to this: the former was in an area where there was little alternative employment apart from in other steel industry establishments; the latter was in a rural area with little alternative employment opportunities.

In all establishments the policy was to recruit junior operatives at the age of sixteen with little or no industrial experience,

TABLE 5.2

Percentage of Each Annual Intake of Junior Operative Trainees That Have Left the Establishment

YEAR	ESTABLISHMENT 1	2	3	5	6	7
1960	-	-	-	82	-	-
1961	-	-	-	78	-	-
1962	66	76	-	86	-	-
1963	90	85	-	76	40	-
1964	71	73	-	76	83	-
1965	65	77	63[1]	84	52	48
1966	65	76	58	78	33	43
1967	50	44	54	81	47	64
1968	41	30	46	62	35	28

[1]Entrants for October-end December 1965 only

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to put them through the training programme which involved a mixture of further education, knowledge of the industry and some basic skills and to feed them onto promotional lines which led onto adult lines. In the establishments with higher losses, in order to obtain one trained young adult from junior operative status the company had to train three or more. From crude turnover rates shown in Table 5.2 it is evident that the number who left within a short period in these plants was relatively high; judging from the data relating to the early 1960's, however, after about four years those that remained provided a hard core out of which few seemed to leave in the next two or three years. The small size of the sample meant that it was not possible to test statistically the relationship between rates of wastage and such factors as the size of the labour market area, the level of demand for labour as evidence by the local employment rate and the level of wastage. There was certainly no obvious relationship between these factors except again in the case of establishments 6 and 7. The rate of wastage of the young operatives did not seem to be influenced by whether the establishment specialised in taking young operatives into the works at fifteen or at sixteen or seventeen years old.

Length of stay data could be obtained from six of the seven establishments. A summary in respect of trainees in five establishments is given in Table 5.3 for the intakes of the years 1963-67. This shows variations between the different annual intakes and between establishments although in many cases about a third of the training intake left within the year and frequently a quarter within six months. Diagram 5.2 shows the shape of the curves of the cumulative distribution of leavers on a basis similar to that shown in Diagram 5.1. The data has been averaged and converted into percentage terms for establishments 1 and 2 for the years 1962-65 for establishment 5 for the years 1960-65. for establishment 6 for the years 1963-65 and for establishment 4(trainees and direct entrants combined) for 1961-65 (see Appendix Tables 1 and 2). In establishments 2 and 4, over a half of eventual leavers from the training intake left within one year, in establishment 6 a third and in establishment 1 about a quarter. The curves all demonstrate the early induction crisis within the first three months although their shape during the 'differential transit' period was by no means uniform.

Establishments 1 and 5 operated junior operative trainees schemes in which the intake of trainees was usually restricted to fifteen year olds. Establishments 2, 3, 4 and 6 had a portion of

- 153 -

TRAINEES

TABLE 5.3

Cumulative Length of Stay-percent Distribution of Leavers from Each Year's Annual Intake

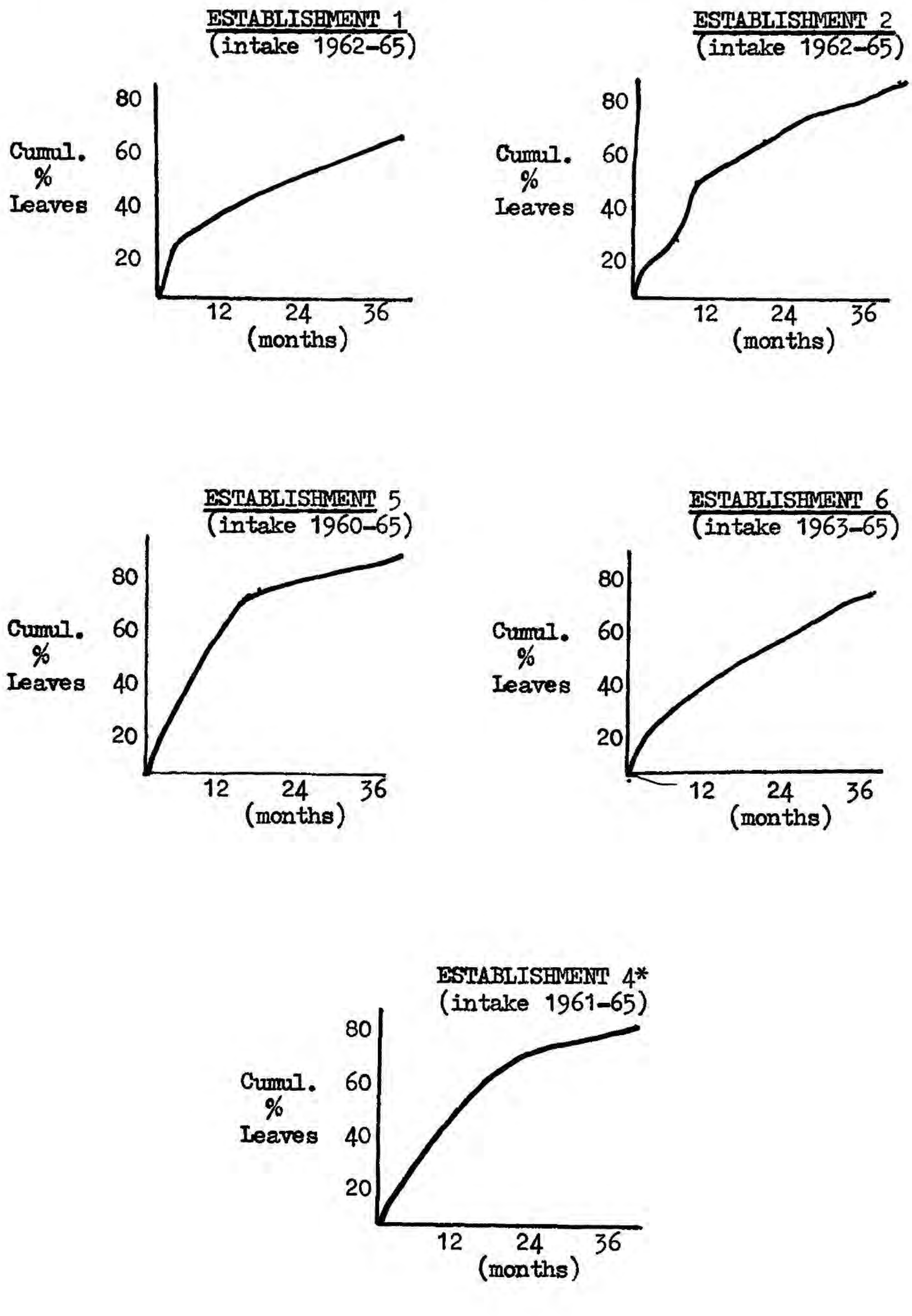
	Total Intake Nos.	1	2	3	6	12	18	36	72	Total Leavers (Nos.)
		(Months)								
Year 1963										
Establishment 1	30	0	3	3	3	3	20	53	90	27
Establishment 2	27	0	0	0	4	22	44	78	85	23
Establishment 5	41	2	5	5	12	39	56	68	76	31
Establishment 6	124(114)	3	3	4	4	5	7	18	35	50
Year 1964										
Establishment 1	38	3	3	5	11	26	34	47	71[1]	27
Establishment 2	30	0	3	7	10	33	50	60	73	22
Establishment 5	68	4	7	10	24	38	54	71	75[2]	52
Establishment 6	92(77)	0	4	6	14	26	38	56	66	76[5]
Year 1965										
Establishment 1	41	-	7	12	15	24	29	39	59	27[3]
Establishment 2	62	8	19	23	37	56	65	69	74	48[4]
Establishment 3	27	4	4	7	19	26	26	41	69	17
Establishment 5	56	5	14	18	43	68	73	82	84	47
Establishment 6	116(90)	0	3	3	10	16	23	31	38	60[5]
Year 1966										
Establishment 1	26	8	19	19	27	31	42	58	65	16
Establishment 2	46	9	17	19	43	50	65	72[4]	-	35
Establishment 3	108	8	14	17	21	33	39	56	58	63
Establishment 5	60	3	5	8	23	42	55	77	78	47
Establishment 6	97(80)	1	5	8	8	11	13	20	21	32[5]
Year 1967										
Establishment 1	14	7	14	21	36	43	50	-	-	7
Establishment 2	34	3	6	6	29	32	38	44	-	15
Establishment 3	142	4	12	14	20	30	44	54	-	77
Establishment 5	62	3	10	16	37	50	68	79	81	50
Establishment 6	72(55)	4	7	13	18	20	31	-	-	34

1 Including one whose length of stay unknown.
2 Including one whose length of stay unknown.
3 Including 3 whose length of stay unknown.
4 Including 2 whose length of stay unknown.
5 Including leaver whose date of leaving was unknown.

The percentage distribution of leavers is however calculated on the basis of the intake minus leavers for whom no date of leaving was available. (Figure in brackets in intake column)

DIAGRAM 5.2

Cumulative Percentage Distribution of Leavers Out of Intakes



*Trainees and Direct Entrants

fifteen year olds in their intake. If only "productive" length of stay of intake is measured (from the time that the junior operative is eligible to work at sixteen) then the proportion of the operatives in the short stay categories is obviously swelled noticeably. For example productive length of stay has been calculated for establishment 1 which has low early leaving rates. This shows that almost one in five of the fifteen year old intakes left before they reached the age of sixteen (Appendix Table 3).

There are, of course, differences in the length of stay structure between the different establishments. In particular, establishments 1 and 6 seem to retain a higher proportion of their labour force for a longer time than the others, although in the case of establishment 1 the eventual loss out of any annual intake is not significantly different from other plants (see Appendix Table 1).

No detailed analysis was undertaken to test whether wastage rates increased or decreased when the junior operative trainees approached adult promotion lines i.e. the age of eighteen. A crude guide to this can however be obtained by comparing the loss from each intake for the first eighteen months with the loss in the second eighteen months when the operative is more likely to be in or near to an adult job. In Table 5.4 below data for individual years has been aggregated to demonstrate this point. While the difference in emphasis between certain of the establishments is marked, the trend is nevertheless uniform throughout (see Appendix Table 4 for detailed year by year data on this basis).

COMPARISON OF WASTAGE OF EX-JUNIOR OPERATIVE TRAINEES WITH DIRECT ENTRY

All of the establishments covered in the enquiry relied as much upon the recruitment of direct entrants as of trainees to supply

TABLE 5.4

Rate of Wastage - Out of Initial Intake During the First Eighteen Months and Out of the Remainder* During the Second Eighteen Months (1962-66)

	TRAINEES		DIRECT ENTRANTS	
	1 - 18	19 - 36	1 - 18	19 - 36
Establishment 1	28	24	57	30
Establishment 2	54	27	49	33
Establishment 3 (1965/66)	36	27	63	35
Establishment 5	58	33	69	48
Establishment 6 (1963/66)	19	14	40	19

*For example, if there is an intake in any single year of 40, and 20 leave in the first eighteen months then the rate for this period would be $\frac{20}{40} \times 100 = 50\%$. If in the second period of eighteen months 5 people leave then the rate would be $\frac{5}{40-20} \times 100 = 25\%$ i.e. the number leaving in the first period is subtracted from the total intake to give the number 'at risk' in the second period.

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their youth labour demands (Table 5.1). Examination of the net wastage out of each annual intake of trainees and direct entry reveals that with few exceptions wastage from direct entries is higher and frequently substantially higher (in percentage terms) than from trainees. (Table 5.5) Only for establishments 1, 6 and 7 were the differences statistically significant although establishment 3 bordered closely on significant. From the data in Appendix Tables 3 and 4 it would also appear that short term losses from the direct entrants were high, relative to trainees. Comparison of the loss of each intake during the first and second period of eighteen months

TABLE 5.5

Comparison of Percentages of Each Annual Intake of Junior Operative Trainees (JOTs) and Direct Entry (JODs) that have left the Establishment and were not with the Establishment in August 1969[1]

YEAR	ESTABLISHMENT 1 JOT	1 JOD	2 JOT	2 JOD	3 JOT	3 JOD	5 JOT	5 JOD	6 JOT	6 JOD	7 JOT	7 JOD
1960	-	-	-	-	-	-	82	71	-	-	-	-
1961	-	-	-	-	-	-	78	84	-	-	-	-
1962	66	85	76	82	-	-	86	96	-	-	-	-
1963	90	75	85	76	-	-	76	83	40	63	-	-
1964	71	89	73	85	-	-	76	91	83	79	-	-
1965	65	82	77	63	63[2]	79[2]	84	96	52	70	48	94
1966	65	82	76	84	58	77	78	87	33	62	43	96
1967	50	80	44	88	54	74	81	73	47	69	64	73
1968	41	78	30	67	46	54	62	68	35	51	28	83

[1]This may include a number who have left, returned, and left again.

[2]Entrants for October-end December 1965 only.

- Years in which the training programme was not in operation.

(Table 5.4 and Appendix Table 5) reveals that wastage falls over time for direct entrants as for trainees.

The differences in rates of wastage out of the annual intakes of trainees and direct entrants are not affected when allowance is made for the number of leavers returning to the works (Appendix Table 6). In each of the establishments a proportion of the leavers returned; and many, shortly after return, left again. A number of those who returned and stayed was small in relation to the total number of leavers except in the case of establishment 6. And again with the exception of establishment 6 there was little difference in the proportion of ex-trainees and direct entry leavers that returned. This, of course, only measures the short run movement in and out of the establishment and a pattern over the work life of operative trainees and direct entrants might be very different.

Closer consideration of the short-term length of stay distributions for the four companies for which detailed comparable year by year data were available (establishments 1, 2, 3 and 5) reveals significant differences in the case of 1, 2 and 5 (Appendix Table 7). In establishments 1 and 5 in particular there are very large differences in the proportion of trainees leaving in this period. It is here perhaps significant that establishments 1 and 5 both operate schemes which concentrate on fifteen year olds. Indeed, if in establishment 1 a distribution of the direct entry leavers is compared with the productive length of stay of operative trainees then the difference is less marked.

It is clear, however, that while the percentage differences in losses of trainees and direct entrants are generally consistent they are sometimes relatively small and in terms of number of employees involved annually, even smaller. For example, percentage losses in 1971 from the intakes of trainees and direct entrants in establishment 5 in the years 1960-63 were 79% and 85% respectively. If this ratio is applied to an average intake of forty five trainees and forty five direct entry in these years then the difference in terms of yield of hard-core employees is only two a year.

EXPLORING THE SIGNIFICANCE OF THE DISTRIBUTIONS FOR MANAGEMENT DECISION MAKING

It can be argued that the firm should know clearly what the costs of training are whatever its training objectives and whether or not the benefits from training can be quantified. It was argued earlier that there may be two practical and useful ways of calculating the costs of training which are relevant to management decision making. The first is by calculating the replacement costs of those operatives "lost" through wastage. This can be done on an annual basis. Such a figure has been calculated showing the average total cost of replacing first year losses from the junior operative training programme calculated on the basis of the average leaving rates in the first year for the period 1966-68 inclusive. This, however, is still very limited in usefulness for it neglects the costs involved in replacing second, third and subsequent year drop-outs from a programme. This method of calculation of costs of training will only be really valuable if the replacement costs of all those estimated to subsequently leave the programme were aggregated and added to the initial programme costs to give the total costs of producing a given number of long-term ex-trainee employees.

One very simple alternative to this is to indicate the total direct expenditure that has been incurred on those who will leave within the year following the period of recruitment, thus demonstrating to management the cost of the induction crises.

Perhaps a more useful calculation might however be an estimate of the mixinum cost of producing one "hard-core" adult worker out of the programme. This has been done by calculating from the distributions of employee tenure given for earlier years the number of "expected" hard-core employees from the 1969 programme in the various establishments. The hard-core has been estimated as those with the company after four years. These figures are shown in Tables 5.6 and 5.7.

TABLE 5.6

Comparison of Junior Operative Training Programme Costs

	ESTABLISHMENTS							
	1		2		3		5[1]	
Average intake 1966/68	19		33		62		65	
Costs varying with throughput	£.	p.	£.	p.	£.	p.	£.	p.
Further Education: wages	752	40	1,544	40	3,013	20	2,340	00
fees	19	00	19	80	80	60	650	00
Materials	133	00	66	00	1,240	00	-	
Induction - wages	104	50	128	70	3,682	80	325	00
In the works training - wages	2,409	00	10,939	50			-	
A SUB TOTAL	3,417	90	12,698	40	8,016	60	3,315	00
Depreciation & maintenance of premises and equipment	146	00	1,703	00	3,015	00	-	
Direct and Indirect Labour costs	1,804	90	3,184	50	1,472	00	-	
B TOTAL	5,167	90	17,595	90	12,503	60	3,315	00
Unit direct cost (A)	174	00	384	00	129	00	51	00
Unit total cost (B)	271	00	532	00	20	00	-	

1. Further training is given only in relation to direct job needs and has not been included here.

TABLE 5.7

Costs of Losses Through Wastage in Certain Junior Operative Programmes[1]

	Establishments			
	1	2	3	5
	£.	£.	£.	£.
Average total cost of replacing first year losses 2	1,084	6,916	4,221	1,632
Total direct expenditure on those who will have left within the year 3	1,566	8,832	4,902	2,499
Maximum real cost of one 'hard core' adult worker developed 4	1,292	2,512	521	221

1. These include only to obvious cash cost of training invested in juniors as soon as they arrive in establishment. They exclude costs of further training which may be undertaken some time after the youth has been employed in the works.

2. Assuming that these can be replaced without any losses from the new replacement. Calculated at leaving rates for 1966/68.

3. Excluding costs (like trainers salary) not directly incurred by the individual youth being on the programme.

4. Still with the establishment after 4 to 5 years. The real costs of a 'hard core' worker would be the total costs minus any return from those who have already left.

It was, however, extremely difficult to arrive at such calculations. For this purpose information was obtained both from the company's grant claim form for 1969 sent to the I.S.I.T.B. and from the establishments themselves. The costs of the training programme in the several establishments excludes any opportunity costs incurred (i.e. forman's time spent on assessment of training) and excludes many of the costs of having a youth supernumerary when he is not on the programme. Further, the inadequacy of the data means that the calculations are unsuitable for fine distinction between the costs of establishments. The data shows that costs varied significantly between establishments. The establishment with the highest unit cost was the one that was nearest at the time to meeting the I.S.I.T.B.'s complete approval. It was clear that the major factor in boosting the cost of the programme was the time spent on job rotation. This is so even when as in Table 5.7 only the most obvious costs are measured.

The size of any financial loss through wastage or indeed the size of the cost of producing one "hard-core worker" only, however, derives much of its importance in relation to the size of the expected benefits. Thus, for example, in the case of establishment 2 if the increase in productivity for each training "hard-core" employee was expected to be worth an extra £500 a year to the firm over and above that produced by a direct entrant, then it would take very little time to obtain an adequate return on the training investment of £2,512.

The point has been made earlier, however, that in considering the relationship of costs to benefits it is important to attempt to distinguish between the possible beneficiaries of the programme as evidenced by content and objectives. An attempt was therefore made to do this with the junior operatives programme. Diagram 5.3 shows in the columns the major educational and training inputs in a tripartite junior operative training programme with the possible beneficiaries along the rows. It is impossible to distinguish exclusively between those inputs of education that are completely specific and those that are completely general. Thus "general" education benefits to the individual may flow from the "specific" iron and steel industry courses and certain benefits may flow to the

DIAGRAM 5.3

A Matrix for determining who might be the beneficiaries of a junior operative training programme[1] and who might bear the costs

Training/Location Centre

<table>
<tr><th colspan="2" rowspan="3"></th><th colspan="4">External</th><th colspan="6">Internal</th></tr>
<tr><th colspan="2" rowspan="2">General Education</th><th colspan="2" rowspan="2">Education related to Iron & Steel Industry</th><th colspan="4">Training Centre</th><th colspan="2" rowspan="2">Rotation at the job (Supernumerary)</th></tr>
<tr><th colspan="2">General education & general training</th><th colspan="2">Education & training relating specifically to the Iron & Steel Industry</th></tr>
<tr><th colspan="2"></th><th colspan="2">Benefits[2]</th><th colspan="2">Benefits[2]</th><th colspan="2">Benefits[2]</th><th colspan="2">Benefits[2]</th><th colspan="2">Benefits[2]</th></tr>
<tr><th colspan="2"></th><th>D</th><th>I</th><th>D</th><th>I</th><th>D</th><th>I</th><th>D</th><th>I</th><th>D</th><th>I</th></tr>
<tr><td rowspan="4">Beneficiaries</td><td>Firm</td><td></td><td>*</td><td>* possibly</td><td></td><td></td><td>*</td><td>*</td><td></td><td>*</td><td></td></tr>
<tr><td>Industry</td><td></td><td>*</td><td>* more likely</td><td></td><td></td><td>*</td><td>* possibly</td><td></td><td>* possibly</td><td></td></tr>
<tr><td>Individual</td><td>*</td><td></td><td></td><td>*</td><td>*</td><td></td><td></td><td>*</td><td></td><td></td></tr>
<tr><td>Society</td><td>*</td><td></td><td></td><td>*</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

1. A programme including further education (external), training centre education and training and at the job rotational training.

2. Where D = mainly direct
   and I = mainly indirect

* Indicates probable type of benefit

firm and/or industry from "general" educational courses. These benefits are in the nature of a spin-off from the courses taught. They therefore may be termed "indirect" as opposed to the more "direct" benefits. A third dimension has therefore been added to Diagram 5.3 in the form of two columns headed "Mainly Direct" and "Mainly Indirect" within each educational or training input category. The boxes indicate, in accordance with the above definitions, to whom the main flows of benefits will be directed from each input. It can be argued that the development of such a matrix may be operationally useful to the company (and perhaps the I.S.I.T.B.) in making decisions about who should get the benefits and who should bear the costs of junior operative training. It may also help in deciding on the content and form of programme and how much each may wish to promote activities that have no direct benefit. For example the firm taking a "direct" criteria only (for itself) would be very concerned about receiving a direct return to training from the "hard-core" as shown above. On the other hand, if the programme embraces a very much wider criteria then the company may expect compensation from the Training Board for the components of the "hard-core" cost relating to industry or national objectives which it does not embrace itself (although it may do so).

The matrix, incidentally, may also help to clarify possible areas of difference between a company and the I.S.I.T.B. For example recommendations about the content and form of further education (whether it should be vocational or non-vocational or "specific" or "general") may be items on which the Board may feel it must take a wider "society" view and/or a view concerned more with the welfare of the individual irrespective of the feelings of the firm. On the other hand recommendations about specific training mean that the

Board is making a rather more direct economic judgement in recommending to a firm a method of undertaking training which may or may not be its own preference.

This point can be illustrated as follows. It is clear that in respect of the costing of the training programmes, in the firms where this exercise was undertaken, a major factor in increasing costs was the time spent on job rotation. This is so even when, as in Table 5.6, only the most obvious costs are measured. The costs in establishment 2 were high primarily because of the extensive job rotation scheme for junior operative trainees. It can be argued that job rotation is "specific" training with direct benefits chiefly or only to the firm and with few indirect benefits. It can be, for example, contrasted with further education which benefits directly the individual and perhaps society and only indirectly the firm. High expenditures on further education even when there is large wastage may be justified on the grounds that the major benefits go to the individual and are retained by him when he leaves. It is very much less easy to justify expenditures on job rotational training in this way when there are high wastage rates.

If a firm therefore has in response to the Training Board policy produced an extensive job rotation scheme then the cost may be quite high. For example in establishment 2, job rotational costs were about three quarters of the total variable costs of the programme. (See Table 5.6) This, coupled with a higher wastage rate, boosted the replacement cost very considerably. In establishment 2, without rotation, the replacement cost for the first year would have been £2,964 as against the actual cost of £6,916. Moreover, assuming that the job rotation does not have any effect on wastage rates the additional cost raises substantially the real cost of producing one "hard-core" worker from the programme. The cost of a "hard-core" worker in establishment 2 was £2,512 with job rotation and £949 without it, a difference of £1,563. This difference of £1,563 is to be considered against possible internal benefits from productivity.

CONCLUSION

This Chapter has discussed and provided evidence on two basic questions relating to the inter-relationship of training and wastage:

A. The importance of measurement of turnover (wastage) in the evaluation of programmed training exemplified here by the steel industry junior operative training programme, and the significance of the shapes of the "length of stay" distributions of new intake for the timing and content of such training.

B. The dependence of the significance of wastage from such programmes and associated costs, on the content of the programme and on the definition of the beneficiaries.

The data produced related only to a few establishments although an attempt has been made to provide a framework within which a firm may try to evaluate its own programme.

In the establishments examined, on average one-third to one-half of the intake into operative trainee programmes were left after three years. The majority of those who left did so within twelve months of joining. From the viewpoint of the firm which has to bear the cost of high turnover, it is worth considering how additional turnover costs resulting from training could be modified. One key possibility for management might be to alter the timing of the programme. In respect of the junior operative programmes there appeared to be three alternatives: to undertake the programme at some point in time after the initial induction wastage when it was hoped that losses would be more moderate; to phase the programme so that the induction and the further educational components were separated from the more intensive training parts; to abandon the idea of a comprehensive programme in favour of providing separate components only when the need arises and when the maximum effect can be achieved.

From the wastage data examined it was difficult to find a "right time" for the programme. Losses out of intake were sometimes still relatively high after a year or eighteen months although generally lower than in the first twelve to eighteen months. This pattern held also for direct entrants the behaviour of whom was a better guide to what might happen if the emphasis of the training programme shifted away from the introductory months. The solution therefore might only be reached after careful experiment by the management of the individual firm.

It has been argued that if wastage rates are favourably affected by training programmes then this will in fact modify the loss of personnel through wastage to the company and count as an additional benefit of the programme. There was indeed evidence to suggest that rates of loss out of intakes of ex-trainees were lower than out of intakes of direct entry and that the length of stay of the former group (in the short run) was longer. Differences were not always, however, statistically significant. This does not mean that there is a causal connection between training and the length of stay although reasons have earlier been suggested as to why there may be relationships; and, because of the way in which the establishments were chosen, there was no reason to expect any major differences, such as in measured intelligence between the two sets of youths. When measured on an annual basis, however, differences in number terms between the "yields" of hard-core employees from the ex-trainees and direct entry groups, do not seem to be substantial.

Finally, it has been demonstrated that the significance of the interaction of training and wastage can only be evaluated in relation to the particular objectives of the programme and that, as has been demonstrated in Diagram 5.3, there is a case for management to consider carefully these objectives in terms of who bears the costs and who gains the benefits.

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PART III

EVALUATING PROGRAMMED TRAINING DECISIONS

CHAPTER VI

EVALUATION OF FACTORS INFLUENCING THE PRODUCTIVITY OF THE TRAINING PROGRAMME

INTRODUCTION

The objective in this chapter is to develop and test a model for evaluating factors influencing the effectiveness of training in Programmed Training situations. The simple model for Programmed Training decisions introduced in Diagram 1.14 in Part I described the conventional feedback loop from company objectives through to training programme implementation and back again while emphasising the point that at various points in the loop training effectiveness could be influenced by "external" factors. The view of evaluation taken by this thesis, in embracing these external supportive and constraining factors in the evaluation, moves the closed loop system of training evaluation towards a more "open systems" approach. It will be argued, and hopefully, demonstrated in this chapter that applying a broader systems approach will enable measurement of factors affecting the productivity of the training investment to be made. This might enable management to spot any possible gaps in the basic "systems support" for training which threaten the objectives of the programme and might open the way for action to be taken to fill them. Thus if a programme is evaluated as satisfactory at the Reaction and Learning levels then it may be possible to assume that if there are no remaining major gaps in the support system then the _potential_ for maximum productivity of the training investment exists, even if this productivity cannot be directly measured. It is, however, also hoped that gaps in the support system that cannot be filled, will by this process of evaluation be more clearly recognised as constraints on the productivity of the programme.

While it is both theoretically and realistically more satisfactory to regard the training sub-system as dependent on other systems for its contribution to organisational effectiveness it nevertheless begs questions about what are the important systems affecting training, how the boundaries of these systems might be defined and what form their influences take. In practice it will also be relevant to ask how far it is necessary to go in terms of identifying relevant systems and interfaces given that the influences on training investment may be myriad.(1) It is recognised that such interfaces will vary with the Level of evaluation and may range from the effect of physical conditions in the classroom at the reaction level to the influence of supervision at the job behaviour level. As the focus of this research has been on the impact of training at the overall organisation level and the evaluation is concerned with the organisation's Programmed commitment to training it seems appropriate to seek to identify the basic organisation supportive systems with which the Programmed Training interacts and possibly also the key tasks which must be accomplished by these systems to ensure effective support for training. By measuring these this will give an indication of the overall coherence of the support by the organisation for the training commitment.

IDENTIFYING BASIC ORGANISATION SUPPORT SYSTEMS FOR PROGRAMMED TRAINING

"An organisation has certain jobs to be filled, it describes the qualifications necessary for these jobs and sets about to locate workers with these qualifications."(2)

E.H. Schein from whom this quote is taken goes on from this, however, to argue that the process of setting manpower objectives that he describes must cater not only for organisation performance needs but also for the needs of individuals and/or society as a whole. Having made this point his main theme is then to argue the case for the importance of considering the necessary interaction of the processes of selection, recruitment training and allocation in terms of successful integration of worker into the organisation. Schein underlines the point that these systems themselves interact with other parts of the organisation and if this is not recognised will create conflict.

"Many of the difficulties encountered in selection and training stem from the failure to see the organisation as a complex set of interdependent overlapping systems with various linkages to the external environment in which the organisation exists."

In pursuing this theme he identified three major problems which it seems very appropriate to recognise in the Programmed Training context namely:

1. That the outcome (of training) may not be clearly specified not because of insufficient study of jobs but because the trainee is expected to develop towards "an uncertain future".
2. Training itself interacts with the organisation producing pressures for change.
3. The training effort interacts with recruitment, selection and job design.

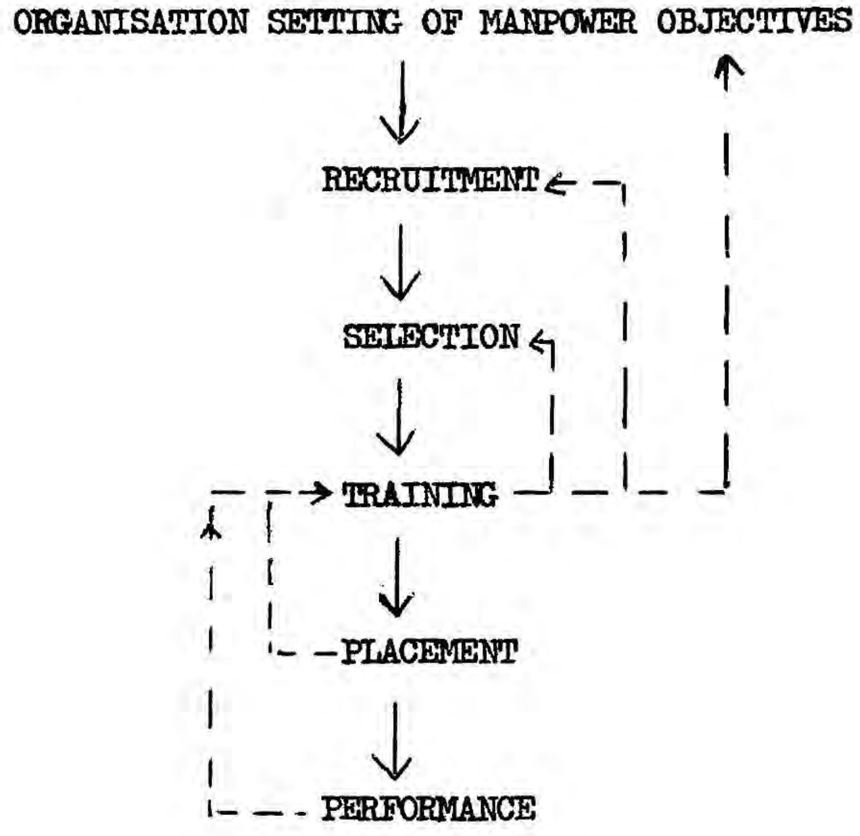
Schein's basic systems points can be simplified into a flow diagram (Diagram 6.1) using training as the focus for the interfaces (dotted lines).

The interfaces in the Diagram point to the possible sources of constraints on training programme effectiveness: for example the productivity of a programme may be affected if:

1. Management fails to establish clear objectives relating to manpower and training needs.

DIAGRAM 6.1

STAGES IN RELATING THE MAN TO THE ORGANISATION



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2. Recruitment procedures are inadequate resulting in untrainable personnel.
3. Selection procedures are inadequate resulting in untrainable personnel.
4. Training is inadequate in organisation and/or methods.
5. Inadequate placement procedures prevent the proper utilisation of the employee after training.
6. There is marked absence of other factors e.g. rewards, supervision, etc. necessary to ensure good performance.

The stages in Diagram 6.1 will therefore be taken as the basic support systems framework for training to which our evaluation may direct itself. With the exception of the performance sub-systems (point 6) it can be argued that all of the other "systems" will lend themselves readily to evaluation. Performance is of course not measured directly - the difficulties in so doing have been discussed at length elsewhere - but is defined as the system surrounding the worker on the job, likely to influence his performance. This, however, seems to raise almost insurmountable difficulties because of the large number of factors which in respect of Programmed Training can subsequently influence performance on-the-job. While there is no shortage of literature on this subject there is little agreement among academics as to the relative importance of different factors.[3] It was decided therefore to develop the enquiry within this framework recognising that there would be limitations on the ability to construct a satisfactory approach to the "performance" system.[4]

The investigation in the companies therefore concentrated on the objectives, selection/recruitment, training organisation and placement interfaces and used a limited proxy for the performance aspect.

- A Digression on the Relationship of Turnover to the Systems Identified

Before developing a detailed approach, however, the question of the relationship between the factors outlined above and the issue of labour turnover dealt with in the previous chapter is worth exploring. The link is through the rather complex relationship between training and job satisfaction and desirability of movement. A number of studies have emphasised the relationship between the individual's satisfaction with the job and his propensity to move.[5] Pettman argues from a review of the literature that job dissatisfaction is a sufficient condition for labour turnover but not a necessary one.(6)

The relationship of training to job satisfaction is, however even more problematical. It is clear that training is only one of a large number of factors that might influence satisfaction.(7) Its major link, however, may be through its influence on three factors which March and Simon(8) among others have considered contribute to job satisfaction namely:

(a) The predictability of job relations

(b) The conformity of the job to "self-characterisation" held by the individual

(c) The compatibility of work requirements with the requirements of other roles

It is possible that a training programme may help meet worker needs in these respects by helping them familiarise themselves with the standards required by the company and giving them the time and opportunity to relate themselves to the job. There is some evidence to suggest that when the potential employee has misunderstood the nature of the job then turnover increases.(9) In terms of the conformity of the job to self image March and Simon have pointed out the role of education of employees and the individual's participation in job choice as two factors of importance both of which may be influenced by a training programme.(10) They have also, interestingly, given some emphasis to the role of rewards not only in terms of the amount of reward but also the rate of change of income and/or status. The relationship between the rewards and turnover has, however, not been clearly established.(11)

As was pointed out in Chapter V the relationship between education and turnover is rather ambiguous. It has, for example, been argued that the higher the level of education the greater might be the conflict between the job and the individual self image:(12) it follows from this that the development of education as part of a training programme may actually encourage turnover. In general, however, the evidence would suggest that the role of training and education may be to increase job satisfaction and therefore discourage turnover. This is an interesting hypothesis in the light of the results of the comparative analysis of wastage of trainees and direct entrants undertaken in Chapter V. Undue concentration on these factors is however ill advised in the light of a large number of other variables which have been discovered to relate to turnover, both internal and external to the firm, and relevant to the individual and/or the organisation.(13) The influence of the size of the work group, supervisory practices, size of the firm, physical working conditions, employee relations are some of the factors that fall into the "internal" category; and the current state of the economy, the influence of the locality and the industrial structure of the local labour market are examples of "external" factors.(14) Differences in turnover have also been related to such individual characteristics as social status, personality, intelligence, sex and age among others.(15) In these circumstances it would be wise to be extremely cautious in relating the findings in this part of the investigation to those outlined in Chapter V.

