effective vocational training design
The general objectives of the Vocational Training Branch of the ILO are to enhance the contribution of vocational training to economic and social development in member States, particularly in the developing countries where the shortage of adequately skilled workers and instruction staff constitutes an acute problem.

The specific objectives are:

• to increase the effectiveness and efficiency of vocational training systems;
• to improve the quality and range of skills of the labour force;
• to make vocational training more responsive to changing employment needs;
• to increase the availability of skilled manpower for priority industries and services; and
• to make training opportunities available to the poorer and more vulnerable population groups, particularly women and youth.

The aim of ILO publications on training is to spread knowledge about both managerial and vocational training, including new approaches to training and guides for tackling the various problems encountered in the following areas: developing human resources; raising productivity; increasing job satisfaction; and factors affecting the socio-economic environment of the enterprise. They cover all levels of training and all branches of economic activity.
Effective vocational training design
effective vocational training design

D. Lockwood
This handbook describes the processes and procedures for the effective designing of vocational training projects. Particular attention is devoted to their application in developing countries.

All too often attempts are made to apply training design to situations in which the presence of political, financial, or socioeconomic problems means that application of an isolated training solution to a specific case will result in an unjustifiably high cost.

Training is applied to people. It can thus improve:
- occupational skills
- performance levels
- work organisation and planning
- working relationships
- workforce effectiveness
- workforce efficiency, etc.

It is not the answer to:
- insufficient financial support
- obsolete production processes or equipment
- supply of inappropriate production materials, etc.
- ineffective use of labour market information.

In some countries, vocational training programmes are producing skilled workers for formal sector industries, where job vacancies are in short supply. At the same time, national training schemes are not being provided for the development of skills in the informal sector, where many more workers could be absorbed.

Good training programme design is essential. Because of the
efficient, but must also produce trainees who are productive in employment. Investments in training and gross national product (GNP) allocations devoted to maintaining and improving training systems must also produce effective returns.

This handbook on the design of effective vocational training programmes complements a series of texts on vocational training prepared by the International Labour Organisation. Taken together, these publications will help the reader to prepare and implement successful vocational training systems, programmes and projects.

The handbook emphasises the need to take a systematic approach to the design of training. The principles and guidelines illustrated have been tried and tested over a wide range of international situations. Where certain elements or principles apply to special cases, they are highlighted and notes are provided.

We shall use the term "vocational training system" for a system that is part of a total environment, in which national development is taking place. Whether considered from a national, sectoral, or individual point of view, it must be based on national development goals, targets and plans, and be responsive to national and individual social and economic objectives. It must also be closely linked to manpower and skills demand and supply forecasts, employment opportunities and the educational level of potential trainees, as well as national and individual social and cultural aspirations.

In the first chapter, an approach to effective training design with methods applicable to a variety of situations is proposed.

One of the first tasks facing a training designer is to extract the essential elements from a multitude of design indicators, opinions, procedures and policy decisions. This topic is discussed in detail and a number of checklists are provided to aid the designer in his choice of appropriate design aims.

In chapter two, three main stages of a training system are dealt with: the identification of needs, designing for implementation, and the measurement and checking of results. These stages are looked at from the viewpoint of the designer. Emphasis is placed on specific design features translating system concepts into concrete training designs ready for application, which is the vi
main topic in chapter three. Maintenance training - a matter of great importance in many countries - is used as a case example.

Chapter four brings together the methods devised for the design of these three stages. A case concerning the development of joint government/industry sponsored vocational training is examined.

Some designs suffer from the slowness of their application and are often outdated when the time comes for them to be put into operation. Chapter five shows how this can be avoided by taking design across the bridge to action through the use of planning techniques, and the application of algorithms and network planning to the scheduling of training. It is primarily concerned with improvement of the efficiency and effectiveness of training systems. Lastly, chapter six deals with control and evaluation as a means of measuring design quality. It also provides an overview of the main topics dealt with in this handbook.

*************************************************************

The aim of this handbook is to assist training practitioners in applying a systematic approach to the design of vocational training programmes. Various methods and techniques are suggested to facilitate the task of designing vocational training schemes that are cost effective and relevant to the training and employment needs of the economy and of individuals.

As concepts, approaches, methodologies and activities are changing everywhere all the time, this handbook should be considered as an evolving document which needs updating and modifications. We should therefore welcome comments and feedback that will help improve and update this study and render it a useful working tool for effective vocational training design.

Chief
Vocational Training Branch
International Labour Office
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CHAPTER ONE

THE APPROACH TO THE EFFECTIVE DESIGNING OF TRAINING

Appropriate training systems can achieve a variety of goals. This chapter shows how systematic design methods can be made a powerful tool for the elaboration of effective vocational training systems.

A prime objective of vocational training is to develop occupational skills within a training institution or industrial workshop, or on a work site. Close proximity with industry encourages an exchange of ideas, concepts and principles that has enabled many training managers to improve their systems and operations by applying industrial design principles to training. "Systems engineering" of this kind can be used to:
- solve new training problems,
- solve the problems of existing vocational training projects by re-design,
- satisfy new training needs created by economic, structural or technological change,
- improve the efficiency of established training schemes.

When developing an industrial system, a designer is constantly questioning what has been achieved, or at all events what he is trying to achieve.

Similarly, training designers should be constantly questioning their design methodology. A sample set of pertinent questions is grouped under six headings in Checklist 1:

WHO; WHY, WHERE, WHEN, WHAT, HOW?

Industrial designers use this form of enquiry in their early design stages.

Suppose you have been asked to lead a design team and be
responsible for preparing an important training project.

Your first task will be to ascertain the project's operational parameters. The questions set out in Checklist 1 offer a useful way of finding out what these parameters should be.

<table>
<thead>
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<tr>
<td><strong>DESIGN PARAMETERS</strong></td>
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<tr>
<td><strong>WHO</strong></td>
</tr>
<tr>
<td>- should be trained?</td>
</tr>
<tr>
<td>- will provide funds for designing the project?</td>
</tr>
<tr>
<td>- will be responsible for developing the project?</td>
</tr>
<tr>
<td><strong>WHY</strong></td>
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<tr>
<td>- should a specific project be worked out? Will training provide the best solution to the problem?</td>
</tr>
<tr>
<td>- should a particular training project be given priority? Could resources be used more efficiently?</td>
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<tr>
<td><strong>WHERE</strong></td>
</tr>
<tr>
<td>- should the programme be implemented to achieve the maximum effect?</td>
</tr>
<tr>
<td>- will employment, self-employment or income earning opportunities be available to trainees on completion of training?</td>
</tr>
<tr>
<td>- are the available physical resources, buildings, equipment, trainers etc. located?</td>
</tr>
<tr>
<td><strong>WHEN</strong></td>
</tr>
<tr>
<td>- will funds, facilities, trainees and trainers be available?</td>
</tr>
<tr>
<td>- should the project start and finish to achieve its optimum effectiveness?</td>
</tr>
<tr>
<td><strong>WHAT</strong></td>
</tr>
<tr>
<td>- will be the project goal?</td>
</tr>
<tr>
<td>- conditions are necessary for the goal to be achieved?</td>
</tr>
<tr>
<td>- factors have to be considered when working out the contents of the programme?</td>
</tr>
<tr>
<td>- mix of training methods will produce effective learning?</td>
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Checklist 1 continued

HOW
- can the project goal be achieved?
- can the designer ensure that the project is both efficient and effective?
- can the designer convince the:
  . social partners
  . sponsors
  . client
  . trainers
  . trainees
  . employers
  . management
  . workers
  that the project will meet their various objectives?

A. Developing a design methodology

Your answers to the questions in Checklist 1 will provide the guidelines for your particular case. If you then apply the same procedure to a variety of situations, the components of a method for designing will emerge. A well-developed method ensures that the steps taken to design any training project will be highly efficient in the achievement of its objectives.

Checklist 2 asks another set of questions. Here, too, your answers will provide the pattern best suited to your requirements.

If this is your first design exercise, you may find it difficult to answer these questions. Do not despair. Many other designers have had this problem. For example, a famous industrialist stated that he had very little knowledge of the technical processes used in his manufacturing plant. In compensation, he had a high degree of skill in two specific areas:

(a) knowing who was the technical specialist likely to be able to answer questions,

(b) formulating pertinent questions to obtain the information required.
Checklist 2

BASIC ELEMENTS IN TRAINING DESIGN

ARE YOUR DESIGN METHODS:
- enhancing national, regional, local or enterprise objectives;
- capable of producing several alternative solutions for each of a variety of vocational training problems;
- effective when applied to different vocational training systems, participant levels or sectors;
- able to produce cost-effective results in both large and small training projects;
- able to produce solutions to training problems in all environments, e.g.:
  - formal or informal industrial sectors,
  - formal or informal service sectors,
  - non-farm products or rural sectors;
- consistent with the development of systematic training;
- producing training programmes that can be evaluated?

Even if you cannot answer all the questions in Checklists 1 or 2, you can still become expert in identifying the specialists in your organisation who may have the answers to your "pertinent questions". To help you work out your design methods, let us follow the progress of some case studies. Reference is made to these separate cases in the remaining chapters and various factors affecting design methodology are dealt with.

Three situations that benefited from systematic training are examined in this chapter. First, however, we must ask: "can training, systematically applied, improve situations?" The answer is not always "yes". Perhaps a better question is "what would be the result of neglecting to apply systematic training to a situation?"

Training designed for training's sake is a futile exercise. Unfortunately, it is practised too often by many trainers. The decision not to support a design project, even if this would be
the best decision, can often be more difficult to take than letting training design proceed.

Checklist 3 illustrates situations that can fully or partly benefit from training systematically designed and applied. Ask yourself: "is my situation one of these?"

---

Checklist 3

**TRAINING APPLICATIONS**

Cost-effective training can benefit situations generated or influenced by:

(a) changes in national and economic plans affecting sectoral growth;
(b) changes in organisational objectives at the enterprise level that create personnel problems;
(c) changes in manufacturing objectives that alter the size of the skilled workforce;
(d) changes in supply to the labour market of potentially skilled workers (e.g. improvement in national educational standards, raising of school leaving age, etc.);
(e) changes in technology requiring new skills for employment in the manufacturing or service industries;
(f) changes in raw material or energy supplies affecting vocational skills (e.g. hand-made wooden component furniture replaced by machine-made plastic and metal frame furniture; diesel-electric power generation replaced by a national electricity grid);
(g) high labour turnover and natural wastage of skilled personnel through illness, accident or retirement;
(h) legislation on equal employment opportunities for men and women;
(i) legislation on national industrial training policy (e.g. apprenticeship replaced by joint industrial training schemes);
(j) changes in demand for goods and services.
B. Case examples

Now let us look at three practical cases. The first deals with improving product quality in a national enterprise with several provincial factories; the second describes the development of a national plan to train instructors; the third responded to a need to train key repair technicians. Try matching these examples with our checklists.

Case A

In twenty small regional companies forming a national group of paint manufacturers, management was satisfied that production targets were being met. However, an investigation showed that in the critical areas of paint mixing and colour standardisation, no checking mechanisms were being used owing to a lack of expertise. When a new machine was supplied, the manufacturers stressed that the use of mixing and colour control mechanisms was one of the main advantages of their paint mixing machines. Training was therefore given to both the mixing shop foreman and the machine operators. The result was an improvement in paint quality. This in turn produced both a higher sales demand and a 20% increase in productivity. Management then reassessed group production targets and reorganised the regional companies to meet these new output figures.

Case B

In a developing country heavily dependent on oil export revenues to offset its debts, a change in export policy had to be introduced owing to the serious effect on GNP figures of the worldwide fall in oil prices.

To remedy this situation, a national skill training policy had to be urgently developed to assist companies manufacturing domestic consumer products for export.

Its first phase required the additional employment of large numbers of vocational training instructors who could only be recruited from two sources:
(1) skilled workers employed in industry; or
(2) newly qualified school teachers.
Case B continued

After careful consideration, the government decided to recruit as many teachers as possible, so as not to further increase the organisational problems of industry. A national "instructor conversion training scheme" was set up and included:

1. in-service training in instruction methods;
2. secondment of trained school teachers to industry to acquire technical skills and know-how;
3. team building seminars concerned with transactional behaviour between policymakers, managers, supervisors, trainers and trainees.

The aim of these measures was to expand the country's effective training force from fifteen hundred to five thousand five hundred instructors in five years.

Case C

A company assembling heavy earth movers had been operating for several years in a developing country. Some major components were manufactured locally, but others were imported. In each case, goods arriving at the assembly plant had to be lifted from road transporters by an overhead crane. During assembly, too, the crane had to carry heavy components between work stations. Since its installation several years earlier, the chief maintenance fitter had been responsible for ensuring that the crane was kept in good working order and had become highly specialised in the repair of its mechanical, electrical and hydraulic systems. Due to a lack of in-plant training facilities, no other worker had been trained to carry out any of these repairs. A problem thus arose when the management decided to promote the chief maintenance fitter to the post of "tractor assembly manager".

The company had two ways of avoiding a major disruption in production activities:

(1) Recruitment of a trained specialist outside the company;

or

(2) In-plant training of a new specialist before promoting the chief fitter.

Since it was uncertain whether a specialist could be recruited externally, the company decided to select one of its employees for in-plant training.
N.B. This is a very good illustration of the fact that there may be several alternative solutions to a problem that can benefit from vocational training, even though only one will give the best result in the circumstances. Although the company felt it had only two options, there were other alternatives; let us look at some of them and try to assess their various merits.

Solution A

Delay promotion of the chief fitter until he has trained a replacement to an appropriate level.

FOR  A comfortable solution. It prevents production from being disrupted at the price of a delay in career progression.

AGAINST  Highly skilled workers are not necessarily competent trainers.

Solution B

Recruit a new fitter from the labour market.

FOR  A quick solution avoiding disruption in production or demotivation of the chief fitter through the delay in his career advancement.

AGAINST  The new employee will need time to adjust to company practices and working procedures. His methods of working may also make it necessary for the company to retrain him.

Solution C

Request the crane manufacturer to train a company employee at their oversees plant.

FOR  The trainee specialist will obtain the latest information and repair skills.

AGAINST  Management may consider overseas training an expensive way of solving a local problem.
Solution D

Subdivision of the crane maintenance and repair schedule.

FOR
Prevention of further situations in which a problem is raised by the existence of a "key" fitter.

AGAINST
Higher preventive and breakdown maintenance costs. Separate specialists needed to maintain the mechanical, electrical and hydraulic systems. Destroys the concept of "integrated skills".

Solution E

Require the chief fitter to continue to be responsible for maintenance and repair of the crane.

FOR
Very little.

AGAINST
The situation will recur.

The solution best able to meet the company's objectives and satisfy personnel will depend on the local circumstances. As Frank Bunker Gilbreth has said "at a particular moment in time, in a particular location, there is only one best way".

It is up to you to "choose the best way" from your alternative training choices.

C. Behavioural influences in training design

What we have been looking at so far is part of the decision-making phase in training design. Checklists allow us to make an initial decision on whether a particular training solution to a problem is the correct one. Another influence affects the decision-making process and we need to be aware of its possible effects on design.

The aims to be served by the design of a programme often depend upon the point of view of the person instructing the designer. For instance:

(a) if you are a minister, your first priority will be to ensure
that the programme design is in keeping with your country's five-year plan;

(b) if you are a treasurer and financial controller, your principal aim will be to obtain an optimum cost-benefit ratio;

(c) if you are a training institute director, you will want the programme designed to ensure that the maximum number of trainees achieve qualification;

(d) if you are an employer, you will want the design to ensure that trainees can work quickly and effectively without too much additional training;

(e) if you are a trainee, you will want the designer to provide you a good chance of obtaining employment.

It is a mistake to let training programme designers construct new designs until you are sure they fully understand why a new training system, structure or programme is requested. The flow chart in Figure 1 illustrates the order of progression into the design process. Project decisions have to be converted by design into programme aims. These, when clearly defined, become measurable training objectives. Figure 2 illustrates the way in which alternative design solutions are systematically compared with programme aims and a solution satisfying both client aspirations and training needs is chosen.

Figure 1

![Diagram](image-url)
ASPIRATIONS AND NEEDS

PROJECT DECISIONS

PROGRAMME AIMS

ALTERNATIVE DESIGN SOLUTIONS

SATISFACTION

DEFINITION OF OBJECTIVES

OBJECTIVE MEASURES

OUTPUT ACHIEVEMENT
D. Building up a set of methods

The concepts and principles illustrated so far can be set out in the form of the action flow chart in Figure 3 to show how to get the design process moving. It is clear that we are beginning to build up a set of training design methods.

Four stages must be completed before the design of the training project is worked out in detail:

(a) decision whether there is a need to design a new training project after considering the checklist factors;
(b) statement of general aims to be achieved by the training solutions envisaged;
(c) examination of these aims and elaboration of broad outline solutions;
(d) choice of the most appropriate detailed design solution.

If you are designing a large project involving sizeable financial commitments, these stages are separate and clearly identifiable. If, however, your project is small, the four stages will probably merge into a continuous process. During this process, two divergencies commonly enter discussions of the aims to be achieved by the programme designers due to:

(1) members of decision-making bodies pushing their personal preferences; or
(2) training designers and committee members being influenced by current fashions.

Personal preferences are easily recognised when a member of your policy group insists that the design brief should take into consideration points such as:
- vocational training is much better conducted off-the-job;
- vocational training can only take place at the worksite;
- vocational training courses must always take six months if they are to be successful;
- training groups must never have more than ten trainees.