SELECTION OF METHODS FOR INVESTIGATION

This section is divided into two parts. The first is concerned with identifying the key questions, related to each of the headings in Diagram 6.1, to which it appears pertinent to address an investigation. The second part describes the development of the methodology for the enquiry in the companies.

(i) Organisation Setting of Manpower Objectives

It has been argued by several writers on manpower development that there should be a clear policy and set of objectives relating to particular training programmes.(16) It seemed this might be of especial importance in respect of Programmed training of the junior operative training type. If such a programme was to meet the needs of the organisation then it can be argued that objectives should at least be set out clearly as a guideline to those developing the programme. The fact that such guidelines are likely to be set by line management in respect of their own identification of needs gives added importance to this point. The problem in practice was, however that of identifying what represented the setting of a reasonably clear objective. In this respect it was determined that there were possibly two key questions to be answered:

- Was a clear target set in terms of numbers of junior operatives to be recruited and trained?
- Was there a clear statement of policy/objectives?

The first question seems to meet a minimum expectation that might be part of a Programmed training decision namely to supply an estimated trained number of personnel for the organisation, presumably relating to need. The second question also seems to be a minimum requirement of a regular programme especially in a large company. It was also considered that the expectation that objectives should be "written" was not unreasonable in view of the repeat nature of the junior operative programme. In short these two questions indicate the nature of the policy making process and whether there is a target.

(ii) Recruitment and Selection

There is considerable evidence to support the importance of adequate recruitment and selection procedures as a foundation on which a training programme may be built.(17) The relationship between recruitment, and selection for training, is close. At the recruitment stage it is commonly regarded as necessary to examine the skills or potential of the applicant in relation to the necessary skills for a competent performance of the job.(18) This process will decide whether the applicant is accepted as already competent, if he is accepted but will require training to achieve competence or whether he is so far below the level of competence that even with training he is unlikely to achieve the required standard. Thus it was considered that in respect of the junior operative programme it might be important to assess whether the applicant has the ability and/or aptitude to reach a required standard. The relevance of this for the successful achievement of the training objective is clear - the quality of the intake will help to determine the success of the training and the return on the training investment. The key questions to be asked are therefore:

- How the firm recruited junior operatives?
- How they were selected for training (if the procedure differed)?
- What methods/tests were used, if any to grade operatives for particular jobs?
- Who was responsible for recruitment and selection and in particular their relationships with the training department?

<u>(iii) Training (Organisation and Method)</u>

It was not the intention in this respect to carry out a detailed audit of the quality of training nor to attempt Reaction or Learning evaluations. The aim was to concentrate purely on the "organisation parameters" of training in order to identify:

- Whether there were clear responsibilities established for programmes.
- Whether in fact the objectives of the programme were met in the administrative sense i.e. whether what was supposed to happen did in fact happen.

(iv) Placement

It can be argued that the links between training and utilisation should be as direct as possible.[19] Proper study of the knowledge and skills required for the job or jobs and comparison of these with existing knowledge and skills of recruits should determine the training needs.[20] Under the junior operative training programme the operatives were however being prepared in the broadest as well as sometimes the narrowest sense to meet the requirements of the establishments. Notwithstanding this point it has been argued above that the return to training will be effected if placement procedures are such that the operative is placed in a job for which he has not been trained or because of constraints on utilisation he is not given the right to fill jobs for which he has been trained. It was therefore considered important to ascertain:

- How junior operative trainees were placed in departments.
- To what jobs they could go.
- What restrictions if any there were on their placement.
- The links between the training department and the placement procedure.

(v) Performance

It was recognised earlier in this chapter that the objective was not to measure performance of ex-trainees, it already having been conceded that there were numerous obstacles to this. The aim was to identify the basic factors supporting performance on the job. It has also been shown earlier that these are numerous and that there is no great measure of agreement among writers as to which is the most important. It has, however, been argued that central in the 'motivation to performance' spectrum is monetary reward. It was therefore decided to take as the central measure, the current wage earned by ex-junior operatives.

The decision to use this latter measure was one founded in simplicity of operation. However, it can be argued in support of the choice that the presence of rewards is important in motivational and therefore performance terms. It will also influence whether the ex-trainee is to remain with the company and indeed may be important to the decision to join the company in the first place as a trainee and extract the most from the programmes. Closely associated with rewards in operative employment in the steel industry is the place on the promotion line: the substantial majority of operative jobs are on fixed promotion lines and wages are related accordingly. Thus, position on promotion line could also be used as a proxy for reward and by inference, performance.

The key question was therefore:

- Were there financial and promotional rewards associated with having undertaken the programme?

B. The Design of the Investigation

It was clear that answers to most of the above questions could be obtained by a questionning of the management of the establishments involved. This would, however, have the limitation that in respect of certain of the key questions the answers would have related only to the perceptions of the management involved. This would, for example, have been the case in respect of the placement and performance questions in particular. More objective evidence however, could only be obtained by interviews with those who had been through the programme. This in turn raised the major question of 'standards' by which to interpret the data: What was adequate recruitment, selection, placement and reward? To overcome this problem it was decided to seek a matching control group for Trainees, from the Direct Entrants to the organisations. Direct Entrants were youths who were recruited as and when needed, directly into jobs, bypassing the training scheme and department. It was argued that differences in experience would highlight the degree to which systems support was geared to the training programme which, when matched with background data, would enable judgement about 'gaps' in the systems to be made. To give information about the adequacy of the match it was decided to collect data from both trainee and direct entrants on key factors likely to account for differences in treatment in the organisation including age, marital status, number of previous jobs, education and distance from work. This information would also point to any obvious reasons for differences that might be found in the labour turnover analysis described in Chapter V.

Finally, it was possible to collect certain "objective" information from each works by the collection of official documents relating to the planning of the training programme, the setting of objectives, the keeping of records, etc. This information could be used not only to answer the key questions but also in a number of cases to verify the initial interviews with company personnel.

Two methods of enquiry were therefore pursued:

(i) An in-company data collection by means of interviews together with a documentation analysis

and (ii) Interviews with operatives (ex-trainees and direct entrants)

<u>- (i) Company Checklist and Documentation Search</u>

Certain information on factors likely to bear on the systems support for the training programme could only be obtained from company training and line management personnel and from company records. For example, a statement on company policy with respect to the junior operative training programme was sought together with information on the organisation of the programme, the content of courses (needed as one check on whether the aims were being fulfilled) and information on the methods of recruitment, selection and placement. It was recognised that the organisation of training and the sources of this information might vary from company to company, that some of this information could be obtained from written sources and some from interviews. With this in mind a checklist approach was preferred to a questionnaire or interview schedule. A copy of the checklist showing the salient points about which information was to be obtained is contained in Appendix 1. This information was obtained by means of interviews with and documentation assistance from the chief training personnel in the respective establishments.

- (ii) The Interviews with Operatives

(a) Selecting a Sample

The purpose of the junior operative training interviews was to identify whether the organisation of the training in fact matched up to the prescribed objectives, whether placement procedures met with requirements and whether promotional and monetary rewards could be associated with training. These requirements meant that a sample of operatives had to be taken which included those who had been through the programme and therefore had experienced placement and/or promotion and were obtaining rewards. At the same time it was thought desirable in order to cast light on present practice to interview operatives who had recently undergone the training programme at the works. It was therefore decided that in order to obtain an overall view of training and subsequent employment experience a sample might be taken from each year over the number of years that the programme had been running. It was possible to do this using the data unearthed during the analysis of the wastage from the programmes described in Chapter V. Using random number tables selections were make from intakes up to 1968 thus ensuring that ex-trainees interviewed had some experience of the works.

A sample of direct entrants matching ex-trainees in numbers year for year was taken from lists of intakes into the works up to 1968 using the same method. Thus the samples were balanced for each annual intake with the result that trainees and the direct entrants were comparable in terms of the length of stay in the establishment and thus in exposure in the works. It was recognised that this was not absolutely true in terms of certain establishments where the trainee intake was of 15 year olds and the direct entrants was 16 year olds only. The aim was to take approximately 80 junior operatives from each establishment (approximately 40 ex-trainees and 40 ex-direct entrants) using random number tables applied to lists of trainees and direct entrants drawn up for each year. This, it was estimated, would give sufficient numbers when amalgamated for the 7 establishments, to attempt most of the comparative analysis that was needed. This obviously represented different proportions of the sample population in different companies (see Table 1, Appendix 3). It should have generated approximately 280 ex-trainees and 280 direct entrants. In fact, such were the problems in programming interviews of operatives on shift work that despite extra co-operation from the companies concerned, the numbers interviewed were less than hoped for in several of the establishments. Actual numbers of ex-trainees and direct entrants intervived were therefore 251 and 208 respectively. The discrepancy in numbers reflects the fact that in one plant located in the industrial conurbation of Scotland it was not possible to achieve a balance between trainees and direct entrants because the company records were found subsequently to be inadequate to enable interviewers to locate a sufficient number of direct entrants to match the number of junior operatives. Therefore, for purposes of the aggregative analysis and comparison not all of the junior operative trainees from this works have been included thus reducing the numbers to 216 ex-trainees and 208 direct entrants. Actual numbers of ex-trainees and direct entrants interviewed by company are given in Table 2 (Appendix 3).

For purposes of analysis the trainees and direct entrants have been aggregated and treated as a total survey sample relating to a 'population' of the total number of ex-trainees and direct entrants in all seven works involved. It can be argued that the operatives in these works represent a distinct population because they come from the only works in the U.K. that over the previous five years had met or were extremely close to the I.S.I.T.B. requirements for junior operative training. An aggregative approach was taken in order to meet the clients requirement that a 'national' picture was taken in respect of 'approved' companies: and the results were related not on an individual basis to the companies but to the principles embodied in the I.S.I.T.B. recommendations for junior operative training programmes and the implicit systems responsibilities of the companies who accepted them as a Programmed commitment. In terms of design therefore a constraint was imposed in so far as the feedback from the survey was not to firms but to the Board and thus only indirectly back to the firms. Nevertheless the aggregation of responses enabled sufficient numbers within cross-tabulations to facilitate testing of differences in the distribution of replies between ex-trainees and direct entrants by means of a chi-squared test. Significant differences at the five per cent level are starred in the Tables in Appendix 3.

It is important to record the major limitations of the above sampling procedure. In the first place it is clear that variances described in the analysis might reflect the differential weight of results in respect of individual companies: for while it was ascertained that results in the various companies followed the trend where certain major points are emphasised the incidence was certainly not uniformly weighted.

An individual company flavour is however given by the results of information obtained from the checklist used by the individual companies and referred to above. Nevertheless it would be unwise to use the results to feedback to the individual company as per the evaluation design for Programmed Training outlined in Diagram 1.14 in Chapter 1. The best use that might be claimed for the results in this respect is that they might be used to encourage the management in the companies involved to look carefully at the relevant parameters in their own company.

Our final limitation of the sampling procedure needs to be pointed out. The fact that the overall sample comes from different years of intake also means that in respect of certain questions and answers practice may have changed. This was an unavoidable problem if a sufficient number of ex-trainees and direct entrants with experience in the works was to be obtained. To help overcome this problem however when generalisations are drawn from the data in respect of current practice every effort was made to check the support for the finding from the information taken from the documentation analysis and interviews with senior training management.

- <u>Developing and Testing the Interview Schedule</u>

All of the samples of trainees and ex-direct entrants were interviewed with the schedules contained in Appendix 2. The interview schedule addressed itself to the key questions outlined in Section A (ii to v) above namely:

1. To measure whether in fact recruitment and selection procedures produced trainees of different characteristics to youths recruited directly into the works

in respect of age, work experience and education (Qs. 4, 9, 10-12, 25-27, 45)

2. To measure how the training scheme measured up in practice to the formal outline i.e. did those recruited to the programmed experience what they were supposed to experience? (Q. 47 A-E)
3. To ascertain how ex-trainees, compared with direct entrants, were used in the works in terms of job experience, departmental, works and occupational mobility and subsequent training (Qs. 2, 3, 5, 6, 13, 14, 19-24, 28-43)
4. To measure rewards to training (as a proxy for performance) in terms of comparison of earnings of ex-trainees and direct entrants and position on the promotion ladder (Qs. 14-18, 46)
5. In addition certain background information was collected (as described in Section A above) to throw light on the comparability of ex-trainees and direct entrants (Qs. 1, 7, 8, 9, 45)

There was virtually no difference between the document used for interviews with trainees and direct entrants except that the experience of the trainee under the training scheme, which represented unique information to that type of operative, was contained in a special section.

The interview schedule was designed for use in the works and was piloted with junior operative trainees and direct entrants at a local steel works in the North East. Almost all the questions were closed questions which lent themselves easily to coding and subsequent computer analysis.

The interviews were undertaken by the author together with an interviewing team recruited and trained by the author, and consisted mainly of second and third year honours university students. The training period lasted approximately one week and consisted of an induction programme which covered the objectives of the research, background information to the steel industry, the types of junior operative programmes to be investigated and detailed training in-company in the use of the interview schedule. Four interviewers were recruited and trained in this manner and following training this group led by the author embarked upon a tour of the various works. The computer programme was not written by the author but was commissioned in the University Computer Unit. All that was asked of it was that it should produce distributions with certain cross tabulations.

FINDINGS FROM THE ENQUIRY

The findings from the enquiry are organised under four headings:

A. Organisation Manpower Objectives and how the Objectives were met

This covers not only the information about the objectives set in process but also evidence from the checklist and operative interviews on the way in which the programmes were organised and implemented. Amalgamation of these two headings seems logical.

B. The Preparation for Training - Selection and Recruitment Methods

This covers evidence on selection and recruitment procedures from the checklist and interviews and on the quality of intake measured by educational experience and previous work experience.

C. Utilisation of Operatives in the Works - Placement and Rewards

This includes evidence on procedures for placement after training, opportunities available in promotional and reward terms.

D. Comparability of Junior Operatives, Ex-Trainees and Direct Entrants

This reviews the evidence on the testing of differences in basic characteristics between the two operative samples.

A. Organisation Manpower Objectives - and How the Objectives Were Met

All but one of the establishments surveyed were wholly owned by the British Steel Corporation. Six of the establishments were therefore subject to the influence of the Corporation in respect of their training policy. At the time of the survey little of this influence had been felt on the individual units although the Corporation had laid down specific objectives with regard to operative training "which should be observed as a matter of policy".[21] These were:

(a) All operative training should derive from an analytical study (which should not be elaborate) of the knowledge and skills required and training experience should be specifically planned and supervised to meet these requirements.

(b) Training in a particular skill should so far as possible immediately precede the opportunity to practice the skill.

(c) Training should seek to develop attitudes as well as skills and to convince the operative that he is identified with the aims of the plant as a whole.

(d) Safety aspects should be especially stressed and integrated into all operative training programmes.

(e) All junior operatives and adult operatives where appropriate should be encouraged to follow courses of further education, the City and Guilds of the London Institute Iron and Steel Operatives Course, being the normal course of study.

At the time of the research the establishments seemed to be operating a system which they had devised themselves as individual establishments or had derived from individual company policy. In none of the establishments visited, including the private sector company, was there a written statement of objectives with regard to the training of junior operatives. Policy making usually rested with a committee of senior management of the company rather than with personnel at the individual works level. The policy committee was, however, in two cases complemented by a series of sub-committees at a works level and at a group level covering all aspects of training. These committees made policy recommendations to the main committee for approval or made recommendations to the individual works manager which he might, or might not accept. In none of the establishments was there a committee concerned solely with junior operative training. While the junior operative training programme had been built up more or less on a group or company recommendation, the actual structure might vary in the establishments investigated from that in other related works.

The junior operative training programmes are summarised in Diagram 4.1 (page 125). Each of the programmes seemed to carry the core components of further education, background knowledge of the industry and works, safety instruction and job knowledge and job training, at-the-job. The timing of the programme and the location of the various component parts varied from one establishment to another.

The analysis of operative interviews provides an overall measure of whether the programmes met the objectives set. It does not need analysis or interviews, however, to establish that objectives were not being met in terms of quantity. In all the establishments there were substan tial numbers of junior operatives entering the works who did not benefit from the programme. This was true in each of the 3 to 8 years for which the wastage data was collected and analysed in Chapter V as well as in the year of interviewing (see Table 1). Moreover in view of the large losses from the various intakes, only a small proportion of the total labour force of each works had benefited from the programme and probably also a relatively small minority of the younger workers. It is clear also that whereas in several of the establishments the direct entrant could be offered a chance to study for City and Guilds Part I Examinations very few in practice took the opportunity. Of the 208 ex-direct entry into the establishments only 10 had taken City and Guilds Part I and 3 City and Guilds Part II. Only two of the operatives gained Part I and none of the operatives Part II. It was evident that only a minority of the total direct entry (28%) subsequently got any off-the-job training in the works during their period of employment with the establishment whereas all of the trainees interviewed had undertaken some kind of off-the-job training.

The interviews of ex-trainees, however, indicate that although they had stayed with the establishment not everyone had fully completed the programme (Table 3). Of the 251 ex-junior operative trainees interviewed, 87 or approximately 35% had failed to complete the programme usually because they had reached the age of 16 and a combination of shift work and manning shortages had intervened. This interruption was usually in the form of the junior operative failing to complete the full rotation although in a number of cases attendance at the technical college was also disrupted. The number quoted above, however, actually over-estimates the real proportion of operatives interviewed who completed the programme because in establishment 7 almost all of the operatives interviewed (with some justification) did not regard their supposed job rotation programme as training at all alth ough they stated they had completed the programme.

In all the establishments there were examples of operatives taken off the programme when they reached the age of 16. Moreover a sizeable proportion of those counted as having completed the programme had had one part of the programme interrupted in some way; for example attendance of 16 year olds particularly at training centre sessions was frequently sporadic because operatives could not be spared from manning on particular days. Problems of attendance after the age of 16 probably also accounted for the high number of failures of the junior operatives in the City and Guilds Examination. 189 of the 250 trainees attended the technical college as part of the junior operative programme, and of these 145 took the City and Guilds Part I; 6 of the remaining 44 went to the technical college for further education only; the remaining 38 dropped out before the examinations. Of the 145 who took the examination 50 passed and the remainder failed. Of those who took City and Guilds in the works (58 in number) only 20 passed. Therefore out of a total sample of 251 ex-trainees only 70 or approximately 25% obtained a City and Guilds certificate. A further 28 had taken a City and Guilds Part II examination out of which 13 had passed.

One further indication of the degree to which the objectives of the establishments' training programme were met is provided by the evidence on rotation of training. Interviewees were initially asked if they had had any other training under the programme apart from that off-the-job in the works training centre. Five of the establishments boasted a full rotation training system and altogether these works employed 170 of the operatives interviewed. Of these operatives rather less than one-third (51) claimed that they had had no other training at all whether at or on-the-job. In only one establishment was there a unanimous opinion that the stated at-the-job training programme had been undertaken. When questioned about the location of the training only 67 of 117 respondents seemed to have regarded the rotational training period as at-the-job. In general, however, as might be expected the inter-departmental rotational training experience of the individual training was mixed; in several jobs and departments the operative was obviously given adequate supervision and training during rotation and in others there was neither one nor the other.

Overall therefore it was clear that the practical objectives of the programme were not being met, partly because of the incidence of turnover but also because the manning pressures facing line management meant that operatives could not be spared and at-the-job rotational training could not adequately be given.

B. The Preparation for Training - Selection and Recruitment

Information was obtained from all the establishments on their selection and recruitment procedures for junior operatives. This was designed to ascertain who undertook the recruitment, how the operatives were recruited, and how they were selected for training (if the procedure differed) and whether tests were used in any way to grade operatives for particular jobs.

It was clear that there were wide differences in the emphasis on recruitment procedures between establishments as well as in the method. And the role of the training department in this varied considerably. In establishment 4 there was no training department in the works and the personnel officer was directly in charge of the administration of the training and therefore was involved directly in the recruiting for this programme in the establishment. In establishment 1 and in establishment 7 to a lesser degree the training officer played a direct role in interviewing the applicants for the junior operative programme; and establishment 6 had its own recruitment officer in the training department although this was a recent innovation and for the years prior to 1969 recruitment had been undertaken by the employment officer who was not directly connected with the training department. In establishments 2, 3 and 5 there were links between the employment office and the training department but these were not of the kind that involved the department in recruitment and selection procedures. The trainers were therefore presented by the employment officer with each intake for training.

The role of the training department in the recruitment campaign seemed to vary with the degree to which the establishment concentrated on the canvassing of schools. Only in establishments 1 and 7 did the training department seem to be heavily involved in a school recruitment campaign involving visits and organised tours of the works. But the new training department recruiting officer at establishment 6 had the occasional help of the training department in his school visiting. In the other works the training department was only occasionally involved in school visiting and the recruitment was undertaken by the employment officer through the Youth Employment Office and the Employment Exchange.

Selection for recruitment purposes was largely by interview. In three of the works some attention was paid to selection tests; but in one, tests seemed to be used very sporadically, in another they were not used for the selection of intake but largely to forecast City and Guilds results; and in the remaining establishment tests were used not for recruitment purposes (i.e. to reject unsuitable candidates) but to separate out the brighter ones which might be used later for clerical jobs. Two of the managements interviewed mentioned that they had used selection tests in the past, but, out of the establishments still using tests, they claimed that they had found the pressure of labour shortage so great that they had been unable to use or continue with the tests in a serious fashion. Only two of the works visited (establishments 2 and 6) occasionally used any tests on direct entrants.

The training departments in general virtually had nothing to do with the recruitment of direct entrants and usually had no knowledge of their whereabouts in the works. Recruitment of these young operatives was usually by the same process as for adults.

C. <u>Utilisation of Operatives in the Works - Placement and Rewards</u>

The formal links between the training department and the employment office in relation to the placement of the operatives after training were, in the establishments visited, generally not strong especially where there was a separate training department. Only in one of the establishments with a separate training department did there appear to be a procedure whereby the training officer, could advise on the placement of the trainee in relation to his own judgement. In establishment 6 the problem of placement of trainees after training did not generally arise in the departmental sense because all the junior operatives were recruited directly into the department and drawn from these departments for training in batches according to age (the eldest first). After training the operatives would re-enter their department. In the two establishments with no separate works training department, placement was undertaken by the personnel officer. In four of the establishments it was the practice of the training officer to keep a check on the whereabouts of the juniors until they reached the age of 18; after that, however, contact faded away.

In the establishments with rotational training schemes the aim was to place the youth in a job at age 16 or over of which he had some experience during the programme; but it was recognised that this was not always possible particularly if the youth had not completed the whole rotational programme. In all the establishments, however, there were definite restrictions on the placement of junior operative trainees. In the first place age restrictions virtually meant that certain departments or jobs in these departments were closed to juniors. This was commonly the case with the melting shops and blast furnance departments and certain jobs such as shunter or crane drivers. The age limit was frequently 18 but in some cases 21. Second, it was in all the works, impossible to give the junior operative trainee any preference over a direct entrant in terms of seniority. Seniority on the manning, a result of union and management agreement, usually began from the age of 16; and technically it was in some cases possible for the junior works trainee who continued on the programme after 16 to lose out to the direct entrant on the youth line. All the establishments operated youth lines which were associated with seniority; in some cases they were departmental - there was a youth line from that department running through a large number of jobs - in others there were specific youth jobs associated with a particular line. This is obviously of some consequence for the ex-trainee for in the first case the youth after being committed to the line was committed only to the department; within the second case the youth was more or less committed from an early age to one specific line. Moreover, in some cases, the line led into the adult labour pool at the bottom of the adult ladder and the youth, whether ex-trainee or not, would have to wait his turn in this pool before moving onto the adult line. It should be noted that more than one senior training or personnel manager thought that the frustrations caused by the youth jobs system contributed substantially to labour turnover in the 16 to 18 years age bracket. The importance of youth seniority was enhanced in 5 of the 7 establishments where there was admitted to be substantial manning of adult jobs by youths because of labour shortages and absenteeism; as adult places are filled from the top of the junior line this could mean very large differences in earnings in relation to seniority on a line.

One consequence of the constraints of the seniority system which operated on promotion lines and the limited role of the training department in placement was that they were very few cases where jobs were reserved for trainees. The most that seemed to be offered to a very limited number of trainees were stock-taking, clerical or laboratory jobs. In establishment 6 however there did appear to be a systematic attempt to cream off by use of tests the best of the intake for stock-taking or clerical jobs. In several of the establishments the only other prospect held out to trainees was that of becoming an apprentice although again the occurrence of this was very infrequent. From the interviews with the training management it was clear that the line management of the various departments which employed junior operatives only rarely expressed any preference for trainees as opposed to direct entries; and given the almost universal manning shortages, few managers were willing to wait for a trainee to mature when they needed a job filling.

The interviews with operatives discussed below, demonstrate how the various constraints in practice affected the career patterns of ex-junior operatives in the works. Experience in the establishment is compared in terms of job location and mobility between jobs and departments and there is some indication of the degree of promotion within the establishments and in particular what this meant in terms of average earnings. There is finally evidence on the educational and training experience of operatives after the training programme and, in the case of direct entrants, since they joined the works.

To facilitate comparison it has been noted that the samples of the direct entrants and ex-trainee operatives were selected year by year in relation to each intake thus matching the length of exposure of each operative in the works. Because, however, the trainees were generally taken on at the age of 15, their average age was rather younger than that of the direct entrants (Table 4). Even so the range of experience in the steel industry and in the establishment was hardly different; but, reflecting the slight age differences, about one quarter of the direct entrants had spent over 5 years on a promotion line compared with 15% of the trainees although this was the only point where there was a significant difference (Table 5). Thus perhaps on average the adult experience of the direct entrant was slightly greater than that of the trainees and this might be possibly reflected in overall experience. In terms of work experience there were no vast differences between ex-trainees and the direct entrants. The emphasis on the mill as a source of employment for both groups is clearly evident from the distribution of operatives by occupation and by department (Tables 6 and 7).

Occupations in the mills (largely connected with speed control type jobs) employed 54% of trainees and 45% of direct entrants; and, outside of the melting shops and warehousing and finishing there were few junior operatives employed. Stockholders and clerks were included in the category "other" but there was no significant difference here between ex-trainees and direct entrants. The only difference between the occupational distribution of two groups is the higher proportion of direct entrants in occupations associated with "finishing". This occupational concentration of operatives in mill-type jobs was underlined in the departmental classification; two out of every three operatives worked in the mills and outside of the melting shops there was little operative employment. But it was clear that while concentration of current jobs in certain departments and occupation classifications was high there had been some dispersion throughout the works since the operatives first joined the establishment; in the case of both direct entrants and ex-trainees the proportion of operatives working in mill-type occupations had been significantly reduced.

The process of de-concentration of ex-junior operative jobs had involved some inter-departmental movement. Approximately one-quarter of the operatives had moved at least once from one department to another in the works, although the mobility differed substantially between various establishments. A significantly larger proportion of the direct entrants had been mobile; although to judge from the distribution of their first departmental location (Table 8) those who moved were originally less concentrated in certain departments than is indicated by the later distribution of operative jobs, and it is possible that their moves were generally in the direction of mills and the melting shop departments where opportunities and rewards for younger people were perhaps greater. Inter-departmental mobility was usually restricted to one or two moves (Table 8).

The information on job mobility in the establishment seems to confirm that, on average, direct entrants were rather more mobile (Table 9) although in both groups about one-quarter of the operatives had over six jobs; but job stability (measured in terms of the length of time in th e present job) seemed to be on average rather greater for direct entrants with a difference almost but not quite significant. This may indicate that direct entrants were further up on the promotion lines, where average job tenure is longer, than the ex-trainee; certainly, significantly, a larger proportion of direct entrants than ex-trainees had been on a promotion line for four or more years although the proportion of total operatives on promotion lines was almost identical at about 90% (Table 10). This is virtually the only indicator that the direct entrants had greater seniority on promotion lines.

Information was sought from the interviewees about the position of operatives on promotion lines and the number of jobs that were on the line; this is summarised in Table 11. But in general, young operatives interviewed demonstrated great ignorance about their promotion prospects on the line and the way in which the particular line developed so the information is to some extent not reliable although attempts were made to check the results by reference to foremen and management in the works. The figures seem to confirm that a large proportion of the young operatives under 18 who were interviewed were working on adult jobs, for with the average length of ladder just over six jobs, approximately two-thirds of junior operatives seemed to be working in jobs less than five jobs below the top of the ladder. This statement must, however, be treated with caution; and there is little point in making detailed comparisons between direct entrants and ex-trainees although the distributions in any case are markedly similar and there is certainly nothing to indicate that trainees had generally higher status on the line than direct entrants. Nor is there any indication from the data that the range of experience on the promotion line in terms of by-turning in jobs further up the line was greater for either group (Table 12). It was clear, however, that absenteeism was such that young operatives in general were called upon a great deal to step up into the jobs above them.

The data on earnings provides a more reliable guide than the promotion line information on both the relative position of trainees and direct entrants in the organisation and the rewards, if any, that might be associated with training (Table 13). There were, however, no significant differences in gross average earnings between the two sets of operatives. Systems of wage payments to young operatives varied from the standardised flat rate age-related payment to a payment related to the particular job that was based on a fraction of the relevant adult rate. In no case was it possible for the organisation to systematically offer a higher rate to ex-trainees than to someone recruited directly from outside the works. In no case was the establishment able to offer anything other than a small "prize" payment usually £3 or so for the passing of the City and Guilds examinations.

Overall therefore the results of the interviewswith operatives confirm the data obtained from the documentation/training personnel interviews. In particular the operation of the almost universal production line system backed by management and unions taken together with age restrictions on entry to a number of departments and manning pressures on line management meant that trainees were generally given no placement advantages over direct entrants, were restricted to various parts of the works and obtained no distinct financial reward or preference.

D. Basic Differences Between Ex-Trainees and Direct Entrants

From the tests carried out there seemed to be few major differences between the groups of ex-trainees and direct entrants in respect of education characteristics, previous experience and education and training response in the works. Table 14 sets out the main educational characteristics of the trainees interviewed and compares these with a similar distribution of direct entrants. It is clear from this that recruitment and selection procedures were not such as to enable establishments to recruit obstensibly "superior" operatives for training in terms of these very basic indicators. Indeed it was evident that a large minority (29%) of all the direct entrants had some kind of further education. It is suspected that this was not infrequently connected with the young workers' attempt to take an apprenticeship and that a number of the direct entrants were young men who gave up apprenticeships. Of the 60 direct entrants who had attended further education courses 25 or 12½% of the total sample had had some kind of further education before joining the company. And of the ex-direct entrants and ex-trainees who had taken some form of further education course after joining the establishment a significantly larger proportion of direct entrants than trainees had undertaken this on their own initiative as opposed to at the initiative of the firm.

In terms of work experience the background of direct entrants and trainees was very different largely reflecting the policy in several of the establishments of taking on 15 year olds only. Table 15 shows that the large majority of ex-trainees first joined the company at age 15. Their experience of other employment therefore ought to have been rather more limited than that of the direct entrant (Table 16); and, reflecting the smaller time spent outside of the industry, the ex-trainees had worked for fewer other firms on average. Mobility between different works in the steel industry was very low in general among the operatives interviewed although in 6 of the 7 establishments there was alternative steel works employment within a dozen miles and in three cases virtually next door. Mobility in and out of the company was not very high. Differences between trainees and direct entrants in relation to movement between works and out of the company were only on the border-line of significance. The differences that could be observed did appear slightly to reflect journey to work circumstances (Table 17). On average about 4 out of 5 operatives interviewed however lived within 15 miles travelling distance of the work, slightly more direct entrants than ex-trainees living farther away from the works. The differences were not significant.

Finally information was obtained about the training and education of direct entry operatives since they joined the company and of ex-trainees since they completed their training programme. Between one-half and two-thirds of the ex-junior operative trainees had had no further education or training after leaving the programme; and the picture was very little different for the ex-direct entry since they joined the establishment. The further education follow-up to the operative training programme was particularly small (Table 18). A similar number and proportion of direct entry had attended technical college courses since joining the establishment although a larger proportion of these than of ex-trainees had done this on their own initiative rather than on the initiative of the company. Of these that attended under the company umbrella very few reached the stage of sitting the City and Guilds Part I examination and the number of passes was negligible.

The numbers of ex-trainees receiving further works based training after the programme was rather larger but still substantially less than half of the operatives interviewed; and if only formal off-the-job training is counted then the proportions are reduced to less than one-third (Table 19). There were no differences with regard to timing and purposes of the works-based training; the average number of training days was between ten and twenty training days (Table 20) and the training was usually regarded by the operative as being aimed at improving existing job efficiency or at training him for the next job up on the promotion ladder (Table 21).

Overall therefore there appeared to be few major differences in the variables examined between ex-trainees and direct entrants.

CONCLUSIONS

The major objective of this chapter was to "develop and test a model for evaluating factors influencing the effectiveness of training in Programmed Training Decisions". It was thought that the use of such a model might enable management to "spot gaps that there might be in the systems support for training". The model adopted was the very basic and simple systems approach suggested by the work of Schein. Within the key sub-systems of Objectives, Setting, Recruitment and Selection, Training Organisation, Placement and Performance, criteria were identified and a mechanism devised for testing these criteria in the context of the junior operative training programmes operating in the works.

It is suggested that the above evidence underlines the value of the approach, by highlighting a number of key areas where systems support for the programmes was failing as follows:

1. The linking of training with management needs through planning is a familiar theme but if the shortfall in numbers of junior operative intake trained is noted then it is certainly not irrelevant to this situation. While establishments were generally meeting the I.S.I.T.B. guidelines for training juniors and possibly the company objectives (if these were to

maximise on the amount of grant obtained), if the works objective was to have a trained progression of junior operatives feeding on to adult lines then this was not being met.

2. With respect to the link between training and recruitment and selection procedures, in almost all of the establishments studied, pressure in terms of meeting manning needs meant that large numbers of operatives were taken on with no real selection even though this proved no solution to chronic manning shortages because of the very large short-term turnover out of intakes. In this situation the training departments were concentrating on recruitment of 15 year olds for a programme because they could obtain "batches" of these which could be easily 'administered'.

3. In respect of placement there was evidence from the questionnaire and checklist interviews that further down the line the link between training and line management was in respect of the programme sometimes critically weak in terms of:

   - Getting acceptance of numbers of places and commitment for junior operatives on a rotational scheme. Hence the large number of drop-outs.
   - Getting adequate supervision and involvement of lower line management and foremen in junior operative rotational training. Many junior operatives for example failed to recognise that they were undertaking training at all.

- The lack of keenness of line management to use junior operative ex-trainees as opposed to direct entries, there being no preferences given to ex-trainees due to manning pressures.
- The lack of development of training as a continuous process once the operative was in the works, a factor underlined by the diminishing link of the trainee with the training department.

4. A further aspect of the limited relationship of junior operative training to needs for trained young adults was seen in the restriction of junior operatives and possibly their subsequent career pattern to certain parts of the works. Thus in respect of placement the question might be asked as to whether the outcome of training was always clearly specifiable in relation to the personal advantage gained and eventual placement. The restriction on occupations and departments into which junior operatives could move and the operation of promotion lines with strict seniority and no allowance for training, a result of management and union agreements, made the position of the ex-trainee extremely difficult and prevented any rewards being associated with training.

The approach therefore focuses critically on the involvement of middle management and unions and their responsibility for training. In all the establishments there were links at the top between unions, line management and trainers by committee but it is clear that acceptance of the training department and its role by senior management might not necessarily be synonomous with the acceptance of training by management further down the line.

This led to the situation where for example the firm could adequately satisfy the I.S.I.T.B. objectives in relation to meeting the broad parameters of the programme as laid down by the Board. Yet it was obvious that in respect of both quantity and quality the programmes were inadequate to meet the total needs of the organisation and could be evaluated as such. This tends to support the point made earlier that Programmed Training may lend itself to "packaged" administration by the training department and that this might be a factor in weakening the link with line management responsibility particularly in the middle of the line.

Thus overall it was clear that the operative training programme made demands on the organisation which it was not always prepared to cope with. The evaluation approach serves to highlight these demands. If undertaken on an individual company basis then there might derive from it pressure on management and unions re their responsibilities to increase the number of junior jobs, to extend them to other departments, to reduce seniority constraints on ex-trainees and to exercise closer supervision of rotational training. Thus by means of identifying the critical interfaces the evaluation might be used in an attempt to more effectively integrate the training programme with other management decision making responsibilities.

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18. Ibid.

19. Bass, Bernard M. and Vaughan, James A. 'Training in Industry'. Tavistock Publications Ltd. 1968. p. 77.

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21. Senior representatives of the B.S.C. training group were questioned about B.S.C. objectives for operative training. Points (a) to (e) are taken from a document handed over at the time of the interview in response to a query as to whether there was a written statement of objectives.

PART IV

CHAPTER VII

SUMMARY AND CONCLUSIONS

SUMMARY

The overall objective of this thesis was to explore the relevance of cost-benefit analysis to evaluation of training. There were, however, three key phrases in the title to the research which in the preface it was argued merited further exploration. The first was 'development appraisal', the second, 'from the management viewpoint', and the third, 'in-company training'.

A preliminary appraisal of the cost benefit concept revealed that it had a rather different context in the evaluation of company expenditure. In recognition of this a different expression 'investment appraisal of training' was proposed. This concept was shown to have relevance at the Organisation and Ultimate Levels of evaluation (levels 4 and 5) as defined by Hamblin. The rigorous methodology demanded and the need for 'hard' data was, however, seen to place limits on the scope for 'investment appraisals'; these limits have been well documented. In a great many cases 'other factors' were seen likely to intervene to effect the training outcome in performance terms and therefore inhibited 'controlled experiment'. Considered another way, however, these 'other factors' were factors upon which a successful outcome to training at the organisational level depended. It was recognised therefore that on occasions these may have to be influenced for training to be successful in organisational terms. This, however, would almost certainly emasculate the 'other things being equal' condition needed for 'scientific evaluation'. Moreover most of these 'other factors' were outside the scope of influence or responsibility of the trainer in the organisation.

It was nevertheless proposed that these apparent constraints on investment appraisal evaluation be treated as opportunities within a 'new' framework the major objective behind the construct of which was to consider evaluation from the 'management viewpoint'. Thus a twin role was allotted for evaluation: the conventional one of feedback to the trainer on whether objectives were met - in investment appraisal terms these objectives being set out where possible in quantifiable terms; and second, of identification of the key tasks within the supportive system relevant to a particular training programme, needed to ensure the successful meeting of objectives.

To test this role a dichotomy was proposed between Programmed and Non-Programmed decisions in training: within this dichotomy a classification of various types of training was suggested. The distinguishing factors in the dichotomy were related to time and the uniqueness of the situation. Non-Programmed training decisions arose out of organisational or individual problems and were likely to be 'once-off' and unique: Programmed training decisions on the other hand were likely to be regularly repeated representing a training commitment of the organisation. It was suggested that the major implication of this dichotomy for investment appraisal evaluation lay in the importance of the pre-training appraisal in the non-programmed decision situation the utility of post-training appraisal being largely obviated from the management decision making viewpoint by the uniqueness of the event.

The case study in Part II was the vehicle for developing and testing a methodology based on the pre-training investment appraisal concept. Using a dynamic interpretation of Warren's training sub-systems approach it was found possible to define a quantifiable training objective as a measure of the 'potential' contribution of training to the solution of a production problem and to identify the 'systems' support necessary for the potential for a successful training contribution to be maximised. A suitable methodology was developed based on a problem solving paradigm. Its successful implementation when the criteria is the relationship of training to a quantitative measure of success was seen to depend upon three factors:

(a) Ability to isolate areas within the production operations establishment which are highly dependent upon individual or group (operated) performance.

(b) That these coincidentally were areas where a problem (defined in terms of deviation from standard) existed and/or there was opportunity for improvement.

(c) That data was available in these situations sufficient to enable the establishment of a quantitative potential for improvement by training.

The case study demonstrated a situation where all three conditions seemed to be met in respect of a 'group' operative training situation. Moreover, post-hoc evaluation carried out over a period after completion of the training was seen to point towards a successful outcome in terms of pay-off. It was argued however, that this was not the most important factor in obtaining management support, the major attribute of the approach in this respect being the way in which the analysis involved management and supervision. Thus even before the formal presentation of the pre-training investment appraisal, management were 'cold' on the importance of the contribution that training might make.

It is recognised that the potential for full realisation of conditions (a), (b) and (c) above will not always exist. Nevertheless it can be argued that this does not obviate the use of the methodology in reactively responding to situations brought to the attention of the trainer by management or proactively seeking them out. It also does not render irrelevant the identification of a quantitative potential for improvement in terms of the removal of the problem even when it is recognised by management and/or trainer that behaviour change brought about by training has a limited contribution to make in relation to other factors involved. For example in the case study described in Part II it was evident that there were other problem situations identified in the initial analysis which could be influenced by operator training even though in these instances technical and other factors were judged to be equally if not more important than training. It is also not necessary that the evaluation methodology should relate to operator training. It was evident that in respect of other problem situations defined in the case study there were several which might have led on, after further analysis, into craft or supervisory training situations. It is therefore possible to use the methodology in identifying training needs relevant to problem situations in respect of a variety of grades of personnel. Nevertheless it must be recognised that the further that the analysis is moved from the production interface the more difficult it will be to define a quantitative objective and therefore the more difficult to conduct a true 'investment appraisal'.

The Programmed Training situation described in Part III began by recognising that it would be difficult to derive quantitative training objectives in most situations embraced by this category because of the likely mix of objectives; individual, societal as well as organisational. Moreover such programmes are frequently not directly job or problem related. It was nevertheless argued that, estimating the potential return from an investment in training, two factors were of importance: the life over which the investment could be expected to yield a return; and any associated increase in productivity. In the case study situation concerning the evaluation of an induction and initial training programme for junior operatives in the steel industry it was evident that the life of the investment could be important in view of the high early drop out rates for new recruits. This was shown to be the case although training itself was also demonstrated to have some effect on the rate of wastage. In the absence of the availability of any direct measure of productivity emphasis was placed on evaluating key factors within the broad organisation 'systems dependency' of the programme which would be likely to influence its effectiveness. This approach enabled the identification of a number of factors outside of the quality of the programme itself which were likely to have a fundamental effect on whether the programme achieved its overall objectives. The identification of such factors was argued to be particularly worthwhile in circumstances where the programme was to be repeated regularly over a number of years.

CONCLUSION AND SOME PRACTICAL DEVELOPMENTS

It was argued in Chapter I that it was perhaps undesirable to accept evaluation as a closed loop system with the influence of 'other factors' at the organisation level operating solely as constraints that might be usefully identified. It has been demonstrated in Parts II and III of this thesis that if the definition of the scope of evaluation is broadened to embrace 'systems dependency' then it might play a useful role in increasing the involvement of management in training matters. This in itself means that the strict 'scientific experimental' approach to the use of investment appraisal and evaluation becomes obsolete. Out of its obselescence, however, arises an opportunity to use evaluation as a means to the integration of trainer and management activity. Investment appraisal has been seen to lend itself conceptually to this objective in pointing the direction of the evaluation in both Parts II and III without the restrictions resulting from its application in the very narrow sense. It must, however, be recognised that that approach is a complement to adequate evaluations at the Reaction, Learning and Behaviour Levels and in no way substitutes for these. It is perhaps at these levels also that more scientific experimental methods may be practically possible.

The research has also demonstrated that it is possible and perhaps frequently proper to undertake evaluations using the investment appraisal concept keeping the focus on training without it turning completely into a broad 'management of change' exercise. In the problem solving approach demonstrated in Part II this became possible by the trainer undertaking an initial appraisal aimed at identifying problem areas relating to human behaviour which were believed to be capable of being substantially influenced by training. Abandonment of this 'training as a means to behaviour change' focus could turn the analysis into a general problem solving exercise of the 'management of change' kind. It has, however, been shown elsewhere[1] that it is possible to introduce a wider focus of the analysis in a company and yet still keep a training focus. Thus instead of concentrating on one problem it is possible for the training adviser to undertake an audit which analyses out all deviations from standard (problems) in an establishment and then seeks to rank these both in terms of importance of benefits to the organisation and degree of direct influence of human behaviour on the problem while at the same time classifying supportive conditions for management. Thus in practical terms the development of the investment appraisal/problem seeking approach in this respect might be described as follows:

Objective - to identify all training needs relevant to solution of major problems in production operating system.

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Problems identified and defined as deviation from standard

↓

Problems measured quantitatively where possible → Each problem cause analysed

↓

For each cause analysed immediate human and other factors weighted

↓

Factors analysed in terms of performance needs from operators, supervisors, managers, others

↓

Division of performance needs into direct training needs and other changes in behaviour/systems/procedures needed (indirect training needs)

↓

Developed into programmes and courses of action aimed at solving all problems

This practical approach has been used as a basis for the development of training advisor programmes with the Iron and Steel Industry Training Board and the Furniture and Timber Industry Training Board. A copy of the simple guide developed for this purpose is contained in Appendix 1 to this chapter.

In the Programmed Training exercise in Part III the legitimate focus of the evaluation of the programme in terms of both the analysis of wastage and systems interface exercise was training;

however, an attempt was made to draw out the relevance of the programme to a number of other management decisions. Such an exercise can be represented as an analysis of the constraints operating on a particular determined course of management action and seems to be an area of legitimate activity for the trainer although it is unlikely that the motivation to undertake such evaluations in a company situation will always come directly from management. Such exercises may indeed be long and costly. In practice, however, it has been found that the approach can be a useful pre-training tool for the trainer particularly at the management level and where a major costly programme is to be attempted. It has, for example, been used as part of a programme for training officers referred to above by D.U.B.S. for the F.T.I.T.B. which itself was based on the use of the problem solving/investment appraisal approach.[2] In this exercise a model was first constructed of the training officers role in the organisation using inputs from the Board and training officers. Using this model a hypothesis was constructed about the direction of behaviour change that the Board was seeking to enforce as a result of the programme. Pre-course data was then collected from participants on the major constraints operating on the personnel involved in the course in relation to those development parts of the model. The model and the perceptual constraints identified (supportive factors) were then discussed in a pre-course module with participants and formed a vehicle both for the modification of the programme and for further dialogue with the sponsoring organisation concerning their assistance in reducing constraints.

Finally, the keynote of the approach in a company situation is either the involvement of middle management in the exercise as in the Non-Programmed training situation or the clear demonstration of their role in ensuring that the programme meets its objectives as in the Programmed training situation. This point can be placed in the context of the overall impact that the Industrial Training Boards have made in elevating the importance of training in the organisation generally through the influence of I.T.B. policy documents and their influence on top management in the company. The critical point recognised in practice is whether on-the-job training will be implemented by line management when the focus of management attention is frequently directly on current operations and plant performance. This is a well documented line management attitude problem. The logic of the approach outlined in Parts II and III, although it was demonstrably more direct in the Part II problem solving model is that it can be one instrument to help bring about necessary attitude change.

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PART II CHAPTER III

A P P E N D I X 1

Results of analysis of shift records on stoppage time in the mill.

October/September 1970/71

TABLE 1

COILED ROD — Time Reported Lost on Shift Reports Through Unscheduled Stoppages - 21 Rolling Weeks

Area/Cause	Time lost		Percent of total unscheduled stoppage time	Budgeted time loss		Variance from budget	
	hours	minutes		hours	minutes	hours	minutes
Stand cobbles	395	47	36.2	350	19	-45	28
Mechanical	284	46	26.0	116	18	-168	28
Electrical	65	52	5.9	50	1	-15	51
Bad steel	60	38	5.5	33	18	-27	20
Conveyors	58	40	5.3	25	48	-32	52
Cooling bed apron	34	21	3.1	8	45	-25	36
Repeater cobbles	33	31	3.0	28	36	-4	55
Furnace	24	26	2.2	11	38	-12	48
Materials and Bent bar	23	54	1.6	3	50	-20	4
Reels	18	12	1.5	37	40	+19	28
Rotary shears	17	36	1.5	19	4	+1	28
Rod switches	10	40	0.9	5	56	-4	44
Hook carrier	4	19	0.3	0	0	-4	19
Q Bar shear	-	26	0	0	0	-	26
Miscellaneous	56	50	5.2	53	11	3	39
Total unscheduled stoppages	1089	58	100.0	744	24	345	34

TABLE 2

STRAIGHT BAR — Time Reported Lost on Shift Reports Through Unscheduled Stoppages – 25 rolling weeks

Area/Cause	Time lost		Percent of total unscheduled stoppage time	Budgeted time loss		Variance from budget	
	hours	minutes		hours	minutes	hours	minutes
Stand cobbles	388	51	30.5	366	34	-22	17
Mechanical	325	40	25.5	168	2	-157	38
Electrical	109	7	8.5	69	32	-39	35
Cooling bed apron	87	38	6.8	17	33	-70	5
Furnance and materials	51	17	4.5	13	16	-44	1
Repeater cobbles	44	19	3.5	31	34	-12	45
Conveyors	44	10	3.5	34	16	-9	54
Bad steels	38	47	3.0	37	29	-1	18
Reels	25	13	2.0	39	5	+13	52
Rotary shears	20	39	1.6	23	25	+2	46
Material and Bent bars	20	10	1.6	2	39	-17	31
Rod switches	11	10	0.9	9	34	-1	36
Hook carrier	1	37	0.2	0	0	-1	37
Q bar shear	-	45	0.1	0	0	-	45
Miscellaneous	99	20	7.8	88	27	-10	53
Total unscheduled stoppages	1274	43	100.0	901	26	-373	-17

PART II CHAPTER III

A P P E N D I X 2

Checklist used to identify major problem areas and operative 'contribution' to problem.

Used with Mill Manager, two Assistant Managers, Mill Engineer, Mill Foreman, Rollers (three).

APPENDIX 2

CHECKLIST USED FOR PROBLEM ANALYSIS

Ask respondent to identify:

(i) Identify 'causes' of problems under each heading.

(ii) Identify which, if any, are related to operator performance deficiencies.

(iii) Ask them to give a percentage weighting in terms of operator performance contribution to the problem.

HEADINGS

Rotary Shears	Furnace
Repeater Cobbles	Mechanical
Stand Cobbles	Reels
Q Bar Shear	Conveyors
Bad Steel	Cooling Bed Apron
Rod Switches	Material and Bent Bar
Hook Carrier	Electrical

Miscellaneous (ask to specify)

PART II CHAPTER III

A P P E N D I X 3

Summary of results of interviews with mill manager, assistant manager, engineers, shift managers and foreman, to isolate causes of unscheduled stoppages in various areas of the plant.

APPENDIX 3

Summary of results of interviews with mill manager, assistant manager, guide engineer and mill foreman, to isolate the major causes of unscheduled stoppages in various areas of the plant

The questions were asked and the answers are summarised under the headings set out in Appendix 2.

Rotary Shears

Most of the stoppages occur because of electrical or mechanical faults. These include:

- the shears are cutting to intermittent length and this causes cobbles.
- the shear blades are badly set or slack or worn and need adjusting.
- the deflector solenoid valves are sticking.
- the speed of the motor is wrong. This could relate to poor operator performance in speed setting or careless time setting but this is rare.

All were agreed that operator inefficiency probably accounted for less than 10 per cent of stoppages under this heading.

Bad Steel

All were agreed thatthis was largely outside the operative's responsibility. (Less than 5 per cent of time lost could be attributed to operative error.)

It was agreed that it was difficult for the operator feeding the bar into the pulpit to see all of the bar and therefore detect bad steel. It was recognised that stoppages under this heading could perhaps be reduced by the appointment of a billet inspect or.

There is, however, a spark tester who acts in the capacity of a billet inspector when there is bar rolling. He is not there for rod rolling. It is therefore of some interest to note in detail (in text) that when coiled rod was being rolled unscheduled stoppages due to bad steel were double those that occurred in the rather longer period when straight bar was being rolled.

Reels

Stoppages here relate mainly to mechanical and electrical faults. These are associated with the rod switches, strippers and the reels themselves. Problems could be caused directly by the reel operator not setting the speeds properly or not watching the switches properly to see that the rod is going into the right pipe. It was felt that there was also scope for limiting mechanical and electrical problems by the operator taking greater notice.

Opinions differed but it was felt that between 15 and 35 per cent of down time under this heading could be caused by inadequate operator performance.

Repeater Cobbles

It was felt that these almost entirely were the fault of the production crew, the roller, the finisher, the rougher (or the main pulpit operator).

- the major factor in causing these cobbles if bad balance in the mill, e.g., uneven balance between one and three strands. The roller's job is to see that the balance is correct, or the rougher may do it under the roller's guidance.
- the twisters may be set too tight or too slack
- there is wrong cross on stand 13 on the rolls
- the repeater is out of line
- the roll height is wrong
- the delivery and entry guides are not perfectly on the hole

- the section may be bucking the groove

<u>Rod Switches</u>

Faults here are mainly mechanical and electrical, such as:

- trailing ends
- end jamming in the conveyor train
- out of sequence
- chains jumping sprockets

<u>Stand Cobbles</u>

It was agreed that down time under this heading was almost wholly to be accounted for by poor operative performance.

Cobbles can occur because of all the reasons listed above under repeater cobbles, but also because of:

- bad back ends relating to poor operative performance in the main pulpit, allowing the back end to lash round the repeater.

<u>Cooling Bed Apron</u>

Stoppages are related to mechanical and electrical faults.

- the photo cell bar/bank timing is inefficient
- the paddles are out of line

<u>Hook Carrier</u>

There are few problems and what there are are mainly mechanical.

<u>Q Bar Shear</u>

Stoppages here are mainly electrical or mechanical and are not significant.

<u>Furnace</u>

Stoppages may occur because there are:

- badly-shaped bars
- the bars roll into a pile in cases where the operator has been charging over- or under-length bars

- the bars stick together if there is trouble in the mill and some delays. This occurs particularly with certain kinds of high carbon steels.

In a number of cases the operator is responsible for the stoppage for he may push the bars wrongly or he can cause bars to stick together by not adjusting the temperature of the furnace while there is down time in the mill.

Mechanical and Electrical

It was suggested that talks should be held with the mill engineer about this.

PART II CHAPTER III

A P P E N D I X 4

Questionnaires used in
Operative Enquiry

APPENDIX 4 - QUESTIONNAIRE A

Questionnaire Checklist for Rod Mill Operatives and Shift Managers

A. Checklist of questions to go with exhibits. Rod Mill

Exhibit 1

1. Could you say all you can about this section?

A. It is an oval which has cobbled.

2. Where did it occur?

A. It cobbled at stand 15.

3. Why did the cobble occur?

A. Because it turned down at 13, finned, went through the oval pass at 14 and cobbled at 15.

IF NOT MENTIONED EARLIER

4. What reasons might there have been for it turning down at stand 13?

A. The entry guide was ineffective in some way at stand 13.

5. What course of action should be taken in this case?

A. Check the entry guides to see if the section was leaning - most probably change the entry guide at 13.

6. Could this cobble have been prevented?

A. Yes, if the entry guides had been checked it might have been caught before it turned down (98% of the time).

7. Whose responsibility was it to take action on this? (once it had happened)

A. The rougher's.

Exhibit 2

8. Could you say all you can about this section?

A. It is a cobble (front end)

9. Where did it occur?

A. It cobbled at stand 7.

10. Why did it occur?

A. The section has gone over the collar of the pass and has formed a 'banana' end. It is this banana end that has caused the cobble.

11. What has caused the section to be off the hole?

A. All three guides (the complete box) could have been off the hole. OR one guide could have been off the hole because it has been shimmed up incorrectly and the other two guides could have been alright.

12. Does this happen often?

A.

IF RELEVANT

13. Why should it be rare?

A. Because the stand should be set up correctly. And once the entry guide is on the pass in stand 6 it won't move if the box is clamped up tightly and the entry guide is shimmed out correctly.

14. What could have caused the section to move off the hole?

A. A slight buckle between stands 5 and 6 when they were just starting up could have moved the guide off the hole. But it would have been shimmed incorrectly.

15. What course of action should be taken?

A. First - check the guide box to see if correct and all 3 guides are on. If not move guide box to correct position. Then check to see if two are on and one is off - if so shim the guide back up correctly.

16. Whose responsibility is it to take action on this?

A. The rougher.

17. Given that the pass had been set up incorrectly could this cobble have been prevented?

A. Yes.

18. How?

A. The bad end coming out of stand 6 should have been noticed and this would have led to a check along and in particular of the entry guide at stand 6. It would have been found that this was off the hole and remedial action could have been taken.

Exhibit 3

19. Could you say all you can about this section?

A. It is a cobble.

20. Where did it occur?

A. It occurred at stand 18.

21. Why did it occur?

A. It occurred because the entry guide was off the hole.

22. Can you tell how much off the hole?

A. $\frac{1}{4}$ to $\frac{1}{3}$ of a pass off the hole.

23. How could this happen (the guide being off the hole)?

A. The guide box was not put on the hole correctly - all three guides off the hole. Or someone moved the Allen screws or slackened them off - causing one guide to move off-centre.

24. Why is it in the finishing cage that if you find one guide off all three are likely to be off?

A. Because the guides are not shimmed in the finishing cage. They are a cartridge type of guide and fit into a guide pocket from which they cannon move. They are centred on a jig in the guide shop.

25. How would you remove the front end of the cobble in the finishing cage?

A. Slacken Allen screw off one side and release if possible.

26. If you had to remove a cobble by slackening the screws how would you do it?

A. You would slacken the screws on one side only. If you cannot remove the cobble by doing this then you must go to the guide shops and get the guide recentred up.

27. Whose responsibility is it to take action on this?

A. The finisher.

Exhibit 4

28. Could you say all you can about this section?

A. This is a cobble (not the front end).

29. Where did it occur?

A. It cobbled in the entry of stand 19 or stand 21 (in the finishing cage).

30. Why did it occur?

A. It is bad steel.

31. Could this have been prevented?

A. Yes, by noting the billet before it went into the furnace.

32. Which part of the bar is this?

A. The middle of the bar - the ends have been burned off.

Exhibit 5

33. Could you say all you can about this section?

A. It is a cobble (a twist cobble, front end of diamond).

34. On taking out this cobble could you have been able to tell whether it was over or under twist?

A. Yes.

35. How?

A. By the way the section was lying. (Ask for demonstration)

36. Where did it occur?

A. It occurred at stand 18 (it is a stand 18 diamond).

37. What might have been the cause of this?

A. The spinners were set too wide apart and were in need of adjustment.
There may have been a loose delivery guide.
There may have been a seized up spinner.

38. Suppose it was a seized up spinner could the cobble have been prevented? - Before it happened

A. Yes.

39. How?

A. It sometimes happens that one or two bars go through before a cobble occurs and the spinner can be seen to be seizing up. The finisher, walking along the cage, could see that the spinner is not working properly.

40. If you thought that the spinner was not working properly how would you check to see if that was the case?

A. I would try it with a piece of wood to see if I could turn it. If it can be turned it is not seized up but only needs adjusting.

41. If the spinner was not seized up then what course of action would be taken in relation to possible other causes?

A. Either tighten the delivery guide by knocking in a wedge if it has worked loose or adjust the spinner unit. There is an adjustment to open and close the spinners.

42. Could this cobble have been prevented?

A. In the case of the loose delivery guide and the spinners being set too wide apart then this ought to have been noticed before it gave rise to a cobble.

43. Whose responsibility is it to take action on this?

A. It is the finisher's responsibility.

Exhibit 6

44. Could you say all you can about this section?

A. It is a cobble (twist - oval).

45. Where did it occur?

A. It occurred at stand 16.

46. What were the possible causes of this cobble?

A. (a) a loose, badly worn delivery guide
(b) the spinner not being adjusted correctly
(c) the wedge on the preset twister guide worked loose (this would give under twist).

47. Why if small ovals are being rolled is the cobble unlikely to have been caused by a badly adjusted spinner?

A. Because the spinners are not often used on ovals at stand 16 as the section will twist up without using the spinners on an oval. Therefore the preset twister guide is used.

48. When would the spinners be used at stand 16?

A. When a big oval (ten millimeters upwards) is being rolled and always when rolling any diamond ending up as small squares (from eight millimeters to six millimeters).

49. Why are the spinners used on the heavier sections?

A. In order to get the necessary amount of twist the guide would have to be ground out to more than 35 degrees. It is not possible to do this in this case. Therefore the spinners are used to give the extra twist.

50. What course of action should be taken in what order?

A. Tighten delivery guide or change worn guide.

51. Could this have been prevented?

A. Yes.

52. How - if so?

A. By making sure that the wedge was kept tight.

53. Whose responsibility was it to take action on this?

A. It is the finisher's.

Exhibit 7

54. Could you say all you can about this section?

A. It is a cobble (front end).

55. Where did it occur?

A. Stand 11 entry.

56. Why did the cobble occur?

A. Because the oval is much too dumpy.

57. What has been the cause of the trouble which has led to the cobble?

A. It was a very badly worn pass at stand 10.

58. In relation to the cobble what kind of action might be taken?

A. To pull down at stand 10.
To change stand 10.

IF BOTH POINTS ARE MADE

59. Which course of action would appear to be the most appropriate from the section?

A. To change stand 10 for the pass is very badly worn.

60. Why and where did this occur?

A. It occurred because the oval was turning down at stand 7 or stand 9 and was subsequently rolled in.

61. Is it possible to know from the section whether it was turning down at stand 7 or stand 9?

A. Yes, it has come from stand 7. If it had come from stand 9 then the lap would have been more in the centre of the section.

62. What course of action would be taken in respect of the lap?

A. The entry guides should be checked at stands 7 and 9.

63. Could the cobble have been prevented?

A. Yes, if it had been noticed that the oval was much too dumpy - the pass should never be allowed to get like this.

64. Could the lap have been noticed and prevented?

A. Yes, if the entry guides along the roughing had been watched to see if none were leaning. The check is made by looking at the black line on the top of every square that runs through the mill.

65. Is it always necessary to take immediate action when the black line goes slightly off the top?

A. No. An operative can let it go so far before it turns down.

66. Whose responsibility was it to take action in the cases mentioned above?

A. It was the rougher's responsibility to detect the bar coming out of stand 7 and to avoid the lap.
It was the roller's responsibility to notice that the oval was much too dumpy.

Exhibit 8

67. Could you say all you can about this section?

A. It is a cobble (middle or back end).

68. Where did it occur?

A. Between 16 and 17 stands.

69. Why did it occur?

A. It occurred because the section bucked the groove in number 3 repeater.

70. What are the particular circumstances that have led to this?

A. This is a speed cobble and could be caused:-
(a) by the loops not being balanced correctly by the speed operator
or (b) by lack of balance in the mill.

71. If the cobble occurred because of bad balance in the mill what course of action might be taken?

A. The need is to get the three loops running together. This is done by draughting at stands 14, 15 or 13. One should also check for pull in stands 1 to 13.

72. How does this drafting take place?

A. The two outside strands (1 and 3) are drafted - if these are correct then number 2 strand should be okay.

73. If strands 1 and 3 are not running correctly what should be done?

A. Check for tension. Draft. And then the passes at stands 14, 15 or 16 should be stoned.

74. What is being done when you are stoning the pass?

A. The depth of the pass is being altered to match the other two passes. Thus more stock is being allowed in which is pushing more into number 3 repeater.

75. Suppose that number 2 strand was running out at number 3 repeater, what could be done?

A. Stone strand number 2 pass at stand 16 and then watch to see it doesn't take too much so that all three strands are running together.

76. Whose responsibility was it to take action on this?

A. It could be the speed operator's fault in losing concentration. If it was the mill balance then it is the roller's job to keep the mill balanced and to take any necessary action.

Exhibit 9

77. Could you say all you can about this section?

A.

78. Where did it occur?

A. It turned down at stand 7 and knocked off the delivery guide. It did not reach stand 8.

79. Why did it occur?

A. Because it is a turned down square.

80. What were the circumstances under which this happened?

A. The entry guide collapsed.

81. What course of action might have been taken?

A. Change the entry guide at stand 7.

82. Could this have been prevented?

A. Yes by keeping a check in the mill along all the square stands.

83. Whose responsibility was it to take action on this?

A. The rougher's.

84. Could you say all you can about this section?

A. Not perfect rod.
Has water mark.

85. What does the water mark mean?

A. The water is off the pass.

86. Can you tell where?

APPENDIX 4 - QUESTIONNAIRE B

Questionnaire Checklist for Rod Mill Operatives and Shift Managers

B. 1. From your experience what do you think are the main areas where production is lost in the mill?

SHOW CARD

2. Please place in order of seriousness of losses through time lost.

3. In relation to the four most important areas where time is lost are there are particularly common causes why these losses occur? (PROMPT)

FOR OPERATIVES ONLY

4. Is there any area where you feel that your knowledge and skills needed for your job could be improved?

5. Do you feel that you have sufficient knowledge and skill to do the job above you on the ladder confidently?

6. If not what are the parts of the job or areas of knowledge and skill where you feel less confident?

7. Do you feel that your general knowledge (practical and theoretical) of how the mill operates is enough for your purposes or would you wish to know more about certain things? (other jobs, technical factors, production data) (PROMPT - EXPLORE LEADS)

8. If YES - About which things would you like to know and what would you like to know about them?

FOR SHIFT MANAGERS ONLY

9. Do you feel that your knowledge of the operation mill is, in the theoretical and practical sense, adequate for you to do your job competently or are there areas where you feel that there is room for improvement?

10. Do you feel that you know enough about the job and responsibilities of the operatives in the mill (especially the top operatives) to do your job competently or are there areas where you require further knowledge?

11. Could you list as many causes of repeater cobbles as you can think of?

    (a) bad balance in the mill

    (b) the twister set too tight or slack at stand 14

    (c) the wrong cross at stand 13 and 15 on the rolls (and when rolling bar at stand 11)

    (d) the roll heights are wrong - stands 13, 14 or 15

    (e) the guides at stands 11, and 13 to 16 are not set correctly on the hole

    (f) on heavy bar sections the repeater inserts may need replacing

    (g) other reasons

12. Which of these are the <u>main</u> causes of repeater cobbles?

SHOW CARD

Would you please place in order of importance.

13. How, when setting up a stand, do you ascertain that the rolls are at the correct height.

A. Get the correct hickey block from the guide shop and the appropriate packing piece for that particular stand. (ASK FOR DESCRIPTION OF USE)

OR Point delivery guide up to roll and adjust roll to delivery guide.

14. How often would you take test pieces off the coil that is being rolled?

A. Approximately every 15 minutes.

15. What temperature is the ideal temperature to roll at?

A. 1,150 degrees centigrade.

16. What temperature would you roll rimmer at?

A. 1,110 degrees centigrade.

17. Why do you roll it at a low temperature?

A. To make it stiffer because it is a softer steel.

18. How do you know when the twister guides are operating correctly?

A. Both rolls should be turning together and the bar can be examined to see if it is going upright into the next stand.

19. If the guide box was knocked off the delivery side of the stand what might be the causes? (What causes would you look for?)

(i) loose delivery guide

(ii) entry guide off the hole

(iii) delivery guide off the hole (badly set)

(iv) roll height wrong

(v) bad section

(vi) seized twisters

(vii) bad front end on billet

(viii) other reasons

20. If the guide was knocked off as described above what action would you take in what order?

(i) check roll and section height

(ii) check the entry guide

(iii) when putting the delivery guide box on check the twisters to see whether they are seized or whether the ball race has gone

(iv) make sure when replacing guide that it is clean (no scale) and seated correctly

(v) check to see whether the allen screw is loose

(vi) check entry guide of next stand

<u>IF NOT MENTIONED</u>

21. Why might you also check the entry guide of next stand?

A. In case the section had buckled back.

22. If the guide box was knocked off again immediately after starting what else might you do?

A. Check rest bar level
Check rolls level

23. If a small fin is being produced on a section how can this be eliminated without stopping the mill?

A. By squeezing up the earlier stands or by opening up the parting at the stand where the finning is occurring.

24. In what circumstances would you not squeeze up (pull down) the earlier stands in the case described below?

A. Where the earlier stands were also finning or full.

25. How do you know when a bar enters the stand whether there is pull or push, i.e. the speeds are right?

A. If when the front end enters the stand the needle falls on the preceding stand ammeter then there is pull. If it rises there is push.

26. Can this be done for all stands?

A. No. Certain stands are tied (on drive) and therefore the roller must use drafting to get the correct balance.

27. Which are the tied stands on the mill?

A. One-two, six-seven, eight-nine, sixteen-twenty-one.

<u>IF NOT MENTIONED ABOVE</u>

28. Are there any other stands where other action might have to be taken to ascertain whether the speeds are right?

A. Yes. At stands 10 to 13.

WHY?

A. Because the ammeter needle rises and falls too quickly to get an accurate idea. You therefore use a bar to check for tension.

29. A particularly large fin can occur when the oval turns down in the square pass. How can you detect this?

A. (a) look at the issuing section on the roll pass

(b) look for the black line on top of the square or round

(c) wood the section (should not be necessary at all)

30. What does a two-sided fin indicate?

A. The pass is over-full owing to being squeezed up too much or because too much stock is coming in from the passes in front.

31. It is a rule that when the rolls have been set to the correct height the top and bottom roll passes are lined up correctly, one exactly above the other. When can this rule be broken?

A. On the squares immediately before the repeaters where the rolls are deliberately crossed to assist the twisting around the repeaters.

32. In this case in which way would you cross the rolls at stand 11 on bar, and stands 13 and 15 on other gauges?

A. The top roll wants to be slightly across to the drive side (in some cases). The bottom roll needs to be pulled to the work side.

33. How can you tell which way the rolls are crossed when you are rolling bar and before you get a test piece?

A. Watch the bar leaving stand 15 for the black line and see which way the bar is apinning.

34. Which way should the bar be spinning if you are rolling rod out of stands 13 and 15?

A. Anti-clockwise or to the work side.

35. If the bar is spinning to the drive side (clockwise) which way would you adjust the roll?

A. Move the bottom roll to the work side.

36. If a raised up bump appears at regular intervals on the bar what does this mean?

A. A piece is out of the rolls. (You have a gimbled pass)

37. How can this be checked?

A. Take the diameter of the rolls from which the piece came and multiply it by 3. If the distance between the bumps is equal to this then there is a piece out of the roll.