On investigation, you will find that this member brings up the same preferences at many policy meetings and has become
Figure 3

POLICY DECISIONS FROM SEVERAL NEEDS

ANALYSIS OF AIMS WITH ALTERNATIVE ACTIONS

SPECIFICATION OF AIMS

CHOICE OF BEST SOLUTION AND FIXING OF OBJECTIVES FOR DESIGN PROCESS
convinced of their validity, often without any proof. All these points are valid in particular situations. What you have to ensure is they they fit the needs you have identified before including them in the design brief. If they neither improve nor support the real aims of your new programme, you may have to reach a compromise.

Similarly, both committee members and designers are influenced by current fashions that are good in themselves, but have proved costly when wrongly or unnecessarily applied. Examples:
- all training software has to be in programmed learning format;
- financial management plans for training institutions cannot be changed by institution managers after annual budget allocations have been approved;
- accreditation of training programmes is not in the general interest as it propagates the diploma syndrome.

As you can see, some of these fashions are only indirectly relevant to training programme design. Unless care is taken to point this out, the aims being set will be diluted or obscured by irrelevant factors.

It cannot be sufficiently stressed that, unless stages 1 and 2 of the preliminary design phase produce clear concepts, the design team will either:

(1) have too much information and spend time and effort on deciding which items are not relevant; or

(2) have gathered too little information and so produce a design that only partially satisfies the needs originally identified.

E. In retrospect

This chapter has considered the reasons for applying training design solutions to national and local training problems. It has also indicated some of the pitfalls facing decision-making bodies that may lead to inefficient use of both financial and human training resources. The training of manpower is an expensive activity. The component factors of effective training of skilled workers are shown in Figure 4.
Figure 4: Training is an expensive activity

IMPLEMENTATION STRATEGY

FINANCIAL ALLOCATION AND CONTROL

PLANNING

ADMINISTRATION OF RESOURCES

TRAINING MANAGEMENT

IMPLEMENTATION OF TRAINING PROGRAMMES

TRAINING POLICY

TRAINING CURRICULUM

TRAINING TECHNIQUES

FACILITIES AND RESOURCES

TRAINERS

TRAIINEES

WORKERS TRAINED TO PRE-DETERMINED PERFORMANCE STANDARDS
The items on the left of the diagram are those which concern the control of efficiency: your design will have to fit into national or company training policies. For the achievement of effective results, you must devise strategies that take account of the technical, cultural and social needs of the locality in which training is to take place, and ensure that training policies and plans are respected, and that the programmes are managed and administered efficiently.

Moving to the right of the diagram: one of the main tasks for your design team will be to work out a training curriculum for each programme from relevant training specifications and state the appropriate resources. Designers must ask who, why, where, when, what and how in checklists similar to our Checklist 1. These should also ask such questions as:

- can the problem be solved by training;
- is a training design solution the most appropriate in terms of efficiency and effectiveness;
- what would be the result of neglecting to provide training;
- will training solve organisation problems;
- can a different design produce a better occupational skill development programme;
- will the company run into difficulties if any of the skilled workers suddenly quit;
- is the enterprise prepared for legislative changes affecting their training schemes;
- are there sufficient skills in the workforce to cope with a change in manufacturing objectives;
- is the enterprise prepared for the introduction of new technologies and changes in material resources;
- has the enterprise sufficient workforce capacity and skills to produce goods that will attract export orders;
- can training improve productivity;
- does the company want to change its quality levels;
- can the enterprise improve worker utilisation and provide better work opportunities?
If you consolidate these thoughts and consider the questions to be asked before designing a training project at the enterprise level, you will come to Checklist 4.

Checklist 4

ENTERPRISE TRAINING

Will training:
(a) Reduce production times to meet quoted delivery dates for finished products?
(b) Correct falling levels of productivity?
(c) Improve product quality?
(d) Reduce material wastage?
(e) Facilitate the introduction of new processes, technologies or utilisation rates?
(f) Increase skilled worker flexibility and mobility?
(g) Reduce accident rates? Reduce equipment down time?
(h) Increase product diversification possibilities?
(i) Increase job satisfaction and improve industrial relations?
(j) Reduce the time required to produce skilled worker competence?
(k) etc.

In this chapter, we looked at three cases where training was required and briefly described what was done. Later chapters will examine further aspects of these three cases.

Lastly, we summarised the checklist points and moved from national macro-considerations affecting training to local micro-situations in enterprise training. The purpose of the chapter, therefore, has been to examine the decision-making stage of systematic training and show how design methods applicable to a variety of situations where such training is needed can be devised.
If our training programmes are to be both efficient and effective, they will have to be worked out systematically. Fortunately we do not have to develop our own systems to training. This has already been researched by others, and is widely applied. This approach is expanded in chapter two to enable a better understanding of the components of a training system to be obtained. You will find that the methods explained can be applied to three training stages. We shall examine a new situation (Case D) in which manpower planning is involved.
A SYSTEMATIC APPROACH TO VOCATIONAL TRAINING

A. The structure of training

Many different types of programme structure can be seen in the training systems of the developing countries. Their comparison lies outside the scope of this handbook. Even so, a detailed account must be given of those that have proved cost-effective and efficient in the teaching of trainees, since studies and surveys carried out in many countries have shown that efficient and effective learning of occupational competences is more likely if training programmes have a systematic structure.

Experience has demonstrated that over-concentration on selected elements in an instructional system, such as instructor training or the production of learning materials, frequently leads to programme failure. The ILO therefore advocates a broad systems approach to vocational training programme design. Furthermore, to be effective, vocational training must be integrated with national development strategies. This can make it difficult to influence training systems by radical design in some countries. However, a systems approach, though difficult, improves relevancy and increases effectiveness. Instructional systems design for vocational training begins with analysis of the problem. It makes sure that training is an appropriate solution to this problem and establishes the magnitude of skill development required. The next step is to identify the competences required, these being based on job and task analysis. Performance standards and reference measures are established against which performance can be judged. On the basis of the competences required, training objectives are established, characteristics of the trainee target group are evaluated, and training programmes are prepared. The success of a vocational training programme design is measured by the extent to which trainees are brought to the pre-established skill standards and, more particularly, how far they succeed in applying their
newly acquired skills to real work situations. The systems approach thus applies a competency-based concept and requires very little modification of existing systems. The main difference is that training programmes are no longer geared to standard curricula, but follow course designs based on actual job requirements. As with all steps taken in the light of research, the success of a systematic training programme hinges on the accuracy of the original assessment.

In examining training strategies, plans and problems:

1. People who will be affected by the introduction of the systematic training have to be CONSULTED.

2. Information has to be obtained by asking searching QUESTIONS.

3. Answers obtained must be fully ANALYSED.

4. CONCLUSIONS have to be converted into competency-based training actions.

The four stages of systematic training design can thus be stated in the form of four imperatives (Figure 5):

**Figure 5**
B. **Looking for systematic design factors**

In your consultation and questioning sessions, you will be looking for information to help you design your training programme.

We saw in chapter one that it is essential to find out whether training is the most adequate solution to an organisation's problems.

A basic premiss for a vocational training programme is that it will be of little use if it does not prepare persons for existing or potential employment. You must be convinced that:

- an employment or income-learning opportunity will exist for trainees after their training;
- the occupational skills it provides are in line with identified needs.

Where these conditions are met and a training programme is needed, its design should follow the paths illustrated schematically in Figure 6.

Systematic design requires information that will help the designer to build the three main stages shown in the diagram. In the first stage, he must:

- identify jobs for which training is not being provided at present;
- analyse jobs and tasks in terms of the skill content they require from employees, both now and in the future.

To design the second stage, he must:

- define the entry criteria for trainees selected for occupational skill training according to the job information gathered in Stage 1;
- identify the sources from which participants can be obtained;
- identify who will carry out the training;
- identify the training resources and facilities required.

Implementation of the programme is followed by the third stage. Here the designer must:

- measure the efficiency and effectiveness of the programme against its objectives;
Figure 6

NATIONAL TRAINING STANDARDS

TRAINING NEEDS ASSESSMENT (JOBS/PRIORITIES)

PERFORMANCE STANDARDS

JOB AND TASK ANALYSIS

JOB SPECIFICATIONS

SKILLS ANALYSIS

TRAINEE SPECIFICATIONS

TRAINING SPECIFICATIONS (TRAINING OBJECTIVES)

TRAINING PROGRAMME PREPARATION

IDENT./DETERM. OF STRATEGIES/RESOURCES FOR PROGRAMME IMPLEMENTATION

TRAINING PROGRAMME IMPLEMENTATION

TESTING CERTIFICATION

EVALUATION VALIDATION FEEDBACK

SELECTION/ASSESSMENT "OF TRAINING POPULATION"
- validate its effectiveness by designing into its structure follow-up methods to provide information on how trainees progress after entering the jobs for which the training was provided.

The abstract diagram in Figure 7 makes it very easy to forget that what you are designing is a systematic plan that may affect the aspirations, attitudes and employment opportunities of real persons.

This will become clear as we examine the three design stages in Figure 6 in greater detail.

C. A methodology for Stage 1

Stage 1 is set out separately in Figure 7. Here it should be noted that both national and local job performance standards have to be taken into account when assessing training needs. If training maintains vocational skills at national standards, trained workers will be more flexible and can find employment in any enterprise where these standards are recognised.

Stage 1 includes four inter-related components:

- national training standards;
- performance standards;
- training needs assessment;
- job and task analysis.

In the case of an enterprise, Stage 1 is primarily concerned with the last two items. Even so, you must ensure that your organisation has national or international job classifications and performance standards for a relevant range of vocational skills. Classifications such as ISCO are fairly easy to obtain, but performance standards appropriate to your local situation may not exist. In this case, you will need to devise another checklist containing the minimum performance standards for trained workers entering the more important skilled occupations being developed in your enterprise. The methods used by the ILO are described in its publications on modules of employable skill schemes and could usefully be studied to help you in this task.

With experience, the checklist for each occupation can be made more detailed, expanded in scope and kept up to date. The
Figure 7

Stage 1

NATIONAL TRAINING STANDARDS

PERFORMANCE STANDARDS

TRAINING NEEDS ASSESSMENT

JOB AND TASK ANALYSIS

JOB SPECIFICATIONS

SKILLS ANALYSIS

TRAINEE SPECIFICATIONS

TRAINING SPECIFICATIONS
basic requirement is a checklist with brief indicators of minimum acceptable performance standards. Figure 8 relates information on national training and worker performance standards with that obtained during job requirement and needs analysis surveys.

Let us return for a moment to the checklist of problem situations that can be solved through training solutions, as outlined in chapter one. It is more than likely that a needs analysis will reveal weaknesses under the following two headings:

- ORGANISATIONAL AND PRODUCTION PROBLEMS AT THE ENTERPRISE LEVEL
- LACK OF OCCUPATIONAL SKILLS FOR SOME PROCESSES.

You saw in "Case B" that it was necessary to prepare for a substantial expansion in the manufacture of domestic consumer products for export, due to a fall in oil revenues. Here, you would have to carry out some form of manpower planning to prepare sufficient skilled personnel in particular occupations, at given times, in line with your enterprise's strategies.

a. **Manpower planning steps**

There are three main steps in manpower planning:

(i) forecasting skilled workforce requirements (demand);
(ii) forecasting workforce recruitment and transfers (supply);
(iii) comparing demand with supply.

After Step (iii), the size of the manpower training requirement can be estimated.

**Manpower planning for Case D**

Let us look at the manpower planning steps in a new case. An enterprise is manufacturing consumer products and needs to expand its workforce to assemble domestic air conditioning units (Case D).

**How to work out a solution for Case D**

The allotted time for the assembly of one unit is five hours. In a 35-hour working week, seven units can be assembled by each worker, resulting in three hundred and fifty units in a 50-week year.
Figure 8

NATIONAL TRAINING STANDARDS

TRAINING NEEDS ASSESSMENT

PERFORMANCE STANDARDS

JOB AND SKILLS ANALYSIS

DEFINITION OF TRAINING COMPONENTS
Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit demand</td>
<td>5,000</td>
<td>7,000</td>
<td>10,000</td>
<td>14,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Skilled workers needed</td>
<td>14</td>
<td>20</td>
<td>29</td>
<td>40</td>
<td>57</td>
</tr>
</tbody>
</table>

When the workforce becomes more proficient, the time needed to assemble each unit may be expected to fall and fewer workers will be required, especially in years four and five. With time, a trend towards higher productivity may be observable. At first, however, guesswork should be avoided. The data in Table 1 should be used for planning until a suitable period of experience shows what progress is being made.

Forecasting manpower needs is a well-documented subject and lies outside the scope of this handbook. It should be noted, however, that our simple example does not take into account possible changes in assembly methods, nor absenteeism and accident ratios. Addition of these factors will give us Table 2.

Table 2

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit demand</td>
<td>5,000</td>
<td>7,000</td>
<td>10,000</td>
<td>14,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Units per worker hour</td>
<td>1:5</td>
<td>1:4.4</td>
<td>1:4</td>
<td>1:3</td>
<td>1:3</td>
</tr>
<tr>
<td>Units per worker year</td>
<td>350</td>
<td>389</td>
<td>437</td>
<td>583</td>
<td>583</td>
</tr>
<tr>
<td>Workers required</td>
<td>14</td>
<td>18</td>
<td>23</td>
<td>24</td>
<td>34</td>
</tr>
<tr>
<td>Estimated % hours lost for absenteeism, etc.</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
<td>8</td>
</tr>
<tr>
<td>Total skilled workers required</td>
<td>15</td>
<td>19</td>
<td>25</td>
<td>26</td>
<td>37</td>
</tr>
</tbody>
</table>
Having established the number of workers required for each year, we can construct a further table to show the yearly recruitment figures. When dealing with small numbers, as in this example, the number to be recruited is the increase in the total of skilled workers required each year. This is taken from the bottom line of Table 2 and shown in Table 3.

Table 3

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruitment</td>
<td>14</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>11</td>
</tr>
</tbody>
</table>

This is a simple example. In practice, continuous attention must be given to assessing manpower needs. When much larger numbers are involved, a better estimate of recruitment figures is also required. The supply forecast will be complicated by such factors as:

- retirements
- deaths
- dismissals
- promotions
- transfers
- resignations.

Techniques for the more detailed assessment of manpower needs can be found in ILO and other publications.

Assessment of training needs for Case D

When assessing training needs, you must identify the types of jobs for which workers need to be trained to appropriate levels of skill. You will also have to estimate how many workers may be required in the short and long terms. This exercise may show that certain occupations and jobs are over-staffed and make it necessary to work out retraining programmes to deploy workers to more productive activities. You will find that the provision of workers for some job categories is more important than for others. This information can be used to draw up a schedule of priorities.

Looking again at Case D, the manpower forecast shows that you will have to train about forty workers to assemble air
conditioning units over a five-year period. To do this, you must first estimate the size and cost of training to bring forty trainees to acceptable levels of proficiency. The design methods worked out in this handbook make this estimate easier by applying industrial engineering techniques to systematic training. One of these techniques, job analysis, can be used to identify the occupational skills, competency levels and knowledge required for the assembly of air conditioning units.

However, job analysts often make the mistake of getting straight down to the technical side of their work and neglecting both the work attitudes and the cultural habits in a given enterprise.

In the case of our forty assembly workers, a detailed job analysis should be preceded by an assessment of the effect on training of:
- personnel policies;
- working practices and attitudes;
- the background, education, previous experience and personal aspirations of potential trainees.

The first item is organisationally important. Neglect of the second will make your design difficult to apply, as one of the main objectives of training is to improve work relationships and assist in increasing shop floor productivity.

An ACTION REQUIREMENT STATEMENT (Table 4) is usually prepared once training needs are identified and assessed.

The statements in the table refer to the four "cases" we have examined so far.

When it is decided to take action in accordance with a statement, the next design step is an in-depth job analysis.

b. Job analysis

A distinction must be made between a job and a task. In general, a job is the piece of work for which a worker has been employed. A job and a task may be the same. In most cases, however, a job consists of several tasks.
<table>
<thead>
<tr>
<th>REF</th>
<th>NEED</th>
<th>TARGET POPULATION</th>
<th>ACTION</th>
<th>BENEFIT</th>
<th>PREPARATION</th>
<th>TARGET DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Improvement of paint quality</td>
<td>20 paint mixing shop foremen</td>
<td>- 35 hours technical specialist training</td>
<td>Improved quality control</td>
<td>Paint manufacturers will train company foremen at work site. Foremen will prepare operator training course under control of group training officer</td>
<td>To start in six weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- 20 hours training in operator training techniques</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased competency of paint shop operators</td>
<td>200 mixing shop operators</td>
<td>- 20 hours operations 'training</td>
<td>Increased productivity</td>
<td>Operators will be trained by foremen</td>
<td>To start in ten weeks</td>
</tr>
<tr>
<td>2B</td>
<td>Increased numbers of qualified vocational training instructors</td>
<td>4,000 assistant school teachers</td>
<td>3 months induction at Government skill centres, 6 months vocational skill practice in industry, 3 months instructor training in N.I.T.C. (National Instructor Training Centre)</td>
<td>To meet requirements of Government's 5-year development plan</td>
<td>Responsibility: Ministry of Manpower, Directorate of Training Action: Project Plan and Programme Design</td>
<td>12 - 15 months for needs survey and design of training scheme</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased numbers of vocational training section managers</td>
<td>200 existing senior instructors</td>
<td>6 weeks course curriculum development, 4 weeks course management of vocational instruction</td>
<td>To induct, prepare and manage new instructors in Government skill centres</td>
<td>Ministry of Manpower Staff Training College Course design for vocational trainers</td>
<td>Design of scheme Development of software 4 - 6 months Ministry Staff College</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3C</td>
<td>Replacement of Chief Fitter (Crane Repair)</td>
<td>1 specialist in general repair skills</td>
<td>4 weeks overseas training at crane manufacturer's plant</td>
<td>Preparation of new specialist to take over vacant post</td>
<td>Company training officer in liaison with crane supplier</td>
<td>4 weeks before promotion date of present incumbent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lifting gear systems repair</td>
<td>3 skilled workers</td>
<td>1 week each mechanical, electrical, hydraulic training by incumbent</td>
<td>To backstop repair processes in absence of specialist fitter</td>
<td>Company training officer and post incumbent</td>
<td>According to work load</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4D</td>
<td>Expansion of competence of air conditioning equipment assembly workers</td>
<td>About 10 workers per year for 5 years. Minimum education secondary technical training basic course at G.I.T.C.</td>
<td>4 weeks on-the-job training 8 weeks in-service training</td>
<td>Quality improvement to export standard for A/C products</td>
<td>Combined action group training officer - assembly shop manager</td>
<td>Implementation of training to be completed within 4 months of each year's &quot;action notice&quot;</td>
</tr>
</tbody>
</table>
Trained workers must be able to carry out their skilled tasks effectively. You must therefore define the performance standards during training. Determination of these standards requires an analysis of the job content, methods and occupational skills for the trainee categories. This analysis will provide training programme designers with the information they need to set training objectives and construct programmes. Job analyses can be made for several purposes, such as equipment design, job method change, work measurement, personnel recruitment and the designing of systematic training.