38. If you were rolling 6mm gauge out of stand 21 and you noticed a small indentation in the section what might be the cause?

A. The roller twister is scrapped up <u>or</u> there is a scrapped up roller entry guide.

39. How would you know by looking at the section whether the cause was a scrapped up roller twister or a scrapped up roller entry guide?

A. If the identation on the section was about every 8-9 inches on the side of the section then it would be the twister guide.
If the indentation was 5-7 inches apart then it would be a scrapped up entry guide.

40. What are likely to be the causes of:-

(i) a scrapped up twister guide

(ii) a scrapped up entry guide?

41. A finished section will sometimes show a knurled effect line mark along its length. (EXPLAIN AND SHOW EXAMPLE) What causes this?

A. This can be caused by the water being off the pass on the top or bottom roll at some preceding round, square or oval or off the finishing pass itself.

42. What is the best method of checking that the roll height is set correctly?

A. Set the rolls to the delivery guides and check so that when you look centrally through the roll entry guide as much of the top roll as of the bottom roll can be seen.

43. How do you eliminate pull at stands 6 and 7 or 8 and 9?

A. Squeeze them down.

44. Before you pull down at the stands what would you first do?

A. Check the section to see if it is not finning already.

45. How do you eliminate buckle at stands 6 and 7 or 8 and 9?

A. Open them up.

46. In what circumstances would you not open them up?

A. If the section is the correct height at stand 6 but too wide then stands 1 to 5 would have to be pulled down.

47. In the finishing cage how can you eliminate pull between stands 16 and 17, 18 and 19, and 20 and 21?

A. Pull down the oval and/or round.

48. Before you pulled down the oval or round what course of action might you first take?

A. Check the section with the wood to see how much you need to pull it down.

49. What factors govern the balance of the loops in the repeaters?

A. Strands 1 and 3 balance at 13, 14, 15 and 16 (draughting at 13-16)
State of tension between stands 1 to 13
The temperature along the length of the billet the pass wear on a particular strand
Other factors.

50. What do you do if the loops of strand 2 are running out badly on the back ends?

A. Check if the tension is down (there is no pull) at the roughing.
Check for uniform temperature along the length of the billet.

51. If strand 2 is <u>out</u> in numbers 1 and 2 repeaters and <u>in</u> in No. 3 repeater what do you do?

A. Stone the number 2 strand at stand 14 until it balances the other two strands in 1 and 2 repeaters. This will also put strand 2 right in No. 3 repeater.

52. If you stone the strand as above what effect does this have?

A. It reduces the direct draught on stands 14 and 15. Therefore, more stock is passed into No. 3 repeater and the direct draught at stand 16 is increased which throws the loop out in this repeater.

53. What could be done if the No. 2 strand is running out in all repeaters?

A. (i) Stone strands 1 and 3 at stands 12 and 13, which gives more stock around the repeaters, thus throwing strands 1 and 3 out. (Jack never does)

OR (ii) Stone No. 2 strand out at 14, 15 and 16 and get No. 2 in.

54. If strand 2 is running in on all three repeaters what ought to be done?

A. (i) The easiest way is to stone stands 12 and 13 on strand 2 to let more stock into the repeater.

(ii) Another way is to stone stands 14 and 15 on strands 1 and 3. This will also help by bringing these loops in towards the bulk head.

55. If you had a strand No. 3 that was laying out in Nos. 2 and 3 repeaters what would you do?

A. Wood the section out of stand 15 and thus ascertain whether to pull strand 1 down or open strand 3 up.

56. In general what is it necessary to do to ensure continuous balance in the repeaters?

A. Keep the mill in balance by wooding regularly stands 1-3, 6-9 and 10-13 and draughting to keep them equal strand for strand.

57. Why do we open up stand 1 when we come on rimmer?
And why do we pull it down on other carbons?

A. Stand 1 is opened up on rimmer to let more stock through the mill because rimmer is very soft and doesn't spread like other carbons.

58. Which kind of pass do you get the biggest reduction on?
An oval <u>or</u> a square?

A. An oval.

59. Finally, I believe it is part of the top operatives job (roller, finisher, rougher) to carry out periodic checks in the mill. Could you tell me what are the main things to be checked regularly and when this is done?
(For the job of the operative interviewed except for the Reel operative or Spare hand in which case ask about rougher's job.)

PART II CHAPTER III

APPENDIX 5

Report and Recommendations to Management following the Enquiry among Operatives in the Mill.

APPENDIX 5

Report on Interviews with Senior Operators, Rodmill

Introduction

This report represents the results of an enquiry into the knowledge and skills and application of skills of the senior operators in the rod mill. The purpose of the enquiry was not primarily to test the skills and knowledge of the operators, but to establish the practice in application of skills and knowledge in certain key areas of the mill.

The enquiry arose from an analysis of shift record data which showed large recorded unscheduled stoppages relating to stand and repeater cobbles in the mill. The enquiry was, therefore, restricted largely to the practices of operators in so far as they can prevent or cause cobbles and therefore production delays.

Two groups of questions were asked. One group related to the skills of operatives in diagnosing causes of cobbles and defining the action required to restart the mill. The second group of questions asked about practice in the mill, about responsibilities and about weaknesses and deficiencies in knowledge or skill. Copies of the questionnaires are attached.

The report is set out as follows:-

Part 1 - Results of Cobble Diagnosis

Part 2 - Operator Comments on Causes of Production Losses in the mill

Part 3 - Admitted Deficiencies in Knowledge and Skill

Part 4 - Knowledge and Practice relating to the Repeaters

Part 5 - Mill Setting Up, Balance and Product Deficiencies

Part 6 - General Knowledge and Practice

Part 7 - Concluuions and Recommendations

Each part is divided up into the comments of the rollers, finishers, roughers and those of the operators further down the line who take over these responsibilities when one of the key men is absent. In all, 11 operatives were interviewed (one rougher being absent). The operatives were told that the information supplied by them as individuals was confidential and any report would preserve anonymity.

It is proposed that the same series of questions be asked of the Shift Managers.

The enquiry was made possible by the help and collaboration of Mr.   Training Officer, who not only provided considerable administrative help but also many ideas. A debt is also acknowledged to Mr.   (mill Foreman) who provided a great deal of advice about mill practice and considerable assistance in framing questions.

PART 1 - Results of Cobble Diagnosis

The rapid and correct diagnosis of the cause of any cobble in the mill must be an important factor in reducing the time of any unscheduled stoppage and in making sure that the mill resumes smooth running. For this reason the operatives were asked to comment on nine examples of cobbles from the rod mill. They were asked to make as many comments as they thought possible about the section and in particular: to estimate where the section had cobbled in the mill; why the cobble had occurred (what was wrong with the section to cause it to cobble); what possible cause there might have been for the section becoming so imperfect that it cobbled; what course of action would be taken; whose responsibility it was to take action; and whether the cobble could have been prevented.

The results have been set out in a form that will lend itself easily to comment by the training officer. An attempt has been made to score the answers, the results of which are incorporated in Table 1. The scores themselves are not a wholly reliable guide to the performance of the operatives, for alternative suggestions and comments made which were not included in the 'model answer' have been ignored. These may well be very viable alternatives; or they may be disastrous courses of action. However, a glance at the table indicates that in general the more senior operatives obtained better 'scores' than the more junior operatives.

A number of further interesting points were raised by these diagnostic questions.

1. Where the cobble occurred

As presumably, the size of the "exhibit" would be related to the size and the type of section being rolled, it could not be expected that there would be exact diagnosis of where the cobble occurred. In fact there were generally wide variations in estimates. There were also differences in estimates of whether the cobble had occurred in a square or oval stand, a factor which is less easily explained by possible differences in section size rolled.

2. Whether cobble could have been prevented

There was no single exhibit about which there was agreement in this respect. In most cases there were disagreements among the senior operatives not only as to whether the cobble could have been prevented but also as to how it might have been prevented. No effort was, however, made to pursue the reasons for these differences in approach.

3. Responsibility for taking action

There were considerable differences in answers to the question asking who was to take responsibility for action following the cobble. To some extent these differences arose from differences in diagnosis as to where the cobble occurred. For example, a cobble in 16 or 17 was mentioned as the finisher's responsibility whereas if it occurred in stand 15 then it became the rougher's responsibility. The differences were, however, not altogether explained by this. They partly arose from differences in opinion as to what was the roller's responsibility in relation to that of the finisher or rougher. The rollers themselves viewed their responsibilities in different ways and this in turn was reflected in the views of the operatives below them.

From the diagnostic questions it became clear that while all the rollers felt that they should have an explanation of any stoppage in the mill, the degree to which they felt that they should be on the spot to diagnose the cause and implement a solution varied. Thus one roller felt that he should be at every mill stoppage and should handle most of the stoppages himself; another obviously felt that he could leave his finisher or rougher to handle a particular stoppage if he wanted to do something else himself and merely ask for an explanation afterwards. This obviously reflected the degree to which the roller had confidence in the abilities of the operatives below him. The answers to the diagnostic questions would tend to suggest that the rollers are correct in suspecting the abilities of the operatives below them to diagnose correctly mill troubles.

As a follow-up to this, all of the rollers and finishers and most of the other senior operatives were asked how they saw the supervisory role of the roller. The rollers obviously saw themselves as being responsible for the shift and for its output and answerable for any shortfalls in performance that occurred. The views of the operatives below the level of roller about responsibilities reflected this although there were some marked differences of opinion as to what extent the roller should take action himself as opposed to give advice or check.

TABLE 1

Scores on Diagnostic Questions[1]
(maximum score for each exhibit was 20)

	Exhibit										
	1	2	3	4	5	6	7	8	9	10	200
R_1	20	20	20	20	16	20	7	20	20	14	177
R_2	20	20	20	20	16	-	6	18	20	20	160
R_3	3	20	20	20	12	17	12	20	-	20	144
F_1	20	20	20	20	16	10	16	15	20	6	163
F_2	20	20	20	20	20	15	11	15	-	20	161
F_3	20	20	20	20	17	4	-	20	-	14	135
RO_1	20	3	-	20	12	4	-	2	20	6	87
RO_2	-	20	20	20	12	7	8	11	-	14	112
S_1	20	20	20	20	20	4	4	17	20	6	151
S_2	20	-	10	20	16	-	12	15	-	14	107
S_3	13	20	-	20	-	-	-	-	-	-	53

[1] The questions were scored on correct description of why section cobbled plus correct analysis of possible causes. Alternative suggestions as to causes have been ignored.

[2] R - Roller
F - Finisher
RO - Rougher
S - Spare man for rougher (usually Reel Operator)

[3] Question 10 was a diagnosis of causes of imperfections in the finished rod.

PART 2 - Operator Comments on Causes of Production Losses in the Mill

Simple analysis of the mill summary production reports reveals that over a period of twelve months to the end of June 1970 approximately one-quarter of the rolling time lost in the mill (on bar and rod) was accounted for by mechanical stoppages. Stand cobbles however, accounted for over a third of the time lost in this period on rod and almost a third of the time lost on bar. The total time lost through unscheduled stoppages on rod in this period was 1,089 hours, and on bar 1,274 hours. This was approximately 40% more than was budgeted for. The analysis of the shift reports reveals that no other sub-heading on the shift report accounted for more than 10% of unscheduled stoppage time. After stand cobbles and mechanical stoppages was electrical faults, which accounted for only 7% of time lost.

As all the mill crews are dependent substantially on a bonus rate to boost their earnings it was considered important to ask them what they thought were the main areas where unscheduled production stoppages occurred in the mill. Operators were also asked to indicate which were the most important causes of time lost. In fact stand cobbles and mechanical stoppages were mentioned more times than any others as being causes of production losses. Significantly, however, mechancial stoppages were usually, when mentioned, referred to as the major cause of production loss. In only one case were stand cobbles referred to as being the major cause of losses. Repeater cobbles, shears, rod switches and conveyors were mentioned very frequently as causing downtime. These were said to have a mechanical or electrical cause generally. And in this context crane breakdowns were mentioned several times.

Surprisingly, in view of the large time losses attributed to this factor, maintenance in the mill was not strongly criticised. There were, however, some complaints about the adequacy of the mill knowledge of the engineers. And, in answers to this question and in other instances throughout the interviews, the quality of the guides and the setting up of the guides was criticised. In general, stand cobbles were recognised to be largely the result of operator error, although bad steel was mentioned in a number of cases. It was quite clear, however, that in the minds of the operators, the losses from stand cobbles were not thought to be anywhere near the proportion referred to above.

PART 3 - Admitted Deficiencies in Knowledge and Skill

When questioned about their knowledge and skills for their own job for the job them in the promotion-ladder where relevant, about the jobs which were connected with their own job and about the level of their general theorectical and practical knowledge of mill operations, the operators were very forth-coming. Their main comments are summarised below.

Rollers

Each of the rollers indicated that they were learning all the time and that there was always something new to learn. Two of the rollers in particular felt that their knowledge and skills could be improved. The suggestion was made by one that this learning process might be helped by more discussion of problems that arose during the shifts. On the other hand this man and one other roller felt that there might be too much interference from the management with events on the mill floor.

Two of the rollers felt also that they could learn more, in terms of general knowledge, in the practical and theoretical sense, about the mill's operation. The feeling was universal, however, about the need to know more about the operation of the main pulpit. While the rollers had varying degrees of knowledge of this, none claimed they could master it and all said that they really ought to know more.

Finishers

The finishers seemed to have a great deal of confidence about their ability to do their own job, and also the rollers. All but one felt that they knew enough about the practice and theory of the mill in general and the finisher who admitted to being weaker stated that it was "all practice anyway". The senior of the finishers, however, felt that there was not enough practical experience or knowledge among those moving up into the rougher, finisher and rollers jobs. Nor was there enough knowledge about pass changing which the roller might ask the younger operatives to do. "This soon leads to trouble." The finishers in general however, admitted only a superficial knowledge of the main pulpit operation.

Roughers

Only two roughers were interviewed. One felt that there was room for improvement in relation to the knowledge and skill that he had for his job, but it was difficult to put the finger on where. The other felt he was learning all the time. Both argued that they could do the finisher's job with some confidence, although both admitted that there were areas of knowledge in relation to the finishing cage and in relation to the causes of cobbles in the cage where they felt very weak and lacked confidence. Both also felt that they would like to know more about the mill in general, about how the different parts operated, about qualities of steel, about factors relevant to getting the right size and quality of section.

Other Operators

The operators interviewed here were those who normally did the rougher's job. They were asked about their ability to do the rougher's job, and if necessary to do the finisher's job. All felt they could know a great deal more about aspects of the rougher's job. More general knowledge of draughting was required, more knowledge of twisters and of guides, of pass changing, and of the workings of the intermediate stands was also mentioned. There was also some concern about the fact that the reel operator might have to do three different jobs, on the furnace, on the floor and in the main pulpit.

None of the operators felt that they had sufficient knowledge or skill to do the finisher's job, though they had occasionally the chance to do it. None felt they could put something right that was wrong in the cage.

Two of the three operators thought that they knew too little in terms of general knowledge of mill operations. One was attending City and Guilds classes on the manufacture of rod bar and billets; but he felt that he needed to know more complex things about this particular mill, for example different roll sizes, differences in speeds, etc.

PART 4 - Knowledge and Practice Relating to Operation of Repeaters

Operators were asked about the causes of the repeater cobbles, about the major factors governing the balance of the loops in the repeaters and about the kind of action they might take when these loops get out of balance between various stands involving different strands. Information obtained about the operation of the repeaters from the diagnostic questions (Part 1) is also included here.

Causes of Repeater Cobbles

Operators were asked to mention as many causes of repeater cobbles as they could recall as an indicator of their general knowledge of the repeaters. Table 2 sets out their replies. On average operators could think of five reasons for repeater cobbles. Two operators mentioned eight of the reasons listed, and one could only mention two reasons. In general a wide variety of emphasis was given to different causes, although there was a tendency to blame the speed operator. Even the rollers did not agree among themselves as to the causes. It is clear from the information obtained during the diagnostic interviews that different philosphies were held about the operation of the repeaters. There are those who consider that the speed operator has predominant responsibility for the balancing of the loops. Others consider that it is primarily the rollers' responsibility, although in some cases little emphasis is placed on the total balance of the mill, more being placed on the operation of twister and entry guides. Nevertheless, when asked to describe generally the various factors which govern the balance of the loops in the repeaters, seven of the eleven operators, including all the rollers, mentioned keeping balance in the intermediate stands and in the mill in general. None of the rollers here mentioned the speed operator as a factor of importance, although he was mentioned by all the finishers; and, although keeping the entry guides correct was mentioned several times, only one roller called attention to this.

In general, however, there was a diversity of opinion about the important factors in balancing the loops. One senior operator suggested that they should be left entirely in the hands of the pulpit operator; and two of the less senior operators interviewed said that they knew nothing at all about the repeaters.

TABLE 2

Causes of Repeater Cobbles

	No. of times mentioned (maximum 11)	No. of times mentioned as main cause
Twisters wrong in some way	10	2
Guides wrong at 11, 13 and 16	9	2
Speed operator has speeds wrong	6	3½
Bad balance in the mill	5	1
Wrong cross on rolls	5	-
Bad back ends	4	-
Troughs out of line	4	-
Bad steel	3	2
Loose delivery guides	3	-
Badly fitting trumpets	2	-
Lack of chains in repeaters	2	½
Repeaters in poor state generally	2	-
Roll heights wrong	1	-
Stands out of line with repeaters	1	-

Action in Balancing the Loops

(A) Each of the questions asked about the corrective action to be taken in relation to the loops in the repeaters being out of balance had 'model' answers. Many of the replies deviated substantially from these answers and it was not possible for the interviewer to determine whether the remedial action suggested was inadequate or not. For this reason the questions and all the replies are printed below leaving the judgement about adequacy to management.

1. What do you do if the loops of strand 2 are running out badly on the back ends?

The model answer was:-

(a) Check if the tension is down (there is no pull) at the roughing.

(b) Check for uniform temperature along the length of the billet.

Rollers

The first reaction of all three rollers to this was to "check the entry guides at 9, 11 and 13". Two of the rollers then suggested going down the mill to look for a bar turning over (back end). These two rollers also suggested looking for pull (one in the context of 1 and 2 stands only). The third roller added "not much can do in most cases as is over-filling throughout mill".

Finishers

F.1 "See roller or rougher to get better drafting. Start stoning 14 out"

F.2 "Check guides on strand 2 at 11 and 13. Stone strand 2 at 14."

F.3 "The only thing to do here is to check for guide turning down."

Roughers

R.1 "Stone out 14 and 15 to allow more stock through."

R.2 "Stone 2 out at 14."

Other Operators

S.1 "Stone out 14 to let more stock through."

S.2 "Open stands up to let more stock through."

S.3 Didn't know.

2. If strand 2 is out in numbers 1 and 2 repeaters and in number 3 repeater, what do you do?

Model answer:

Stone the number 2 strand at stand 14 until it balances the other two strands in 1 and 2 repeaters. This will also put strand 2 right in No. 3 repeater.

Rollers

R.1 "Stone strand 2 at 14 to let the stock in. Don't alter draft at 15 as dumpy section goes in better than full. This puts more stock into 15 to shoot it out at delivery side of 15. Depends, however, on whether strand is out or not. If it is right out, it must be the guides."

R.2 "Stone stand 14 out."

R.3 "Look at guide at 15. Stone number 2 at 14 and 15 depending on guide at 15. (Second thoughts - leave 15 off and stone 14)."

Finishers

F.1 (Model answer given)

F.2 "Open up 15 and take the loop in at 1 and 2 repeaters, or stone out 15 and 16. Put wood on 13 to see if can pull 13 down and check strand 2 to see if turning down."

F.3 "Drafting wrong or guides want renewing at 13 or 15. Roller checks section with wood to see if drafting O.K.; then checks guides. Probably 13 or 15 guides need renewing."

Roughers

RO.1 Didn't know.

RO.2 "Wants more stock letting through, so stone out stand 15 and stand 14. More stock into 16 and makes section run out further in 3 repeater."

Other Operators

S.1 Didn't know.

S.2 Didn't know.

S.3 "Pull down 16 to take 3 repeater out and open 14 and 15 up."

3. <u>What could be done if the number 2 strand was running out in all repeaters?</u>

Model answer:

1. Stone strands 1 and 3 at stands 12 and 13 which gives more stock around the repeaters, thus throwing strands 1 and 3 out.

   OR

2. Stone No. 2 strand out at 14, 15 and 16 and get No. 2 in.

<u>Rollers</u>

R.1 "If happened suddenly, check for useless guides especially in intermediate stands. Put more stock into 1 and 3. Go back to 12 and 11 and stone 1 and 3 to get more stock. Also stone number 2 out at 16 to give better finished rod."

R.2 "Stone 14 and 15 out, or 14 and 16 if really bad."

R.3 "Stone 14 and 15 and 16 out. See if all entry guides are O.K."

<u>Finishers</u>

F.1 "Stone 13, 14 and 15."

F.2 "Stone out at 14 and 16 (<u>not</u> 15 because is a square)."

F.3 "Is impossible - must be something wrong with the other strands. Is mainly roller's job."

<u>Roughers</u>

RO.1 "Check guide."

RO.2 "Never come across it."

<u>Other Operators</u>

S.1 "Pull down 14, 15 and 16 at 1 and 3 strands."

S.2 "Don't know."

S.3 "Run 1 and 2 together and then 2 and 3 together until have balanced all 3 strands."

4. <u>If strand 2 is running in on all three repeaters what ought to be done?</u>

Model answer:

1. Easiest way to stone stands 12 and 13 on strand 2 to let more stock into repeater.

2. Another way is to stone stands 14 and 15 on strands 1 and 3. This will help by bringing these loops in towards the bulkhead.

Rollers

R.1 "If sudden, could be bad steel or must be the guides. Therefore check guides in the intermediate stands and look at 9 and 7 also."

R.2 "Stone strands 1 and 3 at 13, 15 and 16."

R.3 "First check for any turning down at odd number stands throughout mill. Then if guides O.K., stone 1 and 3 at stands 14 and 15 and 16."

Finishers

F.1 "Could be guide somewhere down the mill off the hole."

F.2 "Check section with wood - see if can pull down. If so, pull down at 14 and 15. Or pull down at stands 13, 14, 15 and 16."

F.3 "Never known this to happen. Shouldn't do."

Roughers

RO.1 "Check guides. Maybe stone out 14 and 15."

RO.2 "Stone 13 to allow more through 13 so comes out."

Other Operators

S.1 "Pull down intermediate stands on 1 and 3 strands."

S.2 "Don't know."

S.3 "Open 13 up, let more stock through to 14. Leave 14 alone and open 15."

5. If you had a strand number 3 that was laying out in numbers 2 and 3 repeaters what would you do?

Model answer:

Wood the section out of stand 15 and thus ascertain whether to pull strand 1 down or open strand 3 up.

Rollers

R.1 "Check the guides at stand 15 - should find it there."

R.2 "If guides O.K., open stand 14 on number 2 strand. Check strand 1 at 14 and 15 in case needed pulling down. All depends on section."

R.3 "Open up strand 3 at 15."

<u>Finishers</u>

F.1 "Open up at 14 or pull down strand 1. Could be bad guides."

F.2 "Check 15 and probably open it up as is probably full."

F.3 "Open up 14, 15 and 16 a touch and see how you go."

<u>Roughers</u>

RO.1 "Is getting too much stock through. Therefore pull down on 13."

RO.2 "Check the section, open it up at 14 or 15 on strand 3."

<u>Other Operators</u>

S.1 "Pull 14 and 15 down and open up 16."

S.2 "Don't know."

S.3 "Pull strand 3 down at 14."

<u>The operators were then asked what was it in general necessary to do to ensure continuous balance in the repeaters</u>

<u>Rollers</u>

Two rollers agreed that it was important to keep rolling on all three strands; one of these also argued that the mill should be held well down. The other roller argued that "the main pulpit man is the one to pick up the loops. He is the 100 per cent important factor in keeping the loops right.

<u>Finishers</u>

The finishers generally agreed that drafting in the mill was the most important factor, and that pulling the mill down as much as possible was desirable.

<u>Roughers</u>

The roughers also agreed that checking the section and drafting was the most important factor in obtaining continuous balance.

<u>Other Operators</u>

Two of the three operators agreed that mill drafting was the most important factor, although entry guides were also mentioned. One operator could not reply.

Comments on Repeaters During Diagnostic Session

Suppose that number two strand was running out at number three repeater what could be done?

Model answer:

Stone strand 2 at stand 16 and then watch to see it does not take too much so that all three strands are running together.

Rollers

R.1 "Check entry guide on stand 15. Then stone out 16 on number 2 strand."

R.2 "Stone strand number 2 at 16 provided that balance is O.K."

Finishers

F.1 (Questions about repeater not asked)

F.2 "Stone out on strand 2 at 16 - only in number 3 repeater."

F.3 "Check entry guide. Stone 16. Don't like doing this because it affects my finishing and might end up with the rod too fat or dumpy."

Roughers

RO.1 Didn't know.

RO.2 Didn't know.

Other Operators

S.1 Didn't know.

S.2 "No experience."

S.3 "Stone strand 2 at 16. But trouble could also come from stand 14, and if this is the case stone 14."

The remainder of the comments under this section underlined again the differences in attitude towards the responsibility of the speed operator and the roller in forming good loops.

PART 5 - Mill Setting Up, Balance and Product Imperfections

Questions asked under this heading could be divided into three main groups. The first group related to the setting up of stands, the measuring of roll height, and the significance and practice of roll cross. Complementary questions were asked about methods of checking along certain parts of the plant. Also included here were some questions as to what course of action might be taken if the mill was stopped for particular reasons. These answers are supplemented by the answers to the diagnostic questions from Part 1 where operators were asked what kind of action they would take following a cobble of a certain type.

The second group of questions relates to imperfections in the section while rolling. The causes of finning, indentations and watermark imperfections are discussed.

The third group of questions relates to the balance and preservation of tension in the mill.

Group 1 - Setting Up, Checking and Repairing

1. Roll height and the setting up of a stand

There appeared to be no standard practice here. Two of the rollers said that they used a hickey*; the other argued that it was never accurate and that by far the best method was to use the entry guide, especially in the finishing cage. Even so he admitted that this was not deadly accurate. The other rollers also tended to use the guides for setting up in the finishing stands. One roller used the delivery guide and the other argued that the delivery guide could be used to check oval stands and the entry guide to check square stands.

One finisher argued that the hickey was the only way to check any stand; the other two said that they would use the hickey in the

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*a wooden block made especially for this purpose.

roughing and intermediate stands, but one would use the delivery and the other the entry guide in the finishing stands.

Both roughers interviewed said that they would use the hickey, but one said he would also check with the delivery guides.

Of the other operators, two swore by the hickey block, the other said he would use it on a new set of rolls, but if he was pass changing would check by the delivery and entry guides.

There did not appear to be any standard practice for any particular shift.

2. Checking on Operation of Twister Guides

Operators were asked how they would check on the twister guides to see that they were operating correctly.

The practice again seemed to vary. One roller argued that the section could be wooded and that the shape obtained on the wood, although looking as though the section was off the hole, was in fact the result of the twister being set too tight. Or the roller could walk up and take the twisters off as the bar is running one strand at a time and put them back on the bar. Another roller would use his finger in between the twisters while the mill is operating to check. He argued that he could also look to see if the twisters were turning; if they were not they were too open. The other roller said that he would check by sight alone.

The finishers were more straightforward in their explanations. Two argued that they could, in the roughing, check merely by looking at the section, particularly the front end; and one argued that he could also do this in the finishing cage.

The roughers both agreed that the bar could be watched from the twister as it entered the entry guide.

Two of the "other operators" agreed with this. The other said he didn't know.

In the diagnostic questions the operators were asked, "If the spinner wasn't working properly how would they check if that was the case?

Most argued that one could see the spinner if it was seized up. Two of the finishers argued that you could check this just by looking. The other said that he would use a piece of wood to see if he could turn it. One of the rollers argued that he would hold out the mill and get hold of the spinner to see if it had seized up. He did, however, mention that a good finisher would be able to check while the mill was still going.

3. The Significance of Roll Cross

Where are the rolls crossed?

Rollers

Not all the rollers agreed about the use of roll cross. One, after prompting, argued that only a slight amount was needed on thirteen and fifteen, although this was not so necessary on smaller sections. On three strand rolling it was definitely needed on fifteen. Another argued that roll cross was not necessary if the mill started off with clean passes, for "the section will take itself round".

Finishers

One finisher thought that the rolls should never be crossed if they are correct, although recognised that the practice was used. The other two described the conventional practice.

Roughers

Both described conventional practice.

Other Operators

One said he didn't know. One argued that cross should be put on at thirteen, fourteen and possibly fifteen. The other said that it should be put on at thirteen.

Methods of crossing the rolls

All the rollers knew which way to move the rolls to get the right cross as did two of the finishers. The other finisher argued that there was no specific rule.

Both the roughers were either uncertain or incorrect about this.

Two of the "other operators" were correct, the other said he didn't know.

Most of the operators argued that the only way to tell which was the rolls were crossed before a test piece was obtained, was to wood the section; and that it was not possible clearly to see it. One of the roughers, however, said that it could be seen because one side of the bar is sharper than the other. One of the "other operators" said he didn't know.

All, but one, of the finishers and roughers said that the bar should be spinning anti-clockwise; but one argued that the bar should look as if there is no cross at all.

The roughers were uncertain as to the way in which the bar was spinning; and only one of the "other operators" knew.

Adjustment of rolls if cross incorrect

The question about how to correct the section if it was spinning clockwise out of stand fifteen was probably much more difficult to answer sitting in a lecture room than if out on the mill floor. Nevertheless of the rollers only one was clear about this, another was very unclear and the other one in fact gave the wrong answer. Of the finishers, two could answer correctly and one incorrectly; of the roughers, one could not answer and the other answered incorrectly. Of the "other operators", two answered incorrectly and one could not answer.

Causes of guide box knocked off and replacement procedure

Shift reports indicate that not infrequently the guide box on the delivery side of the stand is knocked off. It is also clear that there might be multiple causes of this some of which might be prevented. Operators were therefore asked what might be the causes of the delivery box being knocked of the stand and later asked to describe what kind of action they would take in what order.

Figure 2 indicates all the answers given and the number of times they were mentioned. It is quite clear that by bar the most important reason thought to be the cause of the delivery guide box being knocked off is a loose delivery guide itself. This was followed by "entry guide off the hole". After this, apart from the several mentions of roll height being wrong, a miscellany of reasons was given. No single operator mentioned all reasons; and the only reason that all three rollers mentioned was loose delivery guides.

TABLE 3

Causes of Guide Box Being Knocked Off

Cause	Numbers of Mentions
loose delivery guide or off the hole	9
entry guide off the hole	8
roll height wrong	6
bad front end	5
bad section	1
seized twisters	1
rest bar height wrong	1
twister set too tight	1
cold bar	1
wrong section	1
bad back end	1

Replacing the guide box

There is no standard procedure or order in the descriptions of actions to be taken to replace the guide box either among the more senior or the more junior operators. In general, the emphasis was placed on different things. For example, several operators stressed very strongly the need to examine the water pipes. Others did not mention these at all.

One or two comments were made that this kind of trouble arises because people are not doing their job properly. For example, in setting up the guides in the first place the practice of examining only one of the guides to see if it is in the correct position was criticised, as was the practice of just looking at the top of the guides to ascertain the correct position.

Few of the operators were able to answer the question about what they would do if after replacement the guide box was again knocked off; the answer was to go through the same procedure again. Only one operator mentioned checking the rest bars, although several talked about re-checking the roll height.

Group 2 - The Noting and Prevention of Product Imperfections

Action On Eliminating Small Fin

The conventional answer was to open up the square stand which was causing the finning. This was reinforced by the argument that there must be enough stock for the finisher. It was also mentioned by most of the more senior operatives that the earlier stands could be pulled down if possible. One senior operative, however, argued that if there is a fin in the roughing then the mill has been pulled down for a purpose and that the fin might be caused deliberately especially when operating on three gauge. One of the rollers also mentioned that he would check the oval to see if it was turning down;

and both of the roughers said that they would check the guides. Of the "other operatives" one had some idea as to the course of action he might take, one said he had no idea an another said that the cause of the finning would be too much cross on the rolls.

A particularly large fin occurs when the oval turns down in the square pass. How can you detect this?

Various methods were described. Not very many of the operatives, however, mentioned that they could watch the black line on top of the square or round. (This might have been too obvious?) The rollers seem to go by the colour; if the bar is turning over it goes bright. One also mentioned that one could see a black fin. One finisher said that he could see this fin in the cage, another argued that it was not possible to see this in the cage but in the roughing one could watch the black line. A third argued that you could either see the fin or use the wood. The roughers indicated that they could detect this and one mentioned watching for the water mark. Two of the "other operatives" suggested looking for the back ends, the other gave possibly the best answer of all, suggesting that the section might be wooded in certain areas, that the black line could be looked for in others, that the bar would be bright, and that one might also be able to tell from the clocks because they don't get as much work load.

What does a two-sided fin indicate?

The rollers generally indicated that the square was being pulled down too much or too much stock was going into the mill. Two rollers also said that this might result from the section turning down. One indicated that this could result from crossed rolls. All three finishers indicated that it could be because the section was too big although one mentioned that the guide might be turning down.

Of the roughers one indicated that the section could be turning down. The others said that this might be the case or that the mill had been pulled down too much. Of the "other operatives" one said the section was too big, another indicated that it was a turned down entry guide and the third said he didn't know.

Product Imperfections

Raised up bump on section

All operatives, when questioned, understood the cause of a raised up bump on the section.

Water Mark

All of the more senior operatives understood what was indicated by a water mark on the finished section. The roughers and other operatives were much less certain and gave answers such as 'scratch on the rolls'.

Indentations caused by scrap

Operatives were asked what might be the cause of the small indentation in the section if they were rolling 6mm gauge out of stand 21. Subsequent to this question they were also asked if they could distinguish between a mark caused by a scrapped-up twister and the one caused by an entry guide, and finally what were likely to be the causes of scrapped-up twister and entry guides.

Only two rollers were able to provide the complete answer to this series of questions. One roller said he would suspect only that there was a seized up entry guide because of lack of lubrication.

Two of the finishers were able to point to the entry and twister guides as being the cause of the problem but neither claimed they could distinguish between the marks made by either of the two guides. The third finisher, despite repetition of the question, insisted that the only cause might be some scrap on the rolls.

In general, the roughers and other operatives were unable to provide a complete answer to the question. Those operatives that could answer pointed to seized up rolls as being the cause of the scrapping up, largely due to lack of lubrication. Bad steel was only mentioned once.

Balance and Tension in the mill

Operatives were asked how they might check for pull and push in the mill, about exceptions where the clocks could not be used and about the intermediate stands where the clocks are not wholly reliable.