Before starting job analysis, it is advisable to contact the work study or personnel department of the organisation or enterprise for which the training scheme is being designed, so as to obtain the full support and cooperation of those involved in supervising or carrying out the job, e.g.
- senior managers;
- supervisors;
- existing workers;
- work study and personnel specialists;
- union representatives.

If unions realise that analyses are being carried out to give effective training to their workers, they can be extremely helpful if correctly approached.

c. **Activities involved in job analysis**

Information for job analyses is best obtained by:
- observation of persons doing the job;
- questioning anyone who can provide relevant information (this is important because the observer may miss important details);
- looking at job analyses prepared by other departments;
- trying to do the job oneself.

d. **The components of job analysis**

These include:
- job descriptions;
- job specifications;
- specific analyses of knowledge, special skills and related competences.
The process of job analysis

Job analysis is only a means to an end, namely effective learning through systematic training. It is an important keystone in the construction of a design but must not be made its most important feature. Designers prepare job descriptions and specifications in minute detail. This is a costly process and may be of little benefit in situations where it was not justified.

The designer should only gather the detail he needs to design effectively. How much detail is required is governed by two factors:

(i) the difficulty of the job. More detail is required for complex occupations, as these will need more learning steps in the design of the training scheme;

(ii) the extent to which the job is critical. More in-depth training is required for jobs that critically affect other jobs performed at a later stage in an enterprise's production sequence.

Detailed information on the process of job analysis can be found in the ILO's publication Introduction to Work Study (3rd. Edition 1979, ILO Geneva).

D. A methodology for Stage 2

The second design stage is shown in Figure 9. Its first three steps are:

- preparing the training specifications;
- preparing the training programme;
- identification and determination of training strategies and resources.

These steps provide the bridge between the identification of training needs and the implementation of an appropriate training programme. The fourth step:

- implementation of a vocational training programme

will not be dealt with here, since we are only concerned with design. It is well covered in texts and modular programmes available from the ILO, or other sources.
Stage 2

1. Training Specifications
2. Training Programme Preparation
3. Ident./Determine of Strategies/Resources
4. Programme Implementation
a. Training aims and their conversion into programme objectives

The information given by the analysis completed in Stage 1 must be inserted in a single training specification.

This specification is derived from the brief details in the notice of agreed training action (Table 4). It must now be stated more precisely so as to convert the general aims proposed in the decision-making stages into defined training objectives.

There is a difference between a general training aim and a training objective. An aim is a general statement of intention. It is not necessarily described in a specification or in a systematic form. Example: "The AIM of a training programme is to prepare two hundred workers to meet labour market requirements".

You will notice that this aim is general because it does not specify:

(i) the entry qualifications needed by trainees to be able to benefit from the programme;

(ii) whether the programme will train in a single skill or in a range of skills;

(iii) the sectors of the labour market that will absorb the trainee output;

Etc, etc. The list is not exhaustive and will also depend on local factors.

A training programme aim does not necessarily refer to the output to be achieved. It may refer to an input situation or a particular learning process.

An objective, on the other hand, always specifies the output to be achieved.

A training programme objective is a specific statement of intention in a systematic form. Example:

"The training programmes will be applied to trainees already in possession of a secondary school certificate or its equivalent. Each programme will produce two hundred qualified automobile service trades instructors. The trainees will reach the standards set by the national accreditation board within one year of
commencing a programme. After passing the test set by
the national body at the end of the training pro-
gramme, the programme graduates will be recognised as
assistant instructors available for employment in
rural training centres".

b. Specifying programme objectives

In this design stage, training programme objectives must
include, as a minimum:
- the education, knowledge, experience and ability candidates
  require for successful participation in the programme;
- the specific knowledge they require of the institution,
  organisation, enterprise or company;
- what specific technical knowledge or competence is required to
  make sure that the programme meets the employer's needs?

The first two questions refer to entry requirements for
acceptance in the training programme. The third specifies in
simple terms what the programme aims to achieve.

In some training designs, entry criteria are separated from
performance standards when setting programme objectives. Our
method combines entry and performance requirements within an over-
all training specification instead of constructing separate
objectives that may well be changed later on.

In Case A (chapter one), it was decided to train paint-
mixing shop supervisors and operators to improve quality control. Here is a training specification for a shop foreman whose training
was requested in reference 1A in the "Notice of Agreed Training
Action" (Table 4).

<table>
<thead>
<tr>
<th>Training Specification</th>
<th>Paint Quality Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic knowledge and experience at start of training</td>
<td></td>
</tr>
<tr>
<td>- Secondary technical school certificate or equivalent.</td>
<td></td>
</tr>
<tr>
<td>- Experience in using simple mathematics.</td>
<td></td>
</tr>
<tr>
<td>- Experience in paint production</td>
<td></td>
</tr>
</tbody>
</table>
Knowledge and experience in the company

- Must currently hold, or be proposed for, a supervisory post in paint manufacture in the company.

General knowledge on completion of training

- Knowledge of paint-making processes in the group's twenty companies.
- Group organisation and systems of communication.
- Quality control policy and procedures.

Specialised knowledge on completion of training

- Raw material specifications.
- Stock control procedures.
- Quality control test procedures.
- How to construct and interpret quality control charts.
- Circumstances under which paint mixing must be stopped.
- Safety and health procedures.
- Quality reporting.

Skills required on completion of training

- Ability to communicate with management and other supervisors.
- Ability to write quality control reports.
- Ability to carry out all standard test procedures according to equipment manufacturers' instructions.
- Ability to motivate and control paint mixing shop operators and obtain good results.

Special abilities

- Not applicable.

The next step is to design a training programme structure that will ensure achievement of the objectives stated in the specification.

c. Designing a training programme structure

It is now time to work out the curriculum and the occupational activity plan for your training project (seminar, training workshop or vocational skills programme). No training, however
short, will be efficient and effective in the absence of a detailed plan. A curriculum is much more than a list of topics (usually called a "syllabus") to be dealt with during a training programme.

Curriculum design requires consideration of all the items that form an integrated workplan for translating information, data and concepts into practical training steps.

A curriculum includes:
- the topics to be presented;
- the training methods to be applied;
- the training media required;
- the facilities to be utilised (training locations);
- the selection, checking and testing of instruments.

Your draft curriculum may have to be rearranged to suit an operational activity plan. Techniques for working out plans of this kind are described in chapter five.

d. Curriculum development factors

Our method has now provided a large quantity of information. This will be of little value unless it can be translated into a programme of action inducing trainees to improve or increase their knowledge and skills.

When you design a curriculum, you need more skills than those required for Stage 1. Here are the skills needed to design the steps in Stage 1 and 2.

<table>
<thead>
<tr>
<th>Design stages</th>
<th>Designer skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>- setting of aims</td>
</tr>
<tr>
<td></td>
<td>- collection and recording of data</td>
</tr>
<tr>
<td></td>
<td>- analysis of alternative solutions</td>
</tr>
<tr>
<td></td>
<td>- decision making</td>
</tr>
<tr>
<td>Stage 2</td>
<td>- specifications of requirements</td>
</tr>
<tr>
<td></td>
<td>needed to implement decisions</td>
</tr>
<tr>
<td></td>
<td>- definition of programme objectives</td>
</tr>
</tbody>
</table>
- translation of technical information and data into an appropriate learning format
- design of a learning plan
- design of learning elements

In many developing countries, designers of training schemes devote insufficient attention to the third step in Stage 2 ("Translation"). This is one of the most difficult steps in the whole design process.

Incorrect interpretation of the training information and data available produces poorly designed training programmes in the same way as a bad translation into another language distorts the meaning of a text.

The mix of training methods is chosen during this step. Before training begins, the means to implement it must be found. This requires the procurement of human and physical resources for the preparation of teachware, modular packages, learning kits, etc. It is difficult to change a mix once this process has been set in motion.

E. A methodology for Stage 3

Figure 10 illustrates the measurement and feedback mechanism intended to check the systematic training processes in Figure 7.

In design Stage 3 (Figure 10) you must devise a procedure to check whether the programme (completed in Stage 2) has achieved the aims, objectives and programme goals as set out in Stage 1.

In other words, will trainees (the output from the training programme) possess the knowledge and skills required by an employer?

The designer should also build into the system some form of reward or recognition for trainees who achieve the programme standards and relate these standards to national and local skill standards through feedback control. Progressive monitoring of training projects and programmes is dealt with in more detail in chapter six.
Stage 3

- NATIONAL TRAINING STANDARDS
  - PERFORMANCE STANDARDS
  - TESTING/CERTIFICATION
    - EVALUATION
    - VALIDATION
    - FEEDBACK

Figure 10
F. In retrospect

In this chapter, we have looked at the three steps involved in the design of systematic training projects. Broad aims are set and developed into more specific training objectives so as to change levels of knowledge, vocational skills and behavioural attitudes. The designer, or a design team, must have a variety of capabilities and a wide range of skills to be able to handle decision-making, alternative choice techniques, risk assessment, needs assessment and job analysis.

A designer's ability to move from the analysis of the training problem to the elaboration of feasible solutions is vital to the success of a design project. It may be necessary to pre-train members of a new design team to translate analytical information into a training plan.

Chapter three examines the relation between identified needs and relevant design solutions. We shall also look at some of the ways in which training requirements can be successfully translated into training plans.

References


CHAPTER THREE

ANALYSING AND EVALUATING TRAINING SITUATIONS

A. Assessing a situation

Let us start by examining the definition "A training need exists when it is found that an organisation has problems that can be fully or partly solved by training".

This definition implies that the size of the problem is likely to depend on the size of the organisation in which it exists. A problem requiring solution in a local enterprise will usually be smaller than a similar problem at the national level. One must not forget, however, that even a problem that can be fully solved by systematic training is part of a larger system, itself affected by many other sub-systems that influence vocational training for industrial processes, namely:

- sociological - cultural
- industrial - economic
- industrial - technical
- educational - learning sub-systems

An acceptable training solution must be compatible with these sub-systems.

At the national level, if there is no development plan, training design will probably start with an assessment of jobs for which vacancies exist, or are likely to exist.

Occupational analysis would then be used to ascertain in which areas of economic activity (occupations and jobs) the production of trained manpower should be made a priority. This is illustrated in Figure 11.

If a developing country has set out its priorities in national development plans, the identification of training needs
DEMOGRAPHIC - ECONOMIC - SOCIAL STRUCTURE AND PROCESSES INCLUDING LABOUR FORCE DATA

SOCIO-ECONOMIC POLICY

DYNAMICS OF THE ECONOMY - Production with the resulting demand for labour

MARKET FOR OTHER FACTORS

LABOUR MARKETS Determination of wage rates and levels of employment by skill

OUTPUT OF INSTITUTIONAL TRAINING SCHEMES

IDENTIFICATION OF SECTORS OF NATIONAL ECONOMY

IDENTIFICATION OF PRIORITY SECTORS

IDENTIFICATION OF PRIORITY ORGANISATIONS

IDENTIFICATION OF PRIORITY DEPARTMENT

DETERMINATION OF PRIORITY OCCUPATIONS

DETERMINATION OF JOBS IN PRIORITY OCCUPATIONS

DETERMINATION OF NUMBERS AND LEVELS OF PERSONS TO BE TRAINED AND TIMING OF TRAINING
can start with a "SITUATION ASSESSMENT". To illustrate this approach, let us look at a recent case: Skilled maintenance and repair technicians were required by the manufacturing industries of a developing country, but were in short supply. You can see how the method we have described was applied to the case (Case E) by following its design stages.

Case E

Manpower Development and Training for Manufacturing Industries

Problem: Shortage of personnel skilled in industrial equipment maintenance and repair

Background information:

Over a five-year period, the number of people looking for employment was expected to be of the order to 750,000 per year, of which 250,000 would be absorbed by manufacturing industries.

Industry was thus expected to grow at a planned rate of three and a half per cent per annum. This had to take place in provincial centres, as industrial development was being restricted in the capital as part of a national social and cultural improvement programme.

The government had recently passed two laws to encourage industrial development and manpower training in the provinces. The first law provided special tax relief for industries in the provinces that were:

(1) manufacturing goods they had previously imported.
(2) producing goods for export and so improving the country's overseas trade balances (recently affected by loss of oil and gas revenues).
(3) processing agricultural products for both home and export markets.

The second law introduced an Industrial Training Act mainly designed to improve the training and qualification of workers. This training was to be developed by the Ministry of Labour and Social Affairs and industry through joint vocational training schemes.
Case E continued

The Design Problem

In the capital, where 55% of the country's plants were located, productivity was reduced by frequent breakdowns. In the provinces, installation and repair of machines and equipment could not be handled owing to a lack of employees with the technical skills required.

The design team was thus called upon to plan training that would give new entrants to manufacturing industries the knowledge and skills required for them to become maintenance and repair technicians.

Data from labour market information analysts showed that the demand for this category of skilled worker was likely to be 450 tradesmen per year or 2,500 over five years, allowing for a normal wastage of 10%.

How our design method was applied to this case

The first step was to examine the information summarised above and work out a set of main aims for the project.

Project aims

1) to produce more local workers able to maintain and repair manufacturing plant and equipment;
2) to train 450 workers a year for five years in installation, maintenance and repair techniques;
3) to distribute the activities involved in the training project evenly between government skill training centres, operated by the Ministry of Labour and Social Affairs, and industrial training centres managed by the National Industrial Training Council.

Strategy planning

Definition of the aims was followed by the drawing up of a strategy plan setting out the sequence of steps to be included in the training design network. These steps are listed in Table 7.
Table 7: Strategy plan

<table>
<thead>
<tr>
<th>EVENT</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20</td>
<td>Prepare situation assessment and job profiles</td>
</tr>
<tr>
<td>20-30</td>
<td>Analyse jobs in plant installation maintenance and repair</td>
</tr>
<tr>
<td>30-60</td>
<td>Identify skills and knowledge required for job</td>
</tr>
<tr>
<td>30-40</td>
<td>Establish proficiency criteria</td>
</tr>
<tr>
<td>30-80</td>
<td>Design curriculum</td>
</tr>
<tr>
<td>60-70</td>
<td>Design skill proficiency tests</td>
</tr>
<tr>
<td>80-90</td>
<td>Prepare training facilities</td>
</tr>
<tr>
<td>80-100</td>
<td>Develop software</td>
</tr>
<tr>
<td>90-100</td>
<td>Install hardware</td>
</tr>
<tr>
<td>70-90</td>
<td>Recruit trainees</td>
</tr>
<tr>
<td>40-50</td>
<td>Recruit additional trainee instructors</td>
</tr>
<tr>
<td>50-80</td>
<td>Train instructors</td>
</tr>
<tr>
<td>100-110</td>
<td>Implement training</td>
</tr>
</tbody>
</table>

Maintenance training project - main activities network

At this stage, a network was constructed to give a visual indication of the sequence of activities and show which of these could be carried out in parallel with others. The training design team was fully involved in the construction of the project activities schedule, but not in the managerial aspects of recruitment of trainers and trainees, preparation of training facilities, the installation of training equipment and other hardware.
The items indicated with the letter "D" in Figure 12 are those in which the design team was mainly responsible for a complete activity. At this stage, it was too early to decide whether the team would be involved in activity 80 to 100 (training software had to be purchased or developed by the instructor team or the project design team).

Situation assessment

For the first step (activity 10-20), a situation assessment was prepared by the design team from the answers they obtained, using the method described in chapter one.

This situation assessment (Table 8) became the basic information document when discussing the project. It served as an amplified statement of the project aims and was used as a reference for job analysis (activity 20-30).

B. Manpower needs and job analysis

As mentioned in chapter two, this is not the place to analyse the jobs to be carried out by machine installation, maintenance and repair personnel. What we can do, however, is to see how the job analysis process was conducted in Case E.
### Table 8: Situation Assessment - Maintenance and Repair Skills Development

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WHO</strong></td>
<td></td>
</tr>
<tr>
<td>Requested the project?</td>
<td>Required by 5-year national plan/Ministry of Labour</td>
</tr>
<tr>
<td>Are to be trained?</td>
<td>Secondary technical'school graduates</td>
</tr>
<tr>
<td>Will be involved?</td>
<td>Ministry of Labour, Ministry for Industry, workers and employers</td>
</tr>
<tr>
<td>Is responsible for design?</td>
<td>Ministry of Labour Planning Bureau</td>
</tr>
<tr>
<td>Is responsible for implementation?</td>
<td>National Industrial Training Council</td>
</tr>
<tr>
<td>Is responsible for recruiting trainers?</td>
<td>National Vocational Instructor Services</td>
</tr>
<tr>
<td>Is responsible for recruiting trainees?</td>
<td>Ministry of Labour &quot;Job Offices&quot;</td>
</tr>
<tr>
<td><strong>WHAT</strong></td>
<td></td>
</tr>
<tr>
<td>Goal has to be achieved?</td>
<td>Train repair fitters in 3 years</td>
</tr>
<tr>
<td>Funds are available?</td>
<td>Industrial training board fund</td>
</tr>
<tr>
<td>Facilities are available?</td>
<td>Government skill centres, &quot;XY&quot; group workshops</td>
</tr>
<tr>
<td>Trainers are available?</td>
<td>30% at present - further 70% to be recruited and trained</td>
</tr>
<tr>
<td>Trainees are available?</td>
<td>No. Have to be recruited after press and TV advertising</td>
</tr>
<tr>
<td>Topics will be prepared?</td>
<td>Mechanical, electrical/electronic, welding, wood working</td>
</tr>
<tr>
<td>Training methods will be developed?</td>
<td>Group and individual repair practices</td>
</tr>
<tr>
<td>Extra resources will be needed?</td>
<td>High technical trainers and facilities to be provided by &quot;XY&quot; Co., specialised modular packages</td>
</tr>
<tr>
<td>WHEN</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---</td>
</tr>
<tr>
<td>- Will planning be completed?</td>
<td>12 weeks from Notice of Agreed Action (NOAA)</td>
</tr>
<tr>
<td>- Will programme design be ready?</td>
<td>30 weeks from issue of NOAA</td>
</tr>
<tr>
<td>- Will facilities be available?</td>
<td>36 weeks from NOAA</td>
</tr>
<tr>
<td>- Will recruitment of trainees begin?</td>
<td>30 weeks from NOAA</td>
</tr>
<tr>
<td>- Will training commence?</td>
<td>40 weeks from NOAA</td>
</tr>
<tr>
<td>WHERE</td>
<td></td>
</tr>
<tr>
<td>- Should training be carried out?</td>
<td>Basic programme in a government skill centre, Advanced programme at the XY industrial-enterprise-workshops</td>
</tr>
<tr>
<td>- Will trainees be employed?</td>
<td>Responsibility: Minilab Vocational Guidance and Placement Office</td>
</tr>
<tr>
<td>HOW</td>
<td></td>
</tr>
<tr>
<td>- Will the design team operate?</td>
<td>Report to Director-General, Manpower Development Department</td>
</tr>
<tr>
<td>- Many persons in the team?</td>
<td>1 Design Manager, 1 Analyst, 2 Industrial Skill Specialists</td>
</tr>
<tr>
<td>- Will information for design be obtained?</td>
<td>Industrial visits, interviews, analysis, priority rating</td>
</tr>
<tr>
<td>WHY</td>
<td></td>
</tr>
<tr>
<td>- Is the proposed solution appropriate?</td>
<td>Modular software can be developed for repair work</td>
</tr>
<tr>
<td>- Should the Ministry be involved?</td>
<td>Apprenticeship governed by Minilab legislation</td>
</tr>
<tr>
<td>- Should industry be involved?</td>
<td>Required by legislation/Industrial Training Council</td>
</tr>
<tr>
<td>Effect of not applying a training solution to the problem will be?</td>
<td>Loss of manufacturing productivity</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Step 1 Designers met the labour market analysts at the Ministry of Labour and Social Affairs, who supplied them with the following data (Table 9):

Table 9

<table>
<thead>
<tr>
<th>Occupation Group</th>
<th>Specialisation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mechanical repair/installation</td>
<td>150-160</td>
</tr>
<tr>
<td>2</td>
<td>Electrical installation/repair</td>
<td>125-140</td>
</tr>
<tr>
<td>3</td>
<td>Welding services</td>
<td>75-80</td>
</tr>
<tr>
<td>4</td>
<td>Woodworking services</td>
<td>50-65</td>
</tr>
<tr>
<td>5</td>
<td>TOTAL PER YEAR</td>
<td>450-500</td>
</tr>
</tbody>
</table>

Step 2 A meeting of the National Industrial Training Council was called by the Minister of Labour and Social Affairs. At this meeting, it was decided to maintain cooperation and improve relationships between:

(a) Ministry of Labour skill centre personnel, and
(b) Industrial managers and trainers.

Training was to take place at three government skill centres in three provinces and three manufacturing plant of the "XY" Group of Companies located in the same areas. As no accommodation existed near the skill centres, it was decided to only take "day-trainees" until hostels could be provided. It was further decided that hostel accommodation would not be provided during the first five years, as this was considered a pilot training scheme to be used as a model for sectoral vocational training development if successful. Other decisions were concerned with providing funds for the implementation of the design. Preparation of a first-year indicative operational budget was included in the design team's brief. This added two activities to the network (Figure 13):

- ACTIVITY "A" - Preparation of project development budget (pre-implementation)
- ACTIVITY "B" - Preparation of project implementation budget
Step 3 Permission was obtained for the design team to carry out job analysis in a number of enterprises in the three provinces, selected by the National Industrial Training Council.

Step 4 Network Activities. 20-30 "Analysing jobs in installation maintenance and repair" was commenced in three factories belonging to the "XY" Company. The team required job information for the later design stages. It was decided to collect this information in two stages (Table 10).

<table>
<thead>
<tr>
<th>STAGES</th>
<th>JOB NEEDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What tasks must trainees learn to perform?</td>
</tr>
<tr>
<td>2</td>
<td>What are the performance standards trainees must achieve during training?</td>
</tr>
</tbody>
</table>

Step 5 The existing job descriptions used by the personnel office when recruiting skilled repairmen were found to be inadequate for job analysis for training. Standard job profiles were therefore prepared for each specialisation identified by the
labour market analysts so as to make it clear what was required in Stage 1. Each profile had three sections:

1. Installation tasks
2. Repair tasks
3. Maintenance tasks

This standardisation was designed to enable learning topics to be grouped together during the job analysis for the easier creation of common training modules when working out the curriculum.

The standard job profile worked out for a machine repair fitter is illustrated in Table 11.

Table 11: Job Profile for Training Purposes

<table>
<thead>
<tr>
<th>Task Type</th>
<th>Specific Tasks</th>
<th>(a) Criticality</th>
<th>(b) Difficulty</th>
<th>(c) Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Maintenance</td>
<td>checking equipment performance in logical sequence</td>
<td>90</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>2. Repair</td>
<td>repairing stripped screw threads</td>
<td>30</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>3. Installation</td>
<td>inspecting machine installation levels</td>
<td>50</td>
<td>60</td>
<td>5</td>
</tr>
</tbody>
</table>
Notes:

(a) **Criticality** is the degree of importance of the task when compared with others in the same occupation.
(b) **Difficulty** refers to the complexity of the task. Greater complexity will require more intensive training to overcome potential learning difficulties.
(c) **Frequency** is the number of occasions the task has to be carried out in a unit time period.

**Scalar Notation**

The values in each column are expressed against a 100 standard, i.e.

- the most critical task is rated 100
- the task most difficult to learn is rated 100
- a frequency rate of 20 indicates that in 100 hours' work the task will occupy 20 hours approximately.

**Step 6** Profiles for tasks related to:

- mechanical repair/installation
- electrical installation/repair
- electronic repair and servicing
- welding services
- woodworking services

were assembled into combined profiles to complete activity 30-60 (Figure 12).

By analogy with the two-level approach used in creating the job profiles, the design team assessed the skills and knowledge that would be required by two categories of persons to be recruited as installation, repair and maintenance trainees (Table 12).

**Step 7** The design team then moved to network activity 30-40 (Table 7, Figure 12) and established proficiency criteria for:

(a) learning programme entry requirements - school leavers;
(b) learning programme entry requirements - in-service trainees;
(c) academic (technology and know-how) competence levels to be achieved;
(d) skill competence levels to be achieved (leading to national skill qualifications).
Table 12: Performance capabilities of maintenance trainees

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>PERFORMANCE GAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PARTIAL CAPABILITY (employed): Candidates experienced in related occupational skills in industry and able to carry out some tasks. They will mainly require on-the-job training.</td>
</tr>
<tr>
<td>2</td>
<td>NO CAPABILITY (new entrant): Candidates are graduates of secondary vocational schools with no industrial experience. They will require basic, intermediate and advanced training to reach specified performance standards.</td>
</tr>
</tbody>
</table>

In setting these criteria, the design team recognised that other job analyses carried out in industry had revealed operational gaps in the work schedules of skilled repair personnel. Further questioning showed that a third level of advanced training would have to be provided for some qualified repair personnel to recycle or update their competences. The mandate of the design team also required them to set entry and exit test criteria for use by the instructors in working out the tests themselves.

C. In retrospect

The design team's tasks were:

(A) To carry out Stage 1 in Table 10

Job analysis - define the activities involved in installing, repairing and maintaining plant and equipment
- specify the functions within these activities by drawing up a standard job profile for each trade (Table 9)
- identify performance gaps by general comparison with potential workforce qualifications and experience
Task analysis
- define the tasks forming each activity
- identify performance gaps by analysing competences of skilled repair personnel on the job
- list tasks in order of priority for satisfactory job performance
- list tasks in order of frequency to establish the amount of in-service learning practice needed
- list tasks in order of learning difficulty to provide information on time and other resources required for improving competence

(B) To carry out Stage 2 in Table 10

Skills analysis
- define the skills required to perform each important task
- establish proficiency criteria for the main skills, in terms of speed, accuracy, quality, etc.
- identify skill type in skill components of each main task, including:
  . practical (psychomotor)
  . social
  . procedural
  . discriminatory
  . logical solution
  . creative solution

Know-how analysis
- define the level of know-how to be obtained by trainees for each main task
- identify learning differences:
  . must know
  . should know
  . nice to know

The design team now left the industrial environment and returned to their base at the Ministry of Labour and Social Affairs.

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It should be realised that, although the design team followed the steps outlined in chapter three, training needs can be identified in other ways.

Specialised techniques for job, task and performance analysis are referred to in a number of the books on training design. Network construction and analysis will be further explained later.

The next design stage in this case was to summarise the information obtained from industry and translate it into a feasible training programme for industrial maintenance and repair technicians. How this was done forms the basis of chapter four.

References

1 More explanation of networking techniques can be found in Chapter 5.

2 This network is revised and simplified in chapter five.
CHAPTER FOUR

HOW TO DEVISE AN EFFECTIVE TRAINING PROGRAMME

A. From identified needs to objective actions

In the previous chapters, we looked at different ways of determining the jobs and levels for which skilled personnel are required, and of establishing the aims and objectives to be achieved.

We saw that the construction of aims and the setting of objectives can lead to arguments on definitions and the meaning of concepts. To bypass this problem and retain precision, the "objective setting phase" is replaced by writing training specifications to bridge the gap between trainee profiles and job entry specifications.

Before rushing into the assembly of resources and then beginning to train manpower according to your specifications, it is better to find out how far local training schemes meet your identified needs.

When assessing the suitability of local training, you will have to take into account:

(1) Where is it being offered?
   - government training centre
   - industrial training centre
   - on-the-job training
   - private training institution
   - distance-learning scheme

(2) When will it take place?
   - does the timing of the programme meet your needs?
   - is the programme too long or too short?
   - is it continuous or only offered at set times?
Who can be accepted?
- do your trainees meet the entry criteria for existing schemes?
- are they over-qualified?
- are there age restrictions or limits?
  e.g. can trainees of widely different ages be admitted, or must all trainees be in a single age group?

How many trainees can be accepted?
- is the unit cost of training affected by the minimum number of participants?
- does the learning method depend on the number of trainees in a group?

What?
- changes would have to be made to the programme offered by the institution or enterprise to make it fit your design?

B. Training programme design decisions

When the answers to these questions show that there is no suitable local training programme, vocational training must be given in an appropriate environment.

Your training specification will indicate whether this should be a work environment, such as an industrial workshop, an off-the-job environment, such as a government or a private training institution, or both.

Figure 14 illustrates the different pictures presented by these two environments. It would seem that a workshop environment is more suitable for the acquisition of vocational skills, this may not be correct in a substantial number of cases. "Sheltered" job training workshops, as opposed to a production environment, offer several advantages, such as:

- similar trainees can be provided with a common basis of know-how, technical knowledge and trade skill
- training does not disrupt production, nor create fluctuations in product quality level
- training errors involving sophisticated equipment can be better controlled
Figure 14: Comparison of training environments

ENVIRONMENT "A"

INSTRUCTOR

TRAINEE

UNEMPLOYED

TRAINING CENTRE

OFF-THE-JOB ENVIRONMENT

WORKSHOP MANAGER

SKILLED

WORKERS

EMPLOYED

PERSONS

ROUTE

WORK ENVIRONMENT

TRAINEE

LEARNING HAS TO BE RETAINED
FOR LATER TRANSFER TO A WORK SITE

LEARNING IS APPLIED
DIRECTLY TO WORK TASKS

ENVIRONMENT "B"

GOVERNMENT TRAINING CENTRE

INDUSTRIAL WORKSHOP TRAINING

LEARNING HAS TO BE RETAINED
FOR LATER TRANSFER TO A WORK SITE

LEARNING IS APPLIED
DIRECTLY TO WORK TASKS
- hostile reactions from older workers, who may feel that their future employment or career patterns is threatened, are avoided
- training in safe working practices is facilitated by simulation away from actual work hazards
- preparing for changes in technologies and processes that involve new skills may not be possible in an old work environment, e.g. electromagnetic control processes being changed to integrated electronic systems.

There may also be bureaucratic reasons for giving training in an off-the-job environment, e.g.:
- a fully equipped training centre is available with substantially under-utilised capacity.

If the designer has to design a curriculum for training off-the-job, he must ensure that learning starts and finishes at the workplace. The routing arrow in Figure 14 illustrates this principle.

NOTE: The shaded area in Figure 14 represents those topics which can be learnt equally well in either environment.

When extended programmes are devised for lifelong training, the designer should make it easy to switch from one environment to another. The choice of "A" or "B" is not final. A coordinated and integrated use should be made of both. The overlap area can be exploited for project exercises, planned discovery learning assignments and similar purposes.

C. The programme design task

How far have we come in our elaboration of a method for designing training projects?

The critical objective in training project design, as mentioned in chapter one, is to make trainees learn. Learning takes place in the learning event phase shown in Figure 15. Before arriving at this event, we started the chain of activities by looking at fundamental decisions that affect training projects and then progressed into more detail. It must be stressed once more that, as training is applied to people, "training programme design" (shown in the figure) is directly aimed at causing learning to happen. This provides a different emphasis for a programme
IDENTIFICATION OF TRAINING NEEDS

DEVELOPMENT OF TRAINING SPECIFICATIONS

TRAINING PROGRAMME DESIGN

LEARNING EVENT

IMPROVED COMPETENCE AND PERFORMANCE

MATERIAL RESOURCES

HUMAN RESOURCES

DESIGNERS

TRAINERS
designer who may previously have prepared schemes that depended on instructors rather than on learners learning.

D. Building a curriculum

An efficient vocational training curriculum is one in which subject-matter, information and training methods combine to produce a maximum learning effect on trainees who finish the programme or course.

Table 13: Elaboration of a curriculum

<table>
<thead>
<tr>
<th>Components</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject areas</td>
<td>Training facilities</td>
</tr>
<tr>
<td>Topics</td>
<td>Training resources</td>
</tr>
<tr>
<td>Training methods</td>
<td>Training budget allocations</td>
</tr>
<tr>
<td>Learning methods</td>
<td>Availability of trainers</td>
</tr>
<tr>
<td>Session schedules including consolidation of practical skills</td>
<td>Availability of trainees</td>
</tr>
<tr>
<td>Checking methods</td>
<td>Timetabling and integration with other activities</td>
</tr>
<tr>
<td></td>
<td>National and local standards</td>
</tr>
</tbody>
</table>

Table 13 shows the components of a curriculum and the constraints that influence its design.

To build a curriculum:

Firstly, the information from your in-plant job analysis will be broken down into main subject areas in a logical order to construct a standard syllabus for your training programme.

There are now two options for the designer to choose, either separately or in combination:

(1) He can prepare a standard topic syllabus for use in any national enterprise or institute, plus a set of special topics to meet the needs of local enterprises; and/or
He can design a topic syllabus with a wide range of practical training exercises broken down into sets of measurable learning elements.

Generally speaking, Option 1 is better suited to institutional off-the-job training.

Option 2 fits in well with on-the-job training.

When the two options are combined into a single design, trainees are given a real opportunity to prepare for the world of work. They are also able to obtain accreditation and skill competence qualifications to national standards. They will enter the labour market with a better chance of finding a job.

Secondly, the training and learning methods to be designed into the curriculum have to be decided upon. These should ensure:

(1) efficient programme operation;
(2) effective learning of subject topics and related know-how;
(3) achievement of practical skill competences to defined performance standards.

Many learning methods can be incorporated into a programme design. The comparative advantages of each method are fully explained in many textbooks on education and training. However, training methods can also be classed by reference to the number of trainees involved:

(1) methods suitable for large groups, e.g. watching a film, attending an industrial visit, induction lectures, etc.;
(2) methods suitable for small groups, e.g. workshop practices, laboratory tests, project working, etc.;
(3) methods suitable for individuals, e.g. programmed learning, computer assisted learning, data searching, technical study, etc.

The way in which this notion of "group size" is applied in programme design and session scheduling is illustrated later.

Thirdly, the complete programme operating schedule is designed and set out as a timetable of activity sessions.

At this stage, a meeting between the design team and the
training project implementation personnel should be arranged to prepare a combined plan of action for the elaboration of training topics and learning element objectives and schedules.