The practice of operatives varied somewhat. One roller stated that he would never trust the clocks and always used the bar because the clocks were not dependable. He re-affirmed that he could use the bar on all stands. Another roller suggested that he could use the clocks on all stands except in the intermediate stands where he used a bar. Despite prompting he failed to mention the tied stands. The remaining roller said that he would use the clocks except in the tied and intermediate stands where he would use a bar. He would also occasionally go to stands 1 and 2 and 'feel the surge' for pull. All of the finishers used the clocks except in the intermediate stands; two of the finishers said they would use a bar on the tied stands and could name them. The remaining finisher, however, could not name the tied stands and failed to mention that the clocks could not be used. One of the roughers similarly, omitted mention of tied stands; and only one of the "other operatives" knew where he could trust the clocks, where he had to use a bar and where the tied stands were.

Elimination of buckle and pull in the mill

Pull

Operatives were asked how they might eliminate pull at stands 6 and 7 or 8 and 9 and also how they might eliminate buckle at the stands. They were also asked to describe in what circumstances they might do this and what checks they would carry out first. Finally they were asked how they might eliminate pull in the finishing cage, and firstly, what checks they might made.

The common answer to eliminating pull was by drafting. The conventional remedy was to pull down after checking the section. There seemed, however, to be some differences in the way in which this might be tackled as emphasized by the following quotes:

R.1 "Look at section 6 and 7. If 7 overfilling, open it up, let more stock into 8 and pull down depending on load and section."

R.2 "Open up the oval and pull down the squares, unless finning."

R.3 "Pull down. Check section. Pull 6 down if dumpy."

Two of the finishers suggested drafting out the pull by pulling down but both emphasized that the operative must tell the speed operator and possibly ask him 'to take the mill down a bit'. One of the roughers also suggested checking with the speed operator before pulling down. One of the "other operatives" suggested asking the speed operator to bring the speed back a touch, the other suggested pulling down stand 7 or opening up 6.

Buckle

In the elimination of buckle in the mill, various alternatives were suggested and some differences in practice emerged. Two of the rollers suggested opening 6 and 7 up; one mentioned that opening up 7 alone was the easiest way. The remaining roller said that if there was a square buckle on no. 1 strand, he would check it and if he found it finning would naturally open it up. But generally, he might take other action as follows:

> 'The action I would take depends on the section. I can now tell when I can pull down on a buckle and made the speed operator take it forward. In a large number of cases of buckle, the rougher tends to take a buckle out by opening up as it is the quickest way. But the section may need pulling down and it is really up to the speed operator to take the stand forward. If strand 1 is buckling I may even pull down strand 3 to make it buckle and ask pulpit operator to help. Many of the operators, when dealing with a buckle have a tendancy to open the wrong stand because they don't know.'

There was also certainly a slight difference in emphasis among the finishers as to how to treat a buckle at the roughing stands. Two of the finishers argued very strongly that they would open up the stand; one of these argued that he would always open up and then check the section and earlier stands afterwards because a buckle meant the possibility of a cobble. The other finisher, however, said that he might also pull down 8 if the section would allow it and if not would ask the speed operator to ease the mill forward a bit.

Both the roughers argued that they would either open up the stand or pull down an earlier stand if the section would allow it.

Of the "other operatives", two said that they would either open up stand 7 or 9 (depending where the buckle was) and depending on the section; one also indicated that he may ask the speed operator to adjust the speed. The other operative was unclear as to what course of action he would take.

When asked about dealing with pull in the cage, almost all the operatives indicated that they would pull down the relevant stands; most, but not all, said they would do this after first checking the section. One roller argued very strongly that he would always pull down hard in the cage to make the section buckle. For, especially when rolling squares, a much better section was obtained by causing a slight buckle. Once the section started to tremble, it was clear there was no pull.

It is interesting to note that in the context of a different question another roller indicated that buckle in the cage was something to be avoided at all cost.

PART 6 - General Knowledge and Practice

General Knowledge

Few of the questions asked were designed to test directly the general knowledge of the operatives. Some questions were, however, asked about billet temperatures in general and about the treatment of rimmer steel, in particular. Operational questions were asked about which pass the largest reduction was obtained on and how frequently test pieces were taken.

Steel Temperature

Only one of the eleven operatives knew precisely the temperature which was ideal to roll at (1150°). A few knew broadly the range of temperature at which steel was rolled; but several of the senior operatives were outside of this range. Almost all the operatives did not know that rimmer steel was rolled at a lower temperature nor did they know why. Most of them, however, had some practical explanation as to why stand 1 was opened up when rolling rimmer although several were muddled about this and two of the more junior operatives didn't know. Almost all of the more senior operatives knew that they could get a bigger reduction from an oval than a square pass. None of the more junior operatives knew this.

General Practice in Checking the Mill

Results from the diagnostic questions indicated that in the case of all the exhibits discussed the cobbles could have been prevented by operatives keeping a check on certain items in the mill. It was therefore considered worthwhile to ask the operatives in the top jobs (roller, finisher and rougher) what periodic checks they carried out in the course of their job, if any, what things they were checking and when they did this.

The reactions of the operatives indicated that while there were one or two general items for which each would check, there was obviously no common recognised or standard procedure for making checks. The emphasis of all the rollers was on checking the section and on checking balance. One roller, however, laid a great deal of emphasis on checking the section for turning down and checking guides throughout the mill.

Each of the finishers had their own practice. All mentioned regular checks on delivery guides and wedges; one emphasised checking the water and two mentioned checking the grease pipes.

It was clear in the case of the roughers and of the "other operatives" that while there were obviously common, important things to be checked in the rougher's job there was no regular system for this.

Operatives were also asked how frequently they would take test pieces from the coil. Answers ranged from every five minutes to 'every 50 or 60 minutes'. The rollers in general took test pieces about every half hour. The finishers tended to agree with this and only the roughers and other operatives who did the rougher's job occasionally gave widely different answers.

PART 7 - Conclusions and Recommendations

The following detailed conclusions may be reached:

Part 1 - Results of cobble diagnosis

A. The diagnostic skills of the senior operatives are less than 100 per cent and are considerably less than 100 per cent among the less senior operatives.

B. There is lack of agreement between the various operatives as to who is responsible for taking action in the case of cobbles. This partly depends upon the roller's definition of his own job and probably his feelings about the capabilities of the operatives further down the line.

Part 2 - Operator comments on causes of production losses in the mill

A. Operatives were not fully aware of the factors causing unscheduled production losses and in turn affecting their bonuses.

B. There were few criticisms of maintenance but it was pointed out that maintenance men did not always seem to have a sound general knowledge of the mill.

Part 3 - Admitted deficiencies in knowledge and skill

A. All of the operatives, but particularly the rollers, felt that they ought to know more about the main pulpit.

B. The finishers in general have a great deal of confidence that they could do the roller's job.

C. The less senior operatives admitted ignorance about the operation of the cage, about the way in which the section was reduced and about the causes of cobbles.

Part 4 - Knowledge and practice relating to the repeaters

A. Operatives frequently submitted very different opinions as to the factors that were important in balancing the loops or in causing cobbles in the repeaters.

B. There was also considerable lack of concensus about what to do when loops were coming out.

Part 5 - Mill setting up balance and product deficiencies

A. Practice in setting roll heights varied considerably between use of hickey, entry and delivery guides.

B. There were considerable differences of practice in checking twister guides to see if they were operating properly.

C. There was some ignorance of the significance, desirability and practice of roll cross.

D. There was deficiency in knowledge of some of the possible reasons for guide boxes being knocked off and of correct procedures for replacement.

E. There were admitted deficiencies in the way guides were adjusted and set up said to be related to the pressure for production.

F. There was criticism of the way in which pass changes were carried out by the less senior operatives.

H. There was lack of knowledge among all the less senior operatives about the causes and treatment of finning.

I. Operatives have different methods of noting when a bar is turning down.

J. Two sided fins were frequently attributed to either roll cross or a pass that was too full.

K. Few operatives could diagnose the difference in imperfections caused by scraps in entry guides or twister guides.

L. There was differences in emphasis in balancing the mill (in getting rid of buckles and pull) particularly between drafting and the possible role of the speed operator.

Part 6 - General Knowledge and Practice

A. There was general ignorance about ideal temperatures for rolling and treatment of different quality steels.

B. Questions about regular checks made by senior operatives on the mill revealed no standard practice and some differences in priorities.

General Conclusions and Recommendations

The preceding analysis and conclusions define the following areas of training need:

1. Training in cobble diagnosis - for all, but especially for the less senior operatives interviewed (finishers downwards).
2. Training in and understanding of the speed operator's job (main pulpit), particularly the relationship between the speed operative's influence on the mill and the roller's influence through balance. For all operatives but for the senior operatives especially.
3. Linked with this, training in the balancing of the loops in the repeater. (It is significant that the finishers were confident about being able to do the roller's job but were frequently ignorant about handling the loops.) Effort should be particularly concentrated on action to be taken when particular loops are out of balance in particular repeaters. For all operatives.
4. Training in pass changing. For less senior operatives who might be asked to do it.

5. Training or retraining in the setting up of guides with emphasis on the dangers of using rough and ready methods of alignment. (Also with emphasis on the fact that Allen screws cannot be adjusted on both sides.) For all operatives.
6. Training of the roughers and "other operatives" likely to do the rougher's job in knowledge about the causes of cobbles, about speeds and balance in the mill, about the finishing cage and about production of section.
7. Explanation of the significant reasons for, and practice of, roll cross on certain stands. For senior and junior operatives alike.
8. Training in the analysis and treatment of finning. For the less senior operatives especially.
9. Training in general knowledge about steel temperatures and reasons for different treatment of different types of steel. For all operatives.
10. Training in general knowledge about steel temperatures and reasons for different treatment of different types of steel. For all operatives.

<u>In addition to the above training areas, there may possibly be other areas where there is a need and where training might be possible. To arrive at these areas, management may try to answer the following questions</u>:

1. Is it possible to establish standard procedures for action when certain types of cobbles occur? (For example, what should be done, what should be checked, who should be informed, what should be replaced in what order.) The case of the guide box being knocked off and the action for its replacement is a case in point. Bad steel is obviously another.

2. Is it possible to decide what is the correct procedure for setting roll height - is there any real difference between setting the height by the entry guide, by the delivery guide or by the hickey?
3. Are there any standard methods to be recommended for checking certain parts of the mill? e.g. for checking that the twisters are working correctly if it is suspected that they are not.
4. In what circumstances can finning be caused deliberately in the roughing? To what purpose?
5. Is it possible to recognise different kinds of fin when the mill is running? e.g. fin caused by roll cross, by the pass being too full or by turning down?
6. Is there scope for training through the examination of a range of product imperfections and analysis of these?
7. What is the relationship between the speed operator and the rougher in getting rid of buckle and pull in the roughing stands?
8. Is it possible to set up (for certain of the senior jobs in the mill) standard procedures for checking certain parts at regular intervals and training people as to the need to carry out these checks? (The questionnaire replies coupled with management advice might serve to do this.)
9. Is it possible to think in terms of more (but not formal) management discussion with the rollers about production losses, shift problems and technical factors that arise as an ongoing learning experience for the rollers?

In addition to the above comments, the following very general points seem worthy of consideration:

Roller's Responsibility

The question that arose generally was the range of the roller's responsibilities for the operation of the shift. In particular, is the speed operator responsible to him in the same way as the operatives on the floor are responsible to him? And, if not, what is his relationship with the speed operator? If the roller is defined as being in charge of the shift then there is a strong case for him to be trained in all aspects of operations of the mill that affect him including the furnance and the main pulpit as well as perhaps a knowledge of major maintenance and mechanical problems.

Is the roller, for example, responsible for training his crew? Certainly two of the rollers feel that this is the case, as well they might do if they are responsible for the shift bonus.

Promotion lines, Pay and Effect on Training

The way that the promotion line in the mill is organised at present there is no clear line of promotion for the operator below the rougher. He can go to the main pulpit, to the furnace, as well as to the roughing. He may therefore be asked to stand in on either of three jobs, each of which are highly important for the efficiency of the mill. If the promotion line cannot be altered then there is certainly a strong case for identifying among the operatives below the rougher those who wish to go into the main pulpit, those who wish to go to the furnace and those who wish to go onto the floor and concentrate training accordingly. This could be done from each shift.

If the roller does have the wider responsibility as defined above and as seems in practice to be the case, then the bonus for the whole shift rests with him. Differentials in pay and bonus rate between him and, for example, the furnaceman appear small in relation to the difference in responsibility. It must also affect the chances of recruiting the better operatives from the lower ranks into the key jobs on the mill floor.

PART II CHAPTER III

APPENDIX 6

Brief Summary of
Training Action Plan

APPENDIX 6

Brief Summary of Training Action Plan - For Each Shift

Subject/Area/Content	For Whom	Method	Location	Time Allocated	By Whom	Preparation (equipment required)
Mill Balance - Speeds/drafting						
1. Mill balance. General principles Clocks, tred, stands, bars, (pulling on No.1 stand to feel surge) Reliability of clocks - finishing cage speed ops. job general. What are the important factors in preserving balance.	A.(Some finishers) roughers reel operators spare hand operators main pulpit operator	Lecture (Follow up on mill floor on next shift)	Lecture room (Mill Floor on the job)	2 x 45 min. (during shift)	Instructor or Mill Foreman	
2. Examples of buckles and pull to underline 1. How analyse causes. 2. What kind of action to take - by whom 3. What checks made 1st 4. What checks made after	"	Discussion using examples	Lecture room	45 min.	Ass. Mngr. or Foreman	Interview Ass. Mngr/ Foreman to discuss examples of buckle in (a) tied stands (b) untied stands (c) cage stands (For each make model check list answer for points in column 1.
3. Speed operators role in the mill. Relationship with job of roller and furnaceman - responsibilities here. Systems of communication between speed op/roller/ furnaceman.	Roller finisher rougher reel op. spare hand speed op. furnaceman	Talk and discussion	Lecture room	45 min.	Ass. Mngr.	Preparation of lecture (diagram of mill) Clarification of responsibilities and communication system

Brief Summary of Training Action Plan - For Each Shift

Subject/Area/Content	For Whom	Method	Location	Time Allocated	By Whom	Preparation (equipment required)
Mill Balance (cont'd)						
4. The speed operators job - what he does and how and when.	Roller finisher rougher reel op. spare hand speed op. furnaceman	Talk Then session in the main pulput	Lecture room Main pulpit	30 min. 30 min.	Ass. Mngr. plus Main Pulpit Operator	Use job description as as example. Prepare diagram of main controls and relationship of these. Brief main pulpit operator on contribution to session.
Repaters, Loop Control and Roll Cross						
5. General principles	Roller finisher rougher reel op. spare hand Plus main pulpit	Talk	Lecture room	45 min.	Management	Discuss with management the general principles behind operation of repeaters.
6. Repeater loops out examples and discussion	"	Discussion Ask for individual comments and solutions	Lecture room	2 x 45 min. or longer depending how examples are dealt with	Foreman Manager Instructor	Devise examples (some of which in questionnaire and answers).
7. Session on causes of repeater cobbles. To point out why it occurs as a result of any cause; where it occurs. What action needed to prevent and what course of action to be taken following.	"	Talk and discussion	"	60 min.	Ass. Mngr. and Foreman Instructor	Diagrams

Brief Summary of Training Action Plan - For Each Shift

Subject/Area/Content	For Whom	Method	Location	Time Allocated	By Whom	Preparation (equipment required)
8. Pass changing and guide setting	Rougher downwards including all those who do pass changing (including (guide fettler)	Talk	Lecture room	30-45 min.	Instructor with Roller	Guides, etc. brought.
9. Practical pass changing	" 2 at a time (guide fettler)	2 at a time under supervision then by themselves	On the job	30 mim. for each charge 4 or 5 groups 4 or 5 shifts	Foreman Roller	Prepare spare stands.
10. Session as to what happens in the guideshop	" plus roller and finisher	Talk and visit	Lecture room and/or guide shop	?	Guide Engineer	Consult guide engineer about details.
Cobble Diagnosis						
11. Introduction - causes of cobbles in mill - various types that occur in different areas. General comment on prevention (what can be prevented and what can't)	Roller finisher rougher reel op. sparehand main pulpit operator furnaceman	Lecture room	Lecture	2 x 45 min.	Manager or Ass. Mnger.	Diagram of mill. Systematic notes on all possible cobble types. Methods of prevention etc.

Brief Summary of Training Action Plan - For Each Shift

Subject/Area/Content	For Whom	Method	Location	Time Allocated	By Whom	Preparation (equipment required)
12. Actual Cobble Diagnosis Taking each exhibit 1. What is wrong with section	Roller finisher rougher reel op. sparehand main pulpit operator	Discussion of exhibits preferably led by the roller of each shift	Lecture room	2 to 4 45 min. sessions	Roller Section Mgr or Foreman Instructor	Clarification by Management and instructor of pts 1 to 4 so that a proper check list is made. Then discussion and briefing of this with roller.
2. What caused the section to get like this 3. What kind of action to take, by whom 4. What kind of action might have prevented it.	furnacemen	As follow up - ask roller to provide cobbles to T.O. that occur during shift - ask what circumstance then when get enough have a meal break session on them or even 1/2 hr. overtime.	Shop floor or canteen	As and when necessary		V.I. that preparation is done properly.

On The Job Training Support For The Programme

It is proposed that in support of the off or at-the-job programme there should be a systematic on-the-job scheme of training for promotion particularly in those job elements relevant to cobble prevention. It is hoped that the roller on each shift will play an important part in this.

The proposal is that, for each day shift fortnight worked, the reel operator (or spare man), rougher and finisher should each spend one full shift standing in for the job above (at different times). On these shifts the training officer will be in attendance all the time along with the operative who normally does the job. The training officer with the help of the foreman will use the shift as a training session for both operatives. It is hoped also that the roller will spend some time during the shift with the operatives concerned while the foreman takes over his job. This will reinforce the rollers training role. On the shift when the finisher takes over the rollers job it will be used as a learning and training experience for the roller as well as for the finisher. On these shifts it is proposed that the roller spend 1 hour with the main pulpit operator, to learn about loop control with the section manager in attendance.

This system should continue until the training officer is satisfied by the performance of operatives in their own jobs and in the job above them with particular respect to cobble prevention.

The rota will be as follows:

Day shift 1 - reel operator or spare hand with rougher.

Day shift 4 - rougher with finisher (with spare hand or reel operator taking over rougher's job.

Day shift 7 - finisher with roller (other operatives moving up).

On Day shift 4 and Day shift 7 the foreman and roller will give particular attention to jobs being 'stood in for' other than the job for which the training is being carried out.

PART II CHAPTER III

APPENDIX 7

Estimating the Costs and Benefits of the Programme

APPENDIX 7

ESTIMATING THE COSTS AND BENEFITS OF THE TRAINING PROGRAMME

1. Estimating the Costs of the Training Programme

These can be estimated as X + Y (+ Z) where

X = the cost of the analysis, research and interviewing

Y = the cost of drawing up, organising and implementing the training programme

Z = the cost of maintaining the training standard

Z will be applicable in full if the cost benefit calculation is to be made over a number of years.

Definition and Calculation of X

The costs under X are the costs of analysis, research and interviewing. They include the cost of the research worker's time, the cost of the help that the training officer gave in this period and the costs of time spent by management, foreman, operatives and any other personnel during the enquiry.

The management and foreman's time taken were judged to have incurred no cost. The use of the foreman was in short periods of slack time (when he could spare some time) although there may have been some small opportunity cost. Interviews with the management and other staff also took place at any time when a short period could be spared; this was extremely uneconomical use of the research worker's time but incurred no real opportunity cost of management time.

The interviews of operatives on average lasted about 3 hours per operative (with one or two breaks). This meant taking the operative off the shift to a spare room. This was possible because the shift carries a spare man whose job is to stand in when there is an absentee. Removing the single operatives from the job therefore did not wholly disrupt the shift; and, it can be argued, that there is a stand in who is paid anyway and therefore no real cost was incurred. It is possible, however, that removing senior operatives from a plant will interfere with production to some degree and for this reason the time of operatives spend during interviews has been estimated at half the wages cost.

The analysis costs are therefore as follows:

Trainer's salary - 20 days	£89
Researcher's salary - 3 full months spread over 7 months	£600
Operatives' time (operatives for 3 hours at half time rate plus bonus average)	£11
TOTAL:	£700

Definition and Calculation of Y

These are mainly the labour costs of those participating in the training including the salary of the training officer. Management time spent on lecturing has been included as it is a formal commitment and is likely to have opportunity costs. There was no real way of estimating opportunity costs of management time other than to use salary as a proxy for marginal revenue foregone.

The training programme proposed can be divided into two parts:

A. A formal programme located off or at the job, following the summary "Training Action Plan" in Appendix 4.

B. An on-the-job training support programme.

A. The costs of the "Training Action Plan" are estimated as:

1.	Trainer's salary - 4 months (Preparation and delivery)	£540
2.	Materials	£10
3.	Operatives' time in formal training sessions (See below for calculation)	£306
4.	Management time (See below for calculation)	£49
	TOTAL	£905

The estimated labour costs of operative and management time (Items 3 and 4 above) were calculated as in Table 1.

TABLE 1

Wages and Salary Costs of Training*

Topic	Session	Operatives involved 1 Shift	Operatives involved 3 Shifts	Total Man/Hours	Rate 1 Hour	Costs £.	s.	d.
Mill	1	5	15	30	12/-	18	0	0
Balance	2	5	15	15	12/-	9	0	0
	3	7	21	21	14/-	14	14	0
	4	7	21	32	14/-	22	8	0
Reapeaters	5	6	18	18	14/-	12	12	0
and	6	6	18	54	14/-	37	16	0
Loop Control	7	6	18	18	14/-	12	12	0
Pass	8	7	21	21	12/-	12	12	0
Changing	9	5	15	120	11/-	66	0	0
	10	9	27	27	12/-	16	4	0
Cobble	11	8	24	48	14/-	33	12	0
Diagnosis	12	8	24	72	14/-	50	8	0
		Total cost of operative wages			=	£305	16	0

*Please note that costs are pre-decimilisation.

Management Time Costs

			£	s.	d.
Sessions	2	Ass. Mill Manager (A.M.M.) 4 hours (25/- per hour)	5	0	0
"	3	A.M.M. 3 hours	3	15	0
"	4	Section Manager (S.M.) 4½ hours	5	12	6
"	5	Mill Manager (M.M.) (30/-)	4	10	0
"	6	A.M.M. 9 hours	11	5	0
"	7	A.M.M. 3 hours	3	15	0
"	12	Guide Engineer 3 hours (20/-)	3	0	0
		TOTAL	36	17	6
		Plus one-third extra for preparation	12	6	0
		TOTAL COSTS	£49	3	6

Notes

a. The training officer costs are included later as a lump sum for both the analysis and training.

b. No cost for the foreman has been included as the mill is down during the training and the opportunity cost is small.

c. Costs of management participation in the programme have been estimated at the hourly salary rate.

d. The training programme will be carried out when the mill is on a dawn shift (it is currently operating on a reduced shift system). The real opportunity costs of training the operative are therefore virtually nil, (he would otherwise largely be 'tidying up'). Nevertheless, the costs of training have been estimated at the hourly wage cost. For each operative this has been calculated at his hourly rate plus his fall-back bonus rate. For groups of operatives, a rough average per head has been taken; this average is higher for the top operatives than for those lower down the line.

Definition and Calculation of Z

Once the necessary standards have been achieved then maintenance training costs will be a function of turnover in the top jobs, technical and other changes than may need retraining and occasional 'remedial' sessions needed when particular problems occur.

Labour turnover in the top jobs is virtually nil and is likely to result only from sickness, injury or retirement. Retirement is more than 10 years over the horizon for all the mill crew and there are only three of the twelve senior operatives aged over 40; thus, barring industrial injury, the incidence of long term sickness is likely to be small. It is assumed therefore that over the next ten years manpower losses in the operative jobs for which training has been undertaken are likely to average only one for every three years. To meet this there will be the cost of training the less senior operative who moves into the bottom job vacated and the cost of training those who have moved up, for the job above the job they have taken up. This will incur costs of off-the-job training for the bottom man and on-the-job training for the others.

The costs of training for technical and other changes are the costs associated with these changes and do not relate to this exercise. The likelihood of changes in these factors making wholly obsolete the current training programme increases with time. For this reason the period over which the programme will remain relevant has been put as 6 years.

If proper validation and performance evaluation of the training is carried out there will be costs associated with this and with any remedial exercise that needs to be undertaken then or in the future. It is impossible to forecast accurately the incidence of any remedial or maintenance training. It is proposed therefore that an annual sum equivalent to one month of the training officer's salary for this purpose plus approximately half the cost of the present programme, be set aside for this.

Costs of maintaining the training over the next six years may therefore be as follows:

<u>Labour Turnover</u> Costs incurred every three years (Estimated to be incurred in years 2 and 4 during the 6 year period).

Costs of formal off-the-job training of one man estimated at 1/16th of the current programme cost minus development costs = £150

Present value of such costs incurred in the second and fourth years = £199 (Discounted back at a rate of 15% chosen because it was the current estimated rate of return on investments in the industry)

Remedial Training Costs (annual)

Trainer's salary for one month	= £134
Further training (half cost of current programme excluding trainer's salary)	= £182
Present value of these costs incurred annually over 6 years	=£1,196

In the case of both labour turnover costs and the remedial training costs there will be costs of on-the-job training to be added.

On the basis described above total maintenance costs of training over a 6 year period = £199 + £1,295.

Total Costs of the Training Programme

These are X + Y (+Z) = £700 + £905 (+ £1,295) = £1,605 + (£1,295).

N.B. The on-the-job support training sessions, as proposed in Appendix 4 would not directly disrupt the operation of the mill. On three day shifts every fortnight, however, one or more of the top three mill floor jobs would be taken up by the operator in the job below. The training officer estimated that up to 12 such sessions may be needed for each job. On these occasions other mill personnel, including the foreman and shift manager, will be attempting to ensure that there are no adverse effects on production. Of the three occasions every fortnight when on-the-job training take place, it is estimated that only in one case - that when the finisher has to do the roller's job and both the rougher and the reel operator have to move up - will shift output be endangered. It is impossible to estimate what the effect might be; but management can made a judgement based on the conclusions to this Appendix as to what kind of effect would be tolerable given the expected rate of return.

Trainers' salary costs for on-the-job training are incorporated in the estimates.

The estimated costs of training however exclude the costs of the on-the-job training support programme. It is also the case that because the mill is operating below capacity at the moment the time of operatives can be costed into the programme at wages cost. If the mill was working at full rate, then training would either have to be undertaken as over-time which could boost costs by approximately 50% or during normal production hours.

2. Estimating the Benefits of the Programme

The estimation of benefits from reducing unscheduled down time in the rod mill was made by measurement of opportunity costs in the form of revenue foregone. The method of calculation is set out below. All calculations are made using 1971 data.

Definitions

The cost per hour of mill down time = £(X + Y)

Where X = the gross revenue contribution form bar/ rod that would have been rolled but which cobbled in the process minus the scrap value of cobbled material.

Where Y = the added value that would have been produced by the mill in the normal running time available (if there had not been cobbles) minus any expenses that vary directly with tonnage (but excluding tonnage bonus which is paid anyway) and minus any contribution from alternative use of variable resources.

The concept of revenue foregone which has been used to calculate Y is most valid if the mill is operating at or near capacity. It has been used because in the latter period this was believed to be the case and is certainly the case now and probably also for the immediately foreseeable future. If this was not the case then Y could be discounted and an additional factor Z introduced where Z = all the incremental costs incurred in running the mill for longer periods of time e.g. overtime payments, power, higher maintenance charges, etc. in order to make good the deficiency caused by unscheduled down time.

Data

The 1971 data on which the calculations are made is as follows:-

1. Standard cost of each billet which enters the mill ($\frac{1}{2}$ ton) = £21.
2. Scrap value is £13. ton : One scrapped $\frac{1}{2}$ ton billet is valued at £6.50.
3. Cobbles cause on average 15 minutes down time (4 per hour - estimated from shift data over 1 year).
4. The sales revenue of a bar = £48 per ton

   The sales revenue of coiled rod = £52 per ton

   $\therefore$ average value per $\frac{1}{2}$ ton billet = £25
5. The mill throughput rate is 41.6 tons per hour for rod and 64.07 tons per hour for bar.
6. Gross added value per ton: of bar = £48 - £42 = £6

   of rod = £37 - £42 = £10

Calculation of X

One hour down time	=	4 cobbles
Average gross revenue per billet processed	=	£25
Average scrap value per billet	=	£6.50.
Therefore X = (4 times £25) minus (4 times £6.50)	=	£74 per hour

Calculation of Y

If the mill had been running smoothly then aside from the 4 bars that cobbled (equivalent to 2 tons of material), throughput would have been 39.6 tons of rod in the hour and approximately 63 tons of bar.

The gross added value foregone per hour for rod is
39.6 x £10 = £396

The gross added value foregone per hour for bar is
63 x £6 = £378

Therefore X + Y (for Rod) = £396 + £74 = £470 per hour

Therefore X + Y (for Bar) = £378 + £74 = £452 per hour

Notes:

1. From this contribution figure ideally ought to be deducted a small sum for direct power cost which are obviously not incurred if the mill does not run.
2. An average gross revenue contribution has been calculated for X rather a specific one for rod and bar separately for ease of convenience. It makes only a marginal difference to the calculation.

In the period from October, 1969, to September, 1970, there were 46 weeks in which either rod (21 weeks) or bar(25 weeks) were rolled. Over this period time lost on rod rolling because of stand cobbles was 45.5 hours and on bar rolling 22.3 hours (see Appendix 1).

The costs of this time lost were therefore:

45.5 x £470 = £21,385 for rod

and 22.3 x £452 = £10,094 for bar

TOTAL: = £31,479

If it is assumed that the variance from standard will persist in the 46 weeks following, unless training takes place, the potential returns to training are £31,479 which discounted back over 1 year gives £26,757.

The Cost Benefit Ratio

Total estimated costs of training (assuming no maintenance costs) over one year	=	£1,605
Total estimated benefits over 46 rolling weeks	=	£26,757

PART II CHAPTER III

A P P E N D I X 8

The Training Programme Implemented

APPENDIX 8

THE TRAINING PROGRAMME IMPLEMENTED

1. Objective of Programme

To reduce time lost through Stand cobbles by 100% of adverse variance from budgeted time.

Sub-objectives

(a) to develop the roller as a trainer of his crew

(b) to create the conditions for effective on-the-job training

(c) to develop in all operatives a systematic approach to the identification of the causes of cobbles

(d) to develop in all operatives a pattern of behaviour designed to prevent the occurrence of cobbles

(e) to provide general operating knowledge for the roller, finisher, rougher and main pulpit operator in any areas of the plant where weaknesses can be agreed

(f) to increase the general knowledge on the operation of the mill for all operatives up to and including reel operators.

From the objective the following courses were designed:

3 days on Instructional Techniques for the rollers

2 days on Cobble Diagnosis and Cobble Prevention for roughers and then finishers and finally (one day) for rollers

2 days on Instructional Techniques for Main Pulpit Operators

2 day course (5) on basic rod mill practice including practical work on guide setting and pass changing for all operatives up to and including reel operators

The off-the-job courses were held over a period of eight weeks from March 6th to April 28th, 1972. Shift workers were taken off their shift and put on 'days' for the duration of the courses they were to attend. No-one lost any wages during the off-the-job training.

2. <u>At-the-job Training - Design</u>

In relation to achieving the main objective (i.e. a reduction in time lost through stand cobbles) great emphasis had been placed in all discussions with management on the importance of the at-the-job training of mill operatives. It was agreed with management that unless the at-the-job training was planned and carried out conscientiously there was little hope of achieving any diminution of time lost. The off-the-job courses were designed to prepare operatives both to give and receive at-the-job training.

The at-the-job training needs were identified by the roller of each crew as follows:-

(a) the roller compared the performance of each operative on his team in key tasks relating to the operative's own job and to two jobs above him in seniority against a standard performance**

(b) where an operative fell short of this standard a training need was said to exist and that this would be covered by at-the-job training

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**<u>Standard Performance</u> - It proved too difficult to establish measurable performance standards in the key tasks and so we had to use the subjective assessment of the roller. The roller was asked to compare the performance of an operative in a key task against the rollers own performance in this task. The assumption was made, not unreasonably, that the roller was the 'best' operative and that we would need to train up to this standard.

This analysis was carried out by each roller during the course on Instructional Techniques and it was used to decide the main at-the-job training priorities. These were as follows:

(a) to train roughers in tasks relating to the job of roughing

(b) to train reel operators in tasks relating to:

  (i) main pulpit operation

  (ii) the job of rougher

(c) to train the furnace charger in:

  (i) main pulpit operation

  (ii) reel operation

3. <u>At-the-job Training - Control</u>

A system of cards was used to control the amount and, hopefully, the quality of the at-the-job training. Each card contained a description of the 'key points' to be covered during the instruction on a particular task. These 'key points' were the summary of discussion held between the rollers and Board training staff and the words used on the cards were those of the rollers.

It was expected that the cards would be issued in careful sequence by training staff to the rollers, they would execute the instruction and return the card. The card would then be handed to the roller foreman who would check and confirm that the trainee could now do the task on the card.

Management agreed that the system of cards and the identification of needs was an on-going process and that events in the mill: job movements, labour turnover etc. might quickly make the present scheme redundant.

At-the-job Training

Considerable importance was attached to this aspect of the training programme and the early progress was disappointing.

One week after issuing the Training Cards no progress had been made on one shift, little on a second, and a suspiciously large amount on the third.

A few weeks later a meeting was held to discuss the situation at which all members of the mill management were present. It was agreed that the responsibility for progressing the system of at-the-job training should pass from the training staff to the shift manager, although the responsibility for instruction would remain with those trained in instructional techniques. Under this system the identified training tasks were completed.

It is difficult to make a reasoned judgement about the quality of the at-the-job training. The system introduced was intended to be used to monitor progress and not to be used to coerce the instructors into carrying out tasks unwillingly. Nevertheless, it is believed that one of the rollers completed training cards without always having completed the instruction. There is no evidence however, to suggest that this practice applied across the other shifts, and on the whole it is accepted that much useful instruction was carried out.

PART II CHAPTER III

APPENDIX 9

Summary of time allocated to preparation and implementation of training

APPENDIX 9

Summary of Time Allocated to Preparation and Implementation of Training

Time spent on

Job Holder	Formal Discussions	Formal Meetings	off-the-job Training: Preparation	off-the-job Training: Conducting or Attending	Full-time
I.S.I.T.B. Staff					55 days (up to 6.7.72)
Training Instructor					75 days (10.1.72 to end of off-the-job training)
Mill Manager		5 hours			
12 Mill Section Manager	2½ hours	4 hours	4 hours	2½ days	
Mill Day Foreman	3½ hours	1 hour	3 hours	4½ days	
3 Shift Managers	6 hours	3 hours	3 hours		
Works Training Officer		3 hours	2½ hours	2 days	
Guide Engineer				4 hours	
3 Rollers				12 days	
3 Finishers				3 days	
3 Roughers				6 days	
3 Main Pulpit Operators				6 days	
Less Senior Operatives				8 days	

PART II CHAPTER III

APPENDIX 10

Calculation of Costs and
Benefits, Post-Training

APPENDIX 10

CALCULATION OF COSTS AND BENEFITS, POST - TRAINING

The formulae suggested in Appendix 7 for calculated costs and benefits were:

Costs		=	X + Y
Where:	X	=	the cost of the analysis
and	Y	=	the cost of drawing up, organising and implementing the training programme
Benefits		=	A + B
Where	A	=	The gross revenue contribution from bar/rod that would have been rolled but which cobbled in the process <u>minus</u> the scrap value of cobbled material.
and	B	=	The added value that would have been produced by the mill in the normal running time available (if there had not been cobbles) minus any expenses that vary directly with tonnage (but excluding tonnage bonus which is payed anyway) and minus any contribution from alternative use of variable resources.