Fourthly, the design team will construct a project and programme evaluation and checking mechanism, covering the:

- project aims
- programme objectives
- learning objectives

If a plan of action for checking progress and methods of evaluation was drawn up at the same time as your project objectives (chapter two), it will now be necessary to add operational information so that evaluation and checking measures become an integral part of the programme schedule.

Failure to do this may result in either:

(a) evaluation being ignored during programme implementation; or
(b) "happy syndrome" evaluation, i.e. results that please trainees but are of little value to trainers or employers in assessing their capability.

E. Designing training schedules

Training programmes range from long-term full-time training for technicians and skilled workers to short-term updating or re-training to meet requirements of industrial or service establishments. Long-term programmes are usually designed to satisfy national policy requirements and thus controlled by a recognised authority, which provides the syllabuses and states what must be done during the course of a programme. Short programmes set out to meet local needs. They are planned by designers and trainers familiar with local problems for which a training solution is an appropriate choice from a range of other possibilities.

Irrespective of the type of programme, some subject areas will have to be dealt with in greater depth than others and will require more time. For example, when training instrument technicians more attention must be given to scientific concepts and principles that when training machine component assemblers. Figure 16 compares curriculum proportions of these two occupations. It is based on the results observed in several ILO technical assistance projects.
SKILLED INSTRUMENT TECHNICIAN

SKILLED MACHINE, COMPONENT ASSEMBLERS

A basic skill training
B advanced skill training
C technical know-how
D principles and concepts
E information and communication
This elementary breakdown of subject areas in graphical terms is very useful when estimating the time to be allotted to each area in separate programmes of varying length. Without a pie chart (as in Figure 16) or a histogram (formed of columns – see Figure 17), it is difficult to ensure that training programmes of different length spans, but with the same objectives, are given equivalent treatment at the design stage.

F. Scheduling a training programme

Let us look at another case (Case F) in which the subject areas of a training programme were scheduled to form a curriculum on the maintenance and repair of railway signalling equipment.
### Case F

Table 14: Breakdown of subject areas in a training curriculum covering the maintenance and repair of railway signalling equipment

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>SUBJECT AREA</th>
<th>PROPORTION</th>
<th>SEGMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS 1.1</td>
<td>standards and safety procedures</td>
<td>10%</td>
<td>C/E</td>
</tr>
<tr>
<td>RS 1.2</td>
<td>electrical operating principles</td>
<td>5%</td>
<td>D</td>
</tr>
<tr>
<td>RS 1.3</td>
<td>instrument mechanisms</td>
<td>10%</td>
<td>C</td>
</tr>
<tr>
<td>RS 1.4</td>
<td>interpreting circuits</td>
<td>15%</td>
<td>C/E</td>
</tr>
<tr>
<td>RS 1.5</td>
<td>inspection techniques</td>
<td>10%</td>
<td>B</td>
</tr>
<tr>
<td>RS 1.6</td>
<td>fault diagnosis</td>
<td>15%</td>
<td>C</td>
</tr>
<tr>
<td>RS 1.7</td>
<td>instrument repair skills</td>
<td>25%</td>
<td>B</td>
</tr>
<tr>
<td>RS 1.8</td>
<td>principles and practices in measurement</td>
<td>10%</td>
<td>B/D</td>
</tr>
</tbody>
</table>

In Case F, the programme was designed by the training team to last 800 hours, or twenty weeks with forty 1-hour training sessions per week. Table 15 shows the curriculum breakdown by subject area.

### Table 15: Curriculum proportions

<table>
<thead>
<tr>
<th>Segment</th>
<th>Area</th>
<th>Proportion</th>
<th>Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Per week</td>
</tr>
<tr>
<td>A</td>
<td>Basic skill</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>Advanced skill</td>
<td>42.5%</td>
<td>340</td>
</tr>
<tr>
<td>C</td>
<td>Know-how</td>
<td>42.5%</td>
<td>340</td>
</tr>
<tr>
<td>D</td>
<td>Principles</td>
<td>7.5%</td>
<td>60</td>
</tr>
<tr>
<td>E</td>
<td>Communication</td>
<td>7.5%</td>
<td>60</td>
</tr>
</tbody>
</table>
Each segment was further broken down into topic proportions, as shown in Table 16.

Table 16: Topic proportions

<table>
<thead>
<tr>
<th>Segment</th>
<th>Subject Reference</th>
<th>Topic</th>
<th>Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>B</td>
<td>RS 1.5</td>
<td>Inspection technique</td>
<td>80</td>
</tr>
<tr>
<td>B</td>
<td>RS 1.7</td>
<td>Instrument repair</td>
<td>200</td>
</tr>
<tr>
<td>B</td>
<td>RS 1.8</td>
<td>Measurement practice</td>
<td>60</td>
</tr>
<tr>
<td>C</td>
<td>RS 1.1</td>
<td>Safety procedures</td>
<td>60</td>
</tr>
<tr>
<td>C</td>
<td>RS 1.3</td>
<td>Instrument mechanisms</td>
<td>80</td>
</tr>
<tr>
<td>C</td>
<td>RS 1.4</td>
<td>Circuits</td>
<td>80</td>
</tr>
<tr>
<td>C</td>
<td>RS 1.6</td>
<td>Fault diagnosis</td>
<td>120</td>
</tr>
<tr>
<td>D</td>
<td>RS 1.2</td>
<td>Electrical principles</td>
<td>40</td>
</tr>
<tr>
<td>D</td>
<td>RS 1.8</td>
<td>Measurement principles</td>
<td>20</td>
</tr>
<tr>
<td>E</td>
<td>RS 1.1</td>
<td>Safety standards</td>
<td>20</td>
</tr>
<tr>
<td>E</td>
<td>RS 1.4</td>
<td>Technical literacy</td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>800</strong></td>
</tr>
</tbody>
</table>

G. Scheduling a programme session

The next design step is the layout of a session schedule. At first, this seems to be just a question of preparing a timetable of sessions. If, however, you work from a standard timetable form and simply add the details for each session, you will find it difficult to make changes, since a lot of time must be spent on extensive erasures and re-entries. It is better to use an intermediary planning board. This will allow schedules to be altered by training managers as they go along. Session schedules built up in this manner permit more creative planning and more flexible time-tables. However, flexibility does not mean that changes during implementation can be allowed to affect your schedule design. In other words, even if changes are made in session schedules during an 800-hour programme, the proportions for each subject area in Table 16 must not be altered.
An industrial engineering planning technique allowing a degree of flexibility in designing time schedules is based on planning boards with separate cards for each session.

A flexible schedule layout is required to handle a number of pieces of information associated with each session:

1. title of session
2. location
3. identity of trainer
4. support staff (if any)
5. method(s) to be used
6. programme code or session number (for reference)

Other items may be included for short programmes or seminars, for example:

7. brief statements of session objectives
8. titles of project exercises
9. titles of case studies or role-playing exercises, etc.

When you begin to design a schedule, you may well find it impossible to fit all these items into a logical frame. If each item is written on a separate card, however, it can be moved from one place to another on the planning board until the best compromise is found.

If slotted planning boards are not available, a similar result can be obtained by using either:

1. coloured card rectangles fixed by map pins to softboard; or
2. coloured stickers on coloured hardboard.

Either technique makes it unnecessary to erase and re-write session details on timetable forms. It also provides an immediate picture of the proportion and spacing of subjects.

a. Coding of session methods and topics

The 800 planning cards listed below could be used to schedule sessions in accordance with the curriculum illustrated in Table 15.
Table 17: Planning card requirement

<table>
<thead>
<tr>
<th>Segment</th>
<th>Classification</th>
<th>Colour</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Advanced skill</td>
<td>White</td>
<td>340</td>
</tr>
<tr>
<td>C</td>
<td>Technical know-how</td>
<td>Pink</td>
<td>340</td>
</tr>
<tr>
<td>D</td>
<td>Principles and concepts</td>
<td>Blue</td>
<td>60</td>
</tr>
<tr>
<td>E</td>
<td>Information and communication</td>
<td>Yellow</td>
<td>60</td>
</tr>
</tbody>
</table>

It is obvious that the proportions between the four segments cannot be altered by any changes made in the arrangement of these cards on the planning board.

b. Scheduling learning methods

When describing the second step in curriculum design, we mentioned that learning methods could be classified under three headings:

- methods suitable for large groups
- methods suitable for small groups
- methods suitable for individuals

A fourth category can be added when scheduling a training session:

- other activities

This includes:

- project construction
- visits to external work sites
- related activities: language training, cultural subjects, sports training, religious observances, etc.

An examination of previous efficient and effective training programmes suggests that these four types of method can be used in the following proportions:
Table 18

<table>
<thead>
<tr>
<th>Method</th>
<th>Proportion</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large group</td>
<td>15%</td>
<td>Cross</td>
</tr>
<tr>
<td>Small group</td>
<td>55%</td>
<td>Square</td>
</tr>
<tr>
<td>Individual</td>
<td>20%</td>
<td>Circle</td>
</tr>
<tr>
<td>Others</td>
<td>10%</td>
<td>Star</td>
</tr>
</tbody>
</table>

c. Session breakdown

Each session card must contain the following details:

- session topic broken down from subject classifications in Tables 16 and 17 (colour coded cards show this classification)
- method(s) to be applied (symbol coded according to Table 18)
- location (room, laboratory, work site, etc.)
- resource persons.

A sample card layout is shown in Figure 18.
d. Finalising the schedule

When the design team has completed an efficient programme schedule on its planning boards, the details these contain must be transferred to weekly timetables. The boards and their cards are kept as they are and can be used by trainers to make day-to-day adjustments to suit the circumstances.

An example of part of a weekly timetable can be seen in Figure 19.

H. In retrospect

This chapter began with information obtained from needs and job and task analysis on the work site. We consider this as Stage 1 of our programme design sequence (chapter two, Figure 7).

Stage 1

Stage 1 provides a list of topics or tasks that form subject areas or jobs. We chose the topics and tasks that must be included in a training programme to ensure that trainees learn facts and skills essential to the job for which they are being trained. The topics and tasks eliminated are those that trainees have previously mastered, are easy to acquire, are not important or are rarely used on the work site. The topics and tasks included in the design schedule are important, are regularly used on the work site, involve some learning difficulties and require regular practice. The synthesis in Stage 1 will take note of those well-known, simple or rarely used topics or tasks, so that they can be dealt with in regular job practice during training, even though they are not part of the formal learning programme.

We mentioned that detailed analysis of the content of a job is an expensive process. The "Pareto" technique can be usefully employed to identify the most widely used industrial skills. When preparing the training schedule, development of these skills to acceptable performance levels should form the main skeleton around which supporting topics and skills are clustered. Less frequently used work tasks and skills should be noted and introduced in daily practice as part of the on-the-job training programme.

An important reason for including this concept is to avoid overloading the training programme with technical details or
<table>
<thead>
<tr>
<th>DAY</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SESSION</td>
<td>MONDAY</td>
<td>TUESDAY</td>
<td>WEDNESDAY</td>
</tr>
<tr>
<td>1</td>
<td>ELECTRICAL WORKSHOP</td>
<td>ELECTRICAL LABORATORY</td>
<td></td>
</tr>
<tr>
<td>8.30 - 9.30</td>
<td>WINDING SOLENOIDS</td>
<td>MEASUREMENT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIN/Soborian</td>
<td>RODRIGUEZ</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ELECTRICAL WORKSHOP</td>
<td>ROOM 6</td>
<td></td>
</tr>
<tr>
<td>9.30 - 10.30</td>
<td>WINDING SOLENOIDS</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIN/Soborian</td>
<td>LANGUAGE TRAINING</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GATZA</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ROOM 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.45 - 11.45</td>
<td>ELECTRICAL SAFETY</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIAZ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 19
repetitive practices that demotivate learners unable to relate major parts of the syllabus to their work experience.

Stage 2

Translation of the information in Stage 1 into a form that will cause trainees to learn involves the designer in further analysis of the more important topics and tasks. This includes:

- examination of topic/task content and structure
- identification of the main elements of the learning process that will lead to mastery of the job
- identification of the elements likely to cause most difficulty
- design of simple solutions or analogies to reduce the effect of factors that may prevent trainees from learning.

The output from Stage 2 should produce:

- a fully detailed training course schedule or learning plan
- session plans indicating the resources needed to cause learning to take place
- progressive session tests for course monitoring.

Stage 3

Lastly, Stage 3 will have project, programme and session objectives relating to:

- prerequisite entry standards
- terminal test standards.

The way the three stages are put together will now be examined in a final case study on joint vocational training.

Case G

Case study on the elaboration of a Combined Vocational Training Scheme (CVTS)

Brief

You are required to outline a national vocational training scheme for "Myrtillia" for the Minister of Manpower. The scheme must satisfy the national need for a standard structure for the training and qualification of young persons in occupational skills. The Government of Myrtillia intends to
Case G continued

set up an integrated industrial vocational training system in which consultation with industrial employers and workers' representative organisations will be an essential feature.

The Minister suggests that you should concentrate on five industrial sectors for a start:

(a) metal working, electrical, electronic
(b) wood processing and wood products, including furniture
(c) construction processes, including prefabricated housing
(d) textile processing and garment making
(e) processing of agricultural produce

A combined vocational training scheme (CVTS) will require periods of induction and off-the-job training in government skill development centres, interspersed with practical exposure to on-the-job training in industry and on a work site.

The scheme should permit young persons to obtain accreditation as skilled workers or technicians and will be given national recognition by the government. Training will normally last two years, but the scheme must be flexible and capable of incorporating advanced skill modules suited to the occasional, but highly specialised needs of particular industries. Initially the design team must give additional consideration to inclusion of unemployed young persons with few qualifications. They should also provide both different points of entry to the scheme, according to previous experience and ability, and multiple points of exit to employment, whenever this seems to be appropriate.

Schematic solution

The question was examined in relation to the background trainees would have on entering the scheme. Three categories were chosen for this purpose. The aim of the scheme was that persons in each category should be able to improve their occupational skills through training. It was in the national interest to find employment for skilled workers, irrespective of their age, experience or educational background.
Category 1

Early school leavers (ESL).

Profile

Unemployed persons aged 14 to 20 who had left school before completing their compulsory education and had done casual work, but not been trained for occupations requiring vocational skill. This group provided the largest target population for vocational training.

Category 2

Higher secondary graduates (HSG).

This category had better chances of obtaining employment. However, as many as one in three (depending on the province in which they were educated) had received no technical training and 70% would require some occupational skills training before they could be usefully employed in industry. Two entry streams to vocational training had to be envisaged for this category to cater for persons with a technical or non-technical background.

Category 3

Industrial employees (IE).

Owing to weak ad-hoc systems of vocational training, many workers who had followed a form of industrial apprenticeship were not proficient in advanced occupational skills. This category would have had to be provided with improved in-service vocational training.

Combined scheme

These three design solutions for the ESL, HSG and IE categories were used to work out a national CVTS for young people and adults that would encourage the concept of lifelong learning as a feature of employment. Labour market figures for the skilled workforce required in each province for the employment sectors were used to work out the trainee target population for each category.
Figure 20:

The separate parts of a combined Government/industry sponsored vocational training scheme

UNEMPLOYED YOUTHS

<table>
<thead>
<tr>
<th>ESL 1</th>
<th>ESL 2</th>
<th>ESL 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOUNDATION TRAINING</td>
<td>DEVELOPING BASIC SKILLS</td>
<td>PRACTICE IN BASIC SKILLS</td>
</tr>
<tr>
<td>TIME =</td>
<td>TIME =</td>
<td>TIME =</td>
</tr>
<tr>
<td></td>
<td>FOUNDATION CERTIFICATE</td>
<td>BASIC TRADE TEST</td>
</tr>
</tbody>
</table>

HIGH SCHOOL GRADUATES AND HOLDERS OF FOUNDATION CERTIFICATES

<table>
<thead>
<tr>
<th>HSG 1</th>
<th>HSG 2</th>
<th>HSG 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIC INDUSTRIAL TRAINING</td>
<td>TRAINING IN OCCUPATIONAL SKILLS</td>
<td>PRACTICE IN OCCUPATIONAL SKILLS</td>
</tr>
<tr>
<td>TIME =</td>
<td>TIME =</td>
<td>TIME =</td>
</tr>
<tr>
<td></td>
<td>BASIC TRADE TEST</td>
<td>INTERMEDIATE TRADE TEST</td>
</tr>
</tbody>
</table>

INTERMEDIATE TRADE TEST HOLDERS

<table>
<thead>
<tr>
<th>IE 1</th>
<th>IE 2</th>
<th>IE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTENDED PRACTICE IN SPECIFIC SKILLS</td>
<td>ADVANCED SKILL TRAINING</td>
<td>ADVANCED SKILL PRACTICE</td>
</tr>
<tr>
<td>TIME =</td>
<td>TIME =</td>
<td>TIME =</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TECHNICIAN LEVEL EMPLOYMENT

ADVANCED SPECIALISATION

ADVANCED CERTIFICATION
The three-module equal-time approach adopted for each part of the scheme allows for:

1. overlaps between modules, e.g. module ESL 3 can take the place of module HGS 1, etc.;
2. implementation on a work site or in a government centre, or both;
3. trainees can enter any module at any time, provided that they meet the entry level standards. ESL, HSG and IE modules can be prepared and introduced as necessary over five or ten years, according to the availability of national resources;
4. industry is made a partner in national training and becomes involved in the setting up of national trade test mechanisms.

In the next chapter, we will look at methods of networking plans for training programmes similar to those illustrated in this case example.

References

1 **NOTE**: A standard syllabus is one in which a minimum number of essential topics are assembled to meet the requirements of a national examining body. These topics allow a learner to qualify and obtain national recognition in his or her occupational skill. They do not automatically ensure that the learner can then use these skills in a way that satisfies the needs of an employer without additional training.

2 Pareto analysis: Industrial engineers use this technique to identify critical production activities. For example, it is often found that 20% of the instructions given by management govern 80% of the actions taken. The remaining 80% are required to avoid errors in marginal activities. This technique is explained in works on production control in manufacturing industries.
A. The industrial manager's point of view

A narrow view of training focuses on helping people to learn a range of facts, procedures or skills that improve job capabilities. Many industrial managers will not be satisfied with this, as they want to obtain a much better return for the money they set aside for training. They therefore tend to have four factors in mind:

1. More skilled workers are required.
2. There is a job performance problem.
3. Levels of skill have to be altered.
4. Training is the correct and most cost-effective way of improving product output with no loss of quality.

Each of these factors must be examined more closely.

a. More skilled workers are required:

The workforce may be both untrained and outside the company on the labour market. The employer wants to obtain the right types of employee at the right time and with the most appropriate education and experience. Unemployed persons with fairly high education are unlikely to be satisfied with a manual job. Unfortunately, in some societies large numbers of well-educated persons prefer to remain unemployed until a prestigious job comes along. In many cases, this is a question of attitude. A social and cultural change must take place before this type of population can be effectively employed. Case studies in Japanese industry have shown that many production operatives have been educated to higher standards than their peers in other countries. This is one of the reasons why the introduction of quality circles has been more successful in Japanese enterprises than elsewhere.
If white-collar workers continue to receive higher wages than blue-collar workers, further education and training as a step towards skilled employment in industry will continue to lack a sufficient motivation. In addition, young people will have little incentive to participate in skill training programmes in countries where more prestige is attached to being a white-collar worker.

For training to be attractive, the employment to which it leads must also be both financially and socially attractive.

b. Performance problems:

Job performance problems may be solved through training. They can also be resolved by technical re-design (e.g. automatic robotised spray painting). They usually arise because performance standards have not been clearly identified, communicated or agreed.

Training designers and trainers often complain that it is difficult to convince managers of the benefits of training. The main reason for this is that trainers spend too much time on technicalities of only marginal interest to the manager. Industrial engineering studies have clearly shown that non-technical managers have little time or interest in unravelling information overflowing with technical jargon. Many policies administered by enterprise managers can have either an adverse or a beneficial effect on training strategies. For example, there is little point in a designer helping managers to set up courses for new job entrants when company policy is concerned with reducing the size of the workforce.

Trainers would often be better advised to work out training exercises, simulation techniques and social awareness programmes to assist managers in increasing productivity. A less formal approach to training may sometimes help to solve organisational, behavioural and performance problems more effectively.

c. Modifying skill levels:

As technology changes, so do manufacturing processes and hence the skills required to carry out production tasks. In some cases the degree of skill a worker needs to complete a task must be raised to meet more stringent specifications. At other times, processes are rationalised and simplified, and thus require a
Figure 21: Flow chart for worker performance improvement

1. **Does Manager Realise There Are Worker Performance Needs?**
   - **Yes**
   - **No** → **Can Manager Be Convinced of Need to Improve Worker Performance?**
     - **Yes** → **Does Manager Give Priority?**
     - **No** → **Can Performance Be Improved by Training?**
       - **Yes** → **Willing Manager Support Training Action?**
       - **No** → **Can Manager Be Shown Benefits To Be Obtained?**
         - **Yes** → **Design Training**
         - **No** → **No Action**

   2. **Can Performance Be Improved by Training?**
      - **Yes** → **Willing Manager Support Training Action?**
      - **No** → **Can Performance Be Improved by Training?**

3. **Willing Manager Support Training Action?**
   - **Yes** → **Design Training**
   - **No** → **Can Manager Be Shown Benefits To Be Obtained?**
lower degree of skill. In both cases, training, or retraining for other tasks, help enterprises and their workforces to reduce the adverse effects of change.

d. Cost-effective training:

When working for an industrial enterprise, a training system designer must constantly look for appropriate and cost-effective training mechanisms that will help to improve performance levels.

In summary, from a manager's point of view:

(1) a training need is effectively satisfied when training improves worker performance levels;

(2) training is effective when it reduces fluctuations in performance, as this affects output and quality;

(3) training is efficient when it solves performance problems at minimum cost.

The flow chart in Figure 21 can be used by a designer to convince an enterprise manager that performance levels can be improved by providing appropriate training.

Flow charts as an aid to communication

Flow charts can be used by designers instead of written instructions to communicate concepts and ideas to managers and trainers. Designers should be encouraged to get into the habit of constructing flow charts and using them to communicate. A more sophisticated form of flow chart is an algorithm.

An algorithm is a set of instructions which, if followed correctly, will lead users to solve relevant problems in the same manner. Algorithms are clear guidelines for action and can be conceived as practical aids to problem solving. An algorithm is little more than a checklist of things to be done in order to achieve a defined goal. What it does is to convert prose instructions into a diagramatic form. An algorithm devised by Romiszowski is shown in Figure 22. It shows the way a vocational training instructor can choose his media effectively.

NOTE: Algorithms are based on a binary yes/no concept. The conventional practice is to use lightly outlined boxes for questions and heavily outlined boxes for answers.
Figure 22: Training media selection algorithm

Adapted from A.J. Romiszowski
To further illustrate how flow charts and algorithms can help a designer communicate his idea to others, let us construct an algorithm based on the information from Case G in chapter four. Figure 20 sets out the three modules forming the combined vocational training scheme. Those who have to put the scheme into practice may find it difficult to decide which types of trainees can enter the scheme, and at what point, if their experiences and educational backgrounds vary.

The algorithm constructed by the designer for Case G, to help those responsible for training is shown in Figure 23.

B. Training centre manager's point of view

Training managers of an industrial enterprise or a private or government controlled training centre will spend at least 80% of their time in running long-standing training programmes. Their main concern is to improve the efficiency and effectiveness of training and render existing programmes more productive at a lower cost.

a. Improving existing programmes:

A cost/benefit analysis of a programme assesses the relation between its results in terms of the training output and the cost of producing them. Three courses of action can be followed to improve a project: you can measure its efficiency, its effectiveness or its productivity. It would be best to measure all three and arrive at a combined assessment.

(1) Measuring efficiency: The aim here is to achieve the same output at lower cost.

(2) Measuring effectiveness: Here you are trying to improve the quality of the output for the same cost.

(3) Measuring productivity: This combines the first two concepts. You are trying to produce effective learning at less cost. As we have said before, where possible you should apply industrial techniques to training. Although the measurement of training productivity is a new concept, it follows the principles of improving industrial productivity.
Figure 23: Entry into combined vocational training

1. UNEMPLOYED?
   - NO
   - YES

2. EARLY SCHOOL LEAVER?
   - NO
   - YES

3. INTERESTED IN TRAINING?
   - NO
   - YES

4. PREVIOUSLY ATTENDED TRAINING?
   - NO
   - YES

5. FOUNDATION TRAINING CERTIFICATE?
   - NO
   - YES

6. PASSED BASIC TRADE TEST?
   - NO
   - YES

7. TRAINING IN BASIC SKILLS?
   - NO
   - YES

8. OBTAINED ADVANCED SKILL QUALIFICATION?
   - NO
   - YES

9. TRAINING IN ADVANCED SKILLS?
   - NO
   - YES

10. EXPERIENCE IN ADVANCED WORK?
    - NO
    - YES

11. TECHNICIAN EMPLOYMENT

12. SKILLED EMPLOYMENT

13. OPERATOR LEVEL EMPLOYMENT

14. CASUAL EMPLOYMENT
b. Measuring training productivity

Analysis of your existing programme or programmes must proceed in six steps:

(1) Statement of the problem in precise terms, e.g. training productivity is to be improved by using training methods that require more independent action by trainees. These improvements should not involve an increase in the number of trainers.

(2) Construction of a model, e.g. a valuation or a graphical representation is made of anticipated costs set against the training activities required. This model is then used as a "benchmark standard" for the assessment of operational training.

(3) Measurement of productivity in training. The measurements to be taken and the method to be used to collect data are defined.

(4) Presentation of data. Data are to be entered on the tabular or graphical format worked out in Step 2 (modelling).

(5) Interpretation of the results. Many training productivity measurement schemes fall into disuse because their data are not interpreted. Similarly, when the designer or evaluation team complete their study of the data, they must communicate their findings to management.

(6) Remedial action. Following step (5), management should take decisions and make changes as appropriate. This does not always happen, as managers may have "loss of face" reasons for resisting change. For this reason, designers should build a training productivity analysis mechanism into their systematic scheme. In this way, data will be regularly collected and analysed, results will be notified to management and improvements will be made as a standard procedure.

c. Productivity modelling

To improve productivity, you must ensure that training resources are more efficiently utilised and more effective learning is achieved.

Let us consider the graph shown in Figure 24 opposite:
Curve 02 gives an equal gain in training output for each incremental increase in training cost. Example: for a maintenance worker to carry out a task twice as competently, or in half the time, his training cost will double.

What has to be avoided is a situation which produces a curve such as 03, where small increases in competence can only be achieved through substantial increases in training cost.

Because of the law of diminishing returns, a more realistic training productivity curve will resemble OAB in Figure 25.
The purpose of carrying out a training productivity analysis should be to find out where point A lies on the curve and determine how far different learning methods can improve or rejuvenate it.

Curve OAB represents the level of cost-effective learning. The two axes OY and OX represent:

OY - the number of trainees satisfactorily qualifying;
OX - the cost of providing staff and training facilities.

As stated earlier, it is virtually impossible to obtain precise, mathematical values for learning outputs expressed in money terms. However, the value of training productivity modelling lies in the construction of an "ideal standard curve" and then using it to compare alternative training strategies. This will provide valuable information on cost-effective trends in various components of your training system.

C. Network planning

In chapter three, we looked at a network constructed by a design team as part of a training project development. Networks can help designers to set out the concepts of a complete system and can then be used to check the correct execution of the steps required to implement the components of the design.

Critical path analysis (CPA) can help a designer if:

(1) The project can be broken down into clearly identifiable activities, e.g. training needs and job analysis, assembling, training resources, recruiting trainers, recruiting trainees, etc.

(2) These activities can be a progressive order, e.g. job analysis follows the identification of training needs.

(3) Some activities are carried out in parallel. For example, it may be possible to recruit and train trainers whilst employment officers are recruiting trainees for the same scheme. However, it is not necessary for recruitment cycles to be of the same duration.

(4) A time can be indicated for each activity to be completed during the project.
CPA definitions

To understand the CPA examples given on the following pages, you must be familiar with two conventions:

1. An activity is represented by an arrow called a vector, and
2. an event is (usually) represented by a circle, also called a node.

**Activity**

This indicates the performance of a task and always involves the application of resources. The length of a vector has no significance.

**Events**

These may be:

1. Predecessor events
2. Successor events

**Note**

Node 2 is the predecessor event for activity B and the successor for activity A.

Similarly, Node 3 is the predecessor event for activity C and the successor event of B.
a. Constructing a network

Before constructing a design network, you have to identify the design stages through which the project must progress. The network does not define the project. It merely presents the activities to be carried out and the relations between in the form of a diagram.

As we saw in chapter three, events are numbered so as to give a reference to each activity. This is particularly useful when adding the earliest and latest times at which particular events may take place. Sometimes two events occur at the same time and a broken arrow is introduced into the diagram to show the logical connection. This dummy arrow does not represent an activity as it does not require the application of resources.

Figure 26

INCORRECT

CORRECT - use of the dummy arrow
b. Network analysis applied to Case E (chapter three)

Let us go back to page 43 and the training of maintenance technicians at the "XY" plants. You may remember that this training programme was to be used at first to test concepts for the development of national advanced occupational skill training schemes.

The preliminary tabulation of the events shown in Table 7 was used to build the network in Figure 12. This lacked detail and the case was reconsidered. Table 19 was worked out so that a more extensive network (Figure 27 et seq.) could be constructed. If you look at Figure 12 you will note similarities in the network format, but realise that the activities represented by the vectors have been modified (or expanded).

Table 19: Event and activity table for training advanced maintenance technicians at the "XY" plant in Myrtillia

<table>
<thead>
<tr>
<th>PREDECESSOR EVENT</th>
<th>SUCCESSOR EVENT</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>-</td>
<td>IDENTIFY TRAINING NEEDS</td>
</tr>
<tr>
<td>40</td>
<td>-</td>
<td>CARRY OUT JOB ANALYSIS</td>
</tr>
<tr>
<td>50</td>
<td>-</td>
<td>WRITE JOB TRAINING SPECIFICATIONS</td>
</tr>
<tr>
<td>60</td>
<td>-</td>
<td>PREPARE TRAINING FACILITIES</td>
</tr>
<tr>
<td>60</td>
<td>-</td>
<td>SELECT STAFF FOR TRAINING</td>
</tr>
<tr>
<td>60</td>
<td>-</td>
<td>WRITE PERFORMANCE CRITERIA</td>
</tr>
<tr>
<td>70</td>
<td>-</td>
<td>PREPARE TRADE TEST MECHANISM</td>
</tr>
<tr>
<td>50</td>
<td>-</td>
<td>SET OUT TRAINING CURRICULUM</td>
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<tr>
<td>80</td>
<td>-</td>
<td>SELECT INSTRUCTORS FOR TRAINING</td>
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<tr>
<td>90</td>
<td>-</td>
<td>TRAIN INSTRUCTORS</td>
</tr>
<tr>
<td>90</td>
<td>-</td>
<td>WORK OUT LEARNING ELEMENTS</td>
</tr>
<tr>
<td>120</td>
<td>-</td>
<td>IMPLEMENT ADVANCED SKILL TRAINING</td>
</tr>
</tbody>
</table>

The information in this table and the earliest and latest times for each event are included in the network (Figures 27-30).
The training designer at the "XY" Plant estimated that the following times (in weeks) would most likely be required for the schedules activities.

Table 20

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>TIME IN WEEKS</th>
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<tbody>
<tr>
<td>30 - 40</td>
<td>1</td>
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<tr>
<td>40 - 50</td>
<td>2</td>
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<tr>
<td>50 - 60</td>
<td>1</td>
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<td>50 - 80</td>
<td>1</td>
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<tr>
<td>80 - 90</td>
<td>2</td>
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<tr>
<td>90 - 100</td>
<td>5</td>
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<tr>
<td>90 - 120</td>
<td>10</td>
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<tr>
<td>60 - 120</td>
<td>5</td>
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<td>60 - 110</td>
<td>10</td>
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<tr>
<td>60 - 70</td>
<td>1</td>
</tr>
<tr>
<td>70 - 120</td>
<td>2</td>
</tr>
<tr>
<td>120 - 130</td>
<td>20</td>
</tr>
</tbody>
</table>
These times are written beside the vectors as shown in Figure 27.

![Diagram](image)

**c. Adding in times and assessing the critical path**

A word must be said about the rules observed by designers in adding earliest and latest times so that the critical path through the network can be calculated.

The networks used for CPA can be drawn in various ways and the symbols used here are not the only ones possible. The rules observed in constructing our networks are explained below.

In Figure 27b, the event number is placed in the left half of the event node. The right half is divided into an upper and lower quadrant. The upper quadrant shows the earliest time an event may take place and the lower quadrant shows the latest possible time for its completion (in weeks).
You can see from the diagram that there is no difference between the earliest and latest times for event 50. It is therefore a critical event. By contrast, event 60 has a "float" of two weeks and is not a critical event. The critical path through the network is the one that joins, in the correct order, the events with a zero float.

How to enter "earliest times": where more than one path arrives at a single event, then the longest time is entered in the upper quadrant, as the event cannot be completed until all previous events are concluded.

Figure 28

How to enter "latest times": the latest times in the Myrtillia case were next computed by working back from event 130 to event 30. Where more than one route to an event gave different latest times, the shortest time was entered, as illustrated in Figure 29.
d. **Finding the critical path**

When all the times were entered, it could be seen that some "Events" had zero float. These provided the critical path marked with the letter C in Figure 30.

**Tabulation of results from CPA**

Once the earliest and latest times are computed for each event and the critical path has been identified, a horizontal bar chart (GANNT chart) can be prepared for project scheduling (Table 21). This kind of chart is widely used in industrial engineering to represent practical and managerial work schedules. It was employed to plan activities at the "XY" Plant in Myrtillia.

**The advantages of CPA:**

A graphical presentation facilitates communication with personnel directly involved in the design project and the reporting of progress to external groups. Similarly, the network (particularly in complex projects) can be split into subjects, so...
Figure 30: Critical path and minimum time required to implement advanced maintenance training at "XY" Myrtillia

MINIMUM PREPARATION AND IMPLEMENTATION TIME: 36 WEEKS

EVENT 70 HAS MAXIMUM FLOAT
Table 21: Management plan for maintenance training

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<th>ACTIVITY</th>
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that outside contractors or industrial groups can be clearly told exactly when their contribution is required and how critical their role is to the project as a whole. CPA forces managers and designers to systematically think through the details of their project design. Inconsistencies or errors are identified at an early stage before heavy costs are incurred.

The difficulties of CPA:

Until recently, CPA was a tedious process. Simple errors introduced at an early stage produced serious mistakes in the evaluation of results. However, the wider use of easy computer programs has virtually removed this drawback.

In the same way, variance and probability factor calculations are now dealt with easily.

2. Allowing for variance and probability

If you look at Table 21, you will notice that preparation of the advanced maintenance skills training programme for the "XY", Myrtillia enterprise required 4 persons in the design team in weeks 4-5, whereas in weeks 3-4 and 12-13 only 2 designers were needed. By rescheduling the dates of float activities the project director was able to complete the design stage with a team of only 2 designers.