Costs

Using the formula for costs:

X = 700

Y = 1,219

X + Y = £1,919

The company accountant provided the overall figure of £669 to cover the time listed in Appendix 9. To this must be added the cost of the time of a member of I.S.I.T.B. staff although the company did not pay for this service. This was assessed at £550 over the period January to April, 1972. There were no consumable expenses in providing the training except chalk. There were no obvious costs associated with the at-the-job training since there was no break in in production. All off-the-job training was undertaken when the mill was down because of shortage of orders. There were therefore no major opportunity costs.

Benefits

The original estimate of benefits was couched in terms of the revenue to be derived from reducing lost time to standard. While this facilitated the setting up of a 'target' for training the simplest way to measure changes in mill utilisation which could be associated with training was to measure the savings in time lost pre- and post-training.

Delays in the implementation of the training programme have been explained in the text. These led to the decision to recalculate the down-time estimate for the period immediately prior to the implementation of training i.e. from April, 1971 to end-February, 1972. This data is summarised in Tables 1 and 2 and indicates that over this period there were 11 rolling weeks for bar, 8 for coiled rod and 27 when straight bar and coiled rod were rolled. Over this period of 46 weeks there was an excess of variance of time lost over budget at all points on the rolling line of 314 hours of which 55 hours was due to stand cobbles.

The post training data was calculated from April, 1972 to the beginning of March 1973 (see Tables 1 and 2). During this period there were 45 rolling weeks 14 of which were on bar, 20 on coiled rod, and 11 mixed rod and bar rolling.

The improvements between the two periods is shown in Tables 1 and 2. Table 1 demonstrates that for the mill as a whole there was an improvement in stoppage time of 277 hours between the two periods. Table 2 indicates that 180 hours of this was due to a reduction in stand cobbles. If these figures are reduced to an average shift basis in order to give comparability for the different number of weeks and shifts worked in the two periods, an average improvement of 32 minutes per shift overall is shown between the two periods. Time saved on the reduction of stand cobbles contributed 23 minutes of this.

If the average time saved per shift is calculated separately for rod, bar and mixed rod and bar rolling shifts between the two periods and this figure is multiplied by the number of shifts worked on each product during the second period a total time saved can be calculated as in Table 3. If the hourly revenue contributions from rod and bar rolling as calculated in the estimates in Appendix 7 are applied, and an average used for weeks when mixed rod and bar rolling took place, a total of £77,055 can be calculated as the amount 'saved' between the two periods (Table 3).

The figure of £77,055 in Table 3 almost certainly does not indicate the benefits associated solely with training inputs. The considerable improvement in mill utilisation between the two periods must be explained in part by the change in product mix. For example there were many more weeks devoted totally to straight bar or rod rolling in the second period than in the first. Longer runs on certain products would be expected to give a lower incidence of stand cobbles.

Support for the calculation that product mix may not account for all the improvement, however, comes from the fact that there is still a noticeable improvement in utilisation of 8 minutes a shift even if only weeks when both bar and rod were rolled are compared (Table 3). In these weeks the economies to be obtained by larger runs would not be available. If it is therefore assumed that this 8 minutes a shift represented the minimum improvement that could be positively associated with the influence of training then, when it is applied to bar rolling and rod rolling in the second period (1972/73), a 'saving' of approximately 32 hours or 22 hours respectively is evident. When added to the 'saving' in weeks when mixed bar and rod were rolled (17 hours) and valued on the basis demonstrated in Appendix there is a benefit greater utilisation between the two periods of £34,070 (Table 4). This could be inferred to represent the minimum benefit from training. Discounted at 15% over 1 year this gives £28,960.

The overall calculation can therefore be presented as

	Estimated (£)	Actual (£)
Costs	1,600	1,919
Benefits	26,757	28,960

N.B. 1. In the calculation of benefits the approach A + B have used because during most of the post training period the steel industry was again booming and the mill operating at full capacity.

2. The rate used for discounting was 15% a year. This is actually higher than the rate expected of a nationalised industry at the time (8%) and is very much higher than the actual return in the steel industry over the previous 10 years. It was however the rate recommended by the then Prices and Incomes Board as a rate for the steel industry.

TABLE 1

SUMMARY: Total Time Lost in Rod Mill Pre- and Post-Training Experience

	Pre-training period 13/4/1971 to 26/2/1972				Post-training period 1/4/1972 to 3/3/1973			
	All rolling weeks	Straight bar rolling weeks	Coiled rod rolling weeks	Straight bar and coiled rod rolling weeks	All rolling shift weeks	Straight bar rolling weeks	Coiled rod rolling weeks	Straight bar and coiled rod rolling weeks
No. of rolling weeks	46	11	8	27	45	14	20	11
No. of shifts	$550\frac{1}{2}$	$115^7/_{16}$	$97\frac{3}{4}$	$337^5/_{16}$	$552^{14}/_{16}$	$178\frac{1}{4}$	$243^1/_{16}$	$131^9/_{16}$
UNSCHEDULE STOPPAGES								
Total hours/minutes lost								
Budget	1491-03	308-06	253-18	929-39	1379-50	444-06	619-32	326-12
Actual	1805-28	368-05	297-24	1139-59	1528-41	430-43	692-35	405-23
Variance	(-) 314-25	(-) 59-59	(-) 44-06	(-) 210-20	(-) 148-51	(+) 13-24	(-) 73-03	(-) 79-11
Time lost per shift								
Budget	2-43	2-40	2-35	2-43	2-30	2-29	2-33	2-29
Actual	3-17	3-11	3-02	3-22	2-45	2-25	2-49	3-05
Variance	(-) 0-35	(-) 0-31	(-) 0-27	(-) 0-39	(-) 0-15	(+) 0-04	(-) 0-16	(-) 0-36

TABLE 2

SUMMARY: Time Lost in Rod Mill Due to Stand Cobbles Pre- and Post-Training Exercise

	Pre-training period 13/4/1971 to 26/2/1972				Post-training period 1/4/1972 to 3/3/1973			
Total Time Lost (Hours - Minutes)	All rolling weeks	Straight bar rolling weeks	Coiled rod rolling weeks	Straight bar and coiled rod rolling weeks	All rolling weeks	Straight bar rolling weeks	Coiled rod rolling weeks	Straight bar and coiled rod rolling weeks
Actual	669–59	138–43	110–54	420–42	489–45	110–52	231–35	147–18
Budget	614–55	121–06	107–24	386–25	562–44	178–38	252–49	131–17
Variance	(–) 55–04	(–) 17–37	(–) 3–30	(–) 34–17	(+) 72–59	(+) 67–46	(+) 21–14	(–) 16–01
Time lost per shift								
Actual	1–13	1–12	1–08	1–15	0–50	0–37	0–57	1–07
Budget	1–07	1–03	1–06	1–09	1–01	1–00	1–02	1–00
Variance	(–) 0–06	(–) 0–09	(–) 0–02	(–) 0–06	(+) 0–11	(+) 0–23	(+) 0–05	(–) 0–07

TABLE 3

Analysis of Total Revenue gained by reduction of Stand Cobbles using average shift improvement criteria

Product	Number of Shifts	Time saved per shift (minutes)	Total time saved hrs.	mins.	Revenue per hour (A + B)	Revenue Gained
	(a)	(b)	(a x b)		£(c)	(a x b x c)
Straight Bar	178	35	103	50	470	48,801
Coiled Rod	243	11	44	33	452	20,136
Mix of Rod and Bar	132	8	17	36	461	8,118
			Total Revenue Gained			£ 77,055

TABLE 4

Analysis of Total Revenue gained by reduction of Stand Cobbles based on estimated minimum shift improvement of 8 minutes

Product	Number of Shifts	Time saved per shift (minutes)	Total time saved hrs.	mins.	Revenue per hour (A + B)	Revenue Gained
	(a)	(b)	(a x b)		£(c)	(a x b x c)
Straight Bar	178	8	32	24	470	15,227
Coiled Rod	243	8	23	44	452	10,725
Mix of Rod and Bar	132	8	17	36	461	8,118
			Total Revenue Gained			£ 34,070

PART III CHAPTER IV

APPENDIX 1

Major Characteristics of Establishments.

APPENDIX 1

Major characteristics of establishments

1. The size of establishment varied from just over 1,000 employees to over 6,000. The number of operatives in the works therefore varied accordingly but not in the strict relationship. Similarly the ratio of junior operative jobs in the works to total jobs varied.

2. Some idea of the range of job opportunities in the works can be obtained from the following summaries of the major operations of the establishments.

Establishment 1 Steel scrap and a smaller amount of pig iron is fed into five open hearth gas-fired and two electric arc furnaces. The open hearth furnaces were installed in 1950 the electric arc in 1958 and the soaking pits in 1967. In addition to this there is a cogging mill, a bar finishing department and a finishing and despatch bay in the mills. There is a continuous casting pilot plant and a vacuum de-gassing plant.

Establishment 2 There is one blast furnace producing 6,000 tons per week. Two mixers. Seven open hearth furnaces, six of which were working. One 42" cogging mill. One 32" finishing and roughing mill. A shot-blast plant and a slow grinding plant. The works mainly manufactures bar and billets.

Establishment 3 There is a coke works, three blast furnaces, (two were in use at the time of the visit), five open hearth furnaces and two mixers, a cogging mill and two plate mills (one mild and one heavy) and two pipe mills (20" and 44").

Establishment 4 There is a melting shop (with six open hearth furnaces), a bar mill, a light section mill, a plate mill and a rod mill.

Establishment 5 There are two coke oven plants, four blast furnaces, four open hearth steel plants, an electric furnace steelmaking plant, a basic oxygen steelmaking plant, two hot rolling heavy mills and two strip mills.

Establishment 6 There were three batteries of coke ovens, four blast furnaces, two melting shops one with 6 furnaces and three mixers the other with three furnaces and one mixer, a 15" and 32" section mill fed from a 42" cogging mill, a rod mill and a plate mill.

Establishment 7 There was a melting shop with 7 basic furnaces, a section and bar rolling mill from which were made rail sleepers, fish plates and base plates.

PART III CHAPTER IV

A P P E N D I X 2

A description of the labour model areas in which the establishments operated.

APPENDIX 2

A description of the labour market areas in which the establishment operated

1. One of the criteria which formed the basis from which the establishments were selected was the type of labour market areas in which they operated. The rationale behind this was simple, that voluntary mobility in and out of the establishment will be partly a function of local and national economic conditions as well as of conditions within the establishment. Given the limitations of the sample it was important to at least create an awareness that any common characteristics of wastage observed might possibly reflect similarities in local labour market factors.*

2. All other things being equal, potential mobility in and out of the establishments studied would be effected by the range of alternative job opportunities within reasonable access of the residence of the worker. The first determinant of this range of opportunities is the size of the local labour market area: if it is small the chances are that there will be fewer job opportunities within it. The second is the size of the steel industry establishment itself in relation to the local labour market. If the local steel works provide a very high proportion of local jobs then this cuts down on opportunities elsewhere. The third determinant is the number and range of jobs provided by other establishments; if the other local job opportunities are largely for females or are largely for certain kinds of workers (craft skilled) then again the local mobility potential of the un-skilled workers is diminished.

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*This does not of course imply that any generalisation from this data can be universally extended to the industry but only that the basis is more firmly set for further work which might establish these generalisations.

3. Within these general constraints, however, mobility will also be influenced by changes in demand and supply conditions over time. Thus it is argued that when the local labour market is "tight", as measured by low unemployment rates or a high ratio of registered vacancies to unemployment then the propensity of workers to quit voluntarily in search of better job opportunities will be higher. A related, but logically distinct, argument to this is that establishments operating in "tight" local labour market conditions will have higher rates of wastage than those in areas of labour market "slack", as, for example, measured by high unemployment rates.

4. Information was obtained from the relevant offices of the Department of Employment and Productivity about the size of labour market, the pattern of employment, the supply/demand position for labour, the peculiarities of the labour market and the problems in finding employment for young people in the vicinity of the establishment. In this Appendix the information is presented in tabulated form with brief comment.

Size of labour market (Table 1)

This was extremely difficult to measure for all the establishments particularly in relation to the larger catchment areas as the travel to work patterns were complex. Establishments 1, 2, 3, 4 and 5 had immediate labour market areas of very similar size. Although no figure is provided for the total catchment area of establishment 4 was likely to be in the 100,000 range. The total labour market area for establishment 5 was more difficult to judge because of very extensive travel to work patterns. Establishment 7, located in a very rural area, recruited a very high proportion of its workforce from the immediate locality.

Available alternative employment opportunities (Table 2)

With one exception the steel industry dominated the local labour market in employment terms accounting for between one-fifth and one-half of male jobs. In the labour market areas of establishments 5, 6 and 7 this domination was complete. The other establishments had, however, some competition for labour largely from the engineering industry. Particularly in the labour market area of establishments 5 and 6, to a lesser degree in relation to establishments 3 and 4 and to an even smaller degree for establishments 1 and 2 there was competition for labour from other steel industry establishments.

In terms of establishment size the only other major competition for labour in the vicinity of establishments 5 and 6 was provided by other steel works, the rest of the labour market being dominated by relatively small firms. Establishments 1, 2, 3 and 4, were competing with other large establishments for labour but together the large works by no means completely dominated the labour market. On a smaller scale the same is true for establishment 7.

Unemployment and vacancies (Table 3)

The demand/supply position for labour in the immediate catchment area of the establishments varied considerably from year to year for individual establishments. And, for any given year, the difference between establishments in different areas was equally marked. The local labour market position has been calculated for individual years by use of male unemployment rates and the ratio of numbers of male unemployed to vacancies registered - a measure of the supply/demand relationship. Thus, for example, in 1969 in the labour market area of establishment 1 there were 1.7 persons unemployed for every vacancy available. It should be noted that registered vacancies probably under-estimate the number of jobs available particularly in areas of high employment where employers have little prospect of obtaining suitable candidates for jobs through the exchange.

The data in Table 3 demonstrates the variety of labour market conditions operating over the time period of the wastage statistics data collection. Establishments 3 and 4 are in high unemployment areas where the numbers of unemployed consistently outstrip the numbers of vacancies. Establishments 1 and 2 are in high employment areas and have continually low unemployment rates, with the rate a little higher on average in the vicinity of establishment 1. Yet, measured in terms of unemployment/vacancies ratio the market appears to be tighter in area 1 than in area 2 in periods of high unemployment. Labour market conditions in the vicinities of establishments 5 and 6 are somewhat similar although the unemployment/vacancies ratio was generally higher over time in the locality of establishment 5. Establishment 7 has relatively high rates of unemployment and a very high ratio of unemployed to vacancies, although in practice the numbers involved are small.

<u>Other labour market characteristics</u>

In the vicinity of establishments 1 and 2 the travel-to-work pattern was very complex. Large numbers of residents travel out of these areas to work and probably correspondingly large numbers travel in. For example, over half of the resident male economically active population in the immediate labour catchment area of establishment 1 travelled outside of the area to work, and over one quarter of the male residents of the establishment 2 area did likewise. In these cases however, this did not reflect the lack of job opportunities for males or young people as these were numerous in the local area. Employment exchanges in these areas reported that there were no problems in finding employment for young workers.

This was less true in establishment areas 5 and 6. In both these labour markets the steel industry was far and above the major employer not only locally but within a wider area. And there was considerable travel into the twonships where the works were located. Of the estimated labour force employed in the immediate area of establishment 6 about one-third were not resident in the locality; and, although the estimate is less exact, over one-fifth of the labour force in establishment area 5 travelled in from outside the immediate residential zone. There were no overall shortages of jobs for young people in either of these areas but apart from the steel works the opportunities were not great, largely being confined to small light manufacturing industry.

In respect of establishments 3 and 4 it is clear that travel-to-work patterns are more complex than in the vicinities of establishments 5 and 6. Opportunities for young people are, however, very much more restricted not so much by the lack of other industry in these areas but because of the low proportion of employment growth industries and the consequently prevailing slack labour market.

Despite the high unemployment rates and unemployment/vacancies ratio there was reported to be no problem in placing young people in local industry in the vicinity of establishment 7.

TABLE 1

Size of Local Labour Market for Males 1968 (males aged 15 and over) (to nearest '000)

	Establishment						
	1	2	3	4	5	6	7
Size of establishment	1,900	1,900	5,600	1,900	4,000	7,000	1,300
Immediate Labour market area[1]							
Manufacturing	14,000	20,000	14,000	14,000	13,000	22,000	2,000
All industries	23,000	24,000	24,000	23,000	19,000	35,000	4,000
Larger catchment area[2]							
Manufacturing	–	–	50,000	–	–	24,000	–
All industries	93,000	110,000	95,000	–	–	39,000[3]	–[3]

1 Usually the local employment exchange area or within five miles radius of the works

2 With recruitment of labour from surrounding towns and villages up to 10 miles radius

3 With recruitment of labour from surrounding villages

– Not available

TABLE 2

Major Industries Employing Male Labour in the Immediate Labour Catchment Area of Establishments, 1968

(expressed as % of total male labour force)

Industry Order	Establishments 1[1]	2[1]	3[1]	4[3]	5	6[2]	7[1]
Total numbers* employed (males)	22,511	23,564	24,155	22,891	18,808	38,493	3,774
Iron and Steel	20	14	20	33	164	44	37
Chemical & allied							
Engineering & electrical goods	13	20	16	21		6	7
Vehicles		7					
Metal goods n.e.s.	8	27	5				
Bricks, pottery etc.	7						
Timber, furniture etc.							
Construction	8	6	14	16	9	10	8
Gas, electricity, water			9				
Transport & communications				9		6	
Distributive trades			5				
Miscellaneous services				3			
Public administration						4	15

*In all industries (males)

[1] Minimum List Headings 311 and 312 only

[2] Total for Order V

[3] M.L.H. 311 and 322

TABLE 3

Male Unemployment rates and Unemployed/Registered Vacancies[1] Ratios in the Immediate Labour Market Areas of Establishments

Immediate labour market area relating to establishments

	1[2]		2[2]		3[3]		4[3]		5[2]		6[3]		7[3]	
	U	$\frac{U}{V}$	U	$\frac{U}{V}$	U	$\frac{U}{V}$	U	$\frac{U}{V}$	U	$\frac{U}{V}$	U	$\frac{U}{V}$	U	$\frac{U}{V}$
1962	1.6	1.1	1.6	5.0	7.4	72.0	5.8	38.0	-	-	2.0	1.0	6.8	313.0
1963	2.1	1.7	1.8	5.0	12.3	42.5	9.0	44.6	2.2	22.1	3.1	3.1	6.7	120.3
1964	0.9	0.3	0.6	0.5	6.9	33.3	4.8	4.9	0.9	1.0	1.6	0.9	3.3	13.6
1965	0.8	0.2	0.3	0.1	4.8	9.6	3.1	2.3	0.8	0.9	1.4	0.5	2.6	10.0
1966	1.0	0.4	0.5	0.3	4.6	6.1	3.2	3.7	0.9	1.1	1.2	0.6	5.2	18.6
1967	2.1	1.7	1.5	10.0	7.6	18.9	5.9	10.7	2.3	5.3	2.0	1.4	5.5	15.7
1968	2.8	2.0	2.0	10.0	8.5	20.6	5.2	13.1	2.9	3.6	2.5	2.2	4.2	13.0
1969	2.8	1.7	1.5	3.3	8.5	16.6	5.0	8.3	3.1	3.2	4.2	1.3	3.2	7.8

[1] Vacancies registered at the local employment exchange.

[2] Average number of unemployed and vacancies for the year.

[3] Average of January and June (or Jan./July) unemployed and vacancies for each year.

PART III CHAPTER V

A P P E N D I X 1

Tables 1 - 7.

TABLE 1

TRAINEES

Cumulative Percentage Distribution of Leavers as a Proportion of Total Leavers

	Total Intake	(Months) 1	3	6	12	18	36	Over 36	Total Leavers (nos.)
Establishment 1 (1962-65)	141	1	8	12	24	36	62	100	101[1]
Establishment 2 (1962-65)	144	6	17	28	53	68	87	100	112[2]
Establishment 5 (1960-65)	293	4	12	30	55	69	87	100	232[3]
Establishment 6 (1963-65)	332	2	10	19	32	46	73	100	186[4]

1 Including 4 leavers whose date of leaving was unknown

2 Including 3 leavers whose date of leaving was unknown

3 Including 9 leavers whose date of leaving was unknown

4 Including 61 leavers whose date of leaving was unknown

TABLE 2

ESTABLISHMENT 4 TRAINEES AND DIRECT ENTRY

Cumulative Distribution of Leavers

	Year	Total Intake	Months 1	2	3	6	12	18	36	72	96	Total Leavers (Nos.)	Leavers as Percent of Intake
Percent distribution for each years intake	1961	112[1] (134)[2]	4	4	5	16	30	47	60	85	86	96	86
	1962	65 (81)	3	5	8	8	25	43	65	92		60	92
	1963	106 (121)	1	5	6	10	25	41	59	80		85	80
	1964	100 (112)	8	11	12	25	44	59	78	86		86	86
	1965	107 (127)	6	12	19	28	54	69	79	91		97	91
	1966	111 (125)	5	10	13	24	50	66	77	83		92	83
	1967	95 (115)	2	7	13	33	53	63	76	77		73	77
	1968	116 (149)	9	22	26	40	55	64	66	———	———	76	66
Percentage distribution of leavers as a proportion of total leavers 1961–65		490 (575)	5	8	12	21	42	61	79			424	

[1] For which length of stay data was available

[2] Total intake

——— not relevant

TABLE 3

TRAINEES

Cumulative Distribution of Leavers - During the First Year

	(Months) 1		2		3		6		12		
	Nos	(%) of intake	Nos	(%) of intake	Nos	(%) of intake	Nos	(%) of intake	Nos	(%) of intake	Total Intake Nos.
Establishment 1 (1963/68)	4	(2)	15	(9)	19	(11)	27	(16)	40	(24)	166
(Productive[1] length of stay	30	(18)	31	(19)	33	(20)	42	(25)	55	(33)	166
Establishment 2 (1963/68)	10	(4)	23	(10)	28	(12)	59	(26)	91	(40)	225
Establishment 3 (1965/68)	24	(6)	49	(13)	62	(16)	85	(22)	122	(32)	382
Establishment 5 (1963/68)	13	(4)	34	(9)	50	(14)	112	(31)	178	(49)	360
Establishment 6 (1963/68)	6	(1)	18	(4)	28	(6)	46	(9)	81	(16)	594(502)[2]

[1] Taken from when the operative becomes 16, and goes onto shift work.
26 of the 30 who 'left' within one month had no 'productive' length of service at all.

[2] 502 is the number of operatives for whom length of stay data was available.

TABLE 4

TRAINEES

Rate of Wastage - Out of Initial Intake During the First Eighteen Months and Out of the Remainder* During the Second Eighteen Months

	1962 Months		1963 Months		1964 Months		1965 Months		1966 Months	
	1-18	19-36	1-18	19-36	1-18	19-36	1-18	19-36	1-18	19-36
Establishment 1	13	21	20	42	37	21	29	15	42	27
Establishment 2	28	33	44	60	50	20	66	15	61	17
Establishment 3	-	-	-	-	-	-	26	20	39	29
Establishment 5	39	19	56	17	54	35	82	50	55	48
Establishment 6	-	-	7	12	43	37	23	10	12	8

* For example, if there is an intake in any single year of 40, and 20 leave in the first eighteen months then the rate for this period would be $\frac{20}{40} \times 100 = 50\%$. If in the second period of eighteen months 5 people leave then the rate would be $\frac{5}{40-20} \times 100 = 25\%$ i.e. the number leaving in the first period is subtracted from the total intake to give the number 'at risk' in the second period.

TABLE 5

DIRECT ENTRY

Cumulative Distribution of Leavers - During the First Year

	1 month Nos	1 month (%) of intake	2 months Nos	2 months (%) of intake	3 months Nos	3 months (%) of intake	6 months Nos	6 months (%) of intake	12 months Nos	12 months (%) of intake	Total Intake Nos.
Establishment 1 (1963/68)	22	(7)	62	(19)	85	(26)	138	(42)	186	(57)	326
Establishment 2 (1963/68)	10	(6)	15	(10)	21	(14)	42	(27)	65	(42)	155
Establishment 3 (1965/68)	26	(8)	53	(17)	62	(20)	93	(30)	140	(45)	311
Establishment 5 (1963/68)	36	(11)	72	(22)	100	(30)	157	(48)	214	(65)	328
Establishment 6 (1963/68)	11	(2)	29	(7)	47	(11)	103	(23)	150	(34)	606(444)[1]

[1] For which length of stay data available.

TABLE 6

TRAINEES AND DIRECT ENTRY

Numbers Leaving and Returning to the Works

		A Nos. leaving	B Gross returns	C Net* returns	$\frac{C}{A} \times 100$ (%)	Nos. recruited
Establishment 1 1962–68	Trainees	133	26	4	3	214
	Direct Entry	305	61	16	5	423
Establishment 2 1962–68	Trainees	168	6	3	2	244
	Direct Entry	139	6	3	2	177
Establishment 3 1965–68	Trainees	211	30	20	9	450
	Direct Entry	177	42	14	8	305
Establishment 5 1960–68	Trainees	374	27	24	6	488
	Direct Entry	374	18	16	5	440
Establishment 6 1963–68	Trainees	285	95	49	17	594
	Direct Entry	565	175	53	9	606

* Those out of B still with the establishment in August 1969

TABLE 7

Leavers Within One Year

(% of Intake)

ESTABLISHMENT

	1		2		3		5	
	JOTS	JODS	JOTS	JODS	JOTS	JODS	JOTS	JODS
1960					30	28		
1961					33	58		
1962	6	40			34	43	24	36
1963	3	30			39	48	22	34
1964	31	58			38	62	33	37
1965	25	51	63	20	68	84	67	37
1966	31	57	47	34	42	64	50	56
1967	43	65	20	61	50	54	33	43
1968	29	64	41	42	56	64	30	58

PART III CHAPTER VI

APPENDIX 1

Checklist for background information to be noted/obtained when visiting establishment.

APPENDIX 1

CHECKLIST FOR BACKGROUND INFORMATION TO BE NOTED/OBTAINED WHEN VISITING ESTABLISHMENTS

GENERAL

1. Note the employment size of the establishment and the total number of operatives and junior operatives employed.

2. Note the plants/departments of establishment.

TRAINING OBJECTIVES

3. Training policy and organisation. How and who makes policy. How training department is organised. Who has responsibility for operative and junior operative training.

RECRUITMENT

4. Size and geography of local labour catchment area from personnel or recruitment officer.

5. Local unemployment conditions, particularly the market for young people. Who are the firms major competitors for young labour.

6. How the firm recruits junior operatives for training - relations with schools etc.

7. What is the definition of a junior operative direct entrant? Do direct entrants undertake any selection tests? Do junior operatives have any introductory training or education?

8. Are tests needed for any jobs (adult or junior)? Do juniors have a chance to sit adult tests?

TRAINING ORGANISATION AND METHOD

9. What is the current junior operative scheme in terms of:

   (a) who undergoes it?

   (b) when does the establishment recruit for these schemes?

   (c) how are the operatives selected (tests) or screened?

   (d) why does the establishment recruit the number that is recruited i.e. why not more or less?

   (e) what are the components of the training programme in terms of location, content and duration?

(f) if there is job rotation - where and for how long?

(g) are there job descriptions and proper job training for jobs they do during rotation?

(h) how, if at all, are they supervised during rotation training?

(i) is there any differentiation between some junior operative training and others e.g. in accordance with when they were recruited (Easter or Summer)? If so, what?

10. How long has the junior operative trainee course been running in its present form? What amendments have taken place - note particularly pre-1964 and post-1964 conditions.

11. Describe training centre facilities if any. How long has the Centre been built?

CAREER 'TRAINING'

12. City and Guilds

(a) What facilities are there for junior operatives to take City and Guilds?

(b) Which and how many operatives do City and Guilds - Section I - Section II - Advanced?

(c) Do any junior operative direct entry get facilities for this? If so, what?

13. Note any future plans for development of junior operative training, or proposed changes.

PLACEMENT

14. How are junior operative trainees placed in departments? Namely:

(a) Into what jobs can junior operatives go (whether trained or not)? Are there special youth jobs or not? (Note if policy is to take any into apprenticeship)

(b) Are there any jobs that junior operative trainees go into that are not given to junior operative direct entry?

15. (c) Are there any age or other restrictions on where junior operatives can be employed in the works? What are these?

    (d) Are there particular junior operative promotion (seniority) lines which feed directly onto adult lines or do junior operatives go straight into a labour pool when they become adults?

    (e) When does seniority begin?

REWARDS

16. How are junior operative trainees and junior operative direct entrants paid?

    (a) Note rates for trainees

    (b) Note average earnings for 16 and 17 year olds in works

    (c) Note any fall-back rates

17. Note whether there are any financial incentives for junior operative training, during and after.

18. Note any other peculiarities.

DOCUMENTS TO BE OBTAINED IF POSSIBLE

1. Description of the training course for junior operative trainees and direct entrants - content and plan.

2. Any in-works assessment forms during rotational training or experience after training.

3. Any papers or tests given for selection or performance.

4. Any written policy statements.

PART III CHAPTER VI

A P P E N D I X 2

Junior Operative Interview Schedule.

APPENDIX 2

EXAMPLE - JUNIOR OPERATIVE INTERVIEW SCHEDULE

Questionnaire No:.....

INFORMATION ABOUT ESTABLISHMENT

THIS MUST BE COMPLETED BEFORE INTERVIEW COMMENCES

Name of
Establishment ....

Region 1. Scotland

2. South-West

3. North-West

4. North East

5. North Midlands

6. Midlands

This interview Schedule was used for Junior operative trainees. The Schedule for 'direct entry' was identical to pages 1 to 12 of this copy (pages 13 onwards, were of course excluded) except in so far as questions 28 to 41 were slightly reworded because the direct entry had not been through the standard junior operative training programme.

The interviewers were asked to place a tick in the box associated with the answer. No boxes have been drawn in this Appendix as this would be a time wasting task.

INTRODUCTION

I am a member of a team from the Durham University Business School which is conducting a national investigation into the training and employment of operatives in the Iron and Steel Industry. The research is financed by the Iron and Steel Industry Training Board. All the Unions and companies concerned have been consulted and have given their support.

In the course of this research we will be interviewing large numbers of operatives, trade unionists, training personnel and managers in the industry, seeking information about their work and training experience. All the people interviewed have been selected at random and all interviews will be confidential. We therefore have no concern with the identity of the individual other than that he/she is employed in the steel industry.

DURHAM UNIVERSITY BUSINESS SCHOOL

I.S.I.T.B. RESEARCH

Junior Operative Interview Schedule

1. How long have you been with the company (continuous employment since the last job?

   Less than 1 month

   1 month and less than 3 months

   3 months and less than 6 months

   6 months and less than 1 year

   1 year and less than 3 years

   3 years and less than 5 years

   5 years and over

2. Occupation: Job Title ....

   Coke making operatives

   Operatives engaged in slinging, raw material handling and stacking - including conveyor operating

   Operatives on road vehicles, including lorries, cranes, fork lift and boom trucks

   Operatives on rail vehicles

   Operatives on overhead cranes

   Operatives on blast furnaces - including pig casting and sintering

   Operatives on steelmaking processes

Operatives on rolling mills:

- reheating furnances and soaking pits
- heat treatment furnaces
- rolling - including speed control operatives on cold rolling and finishing
- dressing, inspection, quality testing

Operatives on pipe and tube making or other further manufacturing pricesses

Warehousing, cutting, straightening and despatching, dressing, inspection quality testing

Operatives on fuel and power services

Operatives on screwing, drilling, sawing and other semi-skilled machine or maintenance jobs, including craftsman's mates

Operatives on general labouring duties

Trainees

3. Department ....

Coke ovens (including by-product plants)

Blast furnaces, sinter plants and ore preparation

Steel meting shops

Rolling mills

Ancillary processes associated with rolling mills

Forges and ancillary processes

Tubes, pipes and fitting manufacture (including coating)

Other production departments

Junior operatives not yet allocated

Maintenance workers other than
skilled craftsmen

Warehouse, packers and despatch
workers

Road and rail transport drivers
and shunters

4. How old were you when you first joined the company?

Years ....

Months ....

5. How long have you been on full production work?
(where relevant)

Months ....

6. At how many different times have you been employed by this company?

once

two times

three times

four times

five or more times

7. How long does it take you on average to travel to work?
(door to door)

15 minutes or less

16 - 30 minutes

31 minutes - 1 hour

Over 1 hour

8. How much does it cost you, on average per week, to travel to and from work?

Less than 10/-

10/- to less than £1

£1 to less than £2

£2 and over

9. Have you always worked in the steel industry?

Yes

No

<u>IF NO TO 9 THEN ASK 10</u>

10. How many firms outside of the steel industry have you worked for?

1.

2.

3.

4 or more

11. How long have you worked in the steel industry?

Years ....

Months ....

12. How many different works have you been employed in, in the steel industry?

Only this one

1 other

2 others

3 or more

13. How long have you worked in your present occupation?
(DEFINE OCCUPATION AS HIS PRESENT SPECIFIC JOB WITH THE FIRM)

Months ....

14. Is your job part of a recognised promotion line?
(BE PREPARED TO EXPLAIN AS BRIEFED)

Yes

No

Don't know

<u>IF YES TO 14 ASK 16, 17 AND 18, OTHERWISE GO TO 'EMPLOYMENT HISTORY'</u>

15. How long have you been on this promotion line?

Months ....

16. How many jobs are there above you on the promotion line?
(If the line splits count the minimum number of jobs to the top of the line)

Number ....

17. How many jobs are there on the promotion line?

Number ....

18. Which jobs above you on the ladder have you worked on, at one time or another?

One above

Up to two above

Up to three above

Up to four or more above

<u>EMPLOYMENT HISTORY</u>

IF THE INTERVIEWEE HAS BEEN THROUGH THE COMPANY JUNIOR OPERATIVE TRAINING SCHEME EITHER IN PART OR FULL THEN STATE. "THE NEXT FEW QUESTIONS ARE ABOUT YOUR EXPERIENCE SINCE YOU COMPLETED THE COMPANY'S JUNIOR OPERATIVE TRAINING

19. What was the first job you had with the company (after you completed the training programme)?

    Job ....

20. Was that job on a promotion line?

    Yes

    No

    Don't know

21. How many different jobs have you had with this company (since you completed the programme)?

    1 job only

    2 jobs

    3 jobs

    4 jobs

    5 jobs

    6 jobs

    Over 6 jobs

22. Have you always worked in the same department (since you completed the programme)?
    (BE PREPARED TO DEFINE DEPARTMENT)

    Yes

    No

<u>IF NO TO 22 THEN ASK 23 AND 24, OTHERWISE GO TO 25</u>

23. Which department was your first job in?

....

24. In how many different departments have you worked?

2

3

4 or more

EDUCATION

25. Which secondary school did you attend?

Secondary Modern or equivalent

Comprehensive

Technical School

Grammer

Other

26. At what age did you leave school?

Years ....

Months ....

27. While you were at school did you obtain any G.C.E.'s, C.S.E.'s or any other educational qualifications?

Yes

No

PROBE AND NOTE THE EDUCATIONAL QUALIFICATIONS OBTAINED

G.C.E.

C.S.E.

Other (Specify)

QUESTIONS FOR J.O.'S THAT HAVE BEEN THROUGH COMPANY PROGRAMME ONLY. STRESS THAT THESE QUESTIONS RELATE TO THEIR EXPERIENCE SINCE LEAVING THE PROGRAMME (INCLUDING ANY ROTATIONAL TRAINING 'EXPERIENCE')

28. Since you completed the company training programme have you attended any college or further education, technical college or any other educational institute?

Yes

No

<u>IF NO THEN GO TO QUESTION 36</u>

29. What further education courses have you attended since you completed the programme?
(INCLUDE ALL EXPERIENCE WITH THE COMPANY NOT JUST SINCE THE LAST TIME HE WAS STARTED)

<u>N.B. DO NOT ENTER WORKS BASED COURSES</u>

30. (Was this course
(Were all these courses laid on by the company?

Yes

No

Some were, some were not

31. Did the company send you on this (these) course(s) or did you volunteer?
PROBE FOR ACCURACY

Sent only

Volunteered only

Some sent, some volunteered

32. Could you estimate how many days of course you have attended over the past four years, or since you completed the training programmed? (whichever is the shorter)

PROMPTING WILL BE NECESSARY TO OBTAIN ESTIMATE

....

33. Since you completed the training programme have you obtained any further educational qualifications?

Yes

No

34. Since you completed the training programme have you taken any of the following courses?

(SHOW CARD)
PROMPT FOR PASS OR FAIL

City and Guilds Iron and Steel Operatives	Taken (being taken)	Passed	Failed	Waiting for results
Part I				
Part II				
Advanced				
Other C. & G. (Specify)				

35. Since you completed the training programme have you obtained any other qualifications? (EXPAND AS BRIEFED)

Yes (specify)

No

TRAINING

36. Have you had any training or further education provided directly by the company?
(EXPLAIN LOCATED IN THE COMPANY NOT AT TECHNICAL COLLEGE)

Yes

No

IF YES TO 36 ASK FOLLOWING QUESTIONS IN THIS SECTION OTHERWISE GO TO QUESTION 42

37. When did you have this training?

Less than 6 months ago

6 months to less than
1 year ago

1 year to less than
2 years ago

2 years to less than
3 years ago

Over 3 years ago

38. Could you estimate how many days of training you have had, for each course?

Course Title	No. of Days
	TOTAL

39. Over what period did the training take place?

Course	Training Period Weeks
	TOTAL

40. Where did the training take place? Classify into:

Off the job

At the job (supernumerary)
(instructor)
(special period)

On the job (with some, but not all, of the 'at-the-job' conditions present)

On the job (with none of the 'at-the-job' conditions present)

41. Was the purpose of the last piece of training that you had to enable you to:

A. do your own job more efficiently

B. do the next job up the promotion ladder

C. do another job involving promotion but not on a ladder

D. retrain for changes in your existing job

E. do another job (not involving promotion

other reasons

do no know purpose

42. Have you had any training for your present job with the company?

Yes

No

IF YES TO 42

43. Could you tell me where this training took place?

Off the job

At the job (supernumerary)
(instructor)
(special time period)

On the job (with some but not all of the 'at-the-job' conditions present)

On the job (with none of the 'at-the-job' conditions present)

44. Marital status.

Single or widowed

Married

45. Age.

15

16-17

18-21

22-26

27-40

41 +

46. Information to be obtained from pay office

Gross average current earnings in present occupation.
(average of last 6 pay weeks, excluding holidays)

....

TRAINING (Junior Operative Scheme - ex-Trainees or Trainees Only)

TO BE CHECKED WITH COMPANY RECORDS, THEREFORE PLEASE NOTE NAME OF BOY

....

'The following questions related only to your training under the company's junior operative training scheme.'

47.A. Further Education

A1. Did you attend a technical college or other institute of further education under the company's junior operative training scheme?

Yes

No

IF YES ASK REST OF QUESTIONS IN THIS SECTION, OTHERWISE GO TO B.

A2. Probe to discover

Days of course attended ....

Period covered ....

A3. Did you obtain any qualification during this (these) course(s)?

Yes

No

A4. What were the courses taken?
(SHOW CARD)
PROMPT

City and Guilds Iron and Steel Operatives	Taken (being taken)	Passed	Failed	Waiting for Results
Part I				
Part II				
Advanced				
Other C. & G. (Specify)				

B. <u>Training Off The Job At The Establishment</u>
<u>(Explain 'Off the Job')</u>

B1. Did you have any training or further education provided directly by the company under the company's junior operative training programme?

(STRESS THAT THIS IS TRAINING NOT ACTUALLY "ON" or "AT" THE JOB)

Yes

No

<u>IF YES ASK REST OF QUESTIONS IN THIS SECTION OTHERWISE GO TO C.</u>

B2. Probe to discover

Days of course attended ....

Period covered (weeks) ....

B3. Did you obtain any further educational qualifications? (SPECIFY)

Yes

No

C. <u>Training At Or On The Job</u>

C1. Did you have any other training?

Yes

No

<u>IF YES ASK REST OF QUESTIONS IN THIS SECTION OTHERWISE GO TO D.</u>

C2. Probe to discover whether all pre-conditions of 'at-the-job' training were present.

Supernumerary

Instructor

Time Period

If so then tick here ....
and probe to discover

Days of training ....

Period covered ....

Otherwise <u>note</u> whether:

One or two of the 'at-the-job' conditions were evident (tick)

None of the 'at-the-bob' conditions were evident (tick)

<u>and</u>

Probe to discover

Days of training ....
(on the job)

Period covered ....
(weeks)

D. Did you complete the training programme?

Yes

No

E. How old were you when you completed the training programme?

Years ....

Months ....

TRAINING (Junior Operative Scheme - ex-Trainees or Trainees only)

CHECKLIST IF THERE ARE COMPANY RECORDS

Note name of boy ....

A. Further Education

At Technical College or equivalent

Days of course attended ....

Period covered (months) ....

Further educational qualifications obtained during course

City and Guilds Iron and Steel Operatives	Taken (being taken)	Passed	Failed	Waiting for results
Part I				
Part II				
Advanced				
Other C. & G. (Specify)				

B. Further Education

At establishment or company training centre

Days of course attended ....

Period covered (weeks) ....

Further education qualifications obtained (Specify)

Yes

No

C. Training off the job at establishment

Days of training ....

Period covered (weeks) ....

D. <u>Training at the job</u>

(supernumerary)
(instructor)
(time period)

Days of training ....

Period covered (weeks) ....

E. <u>Training on the job</u>

Days of training ....

Period covered (weeks) ....

F. Completed training (on the job) entirely in accordance with company scheme.

Training (on the job) varied from company scheme.

G. Age at which completed company J.O. training programme.

Years ....

Months ....

PART III CHAPTER VI

A P P E N D I X 3

Tables 1 - 21.

Table 1

Numbers of Young Operatives still with the Establishment who Benefitted and did not Benefit[1] from the Junior Operative Training Programme

Junior operatives From intake of:		Number of operatives remaining at January 1st 1969	Numbers of J.O.'s taken on in period	Number of J.O.'s taken on in: 1968	1969
Establishment 1	JOT's	65	198	17	16
(1962-68)	JOD's	68	373	64	50
Establishment 2	JOT's	76	244	20	28
(1962-68)	JOD's	38	177	12	27
Establishment 3	JOT's	178	382	105	68
(1965-68)	JOT's	89	296	90	47
Establishment 5	JOT's	114	488	73	-
(1960-68)	JOD's	66	440	56	-
Establishment 6	JOT's	285	594	93	-
(1963-68)	JOD's	200	606	135	-
Establishment 7	JOT's	35	78	18	17
(1965-68)	JOD's	10	92	18	15

[1] the former described as JOT's (junior operative trainees)
the latter as JOD's (junior operative direct intake - junior operatives not trained

- not available

Table 2

Distribution of Ex-Trainees (JOTS) and Ex-Direct Entry (JODS) by Establishment

	ESTABLISHMENTS							
	1	2	3	4	5	6	7	Total
ex-trainees	37	38	37	49*	32	35	23	251
ex-direct entry	35	33	34	13	33	37	23	208

* A large number of JOT's were interviewed at this establishment under the assumption that they were JOD's. The establishment was unable to distinguish from the records those that were ex-trainees and those that were not. For purposes of comparison of JOT's and JOD's, the numbers of JOT's from the establishment were reduced to 14 by sampling from each year's intake sufficient numbers to give comparison with JOD's.

Table 3

Summary Table of Experience of Ex-Junior Operative Trainees in the Works Training Programme

	ESTABLISHMENTS							TOTAL
	1	2	3	4	5	6	7	1 - 7
Total numbers in sample	37	38	37	49	32	35	23	251
Numbers attending technical college or further education institute	21	36	37	44	18	27	6	189
Numbers taking City and Guilds Part I	18	32	37	44	3[1]	10	1[1]	145
Numbers passing City and Guilds Part I	10	21	21	13	3	5	0	73
Numbers passing City and Guilds at Training Centre	2	12[2]	0	0	4	0	12	30
Numbers undertaking off the job training or education at the works	37	37	31	49	20	34	22	230
Numbers having some sort of rotational training	35	28	31	1	4	21	2	122
of which: numbers of cases where this could be described as "at-the-job"	15	22	23	0	3	4	0	67
Number completing training programme	25	17	26	45	20	10	21	164

[1] policy of establishment is that City and Guilds is works training centre based.

[2] these operatives attended the technical college but took City and Guilds through the training centre.

Table 4

Age Distribution of Operatives Interviewed

Age Category	trainees or ex-trainees Nos.	trainees or ex-trainees % of sample	ex-direct entry Nos.	ex-direct entry % of sample
15 or under	2	0.9) *	4	1.9) *
16 - 17	43	19.9)	21	10.1)
18 - 21	143	66.2	127	61.1
22 - 26	28	13.0 *	55	26.4 *
27 - 40	0	0.0	1	0.5
Total	216	100.0	208	100.0

Table 5

Summary Table of Experience in Industry and Establishment

	ex-trainees		ex-direct entry	
	Nos.	% of sample	Nos.	% of sample
Total experience in steel industry (years)				
less than 2	35	16.3	45	22.0
2 to less than 4	86	40.2*	64	31.2*
4 to less than 6	57	26.7	52	25.4
6 and over	36	16.8	44	21.5
Continuous length of stay in establishment				
less than 6 months	10	4.7	16	7.7
6 months to less than 1 year	10	4.7	15	7.2
1 year to less than 3 years	65	30.1	64	30.8
3 years to less than 5 years	73	33.8	56	26.9
5 years and over	58	26.9	57	27.4
Length of time on production work[1] (years)				
less than 1	20	14.1	22	10.8
1 to less than 2	41	19.2	27	13.2
2 to less than 3	40	18.8	31	15.2
3 to less than 4	40	18.8	38	18.6
4 to less than 5	28	13.6	26	12.7
5 to less than 6	14	6.6)*	25	12.3)*
6 or more	20	9.4)	35	17.2)

[1] Usually from age 16 for trainees depending on idiosyncrasies of programme.

Table 6

Occupational Classification of Operative Jobs: First Job and Present Job

	ex-trainees		ex-direct entry	
	1st job[1] %	Present job[1] %	1st job[1] %	Present job[1] %
Coke making operatives	0.0	0.5	0.5	0.5
Operatives engaged in slinging, raw material handling and stocking - including conveyor operating	1.4	1.4	0.5	2.4
Operatives on road vehicles, including lorries, cranes, fork lift and boom trucks	0.5	2.3	0.5	4.3
Operatives on rail vehicles	1.4	3.3	3.2	2.4
Operatives on overhead cranes	0.5	8.4	1.1	5.3
Operatives on blast furnaces - including pig casting and sintering	0.9	2.3	1.1	2.4
Operatives on steelmaking process	11.4	12.6	10.8	11.1
Operatives on rolling mills:				
- reheating furnaces and soaking pits	10.4)	5.6)	10.8	5.3)
- heat treatment furnaces	1.4) 61.6*	2.8) 52.1*	0.0) 54.6*	1.0) 45.0*
- rolling - including speed control operatives on cold rolling and finishing	29.9)	31.6)	24.3)	26.1)
- dressing, inspection, qualify testing	19.9)	12.1)	19.5)	12.6)
Operatives on pipe and tube making or other further manufacturing processes	0.0	0.9	0.0	0.5
Warehousing, cutting, straightening and despatch. Dressing, inspection quality testing	9.5	8.8+	11.4	18.8+
Operatives on fuel and power services	0.0	0.0	0.0	0.5
Operatives on screwing, drilling, sawing and other semi-skilled machine or maintenance jobs, including craftsmen's mates	1.4	1.9	4.3	1.9
Operatives on general labouring duties	0.5	0.9	2.7	1.9
Trainees	0.5	0.0	0.0	0.5
Other	10.4	4.7	9.2	2.4
All Occupations	100.0	100.0	100.0	100.0
Total stated	211	216	185	207

[1] Of total stated.

+ Significant difference also (at 5%).

Table 7

Departmental Classification of Operative Jobs Compared with Departmental Distribution from Part I - Operative Sample

Department	ex-trainees Nos.	ex-trainees % of sample	ex-direct entry Nos.	ex-direct entry % of sample	Total Operative Sample (Part 1) %	of which Type 3 establishment	of which Type 4 establishment
Coke ovens (including by-product plants)	1	0.5	2	1.0	5.1	0.0	7.4
Blast furnaces, sinter plants and ore preparations	2	0.9	6	2.9	10.7	0.0	15.4
Steel melting shops	38	17.9	32	15.5	11.5	14.4	11.1
Rolling mills	135	63.1	135	65.2	26.9	24.7	26.0
Ancillary processes associated with rolling mills	19	8.9	13	6.3	6.9	6.8	6.9
Forges and ancillary processes	0	0.0	2	1.0	0.2	0.0	0.0
Tubes, pipes and fittings manufacture (including coatings)	0	0.0	0	0.0	13.8	17.1	14.1
Other production departments	2	0.9	1	0.5	8.7	19.9	3.5
Junior operatives not yet allocated	1	0.5	0	0.0	0.3	0.7	0.0
Maintenance workers other than skilled craftsmen	5	2.3	4	1.9	6.4	8.2	6.2
Warehouse, packers, and despatch workers	5	2.3	5	2.4	4.0	2.7	4.1
Road and rail transport drivers and shunters	6	2.8	7	3.4	5.6	5.5	5.3
TOTAL	214	100.0	207	100.0	100.0	100.0	100.0
Total no. of operatives					624	146	434

Table 8

Summary Table of Mobility of Operatives Between Departments

		ex-trainees		ex-direct entry	
		Nos.	% of total sample	Nos.	% of total sample
A. Always worked in the same department.		173	80.5	138	70.8
B. Worked in more than one department.		42	19.5	57	29.2
C. of which: department first worked in	Blast furnace	3	8.8[1]*	2	4.4[1]
	Melting shop	4	11.8	7	15.6
	Mills and ancillary process	20	58.8	25	55.6
	Other departments	7	20.6	11	24.4
	Not stated	8		12	
D. How many other departments worked in	One other	30	71.4[1]*	45	78.9[1]
	Two other	11	26.2	10	17.5
	Three or more	1	2.2	2	3.5

[1] Percentage of B.

Table 9

Summary Table of Job Mobility of Operatives

	ex-trainees		ex-direct entry	
	Nos.	% of sample	Nos.	% of sample
Number of different jobs with establishment[1]				
3 and under	97	45.1*	62	32.0*
4 to 6	57	31.2	78	40.2*
over 6	51	23.7	54	27.8
Not stated	1		14	
Length of stay in present job				
under 3 months	58	26.8	37	17.8
3 months to under 6 months	32	14.8	34	16.3
6 months to under 1 year	39	18.1	34	16.3
1 year to under 2 years	42	19.4	46	22.1
2 years to under 3 years	22	10.2	33	15.9
3 years or more	23	10.6	24	11.5

1 In the case of ex-trainees, from the date they completed the training programme. Therefore the number does not include jobs 'visited' during rotation.

Table 10

Summary Table of Promotion Line Status of Jobs - I

	ex-trainees Nos.	ex-trainees % of sample	ex-direct entry Nos.	ex-direct entry % of sample
A. Present job on promotion line	187	87.8	178	87.3
B. Length of time spent on present promotion line				
under 6 months	27	14.4[1]	18	10.1
6 months to under 1 year	26	13.9	26	14.6
1 year to under 2 years	43	23.0	29	16.3
2 years to under 3 years	33	17.6	32	18.0
3 years to under 4 years	25	13.4	21	11.8
4 or more years	33	17.6	52	29.2
Don't know				

[1] Percent of A.

Table 11

Summary Table of Promotion Line Status - II

	ex-trainees Nos.	ex-trainees %[1]	ex-direct entry Nos.	ex-direct entry %[1]
How many jobs above on the promotion line to the top				
2 or less	39	23.1	49	29.0
3 - 4	72	42.6	57	33.7
5 - 6	27	16.0	27	16.0
7 - 8	15	8.9	15	8.9
9 or more	16	9.5	21	12.4
Not stated	18		6	
How many jobs below to the bottom of promotion line				
9 or more	5	3.1	9	5.5
7 - 8	10	6.2	13	7.9
5 - 6	13	7.9	25	15.2
3 - 4	40	24.5	35	21.4
2 or less	95	58.3	82	50.0
Not stated	53		44	
Number of jobs on promotion line				
under 3 jobs	6	3.6	8	4.5
3 - 5 jobs	63	37.5	57	32.4
6 - 8 jobs	54	32.1	53	30.1
9 - 11 jobs	24	14.3	23	13.1
12 jobs or more	21	12.5	35	19.9

[1] Of numbers on promotion lines in the group

Table 12

Work Experience in Jobs Above Existing Job on the Promotion Line

	ex-trainees		ex-direct entry	
	Nos.	% of sample[1]	Nos.	% of sample[1]
Jobs worked on above the existing job on the ladder				
none	42	23.0	27	15.7
one job above	65	35.0	75	43.6
up to two above	42	23.0	41	23.8
up to three above	24	13.1	13	7.6
up to four above	10	5.5	16	9.3
Total numbers	183	100.0	172	100.0

[1] Of those on promotion line jobs.

Table 13

Gross Average Earnings in the Six Full Pay Weeks[1] Prior to the Visit

Gross Average Earnings (£)	ex-trainees Nos.	ex-trainees % of sample	ex-direct entry Nos.	ex-direct entry % of sample
0 - 5	0	0.0	2	1.2
over 5 to 10	10	5.6	13	7.7
over 10 to 15	15	8.3	10	5.9
over 15 to 20	35	19.3	30	17.7
over 20 to 25	64	35.4	50	29.6
over 25 to 30	42	23.2	49	29.0
over 30 to 35	12	6.7	9	5.4
over 35 to 40	2	1.1	5	3.0
40 to 45	1	0.6	1	0.6
Total numbers	169		181	

[1] Holiday pay weeks were excluded. Data was not obtained for establishment 5.

Table 14

Summary Table of Basic Educational Characteristics of Junior Operative Trainees and Direct Entry

Operatives	ex-trainees Nos.	ex-trainees % of total sample [1] [2]	ex-direct entry Nos.	ex-direct entry % of total sample
A. With secondary modern or equivalent education	195	91	183	88
B. Who left school at 15	168	78	151	73
C. Who left school at 16 or over	47	22	55	27
D. Who obtained educational qualifications at school	49	23 [3]	31	15
E. With G.C.E. or C.S.E.	9	4	11	5

1 The total sample of junior operative trainees for purposes of comparison with direct entry was 216.

2 The percentage figure is based on the number of stated answers; the number of 'not stated' rarely, however, exceeded 2.

3 The local authority in the area of establishment 6 awarded a school leaving certificate which was not equivalent to G.C.E. or C.S.E. If the operatives from establishment 6 are removed from the sample this reduces the proportion of ex-trainees with qualifications to 14%.

Table 15

Age When First Joined the Company

	ex-trainees		ex-direct entry	
	Nos.	%	Nos.	%
Under 16	181	83.8	35	17.1
16 to under 17	31	14.3*	99	48.3*
17 to under 18	4	1.9	71	34.6
Total	216	100.0	205	100.0
Not stated	0		3	

Table 16

Summary Table of Work Experience of Ex-trainees and Direct Entry

		ex-trainees Nos.	ex-trainees % of total sample	ex-direct entry Nos.	ex-direct entry % of total sample
A. Operatives with work experience outside the steel industry		64	29.6*	163	78.4*
B. No. of firms outside steel industry that operatives worked for.	1	41	64.1[1]*	82	50.3[1]*
	2	15	23.4	48	29.4
	3	3	4.7	19	11.7
	4 or more	5	7.8	14	8.6
C. No. of different works employed in the steel industry.	only this one	206	95.8*	182	87.9*
	two	8	3.7)	14	6.8)
	three	0	0.0)*	6	2.9)*
	four or more	1	0.5)	5	2.4)
D. No. of different times employed by the company	once only	193	89.4	172	82.7
	two times	18	8.3	28	13.5
	three or more	5	2.3	8	3.9

[1] Percent of total number in A.

Table 17

Travel to Work - Distance and Costs

	ex-trainees		ex-direct entry	
	Nos.	% of sample	Nos.	% of sample
Travel to work (door to door)				
less than 15 minutes	185	85.5	169	79.3
16 - 30 minutes	23	10.6	31	14.6
over 30 minutes	9	4.0	13	6.1
Cost of travel to work				
less than 10/- per week	154	71.3	135	64.9
10/- to 19/11d. per week	55	25.5	53	25.5
£1 and over per week	7	3.2	20	9.6

Table 18

Summary Table of Further Education Undertaken by Operatives in the Technical College or Further Education Institute[1]

	ex-trainees		ex-direct entry	
	Nos.	% of total sample	Nos.	% of total sample
Attended further education courses since joining establishment[1]	36	16.7	35	16.8
of which:				
only attended courses laid on by company	30	13.9	20	9.6
of which: sent to company course	4	1.9	7	3.3
volunteered for company course	26	12.0	12	5.8
took City and Guilds Part I in technical college	1	0.5	10	4.8
passed City and Guilds Part I	0	0.0	2	1.0
took City and Guilds Part II in technical college	28	13.0	3	1.4
passed City and Guilds Part II	14	6.5	0	0.0
attended non-company courses on own initiative	4	1.9	14	6.7

[1]Excluding, for ex-trainees, any education under the initial programme. The taking of City and Guilds Part II was not, however, regarded as part of the programme.

Table 19

Summary of Further Training or Education Undertaken by Operatives in the Establishment[1]

	ex-trainees		ex-direct entry	
	Nos.	% of total sample	Nos.	% of total sample
A. Company based training or education undertaken	84	39.1	92	44.7
B. Where this training took place				
Off the job	43	51.1[2]*	60	65.2[2]*
At the job	24	28.6	24	26.1
On the job (with some but not all at-the-job conditions present)	22	26.2	18	19.6
On the job	1	1.2	1	1.1
C. Has had training for present job				
of which: Off the job	9	4.1	14	6.7
At the job	45	29.8	29	13.9

1 Training or education defined as taking place in the company premises, excluding, for ex-trainees, any training under the junior operative programme.

2 Percent of A total for group. The column, however, adds up to more than the total number of persons with training because any piece of training may have taken place at more than one location.

Table 20

Number of Days of Works-based Training Undertaken

	ex-trainees		ex-direct entry	
	Nos.	%[1]	Nos.	%[1]
Days training				
under 10	26	36.6	40	46.5
10 to 19	31	43.7	28	32.6
20 to 29	4	5.6	3	3.5
30 to 39	6	8.5	10	11.6
over 40	4	5.6	5	5.8
Total number	71		86	100.0
Not stated	13		6	

[1] Percent of those (excluding not-stated ib table) who had some works-based training.

Table 21

Purpose of Last Piece of Training Undertaken[1]

Purposes of training	ex-trainees Nos.	ex-trainees %[2]	ex-direct entry Nos.	ex-direct entry %[2]
to do existing job more efficiently	15	16.1	23	23.5
to do next job up promotion line	39	41.9	33	33.7
to do another job involving promotion but not on a ladder	14	15.1	9	9.2
to retrain for changes in existing job	2	2.2	4	4.1
to do another job (not involving promotion)	3	3.2	4	4.1
other reasons	20	21.5	25	25.5
did not know purpose	3			

1 Only those that had had works based training replied to this question. It is, however, possible that the training may have been seen as multi-purpose and therefore the total response is greater than the number of operatives that were 'at risk'.

2 Percent of those (excluding 'not stated') who had some works based training.

PART IV CHAPTER VII

APPENDIX 1

Problem Solving and Investment Appraisal approach to training. A guide for the Training Officer.

APPENDIX 1

PROBLEM SOLVING AND INVESTMENT APPRAISAL APPROACH TO TRAINING

A GUIDE FOR THE TRAINING OFFICER

Preface

The central purpose of this monograph is to provide a guide to the training officer, as external adviser or as a company employee, in helping management solve human behaviour problems. The guide is based on work undertaken for the Iron and Steel Industry Training Board over the last two years concerned with evaluating the use of investment appraisal of training as a tool for the training practitioner. A full report on this work has been submitted to the Board. As the training officer may find himself concerned with a variety of problem situations the guide does not lay down a categorical step by step approach but merely outlines the stages that might be followed.

The monograph is set out in two parts. Part I contains a brief discussion of the philosophy of the approach. Part II, with Appendices, sets out the main guidelines.

PART I - THE PHILOSOPHY

THE ROLE OF THE TRAINING OFFICER/TRAINING ADVISER IN THE ORGANISATION

Training in the organisation can be divided into five categories:

INDUCTION

INITIAL

MAINTENANCE

CHANGE

DEVELOPMENT

The credibility of training,* in industry has so far largely been built on the trainers' role in induction and initial training. The role of the training officer in relation to the problem solving or cost benefit approach, however, relates to the three latter categories (maintenance,

*An assumption based on the observation of the author of the Iron and Steel and several other industries.

change, development). The MAINTENANCE training of the organisation is defined as that which meets the needs of the organisation to maintain its standards. The failure to maintain standards means that there is a deficiency or problem the removal of which will lead back again to standards. The CHANGE needs of the organisation in respect of training relate to the need to alter skills, knowledge, attitudes to achieve a certain adjustment required in the organisation for improvement purposes. The DEVELOPMENT needs of the organisation in respect of training concern the overall development of people in the organisation with a view to their being prepared to meet specific changes and demands on them as and when the need arises.

Every organisation has at any particular time some maintenance, change and development needs. The problem for the trainer is how to analyse these in such a way that he can play a role in helping to meet them. For example, the existence of a problem (a maintenance need) in the organisation means that behaviour is inappropriate in some way. The trainer must analyse how and why, must endeavour to influence the behaviour back in the right direction, must monitor the effect of his efforts on behaviour and ultimately hope this will lead to the solution of the problem.

IMPROVING EFFECTIVENESS OF TRAINING STAFF IN COMPANIES

The objective of the development of the problem solving approach was to find a means of obtaining greater involvement of line management with training staff. The hope was that this approach would enable the training adviser not only to show that training pays but, where desirable, to involve management in the solution to problems so that in future they might consider using the trainer in seeking solutions to other problems. The philosophy of the approach might therefore be briefly stated as follows:

OBJECT - TO MOTIVATE MANAGEMENT TO USE TRAINING/TRAINER -

BY MEETING THEIR PERCEIVED NEEDS -

BY HELPING TO SOLVE THEIR PROBLEMS IN AN INDENTIFIABLE WAY -

AND BY PROVIDING EVIDENCE OF THIS OR/AND INVOLVEMENT IN THIS -

THUS PROVIDING CREDIBILITY FOR THE TRAINER -

THUS CHANGING MANGEMENT ATTITUDES -

THUS MOTIVATING MANAGEMENT TO USE TRAINING

The ultimate criteria for effectiveness of training staff in this case is the degree to which they can change the attitude of line managers not only to training as a "good" or "bad" thing but to its use in practice to help them with their problems. It is argued that to demonstrate quantifiable outcomes from training may in some cases be sufficient to develop a change of attitude. There are many other cases, however, where this will not lead to any major change in behaviour in the line management, only an extension of the goodwill towards training. Much of the research evidence about attitude change serves to demonstrate that it follows on a change in behaviour itself rather than as commonly supposed the other way round.

MANAGEMENT EXPECTATIONS AND THE PROBLEM SOLVING APPROACH

It will, hopefully, become clear from the text below that the training officer may get involved in a range of problem solving activities depending upon his ability, his status in the organisation and the attitudes of management. Key questions here are:

- WHAT KINDS OF PROBLEM CAN THE TRAINING OFFICER ADDRESS HIMSELF TO?

- WHO DEFINES THE PROBLEM AND UNDERTAKES THE PROBLEM ANALYSIS?

- WHO DEFINES THE CONTRIBUTION THAT TRAINING CAN MAKE TO THE PROBLEM SOLUTION?

Different answers to these questions will provide different definitions of the role of the training adviser. On the one hand it can be argued that every problem is a training problem because it has associated with it a required change in human behaviour which, more often than not, requires some learning or re-learning. On the other hand is the argument that the training officer should deal only with those problems that are brought to him by the manager as perceived training problems. There can therefore be no written rules as to the nature of the approach - so much will depend upon the circumstances in the company. The complexities that the training officer is likely to face in this respect are spelt out in Part II.

THE RELATIONSHIP OF PROBLEM SOLVING TO INVESTMENT APPRAISAL

The approach is directed towards solving problems that relate to the "operating system". In even simpler terms this might be described as concern about production quantity and quality. It is clear, from the outset that, except in the case of a simple man/machine relationship, the influence of any individual or small group behaviour on output quantity or quality is not likely to be independent of other factors. These factors described as "supportive" in Part II are likely to be concerned with the system of relationships and the information and control system in the organisation.

It is the purpose of the approach to seek to identify human performance deficiencies which are critical to the solution of problems. But whether, after training has taken place with the objective of removing the deficiency in behaviour one can point at benefits that accrue in financial terms will depend on just how simple or complex the problem was and the degree to which it is related to any individual's performance isolated from other factors. This is discussed in Part II in relation to the classification of problems by nature and cause. It is only here, necessary to point out that it will often not be possible to state categorically that a given output is likely to be achieved as a result of training, exclusive of the influence of "other factors." It is clear, equally however, that these "other factors" also require changes in behaviour if they are to be influenced in the right direction although the status, ability and/or expertise of the training officer might not always be sufficient to achieve this. In summary, it is frequently possible to demonstrate that a problem is costing a lot of money, that human skill or knowledge deficiency is critically related to that problem and that there is an expectation of some considerable improvement in the quantifiable aspects of that problem as a result of training to remedy the deficiency.

PART II - GUIDELINES TO THE APPROACH

SUMMARISING THE OVERALL OBJECTIVES

The overall objective is to develop an approach which might in certain cases enable quantitative benefits to be associated with training with a.high degree of confidence while simultaneously providing an analytical problem solving approach to the establishment of training needs.

In detail the aims may therefore be set out as follows:-

(a) To attempt to relate training more directly to desired performance changes in the organisation.

(b) To attempt to quantify the potential benefits to be derived from training programmes in order to give some guide to the management as to the possible results from such inputs.

(c) To devise a system that would facilitate improved communications with the line management of the organisation in the analysis of training needs and the implementation of the programme.

(d) To try to bring out the degree of dependency of any training input on the "supportive conditions" in the organisation, these being defined as those conditions which need to be established to make training effective.

WHAT A PROBLEM SOLVING APPROACH MEANS

Problem solving really means taking a logical and scientific approach to the definition, analysis, description and implementation of solutions to problems. The stages are as follows:

1. RECOGNITION OF EXISTENCE OF PROBLEM
2. DEFINITION OF THE PROBLEM.
3. RESEARCH TO FIND POSSIBLE CAUSES.
4. MEASUREMENT OF FACTORS OF IMPORTANCE.
5. GENERATION OF POSSIBLE SOLUTIONS IF CAUSE KNOWN
   OR: FRAMING OF HYPOTHESIS TO TEST DEEPER.
6. STATEMENT OF ADVANTAGES AND DISADVANTAGES OF
   ALTERNATIVE SOLUTIONS PROPOSED.
7. DEVELOPMENT OF USABLE PLAN BASED ON BEST SOLUTION.
8. IMPLEMENTATION OF SYSTEM/PLAN/SOLUTION.
9. MONITORING AND EVALUATION.

HOW THIS RELATES TO THE MANAGERS JOB

The approach is strictly limited to problems that relate to production quantity and quality. Problems pertaining to broader aspects of company management, marketing, finance, etc. are therefore excluded. The manager concerned is therefore the production manager. His major pre-occupation will be to maintain the standards of quantity and quality of output and to make improvements (changes) when and where possible. The broad definition of a problem is therefore anything that stands in the way of adequate maintenance and improvement of output quantity and quality desired by the manager.

PROBLEMS THAT MANAGEMENT HAVE THAT TRAINING CAN HELP WITH

Production management problems are likely to be diverse and complex. A suitable classification might, however, be the following:

SYSTEM OF RELATIONSHIPS PROBLEMS	Boundary disputes over responsibilities Personality Leadership styles Group norms of behaviour
PRODUCTION OPERATING SYSTEM PROBLEMS	Production methods Production sequence Equipment design Allocation of tasks Estimating capacities Production planning
INFORMATION SYSTEM PROBLEMS	Timing Representation Content Methods Integration (styles) Neutrality (power)
CONTROL SYSTEM PROBLEMS	Quality of decisions - crisis or planned Adequacy of cost + quality standards

It is clear that many production problems classified under "operating system" are likely to have ramifications which relate to other categories i.e. the solution of the problem may involve changes in the system of relationships, in the information system and in the control system. Problems will also vary in importance in terms of time, in terms of impact on the organisation and in terms of intensity as follows:

TIME SCALE	- Of immediate significance only - Effects in short term - Effects in long term
SCOPE	- Impact upon limited sub-system only - Effects major part or activity of company - Effects whole organisation

INTENSITY - Relates to low budget/earner area

- Relates to area of moderate volume of costs

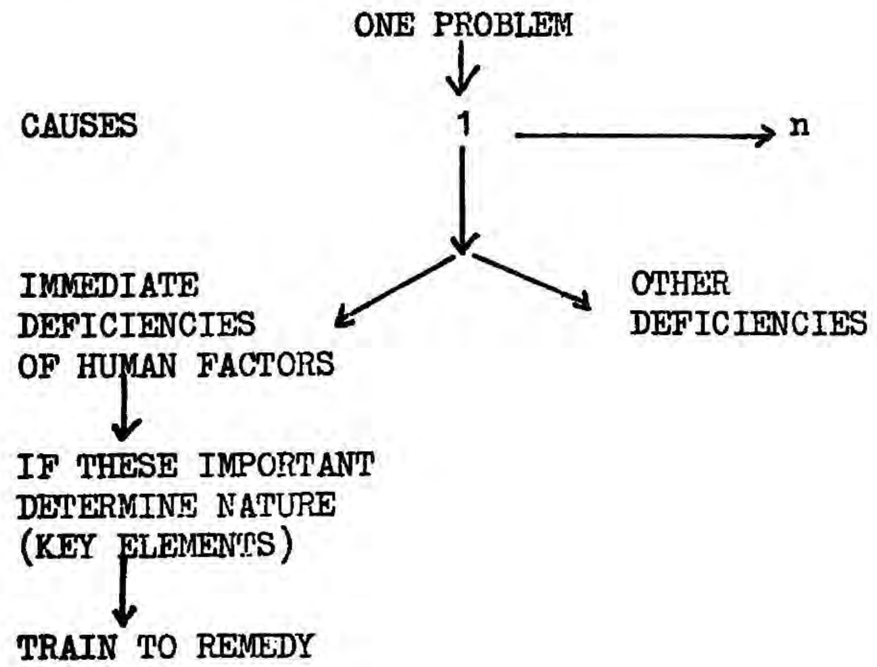
- Relates to high operating costs

It should be clear from the above that while problems will have some necessary behaviour change associated with their solution the analysis of what behaviour change is required and what action might be taken to bring it about is often extremely complex.