In your projects, this may not happen. Activity durations can be estimated fairly well from previous experiences in similar projects. Variations, however, occur during implementation. Even so, you can take this into account in your network by describing your activity times as follows:

(1) the most likely achievement times (tm);
(2) the most optimistic time (to);
(3) the most pessimistic time (tp).

A simple statistical formula gives a variance time tv for an activity network:

\[ tv = \frac{(4tm + to + tp)}{6} \]

Variance times calculated in this way slightly reduce the risk factors influencing completion of the project on the expected date.
f. **Probability in network design**

Your project will have a defined deadline for completing the design stages before the implementation of training. This deadline may or may not be the same as that resulting in your network analysis. If you have inserted variance times (tv), constructed the network and identified the least variance in critical path, this may well give a termination date later than that required by your sponsors. In this case, as your CPA has indicated that there is a high probability of not meeting the design deadlines, there are three possible courses of action:

1. Redefinition of the network and identification of a new critical path.
2. Rescheduling of the float activities to permit transfer of resources and the shifting of critical activities.
3. Employment of extra resources to ensure completion by the specified deadline.

Item (3) may mean contracting extra personnel. Alternatively, existing personnel may have to work an extended week (say six days instead of five), or certain parts of the design work, e.g. preparation of topic objectives and learning element design, may have to be sub-contracted to other bodies, such as institutional trainers.

D. **In retrospect**

In this chapter, we have looked at ways in which training project productivity can be improved. In the first section, we pointed out that designers not only have to be able to produce good training project designs, but will also have to convince ministry officials and industrial managers that correct training solutions can be cost effective. One way of communicating concepts and instructions to other members of a design team without misunderstandings as to the meaning of words is to use algorithms.

Algorithms make communication more productive and avoid the waste of time created by the misinterpretation of verbal or written commands.

Algorithms can also be constructed to show the route to be followed in the analysis of the efficiency and effectiveness of ongoing programmes. Various methods exist for making cost/benefit
and training productivity analyses, including:

2. Project life-cycle costing.
3. Project benefits analysis.
4. Training productivity analysis.

We gave a short account of (1) and (4) and said that, while both techniques are useful, the first deals with specific cost situations of limited dimension, whereas the second, because it deals with both efficiency and effectiveness at the same time, is more extensive, but much more difficult to quantify.

The key to being in a position to investigate productivity is to know which events in a training cycle are most likely to get out of control. In other words, which activities are critical and at risk.

A technique for identifying critical activities at the design stage of a training project is network analysis. Simple analysis can quickly identify activities and event nodes that will be critical to the success of the project.

Examination of the critical path analysis (CPA) technique showed that:

1. Variations from the design plan can seriously affect the progress of a project.
2. It is necessary to consider not only the dates on which critical events should occur, but also the probabilities of the event not taking place as planned.
3. Network analysis calculations taking variance and probability into account can be done much more easily by using simple computer programs.

Obstacles to success

The intention to improve training productivity starts with efficient and effective design. While good in itself, it will meet with resistance for the following reasons:

1. Lack of time to prepare an effective productivity model, analytical plan or network.
2. Managerial objection to the productivity model.
Authority to carry out a productivity analysis not given.

Network preparation beyond the capacity of design team.

Difficulty in defining what is going to be measured.

Difficulty in collecting relevant data.

Poor interpretation of results.

No remedial action taken after submission of analysis of results.

Usually these difficulties can be traced back to one common error, namely failure to involve the parties concerned in the design process. Participation and involvement in network preparation and productivity improvement ensures better understanding of the design model and acceptance of the results of productivity analysis.

Chapter five was mainly concerned with techniques used by designers to improve their planning capabilities and their ways of making design information more readily acceptable to training managers. In chapter six, we shall be looking at the other side of the coin, namely some of the factors that affect the management and outcome of training.

References


2 Footnote: Variance and probability questions arise when estimates have to be made of the duration of each activity in their start and completion times. Many activities are outside the control of the design team and its networks must be provided with built-in safety margins to accommodate variance and probability. Programme Evaluation and Review Techniques (PERT) have been devised to allow variance and probability factors to be taken into account in network construction and analysis.
And so we come to the last chapter in this handbook, in which we will look at measuring and checking training activities and also consider their role in the wider issues of the management of training. Many designs for effective training programmes have been produced, but never brought into operation. The main reasons have been over-sophistication, high cost, or insufficient management capability within the organisation responsible for the realisation of a project.

A. The management of training - some preliminary concepts

Training management is concerned with planning, allocating and utilising the resources required to enable trainees to learn. Firstly, the main resources to be managed are people. Unless they respond positively to your training design, it will have little value.

Secondly, you will have to manage facilities, buildings, material stocks, equipment and aids used in the training process.

Thirdly, you will have to manage money, so that resources can be purchased and accounts settled. Many managers of training institutions are responsible, and accountable, for fixed assets and material resources much greater in value than those in their local industrial complexes. Despite this, the management of training is often ineffective when compared with that of industrial processes.

Industrial managers have to concern themselves with systems for achieving higher productivity. By contrast, few managers of training institutions consider that the need to improve training productivity is part of their job. This situation is now changing, as was noted in chapter three, where we described the birth of a
combined scheme involving both industry and government in the provision of training programmes in occupational skills. As more countries adopt this type of development, so more training managers will be required to participate in quality and productivity improvement programmes.

You may know of trainers currently employed within industry who are daily concerned with aspects of industrial productivity. By contrast, how many managers of government skill centres do you know who are required to set and achieve learning productivity targets? There are historical reasons why you may not know of many:

(1) Government regulations on the recruitment and promotion of ministry officials which often inhibit the movement of professional managers from industry into the higher echelons of national training.

(2) Ministers and senior officials involved in training policies often do not consider that productivity and cost benefits/savings are important items on their list of priorities.

(3) Funds and facilities which are not available for staff training and the updating of training managers.

(4) Designers often produce training systems that are not "manager-friendly". This means that a person will be less inclined to use a system if he does not find it "friendly". The same expression is employed to describe an operator-friendly computer.

We, as designers, may not be able to influence items (1) to (3), but we are responsible for providing designs that can be competently managed (4) and are user-friendly.

B. Positive management indicators

A well-designed vocational training scheme, or programme, will produce positive returns if its implementation stage is successfully managed. Positive returns are likely to be attained when:

(1) Trainees are independently able to apply their new knowledge and practical skills as soon as their training programme is over.

NB: In periods of recession or high unemployment, newly trained persons may not be able to find a job in a
manufacturing or service industry for a long time, but they should have obtained enough skill to find casual employment or become self-employed if this is possible.

(2) A detailed action or work plan has been devised by the programme designer and a training manager has sufficient authority to set it in motion. 
NB: Many training programmes are ineffectively managed by competent training managers who are not permitted to take decisions and consequently are not creative. Managers in this position "play safe". Their programmes are lethargic and trainees lack motivation.

(3) Sufficient financial resources and budget credits exist and the training manager is authorised to operate within clearly defined boundaries. 
NB: In many situations, managers are involved in the practical management of training schemes, but have little control over operational budgets or the purchase of small expendable items. This lack of authority increases the waiting time for materials required by instructors and trainees.

(4) The training and support staff of an institution or enterprise possess the expertise needed to ensure that the design can be effectively and efficiently applied. 
NB: In many developing countries, trainers are academic candidates with little practical experience in industry. For trainers to be effective, they need four identifiable characteristics which have been described as "CASE" factors. The CASE concept was tested during the Five Year Project for the Advanced Training of Trainers in Asia and the Pacific set up by APSDEP (The Asian and Pacific Skill Development Project of the ILO).

Competences required by a vocational trainer

Proportional weightings for each factor vary according to the type and level of occupational skill to be transferred.

C. Negative management indicators

The outward signs of poor management are:

(1) Continuous fall in demand for trainee places in courses offered although local vacancies for skilled manpower still exist.
NB: This indicator assumes that training for vacancies is necessary and that no political, social or cultural influences are present.

(2) Trainees are rapidly de-motivated.
NB: This usually signifies that design objectives and entry criteria are at an incorrect level. Similarly, training session content is either too high or too elementary, and instructors are not capable of developing trainee interest.

(3) Cost of training is increasing out of proportion to the cost of equivalent operations at other institutions.
NB: One or more cost items may be involved:

a) Fixed or temporary staff costs;
b) Cost of maintaining facilities and fixed assets;
c) Indirect overhead costs;
d) Purchases of expendables;
e) Over-stocking of expendables.

Where costs are increasing, the reason is usually the lack of a formal requirement for training managers to be accountable for their actions. Alternatively, the period of accountability may be too long, e.g. the manager only has to present his accounts to the appropriate authority once a year. With long accounting periods, it is virtually impossible for organisations to take corrective measures or modify action plans so as to stay in control, when this is necessary. A strong indicator of poor managerial capability is a lack of attention to accounts receivable or difficulties in recovering long-standing debts.

D. Effects of organisational structure

As the training function within an enterprise grows, its activities become too involved to be handled by one person and a structure becomes necessary. An organisation, such as that shown in Figure 31, can be drawn for this purpose.

When training functions are divided in this way, a system of checking is needed.

a. Checking training

Checking should not be confused with other functions, such as authority, responsibility or supervision. The purpose of
Figure 31: Organisation chart for a small training institution

TM - Training Manager
DO - Delegated Chief Officers
AO1 - Senior Administrator
AO2 - Administrative Officers
SO - Specialist Staff
checking is to ensure that plans are being executed according to specification and that resources are being progressively and efficiently utilised. As the health of a training enterprise depends upon its financial stability, another important aspect of checking is the provision of regular, up-to-date financial statements for the training manager. If you want to check training, you will have to set up procedures for:

1. Measuring progress.
2. Comparing results against forecasts.
3. Reporting on variances.

Measurements cannot be made unless your design team has decided how often they are required and set criteria against which they can be compared. This statement raises an important question: "What items should be measured?". This question refers to the points made in chapter one, where we learnt that designers and managers need to constantly ask six questions, "What, how, when, who, where and why".

For the purpose of checking, we must ask:

1. What needs to be measured?
2. How should the measurements be made?
3. When is the best time to take measurements?
4. Who should carry out, report on and analyse any measurements made?

Of lesser importance are the questions:

5. Where should the measurements be made?
6. Why is it necessary to take measurements?

b. Communicating checking requirements:

The first thing a training manager must do is to communicate his checking requirements to a delegated officer. This formal instruction will advise the D.O. that he must send the manager the measurements of the progress of the course by a prescribed date. As an example, let us look again at Case 4D in chapter two. In this case, it was expected that assembly shop supervisors would train workers in airconditioner unit assembly skills, but that a group of supervisors would first have to be trained in the skills required to train workers. This training was very important, because it had been previously thought that a supervisor highly
skilled in a technical process could effectively transfer that skill to another person. Experience had showed that often this was not so. This can best be explained by taking an example and comparing assembly skills with training skills.

Job example - Assembly of airconditioner units (situation 4D)
Comparison of technical and training skills.

Assembly skills

These will include:

(1) Interpreting two-dimensional diagrams of a three-dimensional airconditioning unit.
(2) Ability to use hand tools such as spanners, screwdrivers, wirecutters, etc.
(3) Recognition of faults in assembled units, so that product quality is maintained.

Training skills

To transfer occupational skill and know-how requires certain competences:

(1) Ability to analyse occupational tasks involved in the assembly of airconditioner units.
(2) Conversion of results of analysis into training.
(3) Ability to communicate understandable information to workers with different levels of competence.
(4) Ability to prepare and implement training sessions.
(5) Ability to evaluate the learning progress of worker trainees.

Comparison of these sets of skills shows technically competent supervisors do not automatically make good trainers.

It was for similar reasons that a decision was taken to train supervisors in training techniques at the "XY" Company in Myrtillia. Subsequently, the training manager sent an instruction to his Chief Instructor. A copy is shown as Figure 32.
This internal communication failed in its purpose as it did not clearly state the type and dimension of the measurements to be made. When the manager eventually received a brief report, it was found that the project had exceeded budget credits and was only partially effective, and that the report had been handed in too late to permit remedial action to be taken. This example shows that progress measurements must be taken frequently and progressively. Reports should be presented with a lead time that allows a training manager to take remedial action well before the termination of a programme.

c. Report content

Deciding on the structure of a checking report brings us back to the question "What should be measured?" For example: Is your manager interested in trainee progress, training cost, instructor performance, quality of learning aids, absences of staff and students, or the added value of units assembled by trainees during practical training sessions? Most training managers would, in fact, be interested in all these items, because they provide an indication of learning productivity and also take into account different aspects of training effectiveness and cost efficiency.
d. **Interim results comparison**

After deciding on the main factors to be measured, appropriate objective or subjective measurements must be made and their results compared with the plan in the original project design. If significant deviations from the forecast measurements are noted, management will have to take action. For example, if trainees are finding difficulty in acquiring an occupational skill, this may be broken down into a series of smaller steps and the session timetable re-scheduled to allow more time for learning. Similarly, if essential practical training equipment is out of action due to a breakdown, you can re-schedule workshop sessions before they are due to occur if a deviation report has been received in advance. Interim results also allow you to compare cash flows with budget forecasts and make adjustments if necessary.

e. **Information reporting**

When information is presented to a training manager, it must be easy to understand and not obscured by a mass of trivial details. The manager can then manage "by exception", since your checking procedure provides signals for factors significantly different from the operational targets or forecasts. This principle of managing by exception concentrates on deviations. Eliminating these should be your main concern if your training project is to remain viable. To ensure that this checking process is effective, your manager should prepare a standard report form that can be adapted to a range of different conditions. A sample form is shown in Table 22.

f. **Performance indicators**

As mentioned above, the design of a report form raises the question: What aspects of training performance are to be measured? Some performance indicators will be concerned with financial control. Others will highlight the quality of learning. We saw in chapter five that measurements of training productivity contain mainly subjective factors, which means that we are dealing with partial performance indicators and estimating trends. Beware of a common error made by many training managers: once performance indicators have been defined, managers begin to think that results are being expressed in absolute values, which is not the case. Partial performance indicators are often applied to:

(a) total programme cost/unit time;
<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>REPORTING PERIOD</th>
</tr>
</thead>
</table>

**MAIN ACTIVITIES IN PERIOD UNDER REVIEW**

**BUDGET ALLOCATION FOR PERIOD** $\$

**TYPE OF REPORT**
- [ ] EVALUATION OF TRAINEES
- [ ] COURSE PROGRESS
- [ ] COURSE ADMINISTRATION
- [ ] EXPENDITURE

**DESCRIPTION OF ACTION**

**RESULTS ACHIEVED**

<table>
<thead>
<tr>
<th>ABOVE</th>
<th>FORECAST</th>
<th>BELOW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROGRESS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LOW</td>
</tr>
</tbody>
</table>

**DEVIATIONS**

<table>
<thead>
<tr>
<th>PLANNED</th>
<th>ACTUAL</th>
</tr>
</thead>
</table>
(b) trainee cost/unit time;
(c) consumable material cost/trainee/unit time;
(d) percentage utilisation of fixed facilities (workshop, etc.);
(e) trainee/trainer ratios;
(f) trainee/support staff ratio;
(g) training hours/trainer/unit time;
(h) trainee attendance/unit time.

In overview reports on training programmes, it is also desirable to include:

(i) % trainee qualification-course
(j) % qualification-national skill tests;
(k) % trainees obtaining employment in unit time.

Experience shows that the critical performance indicators are those concerned with:

(1) Effective staff utilisation.
   NB: In most training institutions, staff salaries are the main expenditure.

(2) Effective utilisation of fixed cost facilities.
   NB: Buildings and equipment depreciate faster when under-utilised. This increases the cost of maintenance and can seriously affect budget balances through failure to work at an optimum level.

(3) Cash flow and procurement of expendable items.
   NB: Cash flow and credit can be influenced by discount purchasing, but overstocking of expendables results in loss due to deterioration.

G. Correction functions

The main purpose in making checking measurements is to find out how much of the system is stable and working according to plan, and which items need correction. There is a danger that if you do not define authorities and responsibilities delegated officers will not only take measurements but will also begin to take remedial action contrary to managerial policy. You should be clear that: "Delegated officers are required to report on deviations from financial, procedural or operational plans, but all remedial actions must receive the formal approval of the training manager". This concept of different roles is important to prevent managers short-circuiting checking reports and DO's by-passing
their managers. On receiving a report requiring remedial action, two solutions can be applied, either (1) operations are corrected back to the norms laid down in the operations plan or (2) operations are consolidated by updating the operations plan.

h. Frequency of checking

Measurements of training programme effectiveness are directly related to management efficiency. As efficiency is reflected by cost figures, most institutions require evaluation frequencies to be the same as those for cost reporting. For example, if financial accounting is done monthly, operational progress reports are likely to be required monthly. Cost account reporting would not be necessary if all transactions were carried out on a cash-in-hand basis. However, training centres do not operate on immediate cash payment. Because of this, the manager has to set up a new, or implement an existing, financial accounting system and produce a balance sheet at the end of each financial period. Usually, this is a legal requirement in the locality in which the institution operates, so as to demonstrate to interested parties that training resources provided from national funds are being correctly utilised.

A balance sheet gives very little help to the training manager in his day-to-day operational management of a training centre. For daily operations, a manager must give attention to expenditures and be aware when expenditure in a given period of time is running well ahead of income without having to wait for the next balance sheet. With a newly established training enterprise, the frequency of accounts reporting should be not less that once a month, but once experience is gained this period can be extended to three months.

i. Reliability of reports

A manager will judge the reliability of the reporting procedures on training effectiveness and operational efficiency by the number of management crises that develop during a normal report period. Good managers are characterised by their ability to take calculated risks and make speedy decisions when a crisis arises. Poor managers can be identified by a style which involves them in constant crisis. Training operations crises are usually attributable to either (1) financial instability, or (2) personnel inadequacy.
In-service training of staff can remedy the second of these weaknesses and the first can be improved by introducing simple cash flow analysis methods.

j. Cash flow

A full discussion of cash flow analysis would be out of place here. An example will highlight the usefulness of this management tool. Cash flow analysis (CFA) looks at both cash inflow (credit) and outflow (expenditure) and can be used by managers to plan future cash requirement forecasts and creditor payment dates. For more reliable financial operations, a manager should draw up a cash flow forecast for the next financial/operational period.