THE RELEVANCE OF THE PROBLEM SOLVING MODEL TO THE TRAINING OFFICER

If a problem can be recognised, defined and analysed in terms of a list of causes then these causes may be divided into those that reflect a direct or immediate deficiency in human behaviour and other deficiencies which may require changes in behaviour but are more complex in their bearing on the problem. They are also likely to involve changes in management behaviour. Immediate or direct deficiencies will relate to operatives and supervision and reflect behaviour which can be seen to have a direct effect on production quantity and quality. Thus the problem approach can be simplified as below:

OBJECTIVE - TO SOLVE ONE PROBLEM



If the immediate and direct human deficiencies appear to weigh heavily in terms of their contribution to the problem then the approach aims to identify their specific nature in terms of the key elements of the individual or individuals jobs. Once these have been identified, training needs can be ascertained and a programme developed and implemented.

The diagram above illustrates the approach in relation to one problem. It can be used to appraise the department's problems as a whole:

OBJECTIVE - TO IDENTIFY ALL TRAINING NEEDS RELEVANT TO SOLUTION OF ALL PROBLEMS IN PRODUCTION DEPARTMENT

PROBLEMS DEFINED AS DEVIATION FROM STANDARD

↓

EACH PROBLEM CAUSED ANALYSED 1 ⟶ n

↓

FOR EACH CAUSE IMMEDIATE HUMAN FACTOR AND OTHER FACTORS WEIGHTED

↓

FACTORS ANALYSED IN TERMS OF PERFORMANCE NEEDS FROM OPERATORS, SUPERVISORS, MANAGERS, OTHERS

↓

DIVISION OF PERFORMANCE NEEDS INTO DIRECT TRAINING NEEDS AND OTHER CHANGES IN BEHAVIOUR/SYSTEMS/PROCEDURES NEEDED (INDIRECT TRAINING NEEDS)

↓

DEVELOPED INTO PROGRAMMES AND COURSES OF ACTION AIMED AT SOLVING ALL PROBLEMS

DETERMINING WHERE TO START

Just where the training adviser starts in the organisation depends on the answers to the following questions:

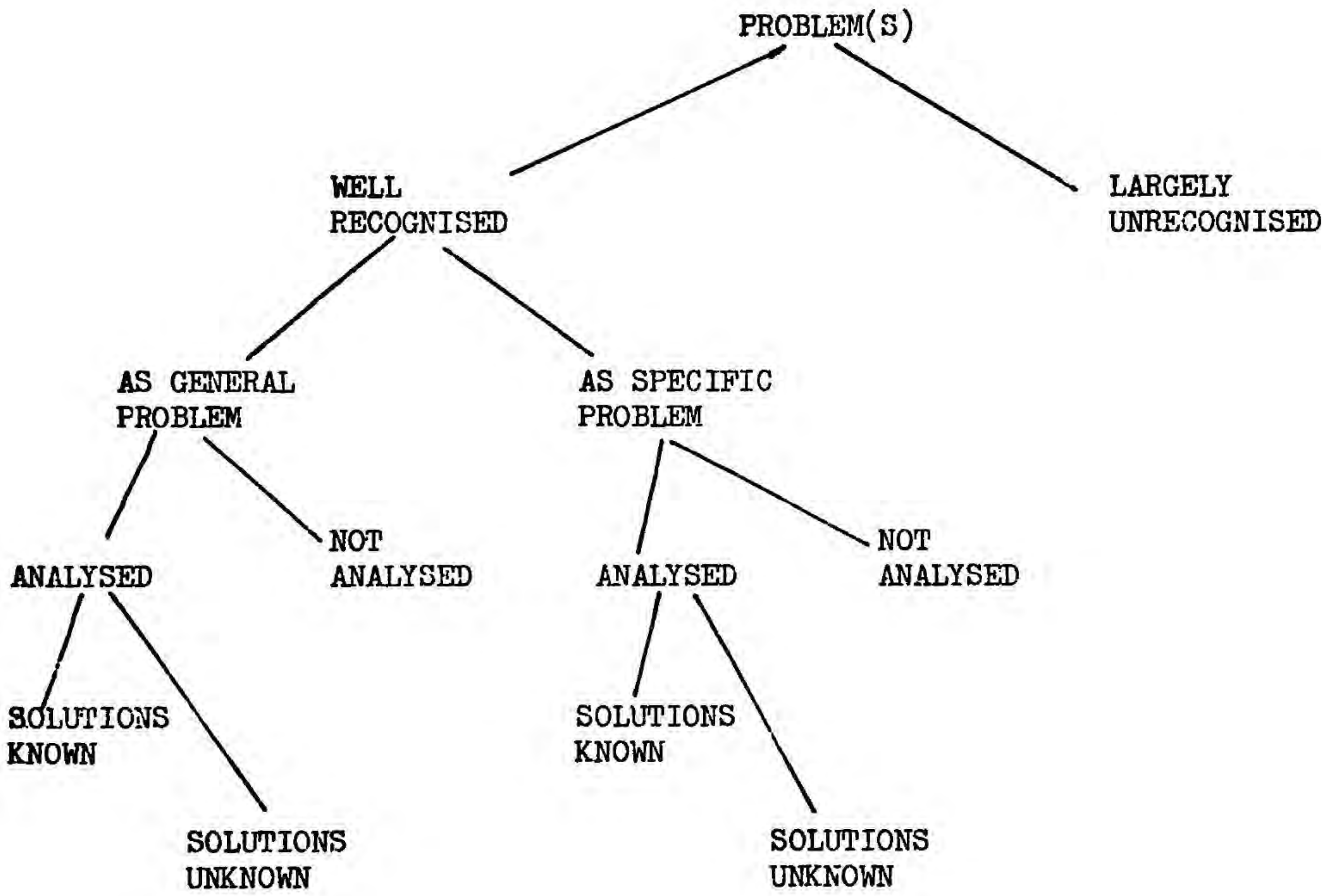
ARE THERE RECOGNISED PROBLEMS (i.e. RECOGNISED BY THE MANAGEMENT)?

ARE THEY RECOGNISED ONLY IN THE GENERAL SENSE (i.e. LOW PRODUCTION) OR ARE THEY FAIRLY SPECIFICALLY RECOGNISED AND DEFINED (SINGLE MACHINE STOPPAGE)?

HAVE THE PROBLEMS BEEN ADEQUATELY ANALYSED?

ARE THE SOLUTIONS KNOWN/UNKNOWN?

Thus the trainer may enter at any level in the diagram below:



Where the problem is well recognised, defined and analysed, and solutions are known, the training officer is likely to find himself called in because a training solution is already seen to be relevant. If however there is:

(a) A general problem which is merely recognised as a production deficiency or quality deficiency the cause of which is not well defined

or

(b) A specific problem relating to a product process or manpower situation the exact nature of which has not been determined

Then the training officer will have to conduct his own analysis of the situation as outlined below.

In many cases the training officer will find that problems have not been fully analysed a process which may be described as DEFINING the PROBLEM, its NATURE and its CAUSE. It is important that proper analysis should take place for there is a natural tendency to interpret the problem in training terms and to jump in and undertake some kind of training programme through a conventional job description/analysis. Proper analysis is important so that:

(a) The training officer addresses himself only to those aspects of the job which are related to the problem cause

and

(b) Supportive factors on which the problem solution is dependant (and therefore the success of any training also) are revealed

In summary the training officer may therefore start off completely "cold" in a production department situation where there is only general concern about performance or he may have his attention drawn to some specific human deficiency which can clearly be seen as affecting output quantity and quality. In the first case he may have to undertake a general performance appraisal leading to an evaluation of training need and in the latter case an analysis of a specific problem leading to a similar evaluation. In between these two extremes there is a wide range of possible ways in which the trainer may lead into the situation.

WHERE TO START - SOME COMMON DIFFICULTIES TO BE OVERCOME

In pursuing a problem solving approach the trainer will commonly come up against certain barriers. Such barriers may exist if there are negative answers to some or all of the following questions:

1. IS THERE GOODWILL/ILLWILL/INDIFFERENCE TOWARDS TRAINING?

2. IS THERE GOODWILL/ILLWILL/INDIFFERENCE TOWARDS THE TRAINING OFFICER/ADVISER?

3. HOW WELL IS THE PROBLEM RECOGNISED BY THE MANAGER(S) INTERVIEWED?

4. HOW IS THE PROBLEM PERCEIVED - AS A TRAINING PROBLEM OR OTHERWISE?

5. IS THE PROBLEM ONE IN WHICH THE MANAGER PERCEIVES THE TRAINER AS HAVING NO ROLE OR SOME ROLE AT ALL?

6. IS THE PROBLEM RECOGNISED AND DEFINED EQUALLY BY ALL MANAGERS AND SUBORDINATES?

7. IF THERE ARE SOLUTIONS KNOWN ARE THEY ACCURATE i.e. THE RESULT OF REAL ANALYSIS, OR DO THEY REFLECT PREJUDICE?

8. IF THERE HAS ALREADY BEEN ANALYSIS OF THE PROBLEM WHO HAS UNDER-TAKEN IT AND WHAT STATUS DOES HE HAVE IN THE ORGANISATION?

- the absence of goodwill

Whether or not a problem is recognised, certain general attitudes towards training will be held by management which range from an attitude of extreme goodwill, to indifference, to no goodwill at all. If there is no goodwill then it is very difficult to accomplish anything. With goodwill the advantages are abvious. But even with indifference there is frequently scope for the trainer to build up goodwill by undertaking a general performance appraisal which might lead to the better recognition and definition of problems.

- recognition of the trainer's role

Even where there is goodwill the trainer may come up against the common barrier that the manager does not see his problems as training problems in the way in which the word is conventionally used. This may in some cases be because the manager sees the training officer as someone dealing solely with specific types of off-the-job or on-the-job skills training. It may also be because the manager does not consider the training officer to be capable of analysing, in depth, more complex, at-the-job, learning problems. It may also be because the manager himself has not analysed the problem in a systematic manner. More often than not then, however, there may be no problem recognised only in the sense that the manager does not regard the problem as one relevant to the trainer. In this kind of situation the trainer faces the challenge of communicating with management in such a way that problems relevant to training solutions are brought to the fore.

OPERATING WITHIN THE ORGANISATIONAL CLIMATE

It has earlier been stressed that the way in which the trainer becomes involved in the problem situation or is introduced into the company will vary considerably. No matter what the manner of introduction the most important thing to be quickly developed and maintained in the ensueing interaction is the trainer's credibility in the eyes of management. Even if the problem does not lend itself to a training solution. If through the exercise training staff can increase their credibility with management then something positive will have been achieved.

No matter what the level or type of problem the approach is bound to necessitate an initial meeting with the senior management of the company. It is from this point in time that the credibility is at stake. While this meeting may have the purpose of exploring a general terms of reference and defining a starting point it will also enable the training adviser to test the organisational climate particularly if the opportunity is given to meet a number of managers. An early assessment is needed so that the approach with the best chance of success can be selected at an early date. The trainer to achieve the maximum chance of success will have to work with and through various people in the organisation. Major factors that will influence the success of his intervention in the organisation include:

THE STYLE OF LEADERSHIP AND AUTHORITY

WHETHER GROUPS IN THE ORGANISATION CO-OPERATE OR ARE COMPETITIVE

THE GENERAL STATE OF COMMUNICATIONS

THE STYLE OF PROBLEM SOLVING (WHETHER THIS IS DONE BY INDIVIDUALS OR BY GROUPS?

Training to evaluate the main elements in the organisation climate may therefore be an important part of developing the training officer in a problem solving approach. This is very important for although checklists can be provided to cover various aspects of the approach their use in a formal sense is usually undesirable and the emphasis must rest upon the personal ability of the training officer to handle the situation as it emerges. A list of factors to look for both in terms of the training officer's own interpersonal skills and his assessment of the climate in the company is given in Appendix 1.

At another level a good understanding of the company and its organisation is extremely useful in establishing credibility of the external training adviser. The kind of knowledge that the trainer ought to have as background before his initial conversations with management is outlined in Appendix 2. This considers the company as a business and describes main production and organisation parameters. This checklist is not a diagnostic tool and cannot be used as such. It is merely a guide to the kind of information which, if the training officer has at his fingertips before a visit, will enable him to hold a fuller discussion with line management. It is the kind of information that might be kept "on file".

In respect of any difficulties there may be in overcoming the manager's perception of what are and what are not training problems there is a need to encourage the manager to talk widely about what may appear to be none training problems and some skill is needed to ensure that:

(a) Problems are identified and agreed without necessarily the word problem being used in the exchange. For example, a straight forward request for "any problems" might with many managers, lead to an early closedown in communications. Moreover managers will then only raise those problems which relate to their perception of the role of training which may be limited.

(b) The opportunity should not be given for the manager to close off any particular further line of enquiry by the training officer showing an undue eagerness to address himself to a problem which while recognised has not been fully defined. Many problems are dismissed as "technical" or "resulting from poor raw materials" when in reality they relate fairly directly to human performance deficiencies.

If after conversations with the management a large number of problems are revealed then the strategy may be either to:

(1) Concentrate on one of these which appears to be major to the production quantity or quality

or

(2) Cover a range of these related to one department.

Whichever option is pursued the officer needs to ensure that he is given the scope to investigate the problem further among supervisors, shift managers, and engineers.

SELECTING PERSONNEL IN THE ORGANISATION LIKELY TO BE OF ASSISTANCE

The effectiveness of the trainer in the problem solving situation depends very much on his ability to use resources in the organisation and to communicate easily with other parts of the organisation which might help in the process of problem recognition, definition and solution. Among those likely to be of assistance are: work study and human engineering personnel; accountancy and wages analysis staff (for costs and bonus rates/ systems); industrial relations personnel; union representatives; maintenance and technical staff; quality control staff; production planning and control staff; line management; supervision as well as operatives.

DECIDING THE APPROACH

As has been stated above the degree of existing problem recognition and definition will determine the approach. Where there is little recognition of specific problems and an overall survey is undertaken in relation to a single production department this might be accomplished within a two or three day period and should cover the following:

(a) A brief review of available information to ascertain:

1. WHAT INFORMATION IS PREPARED FOR MANAGEMENT ON A REGULAR BASIS.

2. WHAT IT SHOWS IN TERMS OF OUTPUT, COST, YIELD, QUALITY, UTILISATION, THROUGHPUT VARIANCES OR OTHER EFFICIENCY MEASURES.

3. WHAT OTHER INFORMATION IS AVAILABLE AND WHAT IT SHOWS e.g. SHIFT REPORTS, MAINTENANCE REPORTS, QUALITY TEST ROOM REPORTS, LOG BOOKS, MACHINE TIME, SCRAP CHECKS ETC.

(b) An analysis of production performance characteristics covering:

1. THE STANDARDS, IF ANY, USED BY THE MANAGEMENT FOR CONTROL OF PLANT PERFORMANCE AS A WHOLE.

2. AN ASSESSMENT OF WHETHER THE PLANT IS OPERATING NEAR THESE.

3. A JUDGEMENT, IF THERE ARE NO WRITTEN STANDARDS, OF HOW THE MANAGEMENT DECIDES WHETHER PERFORMANCE IS ADEQUATE OR INADEQUATE.

4. THE KEY FACTORS WHICH AFFECT PLANT PERFORMANCE CHARACTERISTICS.

5. THE STANDARDS, IF ANY, FOR PARTICULAR PARTS OF THE PLANT e.g. DEPARTMENTS, STANDARD PROCESS TIMES, MACHINE TIMES OR STANDARD LOADING OR HANDLING TIMES.

(c) An analysis of areas of deficiency covering:

1. WHETHER STANDARDS ARE BEING ACHIEVED.

2. WHAT ARE THE MAJOR VARIANCES FROM STANDARDS.

3. WHAT ARE THE MAJOR PROBLEM AREAS RECOGNISED BY MANAGEMENT.

CATEGORISING THE PROBLEM

Most problems can be classified more or less quickly under one of the following headings:

UTILISATION

YIELD

THROUGHPUT

QUALITY

Within these headings the problem may be further classified and certain of the detailed questions that might be asked under each of the headings are given in Appendix 3. It can be seen from these, for example, that while a variety of reasons may exist for poor utilisation only a few will be related directly to the human performance deficiency at the operator level.

ANALYSING THE CAUSES OF THE PROBLEM

Having isolated the problem in terms of the broad classification of utilisation/throughput/yield/quality and further defined its nature by the use of the checklist in Appendix 3 then possible causes of the problem may be identified.

At this stage it is also important to identify which are the major and which are the minor factors in terms of their contribution to the problem and, finally, it is also desirable that attention should simultaneously be paid to how each of these "causes" can be prevented in the first place and prevented from happening again once the problem has occurred.

Information on causes may be available from:

- existing records
- interviews of personnel
- the gathering of extra information

Existing records on downtime may identify the major areas where this occurs. Data on quality rejects may show an analysis by product of stage of process and yields might be similarly calculated.

If information is not readily available to identify causes then a process of interviewing key personnel may be necessary. For example a problem may be identified as a certain inconsistency in quality i.e. too hard or too soft, and the exact location in the process where this actually occurs may not be defined. Thus an enquiry must be carried out among relevant personnel to determine the most likely places for this process to go wrong.

A frequent alternative to this kind of enquiry is to set up an information gathering system or to get operatives or supervisors to make particular notes on job cards, record sheets or shift reports relating to the problem. This produces "hard" evidence.

USING PEOPLE IN THE ORGANISATION FOR ANALYSIS

After an initial appraisal of the situation the training officer/ adviser may wish to encourage personnel in the organisation to help with the analysis. This may be a suitable method of getting involvement. In this respect the following questions seem to be relevant:

1. WHO CAN I GET TO DO THE ANALYSIS IN THE ORGANISATION?
2. WHAT KIND OF TRAINING/PREPARATION DOES HE/SHE NEED?
3. HOW MUCH SUPERVISION DOES HE/SHE NEED?

4. WHO IN THE MANAGEMENT IS IT DESIRABLE TO MOST INVOLVE?

5. WHAT IS THE BEST WAY OF INVOLVING HIM/THEM?

6. WHO ELSE MIGHT BE INVOLVED?

7. OUGHT ONE TO SET UP A WORK GROUP?

CLASSIFYING THE CAUSES OF PROBLEMS

By this stage it will be clear that the basic problem has certain major causes which become evident either from the control information produced or from the interviews with those concerned with the process. If however the causes of problems have not become apparent then further enquiry may be necessary in order to weight possible causes in terms of estimated importance and define the criticality of human performance deficiency in relation to these. Perhaps the most appropriate way for this investigation to be carried out is not to ask personnel directly about the causes of problems in detail and to weight them but to seek a description of the way in which the problem arises and the actions that can be taken to prevent it as well as those actions that must be taken once it has occurred either to remedy the defect or to get production on stream again. This facilitates a description of the key task elements performed, enables a judgement to be made about the criticality of these in relation to the cause of the problem and enables an assessment of the adequacy of the existing understanding of what is required and of the skill and knowledge in execution. This can be then used to identify particular training needs among personnel interviewed. Moreover by this method a more positive and possibly more honest response may be gained than by a direct enquiry as to 'causes' of the 'trouble'. This will be particularly the case where the root of the trouble is directly in human behaviour. As a result of the evidence collected by this process of analysis by description a procedure may be drawn up which everybody adheres to as a basis for a training plan. Moreover and most importantly, an assessment can now be made of whether the causes of the problem relate wholly to a direct human performance deficiency or can be analysed under other headings related to supervisory or management action.

By this stage it ought to be clear what areas of possible human deficiency exist, where they are critical to performance, which are the key elements of the job or jobs and most importantly, what is the nature of deficiency in performance of these tasks. If records are kept of individual interviews then the nature of any skill and knowledge deficiency related to key elements of the tasks of personnel may be defined without any tests. If this has not been the case however then some assessment of this deficiency will have to be made at this stage.

PREPARING THE ACTION PLAN

At this stage it may be possible to define the training input. Situations where senior operatives or supervisors are performing critical tasks in a deficient manner are, however, difficult to handle. Such problems can frequently be tackled by using such senior people in the company as trainers for staff further down the line or for new starters thus providing the excuse for thorough training of the personnel themselves in terms of methods to be employed. Key questions in this respect will be:

WHO IN THE COMPANY WILL TAKE RESPONSIBILITY FOR THE DEVELOPMENT OF THE PROGRAMME?

IS THIS THE SAME PERSON WHO WILL CONCERN HIMSELF WITH IMPLEMENTATION?

IS IT CLEAR THAT THE PROGRAMME WILL BE RELATED TO OPERATING DEFICIENCIES?

WHO WILL PROVIDE THE:

- ORGANISATION SKILL?
- TECHNICAL (TRAINING) SKILL?
- CONTENTS SKILL?

WHAT KIND OF TRAINING DO THE TRAINERS NEED IF ANY?

HOW BEST CAN THE PROGRAMME BE TAILORED TO PROVIDE THE LEAST HINDERENCE TO THE ORGANISATIONS DAY-TO-DAY MANPOWER REQUIREMENTS?

WHAT IS THE BEST WAY TO PRESENT THE PROGRAMME TO GET MAXIMUM ACCEPTANCE BY MANAGEMENT?

ESTIMATING THE COSTS AND BENEFITS

Measuring the Costs

An elementary principle can be applied to measuring the costs of training, that is whether there is any real opportunity cost involved in either the use of the time of a person being trained or of the pèrson employed as trainer. If the person to be trained has to be taken off the job and there is no adequate replacement then the cost of his training is the cost of output foregone. This situation, however, rarely occurs, for usually there are spare men who can take over; and if the operative is critical to the output he is unlikely in any case to be allowed by the management to leave the shift. In these circumstances he may be allowed to undertake training during overtime. The time of management or supervision, when utilised in training, or indeed that of the trainer himself can be costed in at relevant salary or wage rates. Again, however, a key question must be whether this is not really part of their job anyway and there are not real opportunity costs. However for political purposes these costs will usually be incorporated. Finally to be incorporated is the time of the analyst and other staff involved in the analysis although the question of whether there is any real opportunity cost for the trainer is even more relevant here.

Measuring the Benefits

One of the most appropriate ways of estimating the saving of any quantity deficiency by improving plant utilisation is by use of value added. This means multiplying the estimated output foregone during the time period when the plant had hitherto not been used, by the value added by the product. Value added is defined as the difference between the sales price of output (at the end of the process) minus all bought in materials. To this may be added any material written off as a result of the problem. The essential benefit to be saved here is the estimated value of the product ruined minus the scrap value price.

The use of value added for measuring benefits of reducing downtime is legitimate as long as the works is working at full capacity. If in fact there is under-capacity then of course the value of time may be rather different, for time lost can be replaced by working overtime or adding another shift in which case the costs of downtime are the costs associated with producing the extra output. The concept of value added is explained in more detail in Appendix 4.

If the target is to remedy deficiencies in yield or to increase yield then the estimate of benefit is not to be calculated on a value added basis but on the gross sales value of the extra output achieved. This is because material has already been consumed in the process and extra yield means no additional material consumption. This is often something that is overlooked by management and can mean that relatively small increases in yield can bring substantial benefits. This is where the "gravy" on the profits might come from.

Increases in throughput rates can be measured at the value added of output achieved.

If no precise target can be set for the achievement of any training input because of the incidence of other factors then an alternative method may be employed which involves calculating what additional benefit would be required to meet the costs of training and placing this alongside what is known about the criticality of the human performance deficiency analysed. Thus if it is clear to management that a human performance deficiency is the chief among several causes of the problem and it appears likely that this deficiency can be substantially removed by the training action plan then the expected improvement might be considerable even though there are other factors at work.

The benefits from quality improvement brought about by training may not be so easily calculated in financial terms. A list of the cost of quality rejects is given in Appendix 5. The cost of scrap can be easily estimated because it represents the difference between the sales price of the product and the scrap value produced. Other rejects in the quality process may however be more difficult to quantify because many are re-worked so that the real cost is the re-working cost of the product. This again is only a real cost if again the plant is working near capacity and extra factors of production have to be employed to re-work the product. In other cases the benefits may merely have to be measured in unit terms, for example, a reduction in cost of the complaints monitored before and after or a reduction in the precentage rate of rejects.

IMPLEMENTING THE TRAINING PLAN

A major practical problem in undertaking this type of work is that of implementing on-, and off-the-job training inputs. Because the approach endeavours to pinpoint critical elements of jobs which need 'maintenance' attention most of the training is likely to be located in-plant. Thus there is not only the problem of selecting shop floor personnel suitable for development as trainers and of training them but also, and most importantly, that of ensuring effective implementation once the programme is underway. An external training adviser will find great difficulty in providing close supervision of actual training inputs because of the time factor involved. This is therefore an area in which use may be made of the training staff in the company and/or line management. Authority and responsibility for training implementation would seem to rest with the works management but some professional training presence will usually be necessary to oversee the actual training itself.

Casual observation would suggest that the industry as a whole has not yet found the answer to effective on- or at-the-job training. Methods of validation limited to log books, cards, etc. may at best be a form of effective supervision of training input but at worst may be merely a form filling exercise with little real meaning. The chances of sound implementation will vary tremendously with different situations. All the training officer can do is to make forecasts of where the implementation is likely to be weak and to take steps to try and strengthen it in these areas. If direct supervision is not possible then regular visits to ensure that basic elements of the programme are being followed through will be necessary. It is often the case that where attention has been called to certain human performance deficiencies there is also scope for a broader attempt at implementing more formal training schemes as well as tackling the particular problems.

THE MONITORING OF COSTS AND BENEFITS

The monitoring of programme costs is fairly easily accomplished as sessions and times involved can be logged. Evaluation of benefits however needs a 'before and after' situation. Here the length of time to be taken will vary with the nature of the process and the degree of scientific verification needed. It is obviously the case that a great many other factors will be influencing the production situation. Hopefully those that might be expected to have a random effect can be discounted. But other factors such as for example the incidence of product mix which could have a substantial influence on the result will have to be monitored also. Moreover other changes in organisation, technology etc. will have to be noted.

One method of evaluation frequently suggested is the comparison of one shift with another after training has been concentrated there. This is unlikely to be a realistic approach, however, where management's preoccupation is with achieving improvement.

In summary, the analyst is unlikely to be able to achieve the ideal before and after conditions and in general may have to content himself with looking for broad changes in the situation over time. In these circumstances what is important is that training is associated with an improving situation in terms of plant performance even if no more definitive relationship can be established.

A NOTE ON THE ABILITIES NEEDED BY TRAINING OFFICERS

The approach places emphasis on certain abilities and skills which may be rather different, at least in emphasis, from those which the training officer in his more conventional role may need. The following abilities seem necessary to undertake this kind of work:

(a) Ability to recognise, interpret, analyse and use management control information, particularly production control information

(b) An ability to interact with senior executives:

  (i) Socially

  (ii) In handling meetings

  (iii) In conducting face to face interviews to determine problem areas

(c) Ability to devise fact-finding interviews with management and shop-floor employees

(d) Ability to collect, collate and analyse any additional data needed

(e) Sound knowledge of training techniques and methods particularly methods of controlling and evaluating on-the-job training

(f) Ability to understand the process of management development

(g) Some understanding of work study, method study techniques

These abilities can be summarised in terms of basic skill and knowledge needs.

1. Skill in the method of approach to problem solving.
2. Knowledge of management skills and systems so that he can communicate effectively and analyse situations with management.
3. Knowledge and training related to understanding behaviour in organisations, both group and inter-personal.

KEY FACTORS IN SUCCESS OF THE APPROACH

As well as on the individual skills of the entrepreneur the success of the approach seems to be heavily dependant upon the following major factors:

1. The need to adopt a professional approach to senior executives and to give no sign of being subservient.
2. The need to prepare a formal introduction of the project to line managers (i.e. those that are being questioned) to prevent misunderstanding.
3. The need to keep a close dialogue with, as opposed to reporting to, the senior executives who matter.
4. The need to ask "Who can stop the project?" He is the one who must be kept informed and if possible involved.
5. The need to be quick in analysis and feedback reports.
6. The recognition that in terms of confidence and credibility a verbal report is often much superior to a written report (to the right manager).

7. The need to keep reports short and slick, containing only the absolutely relevant material.
8. The need to avoid at all costs threatening any of the senior managers in the organisation by the results of the analysis and, equally desirable the avoidance of prescription.
9. The need at the earliest stage possible to concentrate action on the factors which involve management.

APPENDIX 1

I.S.I.T.B. TRAINING INVESTMENT APPRAISAL STUDIES

CHECKLIST FOR IN-COMPANY BEHAVIOUR/INTERACTION

The training adviser should be able to:

1. Perceive his own behaviour

2. Recognise what is going on in any individual or group meeting

3. Choose the appropriate behaviour pattern

IMPORTANT CHARACTERISTICS AFFECTING PERSONAL CREDIBILITY

1. Avoid prescription

2. Avoid attacking even if threatened

3. If conflict find supporting ground to avoid polarisation (importance of summarising behaviour)

4. Be action oriented (don't delay)

5. Get involved "socially"

6. Do not raise expectations when the need is not there - just because of the feeling that one ought to communicate

7. Use empathy to define expectations

8. Watch and define reactions to one's own behaviour - this is the best way of finding out about ourselves

9. Don't give excessive information

10. Note the myths and do not threaten them directly

11. Avoid scoring for recognition or personal satisfaction

12. Avoid defining the problem narrowly. Where others do this note the training opportunities

13. Note differences in similarities even when get agreement

14. Build on approval and not just counter-attack when disapproval

GENERAL FACTORS AFFECTING IN-COMPANY CREDIBILITY AND EFFECTIVENESS

1. Evaluate and choose carefully the people to work with in the organisation

2. Do not ignore key personnel

3. Define their capabilities and motivation

4. Decide how best to appeal to them

GENERAL FACTORS AFFECTING IN-COMPANY CREDIBILITY AND EFFECTIVENESS (cont'd)

5. Note the organisational climate - the degree of trust and support and assess how it is likely to effect your work e.g. look for signs that there are axes to grind, excessive negative feedback, self protective attitudes.

6. Build your work into the company's system if possible

7. Limit the decision outcome of meetings so that they do not threaten the project and to provide the maximum building on points

8. When testing people try to get them to describe or demonstrate processes of action they take rather than threaten them with a test

9. Try to ensure that necessary upwards communication is well supported

10. Distinguish the perceptions of reality from the reality

11. Try to get people to look first then talk because an investigation can be placed in jeopardy if hasty opinions given by managers are disproved

APPENDIX 2

I.S.I.T.B. - TRAINING INVESTMENT APPRAISAL STUDIES

PRELIMINARY CHECK LIST

The aim of this checklist is to collect background data on companies which might be approached

1. Name of company

2. Ownership (private or subsidiary, member of a group)

3. Is the company owner managed? If so by whom?

4. Who would you deal with in an initial approach to the company?

5. Company size (turnover and labour force figure.

6. Which product(s) manufactured?

7. Are there any rogue products/processes where yields/output is low?

8. What proportion of total output value is provided by each product?

9. What are the relative values of labour/raw materials/manufacturing overhead in the product?

10. Does the company have regular reports on: departmental profit and loss; product costs; standard cost variances?

11. Rough organisation chart

12. Is the firm expanding/contracting/stable?

13. Have there been any recent major changes? (in technology, manpower, utilisation, etc.)

14. How important is quality in the product?

15. Does the company practice preventative or trouble shooting maintenance?

16. To what extent are operatives engaged in maintenance and/or fault diagnosis?

17. Does the company have any recognised production problems in terms of plant utilisation, quality, manpower, materials?

18. Is there good production control information available?

19. What production performance criteria is used?

20. How is the labour force made up (in terms of operatives, craftsmen, etc. - rough proportions?

21. Are there any key workers in each function?

22. What is the labour turnover rate, is it high for this area?

23. Is there much absenteeism?

24. What shift systems are employed (is there much overtime working)?

25. What role do operatives have in quality control?

26. The number of operatives and others employed per shift?

27. Brief description of payment system

28. Is there tight manning on all shifts?

29. Has there been any work study?

30. Who is responsible for training?

31. What training staff does the organisation/plant have?

32. What previous training has been undertaken and what training systems are ongoing?

33. Are there job descriptions?

34. Have there been adequate assessments of training needs?

35. If so how were these done (through job analysis, problem assessment)?

36. Who undertook these assessments?

APPENDIX 3

I.S.I.T.B. TRAINING INVESTMENT APPRAISAL STUDIES

CHECKLIST FOR FACTORS AFFECTING UTILISATION, YIELD, THROUGHPUT, QUALITY

UTILISATION

1. Is there adequate demand?
2. What is the effect of the product mix?
3. Are the bottle-necks caused by limited machine output capacity?
4. Are bottle-necks caused by poor planning?
5. Does the lack of manpower effect utilisation?
6. Is there adequate materials availability?
7. Is materials handling a problem?
8. Are machine speeds right?
9. Are there obstacles from poor plant layout?
10. What are the nature and causes of breakdowns?
11. Where is the information that will give me these answers?
    - Is there a weekly or monthly prediction summary or report?
    - Is there a labour timesheet analysis?
    - What information is kept on the job cards?
    - What information is there on shift reports?
    - Are there machine utilisation reports?

THROUGHPUT

1. Are machine speeds right?
2. How much are machine speeds under operator control?
3. Are there throughput rates specified?
4. What are the origins of these rates?
5. What are the key factors/procedures/operator action affecting throughput?

YIELD

1. Where are the losses in yield at each stage of the process?
2. How are they measured?
3. What are the acceptable standards if any?

APPENDIX 4

DEFINITION OF ADDED VALUE

SALES INCOME

MINUS PURCHASES OF MATERIALS OR SERVICES INVOLVED IN PRODUCING

ADJUSTED for CHANGES IN STOCKS AND W.I.P.

EQUALS ADDED VALUE

ADDED VALUE EQUALS

PLUS (i) (INCOMES OF EMPLOYEES
(EXPENSES OF THEIR EMPLOYMENT

PLUS (ii) OTHER ADMINISTRATIVE EXPENSES

PLUS (iii) PROFITS

1. Added Value can be used to measure the cost of downtime by multiplying the output foregone during the downtime period by the added value per unit.
2. This will only be the case where the company is working at near full capacity. Otherwise the cost of downtime will be the extra costs incurred in producing the material that would have been produced had the downtime not occurred.

QUALITY

1. Where can I get the information from:

   - quality control department
   - sales department
   - test department
   - production reports

2. Who does the tests if any?

3. Who controls quality and in particular how much control does the operator have?

4. Is everyone aware of standards?

5. Is there adequate feedback of control information?

6. Is there adequate control on materials fed into the process?

APPENDIX 5

QUALITY REJECT COSTS

1. Scrap
2. Rework
3. Revised production
4. Additional handling facilities
5. Material shortages
6. Higher W.I.P. costs
7. Longer order book
8. Cost of personnel and department