Let us take a look at a six-month cash flow forecast for the "XY" Company Training Centre in Myrtilla.

It can be seen that credits expected in the first two months will be low, particularly in the second month. Also in the second month, a previous bank loan for the purchase of additional educational technology hardware will require a capital repayment and this will give a negative cash flow. To ensure that the negative balance will be as small as possible, it was decided not to transfer cash to capital reserve during months two and three. The parent company indicated that they would be transferring credit to the Training Centre account towards the end of the period. This prompted the forecasters to include higher cash transfers to reserves in months five and six.

k. Evaluating operational progress

Training institutions do not normally exist in isolation, but form part of a national occupational skill development system usually regulated by a Ministry of Labour, Manpower or Education. Ministries impose constraints on the way in which you can define training policies and manage the implementation of national schemes. In Case 2B (chapter two) concerning the setting-up of a combined Vocational Training Scheme, course designs, syllabuses and learning elements would probably be worked out centrally. Centralised control of course implementation mechanisms would also affect your Centre's chances of becoming more efficient than another institution providing the same service. The training manager in Case 3C (which concerned the in-company training of a
<table>
<thead>
<tr>
<th>PERIOD BY MONTH</th>
<th>ITEM</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASH START</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVAILABLE</td>
<td></td>
<td>35</td>
<td>42</td>
<td>(11)</td>
<td>16</td>
<td>65</td>
<td>64</td>
</tr>
<tr>
<td>(COMPONENT &quot;A&quot;)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASH INFLOW</td>
<td></td>
<td>300</td>
<td>250</td>
<td>320</td>
<td>320</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>&quot;XY&quot; CO. CREDITS</td>
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<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
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<td>DEPRECIATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>TOTAL INCOME</td>
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<td>308</td>
<td>258</td>
<td>328</td>
<td>330</td>
<td>360</td>
<td>360</td>
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<tr>
<td>(COMPONENT &quot;B&quot;)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASH OUTFLOW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIXED COSTS</td>
<td></td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>VARIABLE COSTS</td>
<td></td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>180</td>
<td>210</td>
<td>210</td>
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<tr>
<td>INTEREST PAYMENTS</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CAPITAL REPAYMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAXATION</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>CAPITAL RESERVES</td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td>10</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL EXPENDITURE</td>
<td></td>
<td>301</td>
<td>311</td>
<td>301</td>
<td>281</td>
<td>361</td>
<td>351</td>
</tr>
<tr>
<td>(COMPONENT &quot;C&quot;)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASH AVAILABLE</td>
<td></td>
<td>42</td>
<td>(11)</td>
<td>16</td>
<td>65</td>
<td>64</td>
<td>73</td>
</tr>
<tr>
<td>A + (B - C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: VALUES IN $1,000; ITEMS IN ( ) ARE DEBITS
crane maintenance technician) would have more flexibility and be able to ensure high levels of learning productivity.

We have not considered external efficiency or cost-benefit effectiveness. The reason for this is that other factors, such as depressed wages, high unemployment, etc. seriously influence training productivity ratings. These are outside the scope of this handbook. What we are considering, however, is how your Centre can improve its performance by comparison with an equivalent enterprise offering similar training services under the same bureaucratic constraints. Before this type of comparison can be made, you must have sufficient information on the situation in your own Centre. Earlier in this chapter, a reference was made to objective financial data reporting. In addition you will need subjective assessment information on the operational progress of trainers and trainees' work in your Centre. There are many ways in which this can be obtained. Some are more effective than others. The ILO's experience indicates that three forms of subjective reporting give the best results. These are: (1) Trainee reports in the form of a work-in-progress diary or log book. The log book is inspected and evaluated at intervals by both trainers and industrial practice supervisors. (2) Trainee evaluations of those topics, sessions or learning elements with which they have been involved. (3) Trainer/instructor/supervisor overview evaluations or assessments of topics, sessions or learning modules presented.

Two typical forms that satisfy the requirements in points 2 and 3 are shown in Tables 24 and 25. Note that some institutions require trainees to complete their work progress reports on the back of the form in Table 24.

E. Computer managed training

In chapter five, reference was made to the use of computers to prepare networks for design planning. They are now being widely employed to simplify the management of training.

The most effective use of a computer in training management is to apply it to three areas of activities:

Records and information:
(a) trainee registration;
(b) trainee records;
(c) trainee progress reports.
<table>
<thead>
<tr>
<th>COURSE TITLE</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>EVALUATION DATE</td>
</tr>
<tr>
<td>SESSION No.</td>
<td>TOPIC</td>
</tr>
<tr>
<td>SKILL CENTRE BASED</td>
<td>WORK SITE BASED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MY INTEREST IN THIS TOPIC WAS:</th>
<th>HIGH</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>THE LEARNING TO BE ACHIEVED WAS:</td>
<td>CLEAR</td>
<td>NOT CLEAR</td>
</tr>
<tr>
<td>LEARNING CONTENT WAS:</td>
<td>WELL STRUCTURED</td>
<td>BADLY STRUCTURED</td>
</tr>
<tr>
<td>THE SPOKEN AND WRITTEN COMMUNICATION WAS:</td>
<td>EASY TO UNDERSTAND</td>
<td>HARD TO UNDERSTAND</td>
</tr>
<tr>
<td>PRACTICAL WORK INSTRUCTIONS WERE:</td>
<td>EASY TO UNDERSTAND</td>
<td>HARD TO UNDERSTAND</td>
</tr>
<tr>
<td>I WAS ABLE TO PRACTISE JOB SKILLS:</td>
<td>FULLY</td>
<td>PARTIALLY</td>
</tr>
<tr>
<td>PRACTICAL SKILL EXERCISES WERE:</td>
<td>EASY</td>
<td>DIFFICULT</td>
</tr>
<tr>
<td>BY STUDYING THIS TOPIC I WAS ABLE TO:</td>
<td>LEARN NEW SKILLS</td>
<td>REPEAT OLD SKILLS</td>
</tr>
<tr>
<td>THE JOB SKILLS PRACTISED FOR MY PRESENT EMPLOYMENT</td>
<td>CAN BE APPLIED</td>
<td>CANNOT BE APPLIED</td>
</tr>
<tr>
<td>TO GAIN MORE EXPERTISE I REQUIRE EXTRA MATERIAL FOR:</td>
<td>ADDITIONAL EXERCISES</td>
<td>REFERENCE ONLY</td>
</tr>
</tbody>
</table>

MY WORK REPORT IS INCLUDED FOR ASSESSMENT ON THE BACK OF THIS SHEET

........................................ Signature
Table 25: Session evaluation - instructor form

<table>
<thead>
<tr>
<th>COURSE TITLE</th>
<th>CODE</th>
<th>NAME</th>
<th>EVALUATION DATE</th>
<th>SESSION No.</th>
<th>TOPIC</th>
<th>SKILL CENTRE BASED</th>
<th>WORK SITE BASED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THE LEARNING OBJECTIVES OF THE TOPIC MODULE WERE IN LINE WITH TRAINEE NEEDS:</th>
<th>FULLY</th>
<th>PARTLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>THE KNOW-HOW AND PRACTICAL SKILL EXERCISES WERE:</td>
<td>RELEVANT</td>
<td>REMOTE</td>
</tr>
<tr>
<td>TRAINEES PROGRESSED TO THEIR LEARNING OBJECTIVES:</td>
<td>QUICKLY</td>
<td>SLOWLY</td>
</tr>
<tr>
<td>TRAINING FACILITIES AND LEARNING AIDS WERE:</td>
<td>GOOD</td>
<td>POOR</td>
</tr>
<tr>
<td>TRAINING MATERIAL, HANDOUTS AND INSTRUCTION SHEETS WERE:</td>
<td>GOOD</td>
<td>POOR</td>
</tr>
<tr>
<td>LIST EXTRA TOPICS WHICH SHOULD BE INCLUDED IN FUTURE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIST ITEMS WHICH SHOULD BE REMOVED FROM THE SESSION:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIST CHANGES IN LEARNING METHODS APPLIED TO THE SESSION TO IMPROVE MOTIVATION:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RATE THE SESSION IN TERMS OF THE NUMBER OF TRAINEES WHO SUCCESSFULLY ACHIEVED THEIR LEARNING OBJECTIVES INSIDE STANDARD COURSE TIME SCALES</td>
<td>OVER 80%</td>
<td>65 - 80%</td>
</tr>
</tbody>
</table>

Visa
Staff and facilities:
(d) salary and payroll;
(e) purchasing records;
(f) stock control;
(g) budgets and forecasts;
(h) cost control.

Implementation of training:
(i) word processing training session texts;
(j) designing training graphics;
(k) training video editing processes;
(l) timetabling;
(m) producing reports.

A further point to remember is that computer hardware is of little value if software relevant to your needs is not available. Similarly, the computer will not help to manage training if managers cannot be persuaded to use it. Leaving computers in the hands of data specialists may be satisfactory in some applications, but for the management of training this practice is not recommended. The main cost of a computer system is not the original capital outlay, but the staff cost of employing programmers and system operators if managers cannot carry out these tasks themselves. When you inform your authority that you propose to purchase a computer system out of your next financial allocation, you may be tempted to justify your recommendation by stating that it will also be used for computer aided instruction. The ILO's experience shows that it is easier to familiarise your staff with a CAM (Computer-Assisted Management) programme than to require them to design training packages or author learning texts.

F. In retrospect

In this final chapter on effective vocational training programme design, we have examined the indicators showing that a design is both efficient and effective in practice. We can now add a checklist of some items that will be of importance to you when seeking to improve training productivity.

Assessing design quality

The following checklist includes the main items to be assessed when estimating the comparative value of new, or existing, training programme design. Its purpose is not to give
sets of absolute values for each of the points listed, as this is not feasible. Its main aim is to provide you with a list you can use to assess the effect of your design during its implementation.

(1) **Curricula construction:**

(a) Were curricula based on training needs assessment?
(b) Were training needs effectively translated into learning elements?
(c) Were curricula in line with national performance standards for skilled workers?
(d) Are project, programme, course and session objectives clearly defined?

(2) **Curriculum content:**

(a) Is there a clear time allocation for course components, e.g. theory, practice, related studies, etc.?
(b) Is there a clear breakdown of learning topics, e.g. technology, science, cultural items, etc.?
(c) Is curriculum content identified with project, programme, course and session objectives?
(d) Are the proportions between different disciplines in balance, e.g. theory, practice, on-the-job or off-the-job training, etc.?
(e) Does the curriculum encourage the trainee to take initiatives in learning situations?
(f) Does the curriculum take account of future industrial training needs and technological changes?

(3) **Training methods:**

(a) Are there sufficient training aids?
(b) Are these aids adequate in their support of course content and method?
(c) Is the design of learning elements and training software adequate?
(d) Is sufficient learning material provided individually to trainees?
(e) Is the quality of handout texts, instruction sheets, etc. in line with the curriculum specifications?
(f) Are practical skills development methods in line with local industrial practices?
(g) What are the optimum and actual sizes of occupational practice learning groups?
(h) Is sufficient technical support provided to both trainers and trainees so that acquisition of knowledge and skills can proceed without undue delay?
(i) Are theory and practice sessions coordinated so that learning is reinforced?

(4) Monitoring processes:

(a) Are syllabuses monitored and revised at regular intervals?
(b) What is the frequency of syllabus review?
(c) Are industrial practitioners involved in learning element review?
(d) Have previous trainees been asked to feedback their contributions on how to improve the productivity of training?
(e) Are the monitoring procedures well defined and fairly applied?
(f) Do tests relate to course objectives, fully or only partially?
(g) Is the frequency of testing adequate?
(h) Are trainees maintaining their progress records?
(i) Are both trainers and trainees regularly completing topic or module evaluations?

(5) Trainer/trainee factors

(a) Will course entry criteria attract learners and provide trainees capable of benefiting from the programme?
(b) Are trainee competences sufficient to allow them to achieve course goals?
(c) Are trainer competences sufficient to effectively guide learners towards course goals?
(d) Are trainer/trainee relationships assisting the learning process?
(e) Is there an effective post-course feedback mechanism in operation?

Other questions need to be asked on:

(1) Staff training schemes
(2) Selection and development of trainers and their support staff

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(3) Condition of buildings, equipment and other training facilities
(4) Availability of necessary equipment, materials and documentation
(5) Relevance of equipment and consumable materials to course and session objectives.

Role and effectiveness of evaluation and follow-up

Although much has been written about these topics, in practice determination of the success or failure of training programmes is difficult. Most training practitioners are well aware that absolute and objective evaluation is not possible unless the factors being evaluated are narrow and without variables. Designers attempt to get around this dilemma by specifying that evaluation must be mainly concerned with estimating whether goals have been reached and objectives respected. Real problems also occur when you try to compare the evaluations made in two apparently similar training courses. They never are identical, because adult trainees vary widely in age, educational background, work experience, etc. before they join your training programme. Thus a reasonably flexible interpretation of comparative evaluations has to be made and this means that the absolute value of the results is not very high. One conclusion that can be drawn is that while training managers should evaluate progress, they should not become infatuated with the mysteries of evaluation and begin to spend large sums of money on grandiose evaluation schemes.

The main factor to be borne in mind, however, is that the success of your training design and its later implementation is never proven until the programme has been completed and your trainees are performing well at a place of employment. Training officers in industrial enterprises are one of the best sources of information on the progress of post-course trainees, and it is advisable for training designers and managers working within the government sector to foster good relationships with:

- training officers in enterprises;
- industrial training development units;
- industrial productivity centres.

Not only will this type of collaboration assist in the earlier design stages related to training needs, jobs and task analysis, but more importantly it will form a sound basis for developing an integrated feedback scheme.
In summary, although you can obtain worthwhile information if you restrict evaluation to that which takes place at the training centre, the more realistic information is that which feeds back from the trainees at their workplace, the feelings of their workmates, their employers and families.

If in your future attempts to improve the effectiveness of vocational training programmes through improved design, you discover that your course participants are more highly skilled, are gainfully productive and are enjoying a better life, then the reasons behind the decisions taken to prepare this book will have been justified.

References

1 These items relate more to the administration and management of a training institution and are outside the scope of this handbook.
Recent ILO Training Publications

Training needs: Assessment and monitoring (1986)

This monograph outlines a new approach to the assessment and monitoring of training needs in developing countries and gives examples of how the approach can be applied in practice. It argues that, as conventional manpower planning techniques are primarily concerned with forecasting manpower requirements, they do not give adequate guidance for the planning of vocational training. Rather, the techniques should be used flexibly to investigate the training implications of various manpower plans and should be supplemented by labour marketsignalling - that is, by the regular reporting and analysis of trends in manpower supply and demand, and of potential imbalances at sectoral, occupational and regional levels. The assessment and monitoring of training needs must be seen as a continuous process. A close partnership should be developed between manpower and vocational training planners and an institutional framework established for conducting joint work regularly.

The consequences of adopting such an approach would be far-reaching: long-term manpower forecasting would be less necessary and the cost of training projects reduced, since a constant flow of labour market signals would enable training planners to adjust programmes continuously to meet labour market needs.

ISBN 92-2-105458-6

Vocational training: Glossary of selected terms (1986)

The glossary defines some 300 terms selected on the basis of the following criteria: description of fundamental concepts, and frequency and usage in real situations common to at least several countries or systems. Each entry is accompanied by its equivalent, or corresponding, term in French and Spanish. An index in these languages is also included for easy reference.

The glossary is the result of the collaboration and cooperation of training experts working at the International Labour Office, and reflects the current approach to vocational training terminology. French and Spanish editions of the glossary are issued as separate volumes.

ISBN 92-2-105457-8


Created for a broad range of training and development specialists, trainers, programme designers and organisers, as well as for self-development purposes, this programme is a rich source of material covering the full range of supervisory skills. Its framework was established after systematic analysis of the main supervisory functions and of more than 100 training programmes from different industries and countries. One of its outstanding features is its flexibility; the self-contained modules and loose-leaf presentation make it easy to update systematically, to compile simplified and standardised training packages tailored to the conditions and needs of each organisation, and to help trainers to develop their own specific training modules and to use the programme for initial or advanced training, depending on the modules chosen. The programme training courses have been tested in Sweden, Switzerland, the United Kingdom, the United States, Venezuela and other countries.

Volume 1 - Introduction: Introduction and trainer's guide; The organisation and the supervisor; Principles of supervision.

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Volume 5 - Supervising people, Part 2: Salary and wage administration; Training and development; Behaviour in supervision; Industrial relations; maintaining discipline and morale; Complaints and grievances; Supervising special groups.

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Effective vocational training design

This handbook sets out some principles for designing vocational training programmes that have maximum impact. The emphasis is on design methodologies aimed at producing vocational training schemes that are cost-effective and relevant to the training and employment needs of the economy and of individuals. The text leads the reader systematically through the various steps required to design vocational training programmes. Simple language, checklists and real life examples are used to illustrate and facilitate the understanding of the design process. The use of algorithms, modelling, critical path analysis as well as computers for designing vocational training programmes are also included. Some methods are suggested for continuous monitoring of performance, evaluation and follow-up, since flexibility and continuous adjustment to new requirements are regarded as essential features of effective and relevant vocational training programmes.